US Army Corps of Engineers

Work Plan

Corrective Measures Performance and Vapor Intrusion Monitoring

Watervliet Arsenal Installation Restoration Program
Watervliet, New York

July 2016

Contract No.: W912DR-12-D-0007
Delivery Order No.: 0007

Prepared For:

US ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT
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Acronyms and Abbreviations

APP	Accident Prevention Plan
bgs	Below Ground Surface
CMs	Corrective Measures
CMMP	Corrective Measures Monitoring Plan
CMS	Corrective Measures Study
Cr	Chromium
CVOCs	Chlorinated Volatile Organic Compounds
DMP	Data Management Plan
ERIS	Environmental Restoration Information System
ft	Feet
IA	Indoor Air
ICMs	Interim Corrective Measures
in	Inches
IRP	Installation Restoration Program
LTM	Long-Term Monitoring
MAES	Multiple Award Environmental Services
mg/kg	Milligrams per kilogram
MMA	Main Manufacturing Area
NAP	Natural Attenuation Parameters
NYSDEC	New York State Department of Environmental Conservation
PCE	Tetrachloroethylene

PDBs	Passive Diffusion Bags
PWS	Performance Work Statement
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
SSDSs	Sub-Slab Depressurization Systems
SSHP	Site Safety and Health Plan
SOP	Standard Operating Procedure
SVE	Soil Vapor Extraction
SVOCs	Semi-Volatile Organic Compounds
TCA	1,1,1-Trichloroethane
TCE	Trichloroethylene
µg/L	Micrograms per liter
UFP	Uniform Federal Policy
US	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VI	Vapor Intrusion
VOCs	Volatile Organic Compounds
WP	Work Plan
WVA	Watervliet Arsenal
yrs	Years

1. Introduction

The PIKA - MP JV, LLC[1] (hereinafter referred to as the JV) prepared this Work Plan (WP) to document the activities, procedures, and metrics required to implement long-term obligations under the United States (US) Army's Installation Restoration Program (IRP), as well as under state and federal environmental compliance requirements at the Watervliet Arsenal, Watervliet, New York. The IRP elements described in this WP include long-term groundwater monitoring, operation and monitoring of vapor intrusion (VI) mitigation systems, and potentially the abandonment of monitoring wells that are no longer included in the monitoring program.

These tasks are detailed in the performance work statement (PWS) dated September 30, 2015, from the US Army Corps of Engineers (USACE) Baltimore District, and all amendments and question and answer sets under the Multiple Award Environmental Services (MAES) contract, Award No. W912DR-12-D-0007, Delivery Order 0007. Work will be conducted pursuant to the approval of, and coordination with, the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) Region 2 under the existing Resource Conservation and Recovery Act (RCRA) Order on Consent, as well as the New York State Department of Health (NYSDOH) where applicable.

This WP was prepared in accordance with the provisions of Chapter 4 of the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (DER-10) guidance document. Additionally, in accordance with the PWS, NYSDEC DER-31, and Executive Order 13423, green remediation and sustainable approaches to site remediation were considered in the preparation of this WP.

This WP is supported by a Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP) (Appendix A), Data Management Plan (DMP) (Appendix B), Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP) (Appendix C), Long-Term Monitoring (LTM) Plan Update (Appendix D), and the VI Corrective Measures (CMs) WP (Appendix E). The QAPP contains both field and laboratory standard operating procedures (SOPs).

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[1] The PIKA-MP JV LLC Joint Venture is comprised of PIKA International, Inc. and its partner ARCADIS U.S. Inc.

The LTM Plan Update describes monitoring activities required to support the corrective measures implemented at the Watervliet Arsenal (WVA) Main Manufacturing Area (MMA) (WVAA-32) and Siberia Area (WVAA-25) under a USEPA Administrative Order on Consent (Docket No. II RCRA-3008(h)-93-0210). This IRP WP describes the procedures used to monitor the performance of groundwater remediation corrective measures implemented in various portions of the WVA.

The VI CMs WP describes the MMA VI Monitoring and Systems Operation requirements. WVA is implementing CMs to mitigate VI impacts at eight buildings within the MMA of the WVA. The CMs, which are being conducted in accordance with the Administrative Order on Consent between the WVA, the NYSDEC, and the USEPA, included the construction and operation of sub-slab depressurization systems (SSDSs) in each building to prevent the intrusion of soil vapors containing chlorinated volatile organic compounds (CVOCs). This IRP WP describes the operation, maintenance, and monitoring requirements for the SSDSs in the MMA.

1.1 Objectives

As stated in the PWS, the Army's objectives are to conduct Groundwater Corrective Measures Performance Monitoring and reporting in the Siberia Area and MMA; operate and monitor the VI mitigation systems at the MMA; and, potentially, the abandonment of monitoring wells that are no longer included in the monitoring program.

1.2 Site Description and Background

The WVA encompasses approximately 140 acres in, and around, the City of Watervliet, New York, approximately 3.5 miles northeast of the City of Albany (Figure 1-1). To the east of the WVA, Broadway Street and a six-lane interstate highway (I-787) separate the WVA from the Hudson River. To the west, the WVA extends beyond the limits of the City of Watervliet into the Town of Colonie. Residential areas border the WVA to the north and south. The WVA consists of two primary areas, the MMA and the Siberia Area (Figure 1-2). The MMA is approximately 125 acres in size and is where manufacturing and administrative operations occur. The Siberia Area is chiefly used for the storage of raw and hazardous materials and comprises about 15 acres. These areas are shown on Figure 1-2.

1.2.1 Main Manufacturing Area (WVAA-32)

Several environmental studies have been conducted at the MMA of the WVA. The most comprehensive investigation, a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI), was conducted by Malcolm Pirnie, Inc. (Malcolm Pirnie) and Louis Berger & Associates, Inc. from 1995 to 1998. Previous investigations are summarized in the RFI. Two ICM studies involving in-situ groundwater remedial techniques were conducted at the MMA in the area of Buildings 25 and 40 between 2001 and 2003. Final corrective measures, in the form of in-situ chemical oxidation, were conducted at Building 40 from 2004 through 2007 in accordance with the Corrective Measures Work Plan – Building 40 Groundwater, dated July 2004 (Malcolm Pirnie, 2004). Monitoring of the wells in the Building 40 area (Building 40 Boundary Wells) was conducted separately under the Corrective Measures Monitoring Plan (CMMP), Building 40 Groundwater, dated August 2004 (Malcolm Pirnie, 2004a) during that time, until they were added to the LTM Plan in 2009 with the approval of the NYSDEC.

A VI investigation was performed within, and adjacent to, the MMA, and adjacent to the Siberia Area of the WVA, in November 2007 and February 2008, to assess whether CVOCs were present in the sub-slab soil vapor beneath, and the indoor air within, buildings located in the MMA, including those that once contained degreasing operations, as well as three off-site private residences along the southeastern WVA property boundary. The evaluation also assessed whether soil vapor at the WVA southern property boundary and northern property boundary adjacent to the Siberia Area contained CVOCs.

A total of 25 buildings in the MMA were sampled during at least one of the two investigation phases. Based on the results of the investigations, no further action was required at the off-site residences, the WVA property boundary, and at WVA Buildings 9, 18, 19, 23, 24, 35, 38, 44, 108, 110, 112, 115, 124, and 126. Sub-slab volatile organic compound (VOC) concentrations at Building 15 will require monitoring of the indoor air, but not corrective measures. VOCs detected in the sub-slab at Buildings 116 and 123 were also in the range where indoor air monitoring would be required. However, since Building 116 is not occupied and Building 123 is only periodically used for painting operations, no monitoring will be conducted at these buildings. Indoor air monitoring will be conducted at Buildings 116 and 123 if the use of either building changes in the future. The buildings that required interim corrective measures are presented in Figure 1-2 in Appendix E and summarized in Table 1-1 below.

Table 1-1: Buildings Requiring Soil Vapor Corrective Measures

Building	Impacted Media	Target Chlorinated VOCs
20	Sub-Slab Soil Vapor	PCE, TCE, TCA
21	Sub-Slab Soil Vapor	TCE
22	Sub-Slab Soil Vapor	TCE
25	Indoor Air, Sub-Slab Soil Vapor	TCE, TCA
114	Indoor Air, Sub-Slab Soil Vapor	PCE, TCE
120	Sub-Slab Soil Vapor	PCE, Carbon Tetrachloride
121	Sub-Slab Soil Vapor	TCE
130	Sub-Slab Soil Vapor	TCE

Notes:
PCE – Tetrachloroethene
TCE – Trichloroethene
TCA – 1,1,1-Trichloroethane

The construction, installation, and startup testing of the SSDSs were completed in September 2010, and summarized in the Construction Certification Report (Malcolm Pirnie, 2010). Annual operation, maintenance, and monitoring of the MMA SSDSs was reported separately through 2011, and added to the annual LTM Report in 2012 with the approval of the NYSDEC.

1.2.2 Siberia Area (WVAA-25)

An RFI was conducted by Malcolm Pirnie at the Siberia Area from 1994 to 1995. Additional investigations and ICMs were completed by Malcolm Pirnie from 1996 to 2002. The Corrective Measures Study (CMS) Report for Siberia was approved in August 2003. The CMs Certification Report was approved by the NYSDEC and USEPA in 2007. The CMs are summarized in the Corrective Measures Study Report. The Statement of Basis for the Siberia Area was issued in 2008.

1.3 Generalized Site Geology and Hydrogeology

1.3.1 Main Manufacturing Area

The major overburden unit identified in the MMA is fill, consisting of brown or dark gray silty sand with angular gravel. The fill material is the only unit consistently found throughout the site, with the thickest amount of fill being in the eastern portion of the

MMA. Underlying the fill are the following native overburden units: a fine-grained alluvium, a coarser alluvium, and glacial till. These units are not present in all areas of the site.

The bedrock underlying the site is a black, medium-hard laminated shale, showing some characteristics of minor metamorphism. This shale is part of the Snake Hill Formation. The bedrock can be described in three ways based on the degree of weathering observed. The first is an extremely weathered zone approximately four feet thick. This extremely weathered bedrock unit was encountered at depths ranging from near ground surface to approximately 20 feet below ground surface (bgs). Beneath this extremely weathered bedrock is a zone of less weathered shale showing minimal competency. Competent bedrock is generally encountered at depths ranging from approximately 1.5 feet bgs to 18 feet bgs.

The majority of the MMA is relatively impervious to rainfall except at the residential and recreational areas of the northeastern portion of the WVA. Due to the shallow depth of bedrock and the limited amount of overburden in several areas of the WVA, groundwater is encountered within different geologic units (overburden, weathered bedrock, or bedrock) depending on the location. For instance, groundwater is encountered in the bedrock at the western end of WVA (topographic high and local recharge area); progressing eastward toward the Hudson River, groundwater is encountered in the weathered bedrock and then in the overburden deposits.

Groundwater flow in bedrock in the MMA is primarily controlled by the degree of fracturing within the bedrock itself and in the local recharge area, which is coincident with a topographic high along a bedrock ridge in the central portion of the facility. The most prominent feature on the potentiometric surface is a groundwater divide trending approximately north to south through Buildings 135 and 125. This feature appears to mirror the bedrock ridge. The primary discharge area for groundwater from the Main Manufacturing Area is the Hudson River, which is located to the east of WVA. For the area surrounding Building 25, groundwater in each of the hydrostratigraphic units flows from west to east towards the Hudson River, with a component of flow to the northeast. In the Building 40 area, groundwater in the bedrock unit flows to the east-southeast. West of the groundwater divide, shallow groundwater flow discharges toward the Kromma Kill.

1.3.2 Siberia Area

According to the "Surficial Geologic Map of New York - Hudson-Mohawk Sheet, 1987", a majority of the SA is underlain by recent alluvial deposits. These are defined as fine sand and gravel deposits overlain by silt. The SA, which is at a lower elevation than the MMA of the WVA located to the east, is generally underlain by a layer of fill (sand, shale fragments, slag, cinders, brick, wire, wood and concrete). Alluvium, lenses of peat, and lacustrine clay deposits were encountered beneath the layer of fill material. Bedrock beneath the SA is also the Snake Hill shale. During the SA investigation, highly weathered shale was encountered from approximately 3.5 feet bgs to 31 feet bgs. In general, competent bedrock was encountered at approximately 12 feet bgs. The upper portion of the competent bedrock was found to be fissile and highly fractured with 45 to 60 degree bedding planes.

Groundwater flows generally to the north-northwest in the NE Quadrant of the SA, and generally to the west across the remainder of the SA. The water table responds quickly to recharge events, and during times of low precipitation the water table may be present in the shale bedrock over portions of the SA. However, on the average, the water table is encountered in the overburden. Surface water in the SA that does not infiltrate is generally directed into the existing storm sewers.

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2. Sampling Plan

Annual monitoring consists of sampling and analysis of groundwater and indoor air, as well as performance monitoring of SSDSs.

2.1 Groundwater Sampling Plan

Groundwater samples will be collected at 58 monitoring wells in the MMA (Table 2-1 and Figure 2-1) and 24 monitoring wells in the Siberia Area (Table 2-2 and Figure 2-2). Samples will be collected using Passive Diffusion Bags (PDBs) when the only analysis at a particular well is VOCs. If samples are being collected for multiple analyses at a well, the well will be sampled according to the USEPA protocol for Low Stress (i.e. Low Flow) Purging and Sampling (USEPA, 1998). Additional information about the groundwater field sampling plan may be found in Section 2 of the LTM Plan Update (Appendix D).

Table 2-1: Long-Term Monitoring Wells and Sampling Frequency, Main Manufacturing Area

Well	Area Monitored	Geologic Unit	VOCs (b)	Metals	NAP
83DM-SP-1	Building 25	Hybrid (a)	**Annual**	--	**Every 3 yrs (2017)**
83DM-SP-3	WWTP	Bedrock	**Annual**	**Annual (Cr only)**	**Every 3 yrs (2017)**
83DM-SP-4	WWTP	Bedrock	**Annual**	--	--
86EM-SP-1A	Building 25	Overburden	**Annual**	--	--
86EM-SP-1B	Building 25	Overburden	**Annual**	--	--
86EM-SP-5	Building 25	Overburden	**Annual**	--	**Every 3 yrs (2017)**
86EM-SP-6	WWTP	Overburden	**Annual**	**Annual**	**Every 3 yrs (2017)**
92EM-SP-7	WWTP	Overburden	**Annual**	--	**Every 3 yrs (2017)**
92EM-SP-8	WWTP	Overburden	**Annual**	--	**Every 3 yrs (2017)**
93EM-SP-9	WVA boundary	Overburden	**Annual**	--	--
93EM-SP-11	Building 25	Overburden	**Annual**	--	--
93EM-SP-13	Building 135	Bedrock	**Annual**	--	--
94EM-MW-19	Building 15	Bedrock	**Annual**	**Annual**	--
94EM-MW-20	Building 15	Bedrock	**Annual**	**Annual**	--
94EM-MW-21	Building 15	Bedrock	**Annual**	**Annual**	--
93EM-RW-2	Building 114	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-AW-25-MW-2	Building 25	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-AW-25-MW-3	Building 25	Overburden	**Annual**	--	**Every 3 yrs (2017)**
WVA-AW-25-MW-5	Building 25	Hybrid (a)	**Annual**	--	--

Well	Area Monitored	Geologic Unit	VOCs (b)	Metals	NAP
WVA-AW-25-MW-6	Building 25	Overburden	**Annual**	--	--
WVA-AW-25-MW-7	Building 25	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-AW-35-MW-5	Building 35	Bedrock	**Every 5 yrs (2016)**	--	--
WVA-AW-35-MW-8	Building 35	Bedrock	**Annual**	--	--
WVA-AW-135-MW-2	Building 135	Bedrock	**Every 5 yrs (2016)**	--	--
WVA-AW-135-MW-4	Building 135	Bedrock	**Every 5 yrs (2016)**	--	**Every 5 yrs (2016)**
WVA-AW-MW-22	WVA boundary	Bedrock	**Every 5 yrs (2016)**	--	--
WVA-AW-MW-26	WVA boundary	Bedrock	**Every 5 yrs (2016)**	--	--
WVA-AW-MW-27	WVA boundary	Overburden	**Annual**	--	--
WVA-AW-MW-32	WVA boundary	Weathered	**Annual**	--	--
WVA-AW-MW-35	Building 20	Bedrock	**Annual**	--	--
WVA-AW-MW-36	Building 20	Overburden	**Annual**	--	--
WVA-AW-MW-38	WVA boundary	Bedrock	**Every 5 yrs (2016)**	--	--
WVA-AW-MW-41	WVA boundary	Bedrock	**Every 5 yrs (2016)**	--	--
WVA-AW-MW-43	Building 25	Overburden	**Annual**	--	--
WVA-AW-MW-44	Building 25	Overburden	**Annual**	--	--
WVA-AW-MW-47	WVA boundary	Weathered	**Annual**	--	**Every 3 yrs (2017)**
WVA-AW-MW-52	Building 114	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-AW-MW-64	Building 114	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
B121-N	Building 121	Hybrid (a)	**Annual**	--	**Every 3 yrs (2017)**
B121-S	Building 121	Hybrid (a)	**Annual**	--	**Every 3 yrs (2017)**
WVA-AW-MW-BLD-110	Building 110	Bedrock	**Annual**	--	--
WVA-B35-PW-1	Building 110	Bedrock	**Annual**	--	--
WVA-MW-79	Building 40	Bedrock	**Annual**	--	--
WVA-MW-82R-1	Building 40	Bedrock	**Annual**	--	--
WVA-MW-82R-2	Building 40	Bedrock	**Annual**	--	--
WVA-MW-82R-3	Building 40	Bedrock	**Annual**	--	--
WVA-MW-83-1	Building 40	Bedrock	**Annual**	--	--
WVA-MW-83-2	Building 40	Bedrock	**Annual**	--	--
WVA-MW-83-3	Building 40	Bedrock	**Annual**	--	--
WVA-MW-84R-1	Building 40	Bedrock	**Annual**	--	--
WVA-MW-84R-2	Building 40	Bedrock	**Annual**	--	--
WVA-MW-84R-3	Building 40	Bedrock	**Annual**	--	--
WVA-MW-85R-1	Building 40	Bedrock	**Annual**	--	--
WVA-MW-85R-2	Building 40	Bedrock	**Annual**	--	--
WVA-MW-85R-3	Building 40	Bedrock	**Annual**	--	--
WVA-MW-86R-1	Building 40	Bedrock	**Annual**	--	--
WVA-MW-86R-2	Building 40	Bedrock	**Annual**	--	--
WVA-MW-86R-3	Building 40	Bedrock	**Annual**	--	--

Notes:
For analyses not sampled annually, the next planned sample year is indicated in parentheses
WWTP – wastewater treatment plant.
NAP – natural attenuation parameters
Cr – Chromium
yrs – years
(a) Overburden and weathered bedrock.
(b) If VOCs are the only analysis in any given year, the well will be sampled using passive diffusion bags (PDBs); otherwise, it will be sampled using low-flow methods.

Table 2-2: Long-Term Monitoring Wells and Sampling Frequency, Siberia Area

Well	Area Monitored	Geologic Unit	VOCs (b)	Metals	NAP
WVA-SA-MW-19R	WVA boundary	Overburden	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-20	WVA boundary	Overburden	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-23	WVA boundary	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-32	Burn Pit	Overburden	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-33	WVA boundary	Overburden	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-34	WVA boundary	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-38	WVA boundary	Weathered	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-39	Burn Pit	Weathered	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-41	Burn Pit	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-60	Reactive Wall	Weathered	**Annual**	--	--
WVA-SA-MW-70	Reactive Wall	Overburden	**Annual**	--	--
WVA-SA-MW-75	Reactive Wall	Weathered	**Annual**	--	--
WVA-SA-MW-76	Reactive Wall	Weathered	**Annual**	--	--
WVA-SA-MW-77	Reactive Wall	Weathered	**Annual**	--	--
WVA-SA-MW-78	Burn Pit	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-79	Burn Pit	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-80	Burn Pit	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-81	Burn Pit	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-82	Burn Pit	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-83	Burn Pit	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-84	Burn Pit	Bedrock	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-85	Reactive Wall	Hybrid (a)	**Annual**	--	--
WVA-SA-MW-EA-6	WVA boundary	Weathered	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-MW-ESE-6	WVA boundary	Overburden	**Annual**	--	**Every 3 yrs (2017)**
WVA-SA-STS-3	Sewer	Storm Sewer	**Annual**	--	--
WVA-SA-STS-5	Sewer	Storm Sewer	**Annual**	--	--
WVA-SA-STS-6	Sewer	Storm Sewer	**Annual**	--	--
WVA-SA-SNS-6	Sewer	Sanitary Sewer	**Annual**	--	**Every 3 yrs (2017)**

Notes:
For analyses not sampled annually, the next planned sample year is indicated in parentheses
NAP – natural attenuation parameters
yrs – years

(a) Overburden and weathered bedrock.
(b) If VOCs are the only analysis in any given year, the well will be sampled using passive diffusion bags (PDBs); otherwise, it will be sampled using low-flow methods.

2.2 Vapor Intrusion Sampling

SSDSs were installed at eight buildings within the MMA in 2010. CM performance monitoring will be conducted to evaluate the effectiveness of the SSDSs and to optimize SSDS operation. In addition, since the SSDSs will not depressurize the entire footprint of the buildings being mitigated, annual monitoring of indoor air will be required to evaluate if the corrective action objectives are being met. Performance monitoring includes the following elements:

- Effluent sampling for SSDSs formerly equipped with off-gas treatment to confirm effluent discharge concentrations.
- Indoor air sampling to assess mitigation system performance at meeting the corrective action objectives.

Effluent testing will be conducted semi-annually, while indoor air sampling will be performed once during the heating season, defined as November 15 through March 31. Anticipated CM performance monitoring sampling requirements are listed in Table 2-3. Additional information and procedures regarding indoor air sampling, as well as daily operational monitoring, monthly system checks, and quarterly monitoring events for SSDSs, are included in Section 5 of the VI CM WP (Appendix E).

Table 2-3: CM Performance Monitoring Sampling Requirements

Building	Number IA Samples	Number Effluent Samples
Building 15	2	-
Building 20	1	1*
Building 21	2	1
Building 22	2	-
Building 25	5	1*
Building 114	1	1
Building 120	2	-
Building 121	1	-
Building 130	1	-

Notes: Building 20 and 25 are a combined system; one sample is collected.

IA – Indoor Air*.

3. Sampling Methods

Sampling methods were designed to ensure all data collected are of acceptable quality.

3.1 Groundwater

Groundwater sampling procedures, including water level measurements, sample collection, sample custody, equipment calibration and maintenance, and investigation-derived waste protocol are outlined in Section 3 of the LTM Plan Update (Appendix D) and are based on the following sources:

1. USEPA Region II GROUNDWATER SAMPLING PROCEDURE, LOW STRESS (LOW FLOW) PURGING AND SAMPLING, March, 1998.
2. USEPA Region II CERCLA QUALITY ASSURANCE MANUAL, October, 1989.
3. NYS Department of Environmental Conservation Analytical Services Protocol 9/89, Revisions 12/91, and any subsequent modifications.
4. RCRA Quality Assurance Project Plan Guidance, NYS Department of Environmental Conservation, Division of Hazardous Substances Regulation, 3/29/91.
5. USEPA RCRA Ground Water Monitoring Technical Enforcement Guidance Document, September 1986.

3.2 Vapor Intrusion

Vapor intrusion sampling procedures including indoor air sampling and SSDS monitoring, as well as contingency procedures in the event it is determined that an SSDS is not performing as designed, are described in Section 5 of the VI CM WP (Appendix E).

4. Operation and Maintenance

In addition to performance monitoring, operational monitoring of the SSDSs will also be conducted. These tasks will include: measurement of vacuum pressures, optimization of flow rates and number of extraction points, system balancing, and required maintenance. Detailed operation and maintenance procedures are located in Section 5 of Appendix E.

5. Monitoring Well Abandonment

A total of 101 monitoring wells will be abandoned at WVA. Of these, 48 wells are located in the MMA (Table 5-1) and 53 wells are located in the Siberia Area (Table 5-2). These wells are identified on site-wide monitoring-well location maps of the MMA (Figure 5-1) and the Siberia Area (Figure 5-2). The monitoring wells will be abandoned in accordance with NYSDEC Commissioner's Policy 43: Groundwater Monitoring Well Decommissioning Policy (dated November 3, 2009) and will include the following procedures:

1. Cut and remove well casing to a depth of two feet below ground surface.
2. Backfill (via tremie pipe) each well from the bottom up using cement or bentonite grout.
3. Remove surface completion materials (e.g. flush mounts, stickup mounts, and concrete pads) from each well site and dispose of the materials at an on-site dumpster.
4. Repair ground surface around each abandoned well to match the surrounding areas.

Table 5-1: Monitoring Wells for Abandonment, Main Manufacturing Area

Well ID	Geologic Unit	Casing Diameter (in)	Bottom of Casing Depth (ft bgs)	Total Depth (ft bgs)
83DM-SP-2	Bedrock	2	16.3	20.7
87GTI-MW-1BP	Hybrid	4	13	13
87GTI-MW-2BP	Hybrid	4	12.5	12.5
87GTI-MW-3BP	Hybrid	4	10	10
87GTI-MW-4BP	Hybrid	4	12.5	12.5
93EM-SP-10	Hybrid	4	14	14
93EM-SP-12	Overburden	4	13.5	13.5
93EM-SP-14	Bedrock	4	10.8	22
93EM-SP-15	Bedrock	4	10.7	21
93EM-SP-16	Bedrock	4	5	15
97MPI-25-MW-46	Bedrock	4	19	35
MW-87	Bedrock	4	17	150
MW-88	Hybrid	2	18	41
RW-1	Bedrock	4.5	4	14
WVA-AW-135-MW-3	Bedrock	4	10.5	20.3
WVA-AW-25-IW-1	Bedrock	6	unknown	35

Well ID	Geologic Unit	Casing Diameter (in)	Bottom of Casing Depth (ft bgs)	Total Depth (ft bgs)
WVA-AW-25-IW-2	Bedrock	6	unknown	35
WVA-AW-25-IW-3	Bedrock	6	unknown	35
WVA-AW-25-IW-4	Bedrock	6	unknown	35
WVA-AW-25-IW-5	Bedrock	6	unknown	35
WVA-AW-25-IW-6	Bedrock	6	unknown	35
WVA-AW-25-MW-4	Weathered	2	9	13.5
WVA-AW-35-MW-6	Overburden	2	12	12
WVA-AW-35-MW-7	Bedrock	4	10	44.75
WVA-AW-MW-21	Overburden	2	14	14
WVA-AW-MW-25	Weathered	2	15	15
WVA-AW-MW-28	Bedrock	4	12	25
WVA-AW-MW-31	Overburden	2	21.5	21.5
WVA-AW-MW-37	Bedrock	4	36	45
WVA-AW-MW-39	Bedrock	4	35.5	46.2
WVA-AW-MW-40	Bedrock	4	10.5	25.5
WVA-AW-MW-42	Weathered	2	24.5	24.5
WVA-AW-MW-45	Bedrock	4	45	60.5
WVA-AW-MW-48	Bedrock	4	53	88.5
WVA-AW-MW-49	Bedrock	4	23	35.5
WVA-AW-MW-50	Bedrock	4	80	95
WVA-AW-MW-53	Bedrock	4	61	76
WVA-AW-MW-54	Bedrock	4	65	80
WVA-AW-MW-56	Overburden	2	14	14
WVA-AW-MW-57	Overburden	2	9.5	9.5
WVA-AW-MW-55	Bedrock	4	12	50
WVA-AW-MW-63	Bedrock	4	23	43
WVA-AW-MW-72	Bedrock	4	40	110
WVA-AW-MW-73	Overburden	2	10	20
WVA-P-1	Bedrock	4	11	30
WVA-P-2	Bedrock	4	11	30
WVA-P-3	Bedrock	4	10	30.2
WVA-P-4	Bedrock	4	18	35

Notes:
in - inches
ft – feet
bgs – below ground surface

Table 5-2: Monitoring Wells for Abandonment, Siberia Area

Well ID	Geologic Unit	Casing Diameter (in)	Bottom of Casing Depth (ft bgs)	Total Depth (ft bgs)
WVA-SA-DEC-1	Bedrock	2	43.75	53.75
WVA-SA-DEC-2	Weathered	2	6	16
WVA-SA-ESE-5	Bedrock	2	5.5	11.5
WVA-SA-GTI-1	Overburden	2	5.5	5.5
WVA-SA-GTI-2	Overburden	2	7.5	7.5
WVA-SA-GTI-3	Bedrock	2	9.7	16.2
WVA-SA-GTI-4	Bedrock	2	12	22
WVA-SA-MW-21	Overburden	2	10	10
WVA-SA-MW-22	Bedrock	4	20	35
WVA-SA-MW-24	Overburden	2	10	10
WVA-SA-MW-25	Overburden	2	8.1	8.1
WVA-SA-MW-26	Overburden	2	5	5
WVA-SA-MW-27R	Overburden	2	5.5	5.5
WVA-SA-MW-28	Bedrock	4	19.5	34.5
WVA-SA-MW-29	Overburden	2	9	9
WVA-SA-MW-30	Bedrock	4	35	45
WVA-SA-MW-31	Overburden	2	11.5	11.5
WVA-SA-MW-35	Overburden	2	8	8
WVA-SA-MW-36	Overburden	2	22	22
WVA-SA-MW-37	Overburden	2	7	7
WVA-SA-MW-45	Weathered	2	7.4	9.4
WVA-SA-MW-46	Overburden	2	2.4	5
WVA-SA-MW-48	Overburden	2	2.7	6.4
WVA-SA-MW-50	Weathered	2	5.5	7.5
WVA-SA-MW-51	Overburden	2	3	5
WVA-SA-MW-53	Overburden	2	3	5
WVA-SA-MW-55	Weathered	2	5.5	7.5
WVA-SA-MW-56	Hybrid	2	2.5	7
WVA-SA-MW-61	Overburden	2	2.4	7
WVA-SA-MW-63	Overburden	2	3	8
WVA-SA-MW-64	Weathered	2	9.2	10.4
WVA-SA-MW-65	Overburden	2	3.3	5.7
WVA-SA-MW-68	Weathered	2	5.6	8.5
WVA-SA-MW-69	Overburden	2	2.8	5
WVA-SA-MW-71	Weathered	2	8.3	9.8
WVA-SA-MW-73	Weathered	2	8.5	10

Well ID	Geologic Unit	Casing Diameter (in)	Bottom of Casing Depth (ft bgs)	Total Depth (ft bgs)
WVA-SA-MW-74	Overburden	2	3	7.8
WVA-SA-MW-EA-5	Overburden	2	5.5	5.5
WVA-SA-MW-EA-7	Weathered	2	5.5	5.5
WVA-SA-MW-EA-8	Overburden	2	10	10
WVA-SA-MW-ESE-1	Bedrock	2	13	19
WVA-SA-MW-ESE-2	Bedrock	2	10.5	16.5
WVA-SA-MW-ESE-3	Bedrock	2	11	17.5
WVA-SA-MW-ESE-4	Overburden	2	23	23
WVA-SA-MW-ESE-7	Bedrock	2	14	25
WVA-SA-MW-ESE-8	Weathered	2	8.5	15
WVA-SA-MW-ESE-9	Bedrock	2	11	16

Notes:
in - inches
ft – feet
bgs – below ground surface

6. Reporting

The JV will prepare an annual Data Summary Report and submit the report for review to the USACE - Baltimore District, Watervliet Arsenal, and the NYSDEC. The purpose of this report will be to present the field observations from that year's sampling event, figures and tables summarizing analytical results, operations and maintenance activities, and recommendations for any changes to the operation of SSDSs.

The report will include the following:

- Recommendations for site activities to be completed prior to the next sampling event and/or recommendations for adjustments to the LTM plan;
- Recommendations for abandonment of wells no longer used for monitoring purposes;
- Overall performance of the SSDSs;
- Summary of SSDS operational parameters (i.e., flows, pressures, etc.);
- Discussion of sampling activities and methodologies;
- Analytical results for groundwater, indoor air, and air effluent samples;
- Maps showing the locations of the groundwater and indoor air sampling locations;
- Recommendations for modifications to the SSDSs and/or performance monitoring program based on system performance; and
- Supporting data, including analytical data packages and field log forms.

The draft summary report will be submitted to the agencies upon review by the WVA. A final report and/or response to comments will be prepared and submitted to the regulators upon the receipt of any comments on the draft report.

The JV team will upload analytical data into the NYSDEC's EQuIS™ database.

7. References

Malcolm Pirnie, 2004, Corrective Measures Work Plan – Building 40 Groundwater, Watervliet Arsenal, Watervliet, New York.

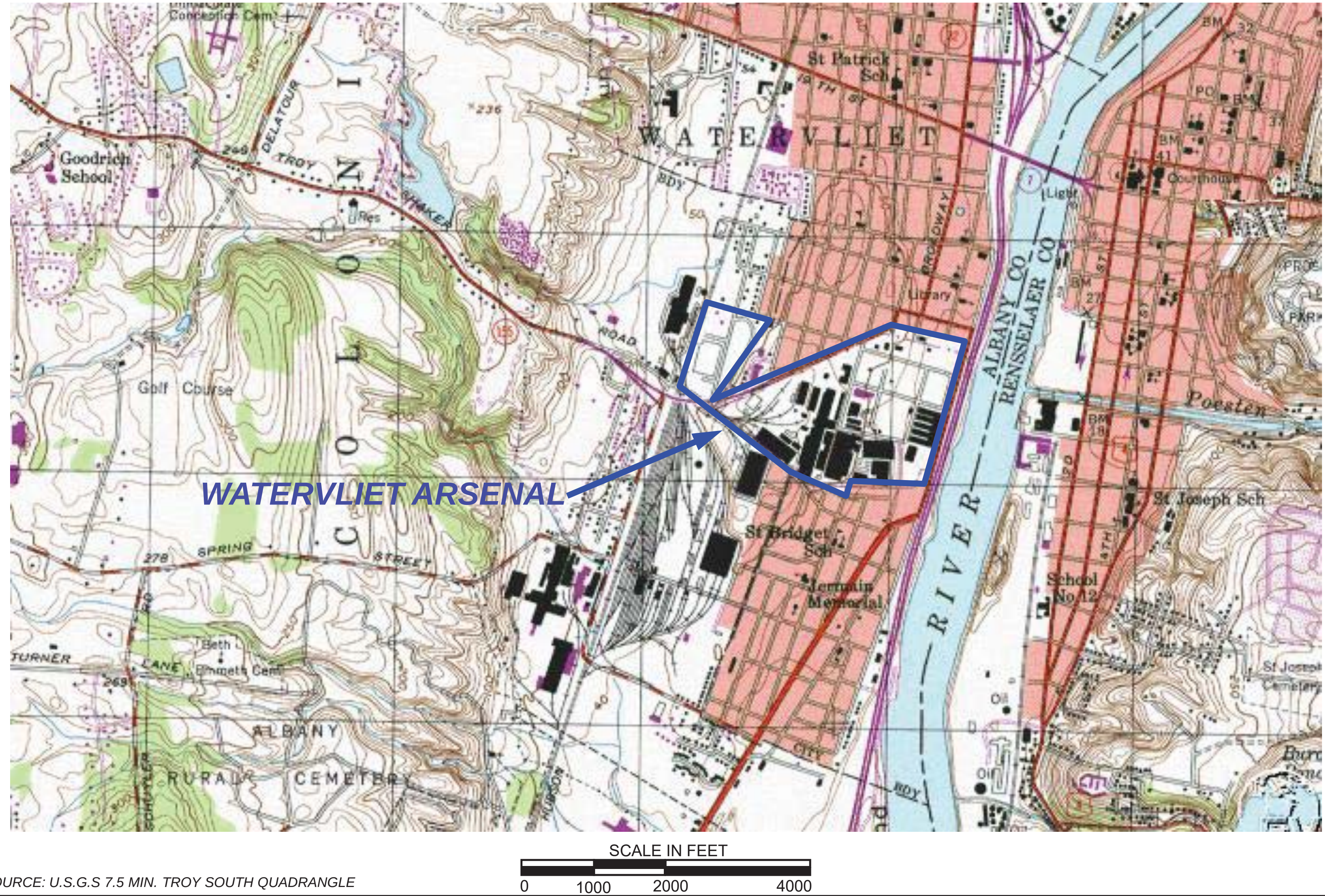
Malcolm Pirnie, 2004a, Corrective Measures Monitoring Plan, Building 40 Groundwater, Watervliet Arsenal, Watervliet, New York.

Malcolm Pirnie, 2009, Corrective Measures Performance Evaluation Report, Building 40 Bedrock Groundwater Corrective Measures, Main Manufacturing Area, Watervliet Arsenal, Watervliet, New York.

Malcolm Pirnie, 2010, VOC Mass Discharge Evaluation and Long-Term Monitoring Work Plan, Building 40 Bedrock Groundwater, Watervliet Arsenal, Watervliet, New York – Attachment B to the Response to Comments on Malcolm Pirnie, 2009.

Figures

PIKA International, Inc.
MALCOLM PIRNIE
A JOINT VENTURE



SOURCE: U.S.G.S 7.5 MIN. TROY SOUTH QUADRANGLE

US Army Corps of Engineers
Baltimore District

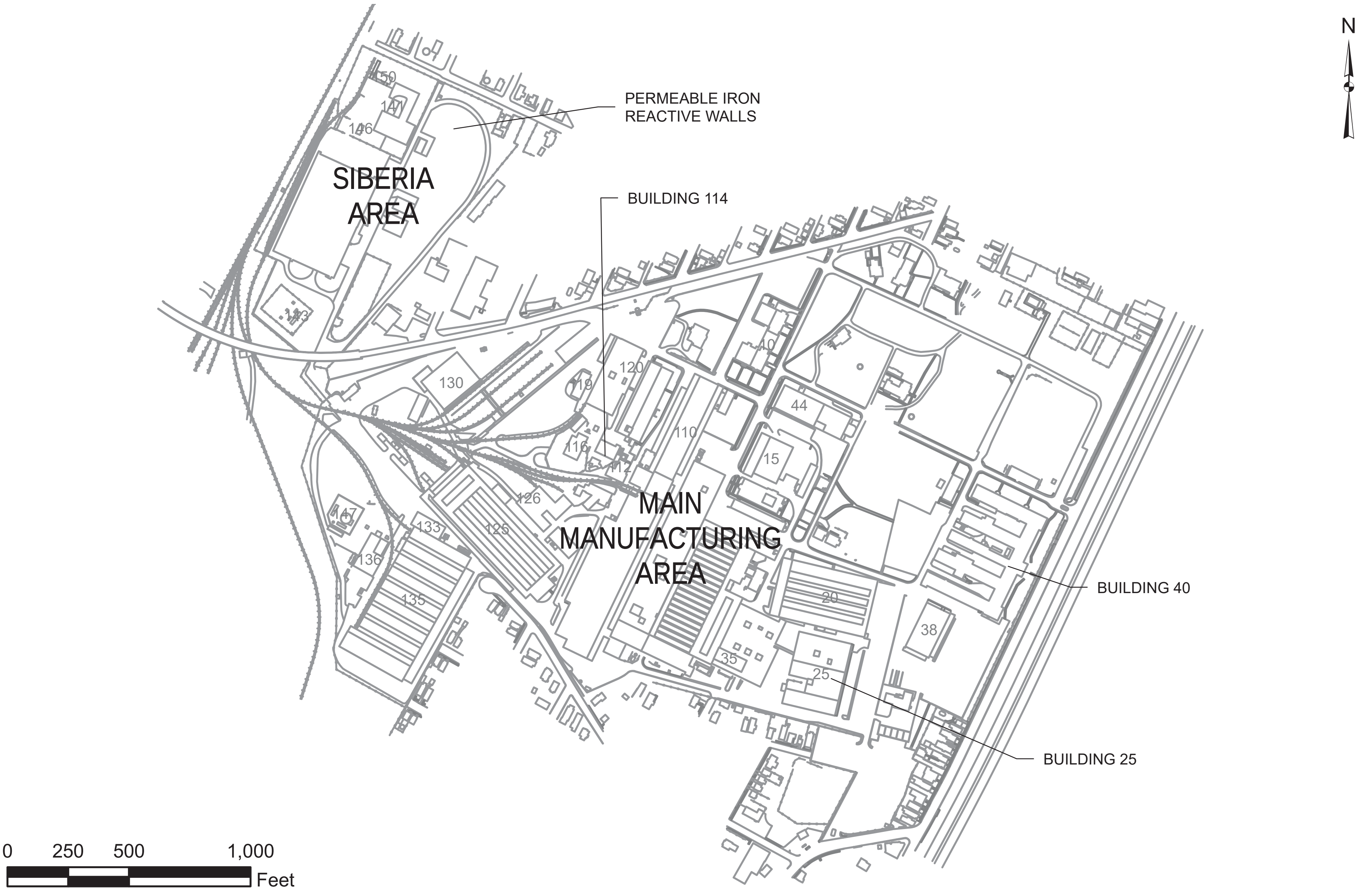
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

CORRECTIVE MEASURES WORK PLAN

SITE LOCATION

FIGURE 1-1

\\ny05fp01\GISMOD\WatervlietArsenal\LTM\Figures\LTM Plan Update 2010\WVA Site Plan.mxd



US Army Corps of Engineers

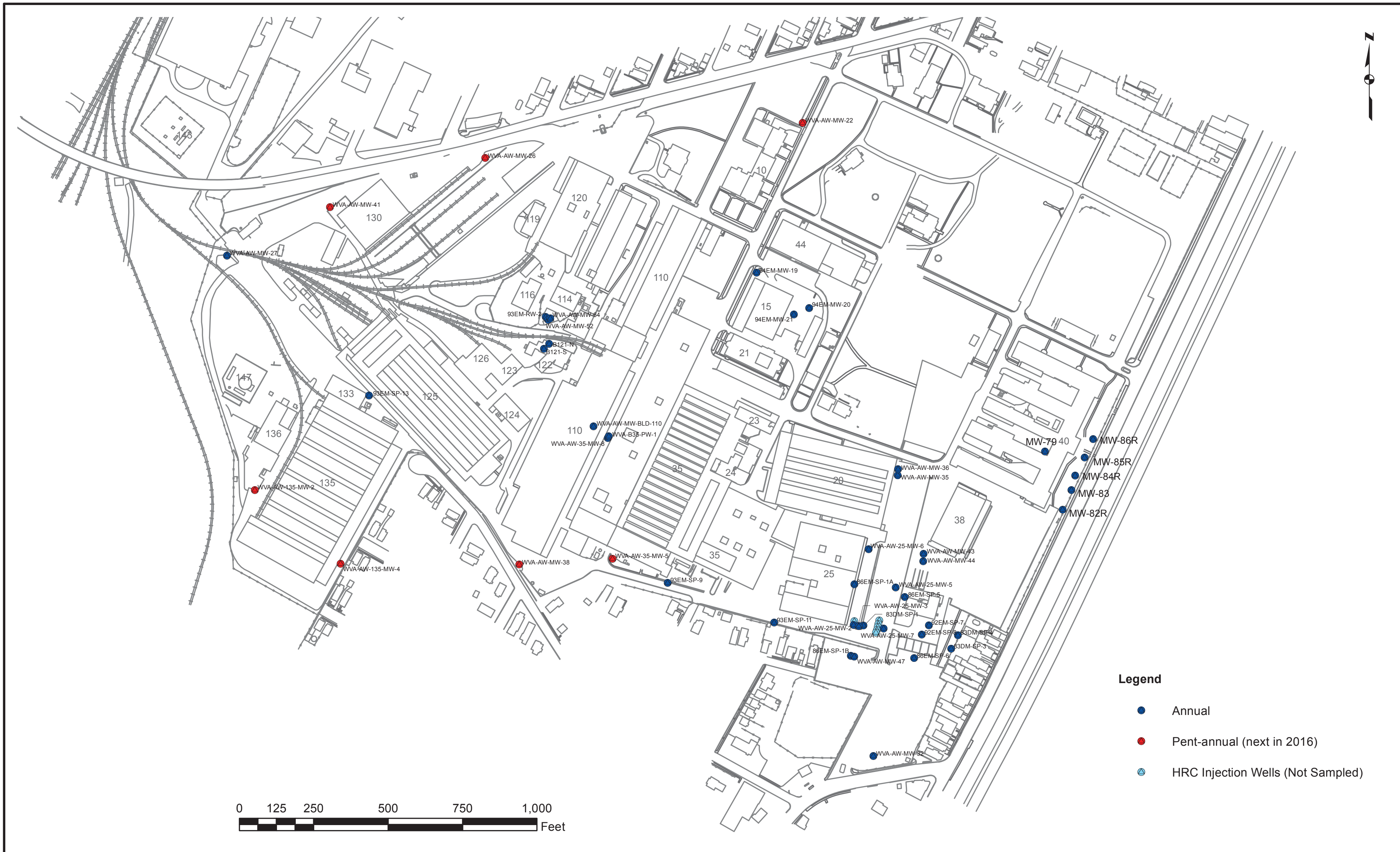
CORRECTIVE MEASURES WORK PLAN
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

SITE MAP

MALCOLM PIRNIE, INC.

JUNE 2016

FIGURE 1-2



US Army Corps of Engineers

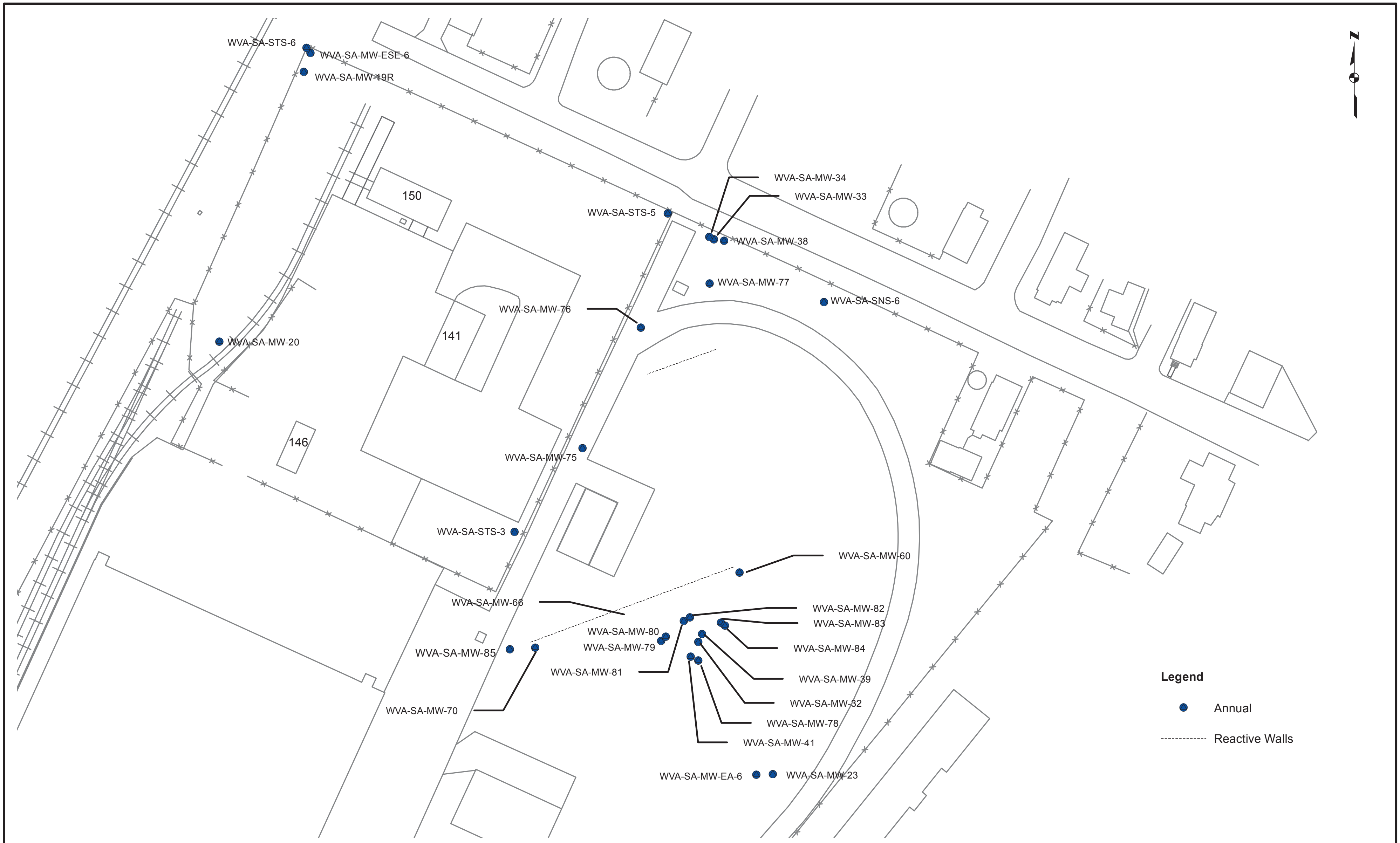
CORRECTIVE MEASURES WORK PLAN
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

MAIN MANUFACTURING AREA
GROUNDWATER MONITORING LOCATIONS

PIKA-MP JV, LLC

JUNE 2016

FIGURE 2-1



US Army Corps of Engineers

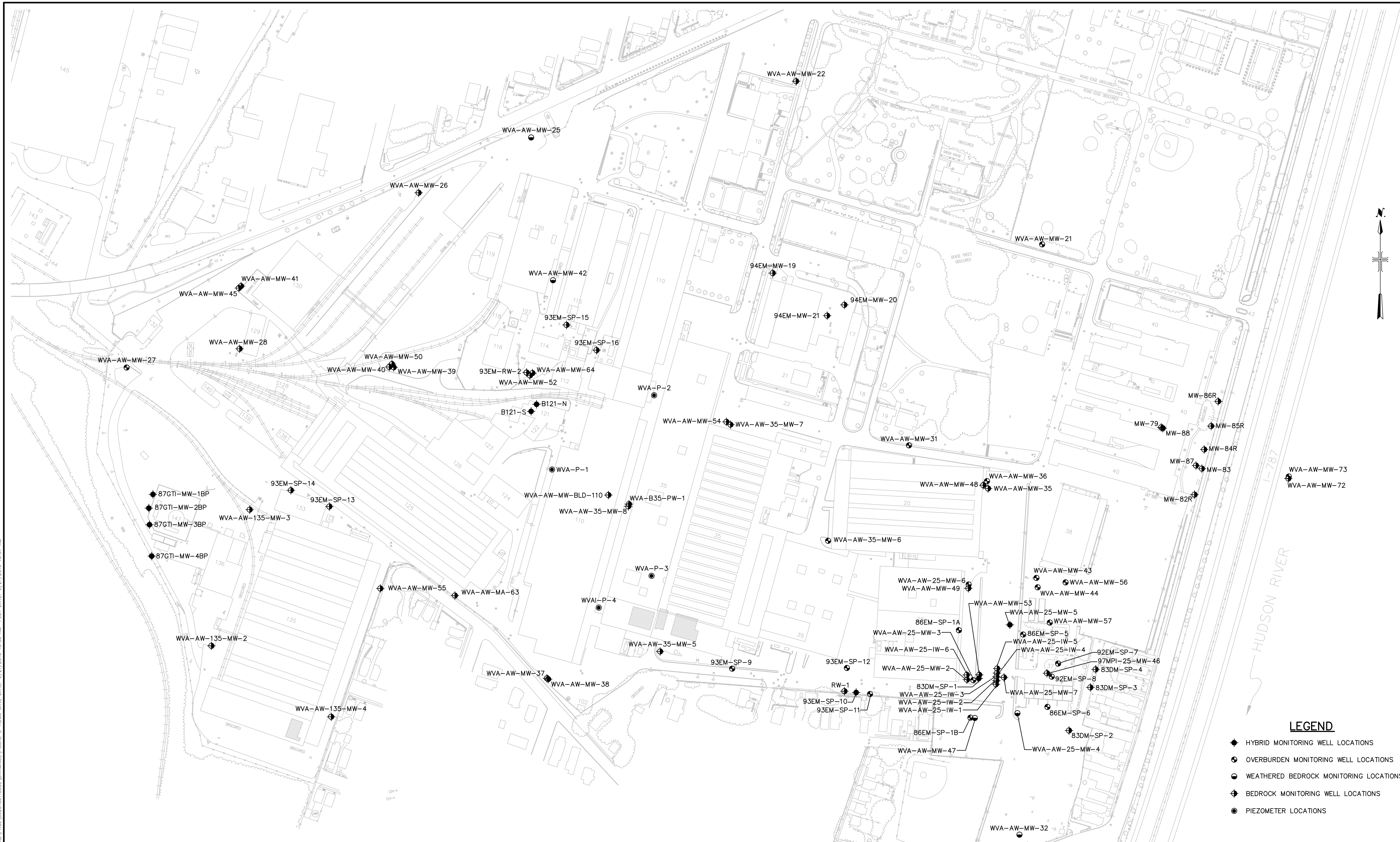
LONG-TERM MONITORING PLAN UPDATE
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

SIBERIA AREA
GROUNDWATER MONITORING LOCATIONS

PIKA-MP JV, LLC

JUNE 2016

FIGURE 2-2



USER: HAUSMANN FILENAME: G:\ACAD\PROJ\06261067.0000\DRAWINGS\FIGURE 5-1.DWG SAVE DATE: 6/21/2016 10:56 AM PLOT DATE: 6/21/2016 10:57 AM

US Army Corps of Engineers

REVISIONS			
NO.	BY	DATE	REMARKS

DES -
DWN SMH
CKD -

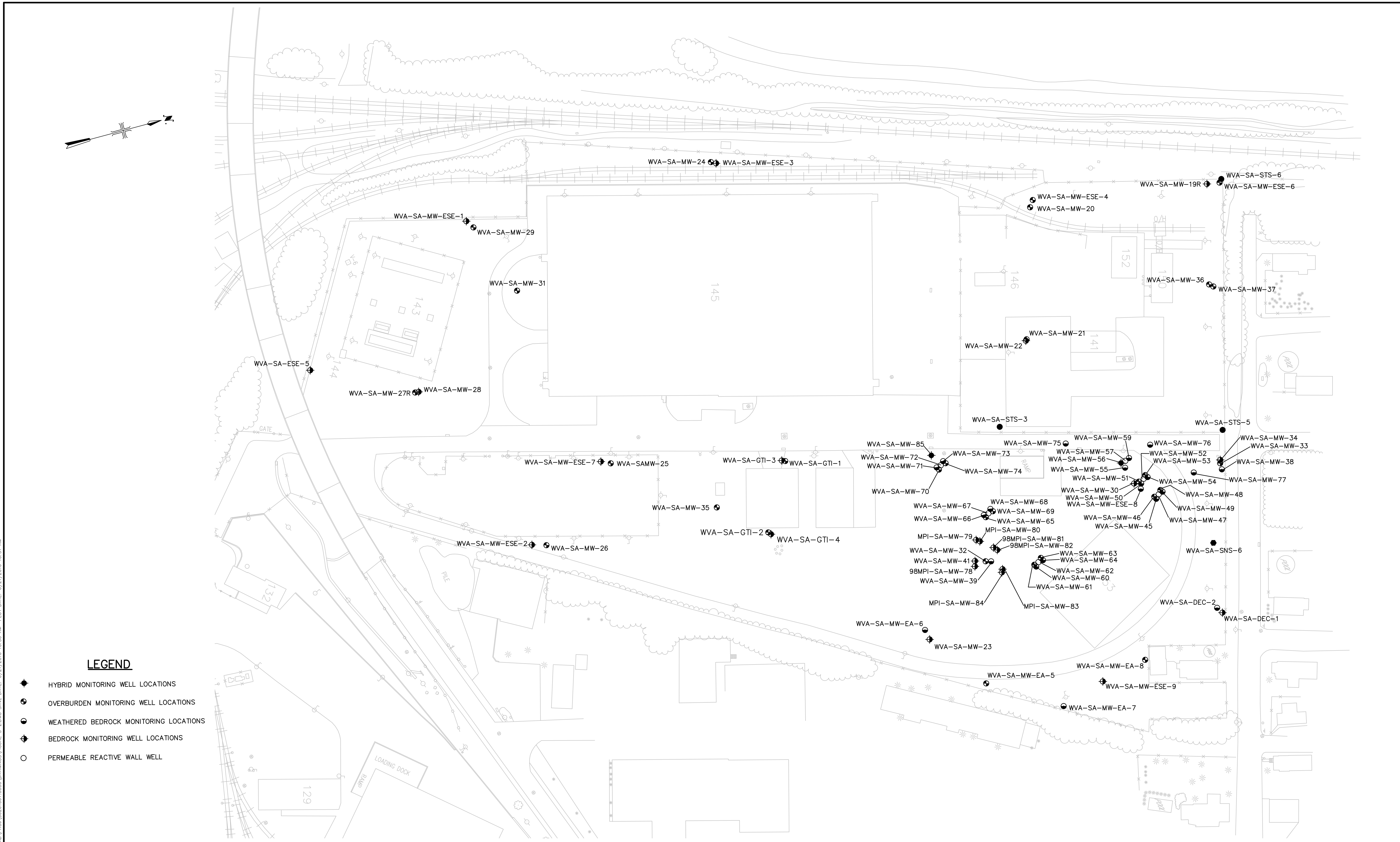
WATERVLIET ARSENAL
MANUFACTURING AREA
CORRECTIVE MEASURES WORK PLAN

MONITORING WELL
LOCATION MAP

60' 0 60' 120'
SCALE: 1"=120'

DATE JUNE 2016

FIGURE 5-1



USER: HAUSMANN FILENAME: G:\ACAD\PROJ\06261067.0000\DRAWINGS\FIGURE 5-2.DWG SAVE DATE: 6/21/2016 10:50 AM PLOT DATE: 6/21/2016 10:51 AM

US Army Corps of Engineers

REVISIONS			
NO.	BY	DATE	REMARKS

DES -

DWN SMH

CKD -

WATERVLIET ARSENAL
SIBERIA AREA
CORRECTIVE MEASURES WORK PLAN

MONITORING WELL LOCATION MAP

30' 0 30' 60'

SCALE: 1" = 60'

DATE JUNE 2016

FIGURE 5-2

Appendix A

Quality Assurance Project Plan

US Army Corps
of Engineers

Uniform Federal Policy-Quality Assurance Project Plan

Watervliet Arsenal Installation Restoration Program
Watervliet, New York

July 2016

Contract No.: W912DR-12-D-0007
Delivery Order No.: 0007

Prepared For:

U.S. ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT
10 South Howard Street
Baltimore, Maryland 21201-2536

Prepared By:

PIKA-MP JV LLC
12723 Capricorn Drive, Suite 500
Stafford, Texas 77477

PIKA International, Inc.
A JOINT VENTURE
MALCOLM PIRNIE

Uniform Federal Policy-Quality
Installation Restoration Program
Water, New York

Prepared for:
US Army Corps of Engineers
Contract No. W912DR-12-D-0007
Delivery Order 0007

Prepared by:
PIKA - MP JV LLC
12723 Capricorn Drive, Suite 500
Stafford, Texas 77477

Our Ref.:
06261067.0000

Date:
July 2016

Larry Jordan
JV Program Manager

Andy Vitolins, PG
JV Project Manager

FOR OFFICIAL USE ONLY

Table of Contents

UFP-QAPP Worksheets

UFP-QAPP Worksheets (continued)

Introduction

This Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) addresses the Installation Restoration Program (IRP) at the Watervliet Arsenal (WVA), Watervliet, Albany County, New York. The purpose of this UFP-QAPP is to detail the planning processes for collecting data at sites managed under WVA's IRP and to describe the implementation of the quality assurance (QA) and quality control (QC) activities developed for this program. The objectives of this UFP-QAPP are to generate project data that are technically valid, legally defensible, and are useful in meeting the project goals, as well as integrate the technical and QC requirements for future remediation activties. This UFP-QAPP addressed four primary elements:

- Project Management
- Measurement and Data Acquisition
- Assessment and Oversight
- Data Review and Usability

The above elements incorporate QA/QC requirements cited within the following documents:

- *U.S. Environmental Protection Agency (USEPA) Requirements for Quality Assurance Project Plans,* USEPA QA/R-5, March 2001.
- *Uniform Federal Policy for Quality Assurance Project Plans,* Final Version, March 2005.
- *Guidance on Systematic Planning Using the Data Quality Objectives Process,* USEPA QA/G-4, EPA/240/B-06/001, February 2006.
- *Department of Defense Quality Systems Manual,* Version 4.2, October 2010
- *USEPA Guidance on Quality Assurance Project Plans,* CIO-2106-G-05, January 2012

The UFP-QAPP worksheet format used herein implements the systematic planning process for environmental sampling and was developed via collaboration between the USEPA, Department of Defense, and the Department of Energy. In 2010, a subgroup composed of members from the participating agencies was established to review and optimize the UFP-QAPP worksheets in close coordination with USEPA's update of QA/G-5 (i.e., CIO-2106-G-05, January 2012). The optimized worksheet format is used for this UFP-QAPP. Table 1 provides a crosswalk between the optimized UFP-QAPP worksheet numbers and titles and the CIO-2106-G-05 guidance.

Table 1. Crosswalk: UFP-QAPP Workbook to ANSI/ASQ E-4

<table>
<tr><th colspan="2">Optimized UFP-QAPP Worksheets</th><th colspan="2">ANSI/ASQ E-4 QAPP Guidance Section</th></tr>
<tr><td>1 & 2</td><td>Title and Approval Page</td><td>2.2.1</td><td>Title, Version, and Approval/Sign-Off</td></tr>
<tr><td rowspan="2">3 & 5</td><td rowspan="2">Project Organization and Quality Assurance Project Plan Distribution</td><td>2.2.3</td><td>Distribution List</td></tr>
<tr><td>2.2.4</td><td>Project Organization and Schedule</td></tr>
<tr><td>4 , 7 & 8</td><td>Personnel Qualifications and Sign-off Sheet</td><td>2.2.1</td><td>Title, Version, and Approval/Sign-Off</td></tr>
</table>

Optimized UFP-QAPP Worksheets		ANSI/ASQ E-4 QAPP Guidance Section	
		2.2.7	Special Training Requirements and Certification
6	Communication Pathways	2.2.4	Project Organization and Schedule
9	Project Planning Session Summary	2.2.5	Project Background, Overview, and Intended Use of Data
10	Conceptual Site Model	2.2.5	Project Background, Overview, and Intended Use of Data
11	Project/Data Quality Objectives	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
12	Measurement Performance Criteria	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
13	Secondary Data Uses and Limitations	Chapter 3	QAPP Elements for Evaluating Existing Data
14 & 16	Project Tasks & Schedule	2.2.4	Project Organization and Schedule
15	Project Action Limits and Laboratory-Specific Detection / Quantitation Limits	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
17	Sampling Design and Rationale	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
18	Sampling Locations and Methods	2.3.1	Sample Collection Procedure , Experimental Design, and Sampling Tasks
		2.3.2	Sampling Procedures and Requirements
19 & 30	Sample Containers, Preservation, and Hold Times	2.3.2	Sampling Procedures and Requirements
20	Field Quality Control	2.3.5	Quality Control Requirements
21	Field Standard Operating Procedures (SOPs)	2.3.2	Sampling Procedures and Requirements
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
23	Analytical SOPs	2.3.4	Analytical Methods Requirements and Task Description
24	Analytical Instrument Calibration	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables

Optimized UFP-QAPP Worksheets		ANSI/ASQ E-4 QAPP Guidance Section	
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
26 & 27	Sample Handling, Custody, and Disposal	2.3.3	Sample Handling, Custody Procedures, and Documentation
28	Analytical Quality Control and Corrective Action	2.3.5	Quality Control Requirements
29	Project Documents and Records	2.2.8	Documentation and Records Requirements
31, 32 & 33	Assessments and Corrective Action	2.4	Assessments and Data Review
		2.5.5	Reports to Management
34	Data Verification and Validation Inputs	2.5.1	Data Verification and Validation Targets and Methods
35	Data Verification Procedures	2.5.1	Data Verification and Validation Targets and Methods
36	Data Validation Procedures	2.5.1	Data Verification and Validation Targets and Methods
37	Data Usability Assessment	2.5.2	Quantitative and Qualitative Evaluations of Usability
		2.5.3	Potential Limitations on Data Interpretation
		2.5.4	Reconciliation with Project Requirements

QAPP Worksheet #1 & 2: Title and Approval Page
(UFP-QAPP Manual Section 2.1)
(EPA 2106-G-05 Section 2.2.1)

1. Project Identifying Information
   a. Site name/project name: Watervliet Arsenal / Watervliet Installation Restoration Program (IRP)
   b. Site location/number: Albany County, New York / NYSDEC Facility No. 401034A
   c. Contract/Work assignment number: W912DR-12-D-0007 / Delivery Order 0007

2. Lead Organization: USACE
   a. Lead Organization Project Manager (name/title/signature/date)

USACE PM: ____
Printed Name/Organization: Stephen Wood, USACE, Baltimore District

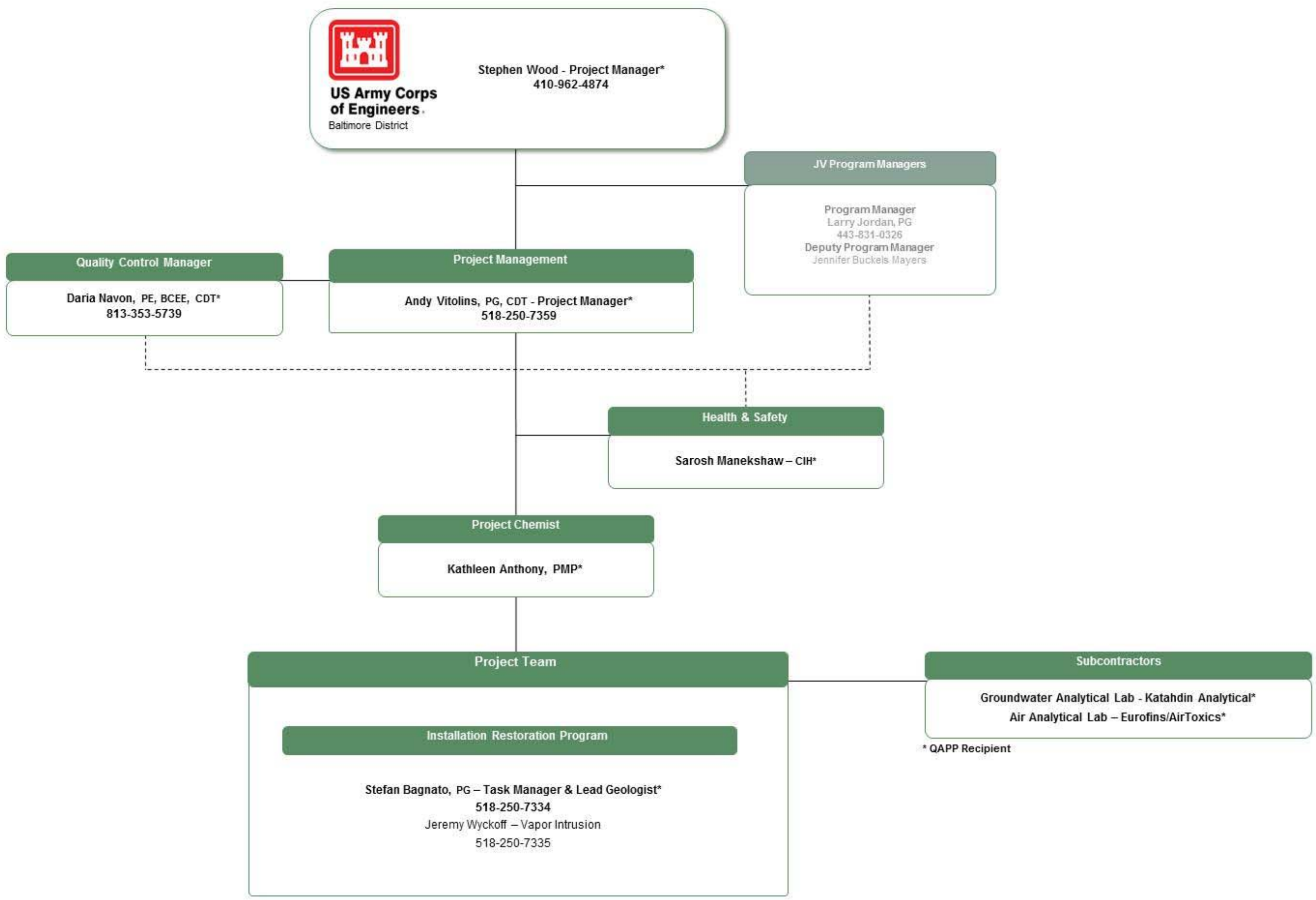
   b. Lead Organization COR (name/title/signature/date)

USACE COR: ____
Printed Name/Organization: Tom Meyer, USACE, Baltimore District

3. List plans and reports from previous investigations relevant to this project

Title	Date
Long-Term Monitoring Plan Update - Main Manufacturing Area (WVAA-32) Siberia Area (WVAA-25) , Watervliet Arsenal, Watervliet, New York	April 2016
Vapor Intrusion Interim Corrective Measures Work Plan- Main Manufacturing Area Watervliet Arsenal, Watervliet, New York	July 2009

QAPP Worksheet #3 & 5: Project Organization and QAPP Distribution
(UFP-QAPP Manual Section 2.3 and 2.4)
(EPA 2106-G-05 Section 2.2.3 and 2.2.4)



QAPP Worksheet #4, 7 & 8: Personnel Qualifications and Sign-off Sheet
(UFP-QAPP Manual Sections 2.3.2 – 2.3.4)
(EPA 2106-G-05 Section 2.2.1 and 2.2.7)

ORGANIZATION: PIKA – MP JV LLC Joint Venture which is comprised of PIKA International, Inc. and its mentor ARCADIS-U.S. Inc.

Name	Project Title/Role	Education/Experience	Signature/Date
Larry Jordan	Program Manager		
Andy Vitolins, PG, CDT	Project Manager	B.S. Geological Sciences, M.S. Environmental Science, 20 years of experience. Project manager on numerous investigation and remediation projects for USACE Baltimore District including Watervliet Arsenal and Ft. Drum IRP and Oasis projects.	
Stefan Bagnato, PG	Assistant Project Manager, IRP Task Manager	B.S. Geology, M.S. Geology/Geochemistry, 12 years of experience. Field lead/task manager/APM on numerous remedial investigations for federal, state, municipal, and commercial projects including Watervliet Arsenal and Ft. Drum IRP and Oasis projects.	
Jeremy Wyckoff	Vapor Intrusion Lead	B.S. Water Resources, 12 years of experience. Field lead/task manager on numerous remediation projects, system pilot testing, system process and mechanical design, and construction management. Field lead for Watervliet Arsenal VI mitigation system installation and O&M.	
Kathleen Anthony	Project Chemist	B.S. Environmental and Resource Science, Minor in Chemistry, 19 years of experience. Project chemist on numerous projects for private clients, USACE, ARNG, and AFCEC	
Sarosh Manekshaw, CIH	Safety& Health Manager	B.S./M.S. Chemical Engineering, 42 years of experience. Senior CIH responsible for developing and implementing S&H Program for numerous HTRW, MMRP, and LLRW projects. Experience working for USACE, NAVFAC, and TACOM.	

ORGANIZATION: Katahdin Analytical Services (aqueous analyses)

Name	Project Title/Role	Education/Experience	Signature/Date
Ms. Jennifer Obrin	Laboratory Project Manager	B.S. Ocean Studies, Maine Maritime Academy, 1999. Ms. Obrin has over 14 years of experience from data management to Project	

Name	Project Title/Role	Education/Experience	Signature/Date
		Manager. Currently is POC for all DoD projects performed by the laboratory.	
Ms. Leslie Dimond	Laboratory QA Manager	B.A. Chemistry, University of Southern Maine, 1991. Ms. Dimond has over 22 years environmental laboratory experience, including 11 years in her current position.	

ORGANIZATION: Eurofins Air Toxics, Inc. (air analyses)

Name	Project Title/Role	Education/Experience	Signature/Date
Melanie Levesque	QA Manager	M.S. in Analytical Chemistry, 20 years laboratory experience	
Ausha Scott	Project Manager	B.S Marine Biology, 16 years laboratory experience	

*Signatures indicate personnel have read and agree to implement this QAPP as written

QAPP Worksheet #6: Communication Pathways
(UFP-QAPP Manual Section 2.4.2)
(EPA 2106-G-05 Section 2.2.4)

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Regulatory agency (NYSDEC) interface	PIKA-MP JV	Andy Vitolins, PIKA-MP JV PM Stefan Bagnato PIKA-MP JV Assistant PM	518-250-7359 518-250-7334	The PM and Assistant PM communicate with the NYSDEC by phone or email with permission of USACE and WVA. USACE and WVA will be copied on communications with NYSDEC.
Field progress reports	PIKA-MP JV	Andy Vitolins, PIKA-MP JV PM	518-250-7359	PIKA-MP JV Field Team Leader will send amended field progress reports via email upon on a daily basis.
Stop work due to safety issues	PIKA-MP JV	Field Team Leader/Task Manager Sarosh Manekshaw, PIKA-MP JV Safety & Health Manager Andy Vitolins, PIKA-MP JV PM	Varies by Task 713-412-9948 518-250-7359	Work may be stopped at any time by any JV staff member for any safety concern. Refer to the Accident Prevention Plan submitted for the WVA IRP Program for specifics related to health and safety. Persons other than the responsible entity may also stop work for safety concerns. WVA and USACE will be notified by the PM or APM within one hour of any safety-related work stoppages and will be consulted prior to re-starting work.
QAPP changes prior to field work	PIKA-MP JV	Andy Vitolins, PIKA-MP JV PM Daria Navon, PIKA-MP JV QC	518-250-7359 813-353-5739	Submit documented amendments within 10 working days for transmittal to USACE for approval.
QAPP changes during project execution	PIKA-MP JV	Field Team Leader/Task Manager Andy Vitolins, PIKA-MP JV PM	Varies by Task 518-250-7359	Secure same-day approval from Field Team Lead and Stefan Bagnato. Andy Vitolins will secure approval for modifications to the QAPP as necessary from USACE. All approved modifications will be included in

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
				the amendments to the QAPP and signed within seven working days.
Field corrective actions	PIKA-MP JV	Field Team Leader/Task Manager Andy Vitolins, PIKA-MP JV PM	Varies by Task 518-250-7359	The PM communicates within 24 hours of stop work to the USACE by phone followed by a confirming e-mail. Resolution of the corrective action will be determined by the JV PM in consultation with the USACE and WVA. Work will be allowed to start once all parties have agreed to the resolution.
Sample receipt variances	Katahdin Analytical Services, LLC Eurofins Air Toxics, Inc.	Ms. Leslie Dimond Ausha Scott	207-874-2400 916-605-3344	All project field samples variance issues will be reported by the laboratory to the PIKA-MP JV Assistant PM within two business days of identification of the technical concern.
Laboratory quality control variances	Katahdin Analytical Services, LLC Eurofins Air Toxics, Inc.	Ms. Leslie Dimond Ausha Scott	207-874-2400 916-605-3344	All QA/QC issues with project field samples will be reported by the laboratory to the PIKA-MP JV Project Chemist and Assistant PM within two business days of identification of the technical concern.
Analytical corrective actions	Katahdin Analytical Services, LLC Eurofins Air Toxics, Inc.	Ms. Leslie Dimond Ausha Scott	207-874-2400 916-605-3344	The need for laboratory corrective actions will be determined by the Project Chemist and Assistant PM and/or Laboratory PM, as appropriate, and will be documented in a memorandum to the PIKA-MP JV PM and the JV QC Manager. The USACE and WVA will be notified if the changes to the data impact reports/data that have already been submitted. Otherwise, the memorandum will be included with the validated data.

Communication Driver	**Organization**	**Name**	**Contact Information**	**Procedure (timing, pathway, documentation, etc.)**
Data verification issues, e.g., incomplete records	Katahdin Analytical Services, LLC Eurofins Air Toxics, Inc.	Ms. Leslie Dimond Ausha Scott	207-874-2400 916-605-3344	All verification issues will be reported by the laboratory to the PIKA-MP JV Project Chemist Assistant PM via e-mail within 24 hours of identification of the technical concern. The PIKA-MP JV QC Manager will be notified of the issue by the PM or APM and will take appropriate action, if necessary.
Data validation issues, e.g., non-compliance with procedures	Katahdin Analytical Services, LLC Eurofins Air Toxics, Inc.	Ms. Leslie Dimond Ausha Scott	207-874-2400 916-605-3344	All validation issues will be reported by the laboratory to the PIKA-MP JV Project Chemist and Assistant PM via email within 24 hours days of identification of the technical concern. The PIKA-MP JV QC Manager will be notified of the issue by the PM or APM and will take appropriate action, if necessary.
Data review corrective actions	PIKA-MP JV	Kathleen Anthony	713-724-2893	The need for data review corrective actions will be determined by the Project Chemist and Assistant PM and/or Laboratory PM, as appropriate, and will be documented in a memorandum to the PIKA-MP JV PM. The PIKA-MP JV QC Manager will be notified of the issue by the PM or APM and will take appropriate action, if necessary.

QAPP Worksheet #9: Project Planning Session Summary
(UFP-QAPP Manual Section 2.5.1 and Figures 9-12)
(EPA 2106-G-05 Section 2.2.5)

Date of planning session: 22 March 2016
Location: Watervliet Arsenal, Watervliet, NY
Purpose: Project Planning

Participants:

Name	Organization	Title/Role	Email/Phone
Mr. Stephen Wood	USACE, Baltimore	Project Manager	410-962-4874 Stephen.C.Wood@usace.army.mil
Mrs. JoAnn Kellogg	WVA	Lead Environmental Protection Specialist	518-266-5286 joann.kellogg@us.army.mil
Ms. Vanessa Duenas	WVA	Environmental Engineer	518-266- 3672 vanessa.m.duenas.civ@mail.mil
Mr. Andy Vitolins	PIKA-MP JV	Project Manager	518-250-7359 andy.vitolins@arcadis.com
Mr. Stefan Bagnato	PIKA-MP JV	Assistant Project Manager	518-250-7334 stefan.bagnato@arcadis.com

Notes/Comments:
Meeting attendees discussed big picture project logistics, points of contact, and WVA's primary concerns relating to components of the JV scope that Ms. Duenas will oversee, including the sanitary sewer evaluation, soluble oil system evaluation, natural gas evaluation, and Industrial Wastewater Treatment Plant (IWTP). Mr. Wood and Mr. Vitolins reviewed the scope of work in the JV's contract with Ms. Duenas to be sure everyone understood the scope and expectations. Mr. Vitolins facilitated discussion about anticipated deliverables, meetings, and schedule for the remainder of 2016. Ms. Duenas provided WVA points of contact for each system/evaluation.

Consensus decisions made:

- IWTP treatment plant evaluation and feasibility study is top priority given other parallel/related evaluations being conducted by WVA. Proposed a potential meeting in mid-April with IWTP personnel.

Action Items:

Action	Responsible Party	Due Date
WVA to provide soluble oil system waste flows and history of inputs	WVA	31 March 2016

Date of planning session: 23 March 2016
Location: Watervliet Arsenal, Watervliet, NY
Purpose: Project Planning

Participants:

Name	Organization	Title/Role	Email/Phone
Mr. Stephen Wood	USACE, Baltimore	Project Manager	410-962-4874 Stephen.C.Wood@usace.army.mil
Mrs. JoAnn Kellogg	WVA	Lead Environmental Protection Specialist	518-266-5286 joann.kellogg@us.army.mil
Mr. Michael Wright	WVA	Environmental Engineer	518-266-4785 michael.t.wright102.civ@mail.mil
Mr. Andy Vitolins	PIKA-MP JV	Project Manager	518-250-7359 andy.vitolins@arcadis-us.com
Mr. Stefan Bagnato	PIKA-MP JV	Assistant Project Manager	518-250-7334 stefan.bagnato@arcadis-us.com

Notes/Comments:
Meeting attendees discussed big picture project logistics, points of contact, and WVA's primary concerns relating to components of the JV scope that Mr. Wright will oversee, including the Long-Term Monitoring Program, Vapor Intrusion (VI) Operations and Maintenance (O&M), Well Abandoning, Chemical Bulk Storage, Spill Plan, Asbestos Survey, Best Management Plan, Air Emission Inventory, and Toxic Release Inventory (TRI) Support. WVA would like to reduce overall cost and liability of VI systems through consideration of lifespan/replacement costs. It was acknowledged by JV and USACE that systems at Buildings 20/25, 114, and 40 would most likely have to stay in place for the foreseeable future. Mr. Wood and Mr. Vitolins reviewed the scope of work in the JV's contract with Mr. Wright to be sure everyone understood the scope and expectations. Mr. Vitolins facilitated discussion about anticipated deliverables, meetings, and schedule for the remainder of 2016. Mr. Wright provided WVA points of contact for each program/evaluation component.

Consensus decisions made:

- Project Management Plan draft schedule will be generated and submitted in the coming weeks.
- Work Plan and Quality Assurance Project Plan format/template from Ft. Drum would be acceptable for WVA.
- Proposed a potential meeting in early May with NYSDEC regarding well abandoning with potential field work to coincide with WVA production shutdown in early August.
- JV will shadow this year's TRI efforts by USAPHC.
- Targeted submission of the IRP and ECP Work Plans by the end of April.

Action Items:

Action	Responsible Party	Due Date
Prepare and submit draft PMP schedule	PIKA-MP JV	1 May 2016
Work Plan Preparation	PIKA-MP JV	Draft to USACE 1 May 2016

QAPP Worksheet #10: Conceptual Site Model
(UFP-QAPP Manual Section 2.5.2)
(EPA 2106-G-05 Section 2.2.5)

The conceptual model for the Watervliet Arsenal IRP project is described in Section 1.2 of the IRP Work Plan. Additional details for the Main Manufacturing Area (WVAA-32) and Siberia Area (WVAA-25) are provided in the corresponding *Long-Term Monitoring Plan Update* and *Vapor Intrusion Interim Corrective Measures Work Plan* in Appendices D and E of the IRP Work Plan.

QAPP Worksheet #11: Project/Data Quality Objectives
(UFP-QAPP Manual Section 2.6.1)
(EPA 2106-G-05 Section 2.2.6)

Step 1: State the Problem:

This worksheet is used to present the sampling rationale, design, and quality assurance and quality control procedures to be followed as part of monitoring activities for groundwater and indoor air.

Groundwater – Groundwater will be monitored as part of an interim/long-term monitoring program for the Main Manufacturing and Siberia Areas of the WVA. Corrective measures have been previously implemented at WVA. Data generated from sampling completed as part of this QAPP will be used to monitor COC concentrations in groundwater.

Air – Air samples will be collected for the purpose of monitoring the effectiveness of the sub-slab depressurization systems (SSDSs) and to optimize SSDS operation. In addition, since the SSDSs will not depressurize the entire footprint of the buildings being mitigated, annual monitoring of the indoor air will be required to evaluate if the corrective action objectives are being met.

Step 2: Identify the Goal of the Study:

The primary goal of the sampling activities is to compile sufficient information to support the optimization of the remedial strategies, document the extent of contamination and trends in contaminant concentrations, and/or meet the sampling requirements of each site. The information will be used in the development of annual monitoring reports. Worksheet #17 summarizes the rationale and approach that will be used. Below are the activities that will be completed and the goal of the activity. Refer to the IRP Work Plan, the Long-Term Monitoring Plan (Appendix D), and the Vapor Intrusion Interim Corrective Measures Work Plan (Appendix E) for the proposed sample locations.

- **Groundwater Sampling –** Groundwater sampling activities will focus on documenting existing conditions and evaluating trends in groundwater impacts.
- **Indoor Air Sampling –** Air sampling will be completed to monitor the effectiveness of the SSDSs and evaluate if corrective action objectives are being met.

Step 3: Identify Information Inputs:

Groundwater - Field data that will be collected as part of this project include depth to water. ARCADIS Standard Operating Procedures (SOPs) that are applicable to the sampling activities are listed in Worksheet #21.

Laboratory data that will be collected as part of these sampling activities include groundwater samples. Groundwater samples are analyzed by a NYSDEC Analytical Services Protocol (ASP)-certified laboratory, for Target Compound List (TCL) volatile organic compounds (VOCs), dissolved sulfide, dissolved organic carbon (DOC), and dissolved gases. Samples collected from reactive wall wells are analyzed for VOCs only. Additional laboratory analyses, including Resource Conservation and Recovery Act (RCRA)-listed metals. Groundwater samples collected as part of the long-term monitoring program are analyzed for VOCs by SW-846 Method 8260, and RCRA-metals by SW-846 Methods 6010 and 7470, by the analytical laboratory under a standard turnaround time with NYSDEC ASP Category A deliverables.

ARCADIS SOPs for collection, handling, and shipping of these samples are listed on Worksheet #21. Worksheets #19 and #23 summarize the laboratory analytical methods that will be used to generate chemical data.

QAPP Worksheet #11: Project/Data Quality Objectives
(UFP-QAPP Manual Section 2.6.1)
(EPA 2106-G-05 Section 2.2.6)

The data collection activities performed as part of the project will be conducted to meet the following objectives:

- Monitor extent of groundwater impacts and remedial system performance

Air - Daily operational monitoring, monthly system checks, and quarterly monitoring events will be conducted during the operation of the SSDSs. Daily operational system monitoring will be conducted remotely through the PLC telemetry for the Type A and Type B SSDSs. Type C systems will be checked on a minimum bi-weekly basis to confirm that they are operating. The monthly system checks will monitor system performance and confirm that equipment is functioning properly. The quarterly monitoring events will evaluate overall performance of the SSDSs and provide information to support any changes to the systems to optimize their operation. Monthly system checks will consist of the following activities:

- Recording of system performance parameters (i.e., flows, pressures, and temperatures).
- Any required maintenance.
- Monitoring of volatile vapor concentrations in the air effluent using a photoionization detector (PID).
- Flow measurements.
- Balancing of flows.

Quarterly monitoring will consist of the same activities as the monthly system checks, plus the following activities:

- Sampling of air effluent for systems with off-gas treatment.

Records of bi-weekly (Type C SSDSs), monthly, and quarterly system checks will be maintained throughout the operation of the SSDSs. Performance monitoring operations are summarized in Table 5-2.

Step 4: Define the Boundaries of the Sampling:

Activities completed as part of the sampling activities will be conducted within the Watervliet Main Manufacturing and Siberia Areas. Refer to Figures 2-1 and 2-2 and Appendices D and E of the IRP Work Plan for the location of the sampling points and remedial areas. See Worksheet #17 for further information on the work with will be completed in each of the areas.

Step 5: Develop the Analytic Approach:

The list of required analytical samples per area and media was determined following review of historical data. The sampling activities will be conducted in accordance with work plans (Appendices D and E of the IRP Work Plan) accepted by both the Army and Regulatory stakeholders. Refer to Worksheets #14, 17, and 18 for information on the types of samples that will be collected.

QAPP Worksheet #11: Project/Data Quality Objectives
(UFP-QAPP Manual Section 2.6.1)
(EPA 2106-G-05 Section 2.2.6)

Step 6: Specify Performance or Acceptance Criteria:
Specifications for this step call for: 1) giving forethought to corrective actions to improve data usability and 2) understanding the representative nature of the sampling design. Acceptance criteria and corrective actions are described within this document. Controls on precision, reporting, and accuracy are provided in Worksheets #12 and #28. As further described in Worksheet #14, field monitoring and detection equipment will be routinely calibrated, which confirms that equipment used is of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. Required corrective actions will be taken as described in Worksheet #14. The Data Usability Assessment process is described in Worksheet #37. The representative nature of the sampling design will be assured by discussions among professionals familiar with the site and the appropriate government agencies.
Step 7: Develop the Plan for Obtaining Data:
Sampling completed as part of the sampling activities is focused on continued monitoring of groundwater and air in accordance with work plans accepted by both Army and Regulatory stakeholders. Worksheet #17 provides further details on the rationale and approach that will be used. Refer to Worksheets #12, 15, 19, 20, and 28 for specific analysis design requirements.

Worksheet #12-1 – Measurement Performance Criteria
(Volatile Organic Compounds in Water)

Matrix	Water				
Analytical Group	Volatile Organic Compounds				
Concentration Level	All				
Sampling Procedure[1]	**Analytical Method/Standard Operating Procedure (SOP)[2]**	**Data Quality Indicators**	**Measurement Performance Criteria**	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
3136199 1833199 2003199	SW846 8260C/ L-1	Precision – Overall	Relative percent difference (RPD) <35%	Field duplicate[3]	S&A
		Accuracy/Bias	Percent recovery (%R), See Table G-3 U.S. Department of Defense (DoD) Quality Systems Manual (QSM) V4.2	Surrogate	A
		Accuracy/Bias Contamination	< ½ Limit of Quantitation	Blanks (field, trip, equipment, method)	S&A
		Accuracy/Bias	%R, See Table G-4 DoD QSM V4.2	Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD)[4]	A
		Accuracy/Bias	% Relative abundance, see analytical SOP	Instrument performance check: bromofluorobenzene	A
		Precision	Area response and retention times, See Table F-4 DoD QSM V4.2	Internal standard	A
		Accuracy/Bias	%R, same as LCS	Matrix spike and matrix spike duplicate (MS/MSD)[4]	A
		Precision	RPD <20%	MS/MSD or LCS/LCSD[4]	A

Notes:
[1]Reference number from Worksheet #21.
[2]Reference number from Worksheet #23.
[3]Field duplicate samples not required in relation to investigation-derived waste samples.
[4]MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

Worksheet #12-2 – Measurement Performance Criteria
(Metals in Water)

Matrix	Water				
Analytical Group	Metals				
Concentration Level	All				
Sampling Procedure[1]	**Analytical Method/Standard Operating Procedure (SOP)[2]**	**Data Quality Indicators**	**Measurement Performance Criteria**	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
3136199 1833199 2003199	SW846 6010C/7470A/ L-3a/L-4	Precision – Overall	Relative percent difference (RPD) <35%	Field duplicate[3]	S&A
		Accuracy/Bias Contamination	< ½ Limit of Quantitation	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	Percent recovery (%R) Inductively Coupled Plasma 90-110% Mercury 80-120%	Initial and continuing calibration verification	A
		Precision – lab	%R, See Table F-7 and F-8 DoD QSM V4.2	Interference check sample (A and AB) (SW846 6010C only)	A
		Precision – lab	%R, See Table F-7 and F-8 DoD QSM V4.2	Reporting limit verification (CRI) (SW846 6010C only)	A
		Accuracy/Bias	%R, See Table G-18 DoD QSM V4.2	Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD)[4]	A
		Accuracy/Bias	%R, same as LCS	Matrix spike and matrix spike duplicate (MS/MSD)[4]	A
		Precision	RPD <20%	MS/MSD or LCS/LCSD[4]	A
		Accuracy/Bias	%R, See Table F-7 and F-8 DoD QSM V4.2	Post-digestion spike (SW846 6010C only)	A
		Precision	Percent difference (%D), See Table F-7 and F-8 DoD QSM V4.2	Serial dilution (SW846 6010C only)[5]	A

Notes:
[1]Reference number from Worksheet #21.
[2]Reference number from Worksheet #23.
[3]Field duplicate samples not required in relation to investigation-derived waste samples.
[4]MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.
[5]Performed as needed only for analytes with concentration > 50 times the method detection limit (MDL).

Worksheet #12-3 – Measurement Performance Criteria
(Dissolved Gases in Water)

Matrix	Water				
Analytical Group	Dissolved Gases				
Concentration Level	All				
Sampling Procedure[1]	**Analytical Method/Standard Operating Procedure (SOP)[2]**	**Data Quality Indicators**	**Measurement Performance Criteria**	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
1833199 2003199	RSK-175/ BR-AT-006	Precision – Overall	Relative percent difference (RPD) <35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< ½ Limit of Quantitation	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	Percent recovery (%R), See Table 42 U.S. Department of Defense Quality Systems Manual V5.0	Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias	%R, same as LCS	Matrix spike and matrix spike duplicate (MS/MSD)[3]	A
		Precision	RPD <20%	MS/MSD or LCS/LCSD[3]	A

Notes:
[1]Reference number from Worksheet #21.
[2]Reference number from Worksheet #23.
[3]MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

Quality Assurance Project Plan Worksheet #12-4 – Measurement Performance Criteria (Total Organic Carbon and Dissolved Organic Carbon in Water)

Matrix	Water				
Analytical Group	Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC)				
Concentration Level	All				
Sampling Procedure[1]	**Analytical Method/ Standard Operating Procedure (SOP)**[2]	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
2003199	EPA Method 415.1, SW846 9060 and SM5310B, 05/12, Revision 7./ CA-763	Precision – Overall	Relative percent difference (RPD) < 50%	Field duplicate	S&A
		Accuracy/Bias Contamination	< ½ Limit of Quantitation (LOQ)	Blanks (field, equipment, calibration, method)	S&A
		Accuracy/Bias	%R 80-120%	Calibration Verification	A
		Accuracy/Bias	%R 85-115%	Laboratory control sample (LCS)	A
		Precision	%RPD <15%	Laboratory duplicate/Matrix spike/Matrix spike duplicate	A

Notes:
[1]Reference number from Quality Assurance Project Plan Worksheet #21.
[2]Reference number from Quality Assurance Project Plan Worksheet #23.

Worksheet #12-3 – Measurement Performance Criteria
(Dissolved Gases in Water)

Matrix	Water				
Analytical Group	Dissolved Gases				
Concentration Level	All				
Sampling Procedure[1]	**Analytical Method/Standard Operating Procedure (SOP)**[2]	**Data Quality Indicators**	**Measurement Performance Criteria**	**Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
1833199 2003199	RSK-175/ BR-AT-006	Precision – Overall	Relative percent difference (RPD) <35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< ½ Limit of Quantitation	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	Percent recovery (%R), See Table 42 U.S. Department of Defense Quality Systems Manual V5.0	Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias	%R, same as LCS	Matrix spike and matrix spike duplicate (MS/MSD)[3]	A
		Precision	RPD <20%	MS/MSD or LCS/LCSD[3]	A

Notes:
[1]Reference number from Worksheet #21.
[2]Reference number from Worksheet #23.
[3]MS and MSD must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

QAPP Worksheet #12-6 Measurement Performance Criteria (Volatile Organic Compounds in Air)

Matrix	Air				
Analytical Group	VOCs				
Concentration Level	All				
Sampling Procedure[1]	**Analytical Method/SOP[2]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
3152010 765199	USEPA TO-15/ SOP-06 and TO-15 SIM SOP-38	Precision — Overall	RPD < 50%	Field duplicate	S&A
		Accuracy/Bias Contamination	< RL	Blanks (field, trip, equipment, method)	S&A
		Accuracy/Bias	%R 70 – 130%	LCS	A
		Accuracy/Bias	% Relative abundance, see Table 3 of TO-15	Instrument performance check: bromofluorobenzene (BFB)	A
		Precision	Area response & retention times, see analytical method	Internal standard	A
		Precision	RPD <25%	LCS/LCSD	A

Notes:
[1]Reference number from QAPP Worksheet #21.
[2]Reference number from QAPP Worksheet #23.

QAPP Worksheet #13: Secondary Data Uses and Limitations
(UFP-QAPP Manual Section 2.7)
(EPA 2106-G-05 Chapter 3: QAPP Elements For Evaluating Existing Data)

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
Historical site data	Long-Term Monitoring 2015 Data Summary Report Watervliet Arsenal, Watervliet, New York (PIKA-Arcadis JV 2015)	Background information on nature and extent of contaminants.	The historical analytical data are considered valid and there are no limitations regarding their use.
Visual Observations	Long-Term Monitoring 2015 Data Summary Report Watervliet Arsenal, Watervliet, New York (PIKA-Arcadis JV 2015)	Observations relative to maintenance and logistics items.	The historical observations are considered valid and there are no limitations regarding their use.

QAPP Worksheet #14/16: Project Tasks & Schedule
(UFP-QAPP Manual Section 2.8.2)
(EPA 2106-G-05 Section 2.2.4)

The proposed schedule for the Watervliet Arsenal IRP project is described in Appendix A of the IRP Project Management Plan.

Worksheet #15-1 Reference Limits and Evaluation (Aqueous Samples)

Analyte	CAS Number	NYSDEC Ambient Water Quality Standard (µg/L)	Laboratory-specific: Limit of Quantitation (LOQ) (µg/L)	Limit of Detection (LOD) (µg/L)	Detection Limit (DL) µg/L	Accuracy Control Limit (%R)	Precision Control Limit (% RPD)
Analytical Group: VOCs / 8260C							
1,1,1-Trichloroethane	71-55-6	5	1	0.5	0.20	74-131	30
1,1,2,2-Tetrachloroethane	630-20-6	5	1	0.5	0.38	71-121	30
1,1,2-Trichloroethane	79-00-5	1	1	0.5	0.33	80-119	30
1,1-Dichloroethane	75-34-3	5	1	0.5	0.21	77-125	30
1,1-Dichloroethene	75-35-4	0.7	1	0.5	0.35	71-131	30
1,2-Dichloroethane	107-06-2	0.6	1	0.5	0.20	73-128	30
1,2-Dichloropropane	78-87-5	1	1	0.5	0.25	78-122	30
2-Butanone (MEK)	78-93-3	50	5	2.5	1.31	56-143	30
Benzene	71-43-2	1	1	0.5	0.26	79-120	30
Bromodichloromethane	75-27-4	5	1	0.5	0.33	79-125	30
Bromoform	75-25-2	50	1	0.5	0.23	66-130	30
Bromomethane	74-83-9	5	2	1	0.49	53-141	30
Carbon Disulfide	75-15-0	60	1	0.5	0.25	64-133	30
Carbon Tetrachloride	56-23-5	0.4	1	0.5	0.22	72-136	30
Chlorobenzene	108-90-7	5	1	0.5	0.22	82-118	30
Chloroethane	75-00-3	5	2	1	0.55	60-138	30
Chloroform	67-66-3	7	1	0.5	0.32	79-124	30
Chloromethane	74-87-3		2	1	0.36	50-139	30
cis-1,3-Dichloropropene	10061-01-5	0.4	1	0.5	0.19	75-124	30
Dibromochloromethane	124-48-1	50	1	0.5	0.30	74-126	30
Ethylbenzene	100-41-4	5	1	0.5	0.21	79-121	30
m+p-Xylene	179601-23-1	5	2	1	0.59	80-121	30
Methylene Chloride	75-09-2	5	5	2.5	1.13	74-124	30
o-Xylene	95-47-6	5	1	0.5	0.25	77-123	30
Tetrachloroethene	127-18-4	0.7	1	0.5	0.40	74-129	30
Toluene	108-88-3	5	1	0.5	0.27	80-121	30
trans-1,2-Dichloroethene	156-60-5	5	1	0.5	0.25	75-124	30
trans-1,3-Dichloropropene	10061-02-6	0.4	1	0.5	0.20	71-130	30
Trichloroethene	79-01-6	5	1	0.5	0.28	79-123	30
Trichlorofluoromethane	75-69-4	5	2	1	0.24	65-141	30
Vinyl Chloride	75-01-4	2	2	1	0.25	58-137	30
Xylenes (Total)	1330-20-7	5	3	1.5	0.25	79-121	30
Analytical Group: Metals / 6010C, 7470A							
Arsenic	7440-38-2	50	8	5	1.40	80-120	20
Barium	7440-39-3	1000	5	3	0.23	80-120	20
Cadmium	7440-43-9	5	5	3	0.05	80-120	20
Chromium	7440-47-3	50	10	4	0.36	80-120	20
Lead	7439-92-1	50	5	4	1.07	80-120	20
Mercury	7439-97-6	0.7	0.2	0.1	0.01	80-120	20
Selenium	7782-49-2	10	10	7	2.40	80-120	20
Silver	7440-22-4	50	10	4	0.27	80-120	20
Analytical Group: Dissolved Sulfide / E376.1							
Dissolved sulfide	--	50	1	0.8	0.69	80-120	20
Analytical Group: Dissolved Organic Carbon / E415.1							
Dissolved Organic Carbon	--		1	0.5	0.10	80-120	20
Analytical Group: Dissolved Gases / RSK-175							
Carbon Dioxide	124-38-9		1,000	751	260.00	70-130	30
Ethane	74-84-0		10	5	0.69	70-130	30
Ethene	74-85-1		10	5	0.58	70-130	30
Methane	74-82-8		10	5	0.68	70-130	30

Notes:
1. Screening criteria is from New York State Division of Water Technical and Operational Guidance Series (1.1.1) Groundwater Effluent Limitations (Class
2. Remedial system performance criteria is from the State Pollution Discharge Elimination System permit for the site. This permit application is in process.

Worksheet #15-2 Reference Limits and Evaluation (Air Samples)

Analyte	Chemical Abstracts Service Number	Laboratory-Specific		
		Quantitation Limit (QL) µg/m³	Limit of Detection[1] (LOD) µg/m³	Method Detection[1] Limit (MDL) µg/m³
Analytical Group: Volatile Organic Compounds / TO-15 Selective Ion Monitoring (SIM)				
1,1,1-Trichloroethane	71-55-6	0.11	0.027	0.005
1,1,2,2-Tetrachloroethane	79-34-5	0.14	0.034	0.007
1,1,2-Trichloroethane	79-00-5	0.11	0.027	0.011
1,1-Dichloroethane	75-34-3	0.081	0.02	0.004
1,1-Dichloroethene	75-35-4	0.04	0.019	0.004
1,2-Dichloroethane	107-06-2	0.081	0.02	0.004
Carbon Tetrachloride	56-23-5	0.12	0.031	0.006
Chlorobenzene	108-90-7	0.092	N/A	0.005
Chloroethane	75-00-3	0.13	0.019	0.018
Chloromethane	74-87-3	0.1	0.014	0.014
cis-1,2-Dichloroethene	156-59-2	0.079	0.019	0.004
Tetrachloroethene	127-18-4	0.14	0.033	0.007
trans-1,2-Dichloroethene	156-60-5	0.4	0.019	0.004
Trichloroethene	79-01-6	0.11	0.026	0.005
Vinyl Chloride	75-01-4	0.026	0.012	0.003
Analytical Group: Volatile Organic Compounds / Standard TO-15				
1,1,1-Trichloroethane	71-55-6	2.8	2.2	0.55
1,1,2,2-Tetrachloroethane	79-34-5	3.5	2.7	0.67
1,1,2-Trichloroethane	79-00-5	2.8	2.2	0.96
1,1-Dichloroethane	75-34-3	2	1.6	0.51
1,1-Dichloroethene	75-35-4	2	1.6	0.47
1,2-Dichloroethane	107-06-2	2	1.6	0.58
Carbon Tetrachloride	56-23-5	3.2	2.5	0.79
Chlorobenzene	108-90-7	2.3	1.8	0.67
Chloroethane	75-00-3	1.3	3.3	0.61
Chloromethane	74-87-3	4.2	2.6	0.47
cis-1,2-Dichloroethene	156-59-2	2	1.6	0.29
Tetrachloroethene	127-18-4	3.4	2.7	1.2
trans-1,2-Dichloroethene	156-60-5	2	1.6	0.35
Trichloroethene	79-01-6	2.7	2.1	0.83
Vinyl Chloride	75-01-4	1.3	4.4	0.25

Notes:

[1]Current values are from instrument MSD-3 (2016). LOD values are completed every quarter.

QAPP Worksheet #17: Sampling Design and Rationale
(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

The sampling design and rationale for the Watervliet Arsenal IRP program is described in Sections 2 and 3 and Appendices D and E of the IRP Work Plan.

QAPP Worksheet #18: Sampling Locations and Methods
(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.1 and 2.3.2)

The sampling locations for the Watervliet Arsenal IRP program are described in Sections 2 and 3 and Appendices D and E of the IRP Work Plan.

QAPP Worksheet #19 & 30: Sample Containers, Preservation, and Hold Times

Laboratory:

Groundwater samples will be sent to the **Katahdin Analytical Services – Scarborough, Maine** laboratory for **volatile organic compounds (VOCs), RCRA metals, dissolved gases (ethane, methane, ethene, and dissolved carbon dioxide), dissolved organic carbon, and dissolved sulfide** analyses:

Katahdin Analytical Services
600 Technology Way
Scarborough, ME 04074
Contact: Jennifer Obrin
Phone: 207.874.2400
Email: jobrin@katahdinlab.com

Indoor air and effluent samples will be sent to the **Eurofins – Folsom, California** laboratory for **volatile organic compounds** analyses:

Eurofins
180 Blue Ravine Road
Suite B
Folsom, California 95630
Contact: Ausha Scott
Phone: (800) 985-5955 x3314
Email: AushaScott@eurofinsUS.com

Back-up Laboratory: Not identified

Sample Delivery Method: Federal Express Overnight

Matrix	Analytical Group[1]	Analytical and Preparation Method/SOP Reference[2]	Containers (number, size, and type)	Sample volume[3] (units)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time[4] (preparation/ analysis)
Water	VOCs	SW846 5030B, 8260C / CA-202	Three 40-ml VOA vials	40 milliliter (mL)	Hydrochloric acid (HCl) to pH < 2, cool to ≤ 6 ºC.	14 days
	Methane, Ethane, Ethene	RSK-175 / CA-336	Two 40-ml VOA vial	40 mL	HCl, pH <2, Cool to ≤ 6 ºC, no headspace	14 days
	Carbon Dioxide	RSK-175 / BR-AT-006(A/P)	Three 40 mL glass vials	40 mL	Cool to 4±2°C	14 days
	Metals - 6010	SW846 3010A, 6010C / CA-604, CA-608	One 250-ml polyethylene bottle	50 mL	Nitric Acid to pH<2.	6 months
	Mercury	SW7470A / CA-615	One 250-ml polyethylene bottle	25 mL	Nitric Acid to pH<2.	28 days
	Sulfide	E376.1 / CA-722	One 500-ml polyethylene bottle	200 mL	2NZnAc/L & NaOH, Cool to ≤ 6 ºC	7 days
	Dissolved Organic Carbon	E415.1 / CA-763	Two 40-ml VOA vials	40 mL	Cool to ≤ 6 °C	28 days
Air	VOCs	TO-15 / SOP-06	1L Summa Canister	60 mL	None	30 days
		TO-15 / SOP-38	6L Summa Canister (SIM Certified	6L	None	30 days

Notes:
1. Refer to Worksheet #15 for specific target analytes.
2. Refer to the Analytical SOP References table (Worksheet #23).
3. Minimum sample volume requirement.
4. Maximum holding time is calculated from the time the sample is collected to the time the sample is extracted, digested or analyzed.

QAPP Worksheet #20: Field QC Summary
(UFP-QAPP Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.5)

This worksheet provides a summary of the types of samples to be collected and analyzed for the project. Its purpose is to show the relationship between the number of field samples and associated QC samples for each combination of analyte/analytical group and matrix. Groundwater samples will be collected at 58 monitoring wells in the MMA and 24 monitoring wells and four stormwater/sanitary sewer locations in the Siberia Area. The sample frequencies are listed in Tables 2-1 and 2-2 of the IRP Work Plan. Soil gas effluent samples will be collected semi-annually from the Sub-Slab Depressurization Systems (SSDSs) to evaluate effluent discharge concentrations. Indoor air samples will be collected from the nine locations listed in Table 2-3 of the IRP Work Plan to assess mitigation system performance at meeting the corrective action objectives.

2016 Monitoring Event

Matrix	Analyte/Analytical Group	Field Samples	Field Duplicates (1 per 20)	Trip Blanks (1 per cooler)	Total # Analyses
Groundwater	VOCs/8260C	86	5	5	106
Groundwater	Metals/6010C and 7470A	5	1	0	8
Groundwater	Dissolved Gases - Methane, Ethane, Ethene/RSK-175	1	1	0	4
Groundwater	Total Organic Carbon/415.1	1	1	0	4
Groundwater	Sulfide/376.1	1	1	0	4
Indoor Air	VOCs/TO-15	12	1	N/A	13
SSDS Effluent	VOCs/TO-15	3	1	N/A	4

SSDS - Sub-Slab Depressurization Systems
VOCs – Volatile Organic Compounds

2017 Monitoring Event

Matrix	Analyte/Analytical Group	Field Samples	Field Duplicates (1 per 20)	Trip Blanks (1 per cooler)	Total # Analyses
Groundwater	VOCs/8260C	79	5	5	99
Groundwater	Metals/6010C and 7470A	5	1	0	8
Groundwater	Dissolved Gases - Methane, Ethane, Ethene/RSK-175	34	2	0	40
Groundwater	Total Organic Carbon/415.1	34	2	0	40
Groundwater	Sulfide/376.1	34	2	0	40
Indoor Air	VOCs/TO-15	12	1	N/A	13
SSDS Effluent	VOCs/TO-15	3	1	N/A	4

SSDS - Sub-Slab Depressurization Systems
VOCs – Volatile Organic Compounds

QAPP Worksheet #21: Field SOPs
(UFP-QAPP Manual Section 3.1.2)
(EPA 2106-G-05 Section 2.3.2)

SOP # or reference[1]	Title, Revision, Date, and URL (if available)	SOP option or Equipment Type (if SOP provides different options)	Modified for Project? Y/N	Comments
3152010	Soil Vapor Extraction and Treatment System Sampling	N/A	N	N/A
765199	Indoor or Ambient Air Sampling and Analysis Using USEPA Method TO-15	N/A	N	N/A
1213199	Field Equipment Decontamination, Revision 3, April 2010	Applies to all general field equipment	N	N/A
1343199	Measuring Basic Water Quality In-Situ, Revision 1, April 2005	Horiba U-10 or equivalent	Y	Likely, a Horiba U-52 or U-53 will be used
1663199	Chain of Custody, Handling, Packing and Shipping, Revision 2, March 2009	N/A	N	N/A
1673199	Hazardous Materials Handling, Revision 0, August 2003	N/A	N	N/A
3136199	Investigation-Derived Waste Handling and Storage, Revision # 2, 2009	55 gal. drum, polyethylene storage tank	N	N/A
4098782	Field Log Book Entries, Revision # 0, August 2009	N/A	N	N/A
1763199	Photoionization Detector and Field Screening, Revision #1, November 2009	PID & Cal. canisters	N	N/A
1643199	Water Level Measurement, Revision # 2, February 2011	N/A	N	N/A

SOP # or reference[1]	Title, Revision, Date, and URL (if available)	SOP option or Equipment Type (if SOP provides different options)	Modified for Project? Y/N	Comments
2003199	Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells, Revision # 4, February 2011	Bladder and Peristaltic Pumps, QED MP10 Controller/Compressor	N	N/A
9098782	Hazardous Weather Procedures, Revision # 2, June 2014	N/A	N	N/A
1703199	Monitoring Well Decommissioning, Revision # 0, July 2010	N/A	N	N/A
ALS Website	Passive Diffusion Bags (PDB) Samplers Instructions	N/A	N	N/A

Notes: [1]Copies of the field SOPs are included in Appendix A.

QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection
(UFP-QAPP Manual Section 3.1.2.4)
(EPA 2106-G-05 Section 2.3.6)

Field Equipment	Activity	SOP Reference[1]	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
Air Monitoring Instruments	Various air monitoring instruments may be used to assess health and safety or for evidentiary air data collection.	1583199 – Air Monitoring Instruments, Revision # 0, August 2003	HSS/Field Team Leader			
Photoionization Detector (PID)	PID will be swept across work area to assess exposure to contaminants, used to measure well head spaces as a precautionary measure, or used to measure soil headspaces of VOCs.	1763199 – Photoionization Detector Air Monitoring and Field Screening, Revision # 1, November 2009	HSS/Field Team Leader			
Water Level Meter	Water level tape and probe will be reeled down wells to measure water levels.	Per Heron equipment manual	HSS/Field Team Leader			

Field Equipment	Activity	SOP Reference[1]	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
QED MP10 Bladder Pump	Use to control and as air supply for bladder pump groundwater sampling.	Per equipment manual	HSS/Field Team Leader			
Geopump 57200 Series Bladder Pump	Groundwater will be purged from wells deeper than 25' bgs.	Per equipment manual	HSS/Field Team Leader			
Passive Diffusion Bags	Bags will be placed down wells. Used for sampling a high number of wells for VOCs.	Per samplers instructions	HSS/Field Team Leader			
Horiba U-52 or equivalent	Measuring water quality parameters.	Per equipment manual	HSS/Field Team Leader			
Oil Interface Meter	Measuring depth to product and depth to water in wells by sending interface probe down well.	Per Heron equipment manual	HSS/Field Team Leader			
MultiRAE Multiple Gas Monitor	Used to measure LEL, O_2, CO, and H_2S for confined space protection as well as VOCs.	Per equipment manual	HSS/Field Team Leader			
Hot Wire Anemometer	Sensor will be placed in airways such as ducts or vents to measure temperature and air flow.	Per equipment manual	HSS/Field Team Leader			

Field Equipment	Activity	SOP Reference[1]	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
Dwyer Digital Anemometer	Will be used to measure pressure and vacuum readings.	Per equipment manual	HSS/Field Team Leader			

Notes: [1]Copies of the field equipment SOPs are included in Appendix A.

QAPP Worksheet #23 - Analytical SOP References

SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
CA-202	Analysis of VOAs by Purge and Trap GC/MS: SW-846 Method 8260, 04/14, Revision 15.	Definitive	Water / VOCs	Gas Chromatography (GC)/Mass Spectroscopy (MS)	Katahdin Analytical Services	N
CA-336	Dissolved Gas Analysis In Water Samples Using GC Headspace Equilibration Technique EPA SOP RSK-175, 05/13, Revision 6.	Definitive	Water / MEE	GC/FID	Katahdin Analytical Services	N
CA-604	Acid Digestion of Aqueous Samples by USEPA Method 3010 for ICP Analysis of Total or Dissolved Metals, 06/15, Revision 6.	Definitive	Water / Metals	Not applicable (digestion)	Katahdin Analytical Services	N
CA-608	Trace Metals Analysis By ICP-AES Using EPA Method 6010, 12/14, Revision 15.	Definitive	Water / Metals	Inductively Coupled Plasma (ICP) – Atomic Emission Spectroscopy (AES)	Katahdin Analytical Services	N
CA-615	Digestion and Analysis of Aqueous Samples for Mercury by USEPA Method 7470, 06/14, Revision 8.	Definitive	Water / Mercury	Mercury Analyzer	Katahdin Analytical Services	N
CA-722	Trimetric Determination of Sulfide Using EPA Method 376.1, SM4500S2- F, SW846 9034 ans SW846 7.3.4, 02/13, Revision 6.	Definitive	Water / Sulfide	Buret	Katahdin Analytical Services	N
CA-763	Analysis of TOC, DOC, and TIC in Aqueous Samples using the Shimadzu Carbon Analyzer: EPA Method 415.1, SW846 9060 and SM5310B, 05/12, Revision 7.	Definitive	Water / Total Organic Carbon	Total Organic Carbon Analyzer	Katahdin Analytical Services	N
SOP-06 r.33	Analysis of Volatile Organic Compounds in SUMMA™ Polished Canisters by Modified EPA Methods TO-14A/TO-15 12/4/08	Definitive	Air-VOCs	GC/MS	Eurofins Air Toxics	N

SOP-38 r.19	Analysis of Volatile Organic Compounds in SUMMA™ Polished Canisters by GC/MS Selective Ion Monitoring Modified EPA Methods TO-14A/TO-15 6/24/08	Definitive	Air-VOCs	GC/MS	Eurofins Air Toxics	N
SOP-63 r.18	Sample Custody Cage Logbook Documentation 12/04/08	Definitive	Air-VOCs	NA	Eurofins Air Toxics	N
BR-AT-006	Dissolved Gases in Groundwater (RSK-175) SOP No. BR-AT-006, Rev 15, 11/23/15	Definitive	Aqueous Carbon Dioxide	GC/TCD	TestAmerica-Burlington	N

Notes: [1]Copies of the laboratory SOPs are included in Appendix B.

Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GCMS-VOCs	Initial Calibration (ICAL) - A minimum 5-point initial calibration is required for all VOCs.	Instrument receipt, major instrument change, when continuing calibration verification does not meet criteria.	Each analyte must meet one of the three options below: Option 1: RSD for each analyte = 15%; Option 2: linear least squares regression for each analyte: r2 = 0.99; Option 3: non-linear least squares regression (quadratic) for each analyte: r2 = 0.99.	Correct problem then repeat calibration.	Analyst, Department Manager	CA-202
	Second Source Calibration Verification (ICV)	Once after each ICAL.	All reported analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Analyst, Department Manager	
	Continuing Calibration (CCV)	Daily before sample analysis and every 12 hours	All reported analytes and surrogates within ± 20% of true value. All reported analytes and surrogates within ± 50% for end of analytical batch CCV.	DoD (Department of Defense) project level approval must be obtained for each of the failed analytes or corrective action must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.	Analyst, Department Manager	
	BFB Tune	Prior to ICAL and at the beginning of each 12-hour clock.	Must meet criteria listed in Section 7.3, current revision of SOP CA-202.	Retune and/or clean source.	Analyst, Department Manager	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/FID-Methane, Ethane, Ethene	ICAL	Instrument receipt, major instrument change, when CCV does not meet criteria	Average %RSD must be </= 30	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst, Supervisor	CA-336
	ICV	Immediately following calibration.	The %D of the expected value must be ≤25%for all analytes.	Correct problem, rerun ICV. If that fails, repeat ICAL.	Analyst, Department Manager	
	CCV	If initial calibration analyzed, daily and after 20 samples, and at end of sequence.	%D for all analytes within 30%	Evaluate the samples: If the %RPD >30% and sample results are < PQL, narrate. If %RPD >30% and is likely a result of matrix interference, narrate. Otherwise, reanalyze all samples after last acceptable CV.		
GC-FID – Carbon Dioxide	Five-point calibration	Before sample analysis, when CCVs indicate calibration is no longer valid; after major instrument maintenance	Calibration Factor RSD < 20%	Instrument maintenance, standard, inspection, recalibration	Laboratory Analyst	BR-AT-006
	Initial Calibration Verification	Immediately after each initial calibration	%R ± 20%	Correct problem and verify second source standard. If that fails repeat calibration.	Laboratory Analyst	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
	Continuing Calibration Verification	Beginning of each 24-hour window	%D ± 20%	See Laboratory SOP	Laboratory Analyst	
ICP-AES – Metals	ICAL	At the beginning of each day or if QC is out of criteria.	One point calibration plus a blank per manufacturer's guidelines.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards.	Analyst, Department Manager	CA-608
	ICV	Once after each ICAL, prior to beginning a sample run.	%R must be within 90-110% for all project compounds.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst, Department Manager	
	Calibration Blank (CB)	Before beginning a sample sequence, after every 10 samples and at end of the analysis sequence.	No analytes detected > LOD. For negative blanks, absolute value < LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Department Manager	
	CCV	After every 10 samples and at the end of each run sequence.	%R must be within 90-110% for all project compounds.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst, Department Manager	
	Low-level Calibration Check Standard (if using one-point ICAL)	Daily after one-point ICAL.	%R must within 80%-120% for all project compounds.	Correct problem, then reanalyze.	Analyst, Department Manager	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
	ICS - ICSA & ICSB	Daily, before sample injections	ICSA recoveries must be less than the absolute value of the LOD and ICSB %Rs must be within 80-120%.	Correct the problem, then re-prepare checks and reanalyze all affected samples.	Analyst, Department Manager	
Mercury analyzer	ICAL - 5 points plus a calibration blank	Upon instrument receipt, major instrument change, at the start of each day.	Correlation coefficient (r) must be ≥ 0.995.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards.	Analyst, Department Manager	CA-615
	ICV	Once after each ICAL, prior to beginning a sample run.	%R must be within 90-110%	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst, Department Manager	
	CCB	Before beginning a sample sequence, after every 10 samples and at end of the analysis sequence. For negative blanks, absolute value < LOD.	No analytes detected > LOD.	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Department Manager	
	CCV	Beginning and end of each run sequence and every 10 samples.	%R must be within 80-120%	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst, Department Manager	

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Total Organic Carbon Analyzer / Total Organic Carbon	ICAL – Minimum of a 5-point calibration curve plus a blank is prepared.	Initially, when the daily CCV does not pass, but, no longer than every 3 months.	Correlation coefficient ≤ 0.995	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards	Analyst, Department Manager	CA-763
	ICV	Once after each ICAL, prior to beginning a sample run.	Lloyd Kahn: %R must within 80%-120% SM5310B: %R must within 90%-110%	(1) If the ICV fails high, report samples that are <PQL. (2) Redigest, recalibrate and/or reanalyze other samples.	Analyst, Department Manager	
	CCV	Every 10 samples and at the end of the run	Lloyd Kahn: %R must within 80%-120% SM5310B: %R must within 90%-110%	If the CCV fails high, report samples that are <PQL. Recalibrate and/or reanalyze samples back to last acceptable CCV recovery.	Analyst, Department Manager	
Buret – Sulfide	Standardization	Daily prior to sample analysis.	Standardized using 0.25 N Sodium thiosulfate	An acceptable titrant is compared against an independent source identified as an LCS/ICV (see next line)	Analyst, Department Manager	CA-722

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
	Calibration Verification (CCV)	At beginning and end of each run sequence and every 10 samples	80-120 %	If the Continuing Calibration Verification fails high, report samples that are less than the PQL. Recalibrate and/or reanalyze samples back to last acceptable Continuing Calibration Verification recovery.	Analyst, Department Manager	
GC-MS full scan and GC-MS selective ion monitoring(TO-15 - Standard level and SIM)	ICAL- 5 point minimum	As needed	≤ 30 percent RSD with two compounds allowed out to ≤40 percent	Correct problem then repeat ICAL	Analyst/ Supervisor	SOP-06 and SOP-38
	CCV	Daily	≤ 30% Difference	Compounds exceeding this criterion and associated data will be flagged and narrated. If more than two compounds from the list recover outside of 60-140%, samples are not analyzed unless data meets project needs. Check system and reanalyze standard. Re-prepare standard if necessary. Repeat ICAL if criteria cannot be met.	Analyst/ Supervisor	

Note: [1] SOP reference numbers correspond to Laboratory SOPs in Worksheet #23.

Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC/MS VOCs	Check pressure and gas supply daily. Bake out trap and column, manual tune if BFB not in criteria, change septa as needed, cut column as needed, change trap as needed. Other maintenance specified in lab Equipment Maintenance SOP.	VOCs	Ion source, injector liner, column, column flow, purge lines, purge flow, trap.	Prior to ICAL and/or as necessary.	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-202
GC/FID	Check pressure and gas supply daily. Change septa and/or GC injector glass liner as needed. Replace or cut GC column as needed. Other maintenance specified in lab Equipment Maintenance SOP.	MEE	Injector liner, septa, column, column flow.	Prior to ICAL and/or as necessary.	Acceptable ICAL or CCV	Correct the problem and repeat ICAL or CCV.	Analyst, Department Manager	CA-336
ICP-AES	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, replace peristaltic pump tubing as needed. Other maintenance specified in lab Equipment Maintenance SOP.	Metals	Torch, nebulizer chamber, pump, pump tubing.	Prior to ICAL and as necessary.	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-608
Mercury Analyzer	Replace peristaltic pump tubing, replace mercury lamp, replace drying tube, clean optical cell and/or clean liquid/gas separator as needed. Other maintenance specified in lab Equipment Maintenance SOP.	Mercury	Tubing, sample probe, optical cell.	Prior to ICAL and as necessary	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-615
Buret - Sulfide	N/A	Sulfide	Visual inspection for cracks or chips	Each use	N/A	Remove from service	Analyst, Department Manager	CA-722

Worksheet #25 – Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
TOC Combustion Analyzer	Check level of dilution water, drain vessel water, humidifier water, auto sampler rinse water and phosphoric acid vessel and fill as needed. Replace oxygen cylinder.	Total Organic Carbon	Tubing, sample boat, syringe, humidifier, rinse reservoir, phosphoric acid vessel, oxygen pressure	Prior to initial calibration and as necessary	Acceptable calibration or CCV	Correct the problem and repeat calibration or CCV	Analyst, Department Manager	CA-763
GC/MS (VOA)	Clean Injection Port and Liner, Change Septa, Cut 2-3 inches from GC Column, Fill Autosampler rinse vials, Clean Purge and Trap mount and purge vessel	Dissolved Carbon Dioxide	Check Injection Port and GC columns, Check autosampler rinse vials, check purge and trap mount and purge vessel, check Purge Flow	As required	Passing calibration	Perform maintenance, check standards, recalibrate	Laboratory Analyst	A-13
GC-MS (air)	Preventative maintenance	Volatiles	Ion source, injector liner, column, column flow, purge lines, purge flow, trap	As needed	See Worksheet #24	Correct the problem and repeat calibration or calibration verification	Analyst/ Supervisor	SOP-06 and SOP-38 (Eurofins Air Toxics)

Note:
SOP – Standard operating procedure
[1]SOP reference numbers correspond to analytical SOPs in Worksheet #23.

QAPP Worksheet #26 & 27: Sample Handling, Custody, and Disposal

Sampling Organization: PIKA-MP JV LLC
Laboratory: Katahdin Analytical Services (Scarborough, Maine) and Eurofins Air Toxics (Folsom, CA)
Method of sample delivery (shipper/carrier): Laboratory Courier and/or Federal Express
Number of days from reporting until sample disposal: at least 60 days

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample labeling	Field Team Leader PIKA-MP JV LLC	See “Sample Identification System” below.
Chain-of-custody form completion	Field Team Leader PIKA-MP JV LLC	See “Sample Handling and Custody” below.
Packaging	Field Team Leader PIKA-MP JV LLC	See “Field Procedures” below.
Shipping coordination	Field Team Leader PIKA-MP JV LLC	See “Transfer of Custody and Shipment” below.
Sample receipt, inspection, & log-in	Katahdin/Eurofins	See “Laboratory Custody Procedures” below.
Sample custody and storage	Katahdin/Eurofins	See “Laboratory Custody Procedures” and “Final Evidence Files” below.
Sample disposal	Katahdin/Eurofins	See “Sample Holding Times” below or Worksheet 19.

Sample Identification System

A sample numbering system will be used to identify each sample; the sample numbers will be sequentially assigned to ensure there is no duplication of sample numbers. This system will provide a tracking procedure to allow retrieval of information about a particular sample and will assure that each sample is uniquely numbered. The sample identification will consist of the components described below.

For groundwater monitoring wells the sample identification number will include the established sampling location identification number followed by the six-digit sample collection date. For example, “WVA-AW-25-MW-6--063016” would be used to designate the groundwater monitoring well sample collected from location WVA-AW-25-MW-6on June 30, 2016.

Other field quality control samples will be designated by a sample type code followed by a sequential sample number and a six-digit sample collection date. The sample type codes are as follows:

- Trip blank sample – TB
- Field duplicate sample – DUP

For example, "DUP01-063016" would be used to identify the first field duplicate collected during the annual groundwater sampling event on June 30, 2016. The sampling point associations for field duplicate must be recorded in the field log, as they will be submitted blind to the laboratory with no indication of the parent sample location.

Sample Handling and Custody

Sample custody procedures ensure the timely, correct, and complete analysis of each sample for all parameters requested. A sample is considered to be in someone's custody if it:

Is in his/her possession

Is in his/her view, after being in his/her possession

Is in his/her possession and has been placed in a secured location

Is in a designated secure area

Sample custody documentation provides a written record of sample collection and analysis. The sample custody procedures provide for specific identification of samples associated with an exact location, the recording of pertinent information associated with the sample, including time of sample collection and any preservation techniques, and a Chain of Custody (COC) record that serves as physical evidence of sample custody. Custody procedures will be similar to the procedures outlined in the USACE's *Requirements for the Preparation of Sampling and Analysis Plans* (USACE, 2001) and the USEPA's *Contract Laboratory Program Guidance for Field Samplers* (USEPA, 2004).

The COC documentation system provides the means to individually identify, track, and monitor each sample from the time of collection through final data reporting. COC procedures document pertinent sampling data and all transfers of custody until the samples reach the analytical laboratory. The following information is typically recorded on manual COC forms. All COC forms must be signed in ink:

- Project name and/or project number
- Signature of field team leader or designee
- Sampling station number
- Date and time of collection
- Discrete sample designation
- Sample matrix
- Sampling location description

- Field identification number
- Analyses required
- Preservation technique
- Signatures and dates for transfers of custody
- Air express/shipper's bill of lading identification numbers

The COC form serves as an official communication to the laboratory detailing the particular analyses required for each sample. The COC record will accompany the samples from the time of sampling through all transfers of custody. It will be kept on file at the laboratory where samples are analyzed and archived. Two copies of the COC form are created; one copy is retained by the field team leader and one is sent to the laboratory. The field team leader or designee completes a COC record to accompany each shipment from the field to the laboratory. The completed COC is put in a zip-lock bag and taped to the inside cover of the sample shipping container. If there are more than one container in a shipment, copies of the COC forms will be placed in each container. The container is then sealed with custody seals and custody is transferred to the laboratory.

Field Procedures

The field sampler is personally responsible for the care and custody of the samples until they are transferred to the field team leader or until they are properly dispatched. As few people as possible should handle the samples.

The field team leader, or designee, is responsible for entering the proper information in the field logbook, including all pertinent information such as sample identification number, date and time of sample collection, type of analysis, and description of sample location. The information entered into the field logbook will be used to generate a COC. Field logbook entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory. Entries should be made in ink, with no erasures. If an incorrect entry is made, the information will be crossed out with one strike mark and initialed.

All sample containers will be labeled with the project identification, sample number, matrix, date and time collected, type of analysis required, and preservation requirements.

The samples will be properly preserved, bagged, and packed into coolers. The original COC form will be placed into the lead cooler and will be shipped to the laboratory.

The field team leader or designee will review all field activities to determine whether proper custody procedures were followed during the field work and if additional samples are required.

Transfer of Custody and Shipment

The custody of samples must be maintained from the time of sampling through shipment and relinquishment to the laboratory. Instructions for transferring custody are given below:

All samples are accompanied by a COC. When transferring custody of samples, the individuals relinquishing and receiving will sign, date, and note the time on the COC. This form documents sample custody transfer from the field team leader or designee, through the shipper, to the analytical laboratory. Since a common carrier will usually not accept responsibility for handling COC forms, the name of the carrier is entered under "Received by," the bill-of-lading number is recorded in the comments section, and the COC form is placed in a zip-lock plastic bag and taped to the inside lid of the shipping cooler. Copies of the COC forms will be placed in each cooler in a shipment. The original COC will accompany the shipment and a copy will be retained by the field team leader.

Samples will be packaged for shipment and either picked up at the Site by a laboratory courier or dispatched to the appropriate laboratory via overnight delivery service. If the samples are sent by common carrier or air freight, proper documentation must be maintained. For example, the bill of lading must be retained by the field team leader. Samples will be shipped within 24 hours of sampling. Shipping containers will be sealed for shipment to the laboratory. Custody seals will be applied to each cooler to document that the container was properly sealed and to determine if the container was tampered with during shipment. The custody seals will be placed on the coolers in such a manner that the custody seal would be broken if the cooler were opened (*i.e.*, diagonally opposite corners of the cooler lid).

Samples will be packaged for shipment as outlined below:

- Securely affix the sample label to the container with clear packing tape.
- Check the cap on the sample container to confirm that it is properly sealed.
- Wrap the sample container cap with clear packing tape to prevent the label from becoming loose.
- Complete the chain-of-custody form with the required sampling information and confirm that the recorded information matches the sample labels. **Note:** If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the chain-of-custody prior to this transfer. The appropriate personnel will sign and date the chain-of-custody form to document the sample custody transfer.
- Using duct tape, secure the outside drain plug at the bottom of the cooler.
- Wrap sample containers in bubble wrap or other cushioning material.
- Place 1 to 2 inches of cushioning material at the bottom of the cooler.
- Place the sealed sample containers into the cooler.
- Place ice in plastic bags and seal. Place loosely in the cooler.
- Fill the remaining space in the cooler with cushioning material.
- Place chain-of-custody forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid.
- Close the lid of the cooler, lock and secure with duct tape.
- Wrap strapping tape around both ends of the cooler at least twice.

- Mark the cooler on the outside with the shipping address and return address, affix “Fragile” labels and draw (or affix) arrows indicating “this side up.” Cover the labels with clear plastic tape.
- Place two signed custody seals over the sample cooler lid.

Laboratory Custody Procedures

A designated sample custodian accepts custody of the samples and verifies that the information on the sample labels matches that on the COC(s). The sample custodian will document any discrepancies and will sign and date all appropriate receiving documents. The sample custodian will also document the condition of the samples upon receipt at the laboratory. If a sample container is missing, a sample container is received broken, the sample is in an inappropriate container, or the sample has not been preserved by appropriate means, PIKA-MP JV personnel will be notified.

In accordance with laboratory custody and security requirements, the laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample to assure traceability of samples while in possession of the laboratory, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

The following stages of analysis must be documented by the laboratory:

- Sample Extraction/Preparation
- Sample Analysis
- Data Reduction
- Data Reporting

Laboratory personnel are responsible for the custody of the samples until they are returned to the sample custodian.

Sample Holding Times

Information on sample holding times and required preservation for each test method are provided in Worksheet 19.

Final Evidence Files

This is the final phase of sample custody. The COC records and sample analysis request form copies are archived in their respective project files. Laboratory custody forms, sample preparation and analysis logbooks, and data packages will become part of the laboratory final evidence file. Other relevant documentation including records, reports, correspondence, logs, pictures, and data review reports will be archived by PIKA-MP JV personnel.

Worksheet #28-1 – Quality Control Samples (Volatile Organic Compounds in Water)

Matrix	Water
Analytical Group	Volatile Organic Compounds
Analytical Method/ SOP Reference	SW-846 8260C/CA-202

Quality Control (QC) Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparation batch of twenty or fewer samples of similar matrix.	No target compounds > ½ LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the REGULATORY LIMIT, whichever is greater.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Reprepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager, and Data Validator	Bias/Contamination	Same as Method/SOP QC Acceptance Limits.

Worksheet #28-1 – Quality Control Samples (Volatile Organic Compounds in Water)

Matrix	Water
Analytical Group	Volatile Organic Compounds
Analytical Method/ SOP Reference	SW-846 8260C/CA-202

Quality Control (QC) Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Surrogate	Four per sample: Dibromofluoromethane 1,2-Dichloroethane-d4 Toluene-d8 4-Bromofluorobenzene (BFB)	%R must be within DoD QSM limits.	For QC and field samples, correct problem then reprepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Contact Client if samples cannot be reanalyzed within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Worksheet #28-1 – Quality Control Samples (Volatile Organic Compounds in Water)

Matrix	Water
Analytical Group	Volatile Organic Compounds
Analytical Method/ SOP Reference	SW-846 8260C/CA-202

Quality Control (QC) Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Laboratory Control Sample (LCS)	One per preparation batch of twenty or fewer samples of similar matrix.	%R must be within DoD QSM limits, if available; otherwise, within laboratory's statistically-derived QC limits. Allow for the number of marginal exceedances presented in DoD QSM Table G-1.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact Client if samples cannot be reanalyzed within hold time.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Matrix Spike/ Matrix Spike Duplicate (MS/MSD) (not applicable for rinsate blanks)	One per sample delivery group (SDG) or every 20 samples.	%R should be within the same limits as for the LCS. RPD should be ≤ 30%.	Corrective actions will not be taken for samples when recoveries are outside limits if likely due to matrix; otherwise contact client.	Analyst, Laboratory Department Manager, and Data Validator	Precision/Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.

Worksheet #28-1 – Quality Control Samples (Volatile Organic Compounds in Water)

Matrix	Water
Analytical Group	Volatile Organic Compounds
Analytical Method/ SOP Reference	SW-846 8260C/CA-202

Quality Control (QC) Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Internal Standard (IS)	Four per sample: Pentafluorobenzene Chlorobenzene-d5 1,4-dichlorobenzene-d4 1,4-difluorobenzene	Retention times for internal standards must be ± 30 seconds and the responses within -50% to +100% of the ICAL midpoint standard.	Inspect mass spectrometer or gas chromatograph for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	Not applicable (NA)	Apply “J” qualifier to results between DL and LOQ.	NA	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

Notes:
SOP – Standard operating procedure

Worksheet #28-2 – Quality Control Samples (Metals in Water)

Matrix	Water					
Analytical Group	Metals (ICP-AES)					
Analytical Method/ SOP Reference	SW-846 6010C/CA-608					
Quality Control (QC) Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Method Blank	One per digestion batch of 20 or fewer samples of similar matrix.	No target metals> ½ LOQ (> LOQ for common laboratory contaminants) and > 1/10 the amount measured in any sample or 1/10 the REGULATORY LIMIT, whichever is greater. For negative blanks, absolute value must be < LOD.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per digestion batch of 20 or fewer samples of similar matrix (varies by lot).	%R must be within DoD QSM limits, allowing for the marginal exceedances presented in DoD QSM Table G-1.	Re-digest and reanalyze all associated samples for affected analyte.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/ Contamination	Same as Method/SOP QC Acceptance Limits.
Matrix Spike	One per sample delivery group (SDG) or every 20 samples.	%R should be within the DoD QSM limits for LCS, if sample < 4x spike added.	Flag results for affected analytes for all associated samples with "N".	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Post-digestion Spike	When dilution test fails or analyte concentration in all samples < 50x LOD	%R should be within 75-125%.	Run associated samples by method of standard addition or flag results.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Worksheet #28-2 – Quality Control Samples (Metals in Water)

Matrix	Water					
Analytical Group	Metals (ICP-AES)					
Analytical Method/ SOP Reference	SW-846 6010C/CA-608					
Quality Control (QC) Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Laboratory Duplicate	One per sample delivery group (SDG) or every 20 samples.	Project-specific criteria: If values are ≥ 5x LOQ, RPD should be ≤ 20%. If values are < 5x LOQ, Absolute Difference should be ≤ LOQ.	Flag results for affected analytes for all associated samples.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance Limits.
ICP Serial Dilution	One per preparation batch of 20 or fewer samples of similar matrix.	If original sample result is at least 50x LOQ, 5-fold dilution must agree within ± 10% of the original result.	Flag results for affected analytes for all associated samples with "E".	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ.	NA	Analyst, Laboratory Department Manager, and Data Validator	Accuracy	Same as QC Acceptance Limits.

Notes:
SOP – Standard operating procedure

Worksheet #28-3 – Quality Control Samples (Mercury in Water)

Matrix	Water					
Analytical Group	Mercury					
Analytical Method/ SOP Reference	SW-846 7470A/CA-615					
Quality Control (QC) Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Method Blank	One per digestion batch of 20 or fewer samples of similar matrix.	No mercury > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the REGULATORY LIMIT, whichever is greater. For negative blanks, absolute value < LOD.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Reprepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/ contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per digestion batch of 20 or fewer samples of similar matrix.	Water and Sediment: %R must be within 80-120%.	Redigest and reanalyze all associated samples for affected analyte.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/ Contamination	Same as Method/SOP QC Acceptance Limits.
MS	One per sample delivery group (SDG) or every 20 samples.	%R should be within 80-120% if sample < 4x spike added.	Flag results for affected analytes for all associated samples with"N".	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Laboratory Duplicate	One per sample delivery group (SDG) or every 20 samples.	Project-specific criteria: If values are ≥ 5x LOQ, RPD should be ≤ 20%. If values are < 5x LOQ, Absolute Difference should be ≤ LOQ.	Flag results for affected analytes for all associated samples.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance Limits.

Notes:
SOP – Standard operating procedure

Worksheet #28-4 – Quality Control Samples (Total Organic Carbon and Dissolved Organic Carbon in Water)

Matrix	Water
Analytical Group	Total Organic Carbon and D Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC)
Analytical Method/ SOP Reference	EPA 415.1/CA-763

Quality Control (QC) Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per analytical batch of 20 or fewer samples.	No target analytes > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the REGULATORY LIMIT, whichever is greater.	Correct the problem. Report sample results that are <LOD or >10x the blank concentration. Re-prepare and reanalyze the method blank and all associated samples with results > LOD and < 10x the contaminated blank result.	Analyst, Laboratory Department Manager and Data Validator	Bias/ contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per analytical batch of 20 or fewer samples.	%R must be within 80-120	(1) Investigate source of problem. (2) If the LCS recovery is high but the sample results are <PQL, narrate. Otherwise, reprep a blank and the remaining samples.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/ Contamination	Same as Method/SOP QC Acceptance Limits.
MS	One for every set 10 samples	%R must be within: 75-125	(1) Evaluate the samples and associated QC: i.e. If the LCS results are acceptable, narrate. (2) If both the LCS and MS are unacceptable reprep and reanalyze the samples and QC. (3) Notate sample result in raw data if matrix interference suspected.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Laboratory Duplicate	One sample duplicate per 20 samples.	RPD ≤20 for samples >3X the PQL, <100% RPD for samples <3X the PQL.	(1) Investigate problem and reanalyze sample in duplicate (2) If RPD still >20, report original result with notation or narration.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance Limits.

Notes:
SOP – Standard operating procedure

Worksheet #28-05 – Quality Control Samples (Sulfide in Water)

Matrix	Water					
Analytical Group	Sulfide					
Analytical Method/ SOP Reference	EPA 376.1/CA-722					
Quality Control (QC) Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Method Blank	One per analytical batch of 20 or fewer samples.	Target compound < 1/2 LOQ	If all samples are below ½ LOQ, no CA; otherwise reanalyze the batch	Analyst, Laboratory Department Manager, and Data Validator	Bias/contamin ation	Same as Method/SOP QC Acceptance Limits.
LCS	One per analytical batch of 20 or fewer samples.	%R must be within: 80-120	If the LCS fails repeat LCS determination Restandardize sulfide, iodine, and/or thiosulfate and repeat LCS. Reprepare affected reagent or standard and repeat LCS	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias/ Contamination	Same as Method/SOP QC Acceptance Limits.
MS	One for every batch of 10 samples	%R must be within: 80-120	Evaluate the samples and associated QC: i.e. If the LCS results are acceptable, narrate. Low recovery may be due to acid-insoluble sulfides.	Analyst, Laboratory Department Manager, and Data Validator	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Lab Duplicate	One sample duplicate per 20 samples.	RPD </= 20%	If RPD is outside criteria report original result with notation or narration.	Analyst, Laboratory Department Manager, and Data Validator	Precision	Same as Method/SOP QC Acceptance Limits.

Notes:
SOP – Standard operating procedure

Worksheet #28-7 – Quality Control Samples (Volatile Organic Compounds in Air)

Matrix	Air
Analytical Group	VOCs
Analytical Method/ Standard Operating Procedure (SOP) Reference	USEPA TO-15/ SOP-06 and TO-15 SIM SOP-38

Quality Control (QC) Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Tuning Criteria	Every 24 hours.	TO-15 ion abundance criteria.	Correct problem then repeat tune.	Analyst/ Supervisor	Contamination/ Bias	Same as Method / SOP QC Acceptance Limits.
Initial Calibration Verification and Laboratory Control Spike (ICV and LCS)	After each initial calibration curve, and daily, prior to sample analysis.	Recoveries for 85% of Standard compounds must be 70-130%. No recovery may be <50%. If specified by the client in-house generated control limits may be used.	Check the system and reanalyze the standard. Re-prepare the standard if necessary to determine the source of error. Re-calibrate the instrument if the primary standard is found to be in error.		Accuracy/ Bias	
Laboratory Blank	After analysis of standards and prior to sample analysis, or when contamination is present.	Results less than the laboratory reporting limit.	Inspect the system and Re-analyze the blank. B-flag data for common contaminants.		Accuracy/ Bias	

Worksheet #28-7 – Quality Control Samples (Volatile Organic Compounds in Air)

Matrix	Air					
Analytical Group	VOCs					
Analytical Method/ Standard Operating Procedure (SOP) Reference	USEPA TO-15/ SOP-06 and TO-15 SIM SOP-38					
Quality Control (QC) Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
IS	As each standard, blank, and sample is being loaded.	Retention time (RT) for blanks and samples must be within ±0.33 minutes of the RT in the CCV and within ±40 percent of the area counts of the daily CCV ISs.	**For blanks:** inspect the system and reanalyze the blank. **For samples:** re-analyze the sample. If the ISs are within limits in the re-analysis, report the second analysis. If ISs are out-of-limits a second time, dilute the sample until ISs are within acceptance limits and narrate.		Accuracy/ Bias	
Surrogates	As each standard, blank, and sample is being loaded.	70 - 130%. * If specified by the client in-house generated control limits may be used.	**For blanks:** inspect the system and reanalyze the blank. **For samples:** re-analyze the sample unless obvious matrix interference is documented. If the %R is within limits in the reanalysis, report the second analysis. If %R is out-of-limits a second time, then narrate exceedance.		Accuracy/ Bias	

Worksheet #28-7 – Quality Control Samples (Volatile Organic Compounds in Air)

Matrix	Air					
Analytical Group	VOCs					
Analytical Method/ Standard Operating Procedure (SOP) Reference	USEPA TO-15/ SOP-06 and TO-15 SIM SOP-38					
Quality Control (QC) Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Laboratory Duplicates -Analysis of an LCSD	One per analytical batch.	RPD ≤25%.	Narrate exceedances. If more than 5% of compound list outside criteria or if compound is >40%RPD, investigate the cause and perform maintenance as required. If instrument maintenance is required, calibrate as needed.		Precision	

Worksheet #28-6 – Quality Control Samples (Dissolved Methane, Ethane, Ethene, and Carbon Dioxide in Water)

Matrix	Water
Analytical Group	Methane, Ethane, Ethene, Carbon Dioxide
Analytical Method/ Standard Operating Procedure (SOP) Reference	RSK-175/CA-336/ BR-AT-006

Quality Control (QC) Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank	One per preparation batch of 20 or fewer samples.	Analyte concentration must be < ½ LOQ.	Investigate source of contamination. Evaluate the samples and associated QC: i.e. If the blank results are above the PQL, report samples results which are □ PQL □10X the blank concentration. Otherwise, reprep a blank and the remaining samples.	Analyst, Department Manager	Bias/ contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per batch of up to 20 samples.	%R must be within 80-122%.	Evaluate the samples and associated QC. If an MS/MSD was performed and acceptable, narrate. If the LCS recovery is high but the sample results are < PQL, narrate. Otherwise, reprep.	Analyst, Department Manager	Accuracy/bias	Same as Method/SOP QC Acceptance Limits.
MS	One MS per 10 field samples	%R must be within 80-122%.	Evaluate the samples and associated QC. If an LCS was performed and acceptable, narrate. If the LCS recovery is high but the sample results are < PQL, narrate. Otherwise, reprep	Analyst, Department Manager	Accuracy/bias	Same as Method/SOP QC Acceptance Limits.
Laboratory Duplicate	One per batch of up to 20 samples.	RPD must be ≤ 30%.	Check calculations, Evaluate QC	Analyst, Department Manager	Precision	Same as Method/SOP QC Acceptance Limits.

QAPP Worksheet #29: Project Documents and Records

Sample Collection Documents and Records	On-Site Analysis Documents and Records[1]	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
- Field Notes - Sampling Logs - Chain-of-Custody Records - Air Bills - Custody Seals	- Equipment Calibration Logs - Field Data Records - Field Instrument Maintenance Logs	- Sample Receipt, Custody and Tracking Records - Standard Traceability Logs - Equipment Calibration Logs - Sample Prep Logs - Run Logs - Equipment Maintenance, Testing and Inspection Logs - Corrective Action Forms - Reported Field Sample Results - Reported Results for Standards, Quality Control (QC) Checks and QC Samples - Instrument PDF of (raw data) for Field Samples, Standards, QC Checks and QC Samples - Data Package Completeness Checklists - Sample Disposal Records - Extraction/Cleanup Records - Raw Data (stored on disk or CD-R) - Analytical Reports to PIKA-MP JV	- Data Review Checklists - Data Quality Assessments - Data Usability Summary Report	- IRP Work Plan - Safety and Health Plan

Note: [1]Records and logs from the project will be stored in the PIKA-MP JV office in Clifton Park, New York.

Worksheet #31, 32 & 33 –Assessments and Corrective Action

Assessments: See Worksheet 14/16 for estimated dates					
Assessment Type	**Responsible Party & Organization**	**Number/Frequency**	**Estimated Dates**	**Assessment Deliverable**	**Deliverable Due Date**
Review of QAPP and SOPs with field staff	PIKA-MP JV LLC	Prior to sampling start up	Prior to sampling	Contained within daily QC Report	Prior to sampling
Daily logbook and field forms	PIKA-MP JV LLC	Daily	During field activities	Contained within written report	As part of Draft Report
Laboratory assessment for appropriate certifications and capacity and QAPP review with laboratory staff	PIKA-MP JV LLC	Prior to sampling start up	Prior to sampling	Receipt of copies of certifications. Email traffic concerning laboratory capacity prior to sampling start-up. QAPP sign-off sheet received from laboratory.	Prior to sampling
Field sampling and chain of custody review against QAPP requirements	PIKA-MP JV LLC	Daily	During field activities	Communication in the form of an email.	Last email received no later than 24 hours after last sampling event
Laboratory report deliverables and analytical results review against QAPP requirements	PIKA-MP JV LLC	Per sample delivery ground	Immediately following field sampling	Communication in the form of an email.	Three weeks after receipt of data

Worksheet #31, 32 & 33 –Assessments and Corrective Action

Assessments: See Worksheet 14/16 for estimated dates					
Assessment Type	**Responsible Party & Organization**	**Number/Frequency**	**Estimated Dates**	**Assessment Deliverable**	**Deliverable Due Date**
Data verification	Katahdin Analytical Services (Scarborough, Maine) Eurofins Air Toxics (Folsom, CA)	Per sample delivery group	Immediately following field sampling	Communication in the form of an email requesting additional laboratory forms, backup data that may be missing and/or clarification of the analytical report.	Three weeks after receipt of data.
Data validation	PIKA-MP JV LLC	Per sample delivery group	Following analytical report	Communication in the form of an email requesting additional laboratory forms, backup data that may be missing and/or clarification of the analytical report.	Three weeks after receipt of data.

Assessment Response and Corrective Action					
Assessment Type	**Responsibility for Responding to Assessment Finding**	**Assessment Response Documentation**	**Timeframe for Response**	**Responsibility for Implementing Corrective Action**	**Responsible for Monitoring Corrective Action Implementation**
Review of QAPP and SOPs with field staff	Andy Vitolins Project Manager PIKA-MP JV Stefan Bagnato Assistant Project Manager PIKA-MP JV	Daily QC report will be amended with corrective action	Within 24 hours	Field Team Leader PIKA-MP JV	Andy Vitolins Project Manager PIKA-MP JV Stefan Bagnato Assistant Project Manager PIKA-MP JV
Daily logbook and field forms	Field Team Leader PIKA-MP JV	Daily QC report will be amended with corrective action	Within 24 hours	Field Team Leader PIKA-MP JV	Andy Vitolins Project Manager PIKA-MP JV Stefan Bagnato Assistant Project Manager PIKA-MP JV
Laboratory assessment for appropriate certifications and capacity and QAPP review with laboratory staff	Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA)	Response to email	Within 48 hours of notification	Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA)	Kathleen Anthony Project Chemist PIKA-MP JV
Field sampling and chain of custody review against QAPP requirements	Andy Vitolins Project Manager PIKA-MP JV Stefan Bagnato Assistant Project Manager PIKA-MP JV	Response to email	Within 24 hours after sampling	Field Team Leader PIKA-MP JV	Andy Vitolins Project Manager PIKA-MP JV Stefan Bagnato Assistant Project Manager PIKA-MP JV

Assessment Response and Corrective Action					
Assessment Type	**Responsibility for Responding to Assessment Finding**	**Assessment Response Documentation**	**Timeframe for Response**	**Responsibility for Implementing Corrective Action**	**Responsible for Monitoring Corrective Action Implementation**
Laboratory report deliverables and analytical results review against QAPP requirements	Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA)	If required, laboratory reports will be amended and corrections noted in the case narrative	Within 72 hours after notification	Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA)	Kathleen Anthony Project Chemist PIKA-MP JV
Data verification	Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA)	If required, laboratory reports will be amended and corrections noted in the case narrative and contained within the validation report	Up to 7 days	Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA)	Kathleen Anthony Project Chemist PIKA-MP JV
Data validation	Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA)	If required, laboratory reports will be amended and corrections noted in the case narrative and contained within the validation report	Up to 7 days	Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA)	Kathleen Anthony Project Chemist PIKA-MP JV

Worksheet #34 – Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (conformance to specifications)
	Planning Documents/Records		
1	Approved QAPP	**X**	
2	Contract	**X**	
4	Field SOPs	**X**	
5	Laboratory SOPs	**X**	
Field Records			
6	Field logbooks	**X**	
7	Equipment calibration records	**X**	
8	Chain-of-Custody Forms	**X**	
9	Sampling logs	**X**	
10	Drilling logs	**X**	
13	Change orders/deviations	**X**	
14	Field audit reports	**X**	
15	Field corrective action reports	**X**	
Analytical Data Package			
16	Cover sheet (laboratory identifying information)	**X**	**X**
17	Case narrative	**X**	**X**
18	Internal laboratory chain-of-custody	**X**	**X**
19	Sample receipt records	**X**	**X**
20	Sample chronology (i.e. dates and times of receipt, preparation, & analysis)	**X**	**X**
21	Communication records	**X**	**X**
22	Project-specific PT sample results	**X**	**X**
23	LOD/LOQ establishment and verification	**X**	**X**
24	Standards Traceability	**X**	
25	Instrument calibration records	**X**	**X**
26	Definition of laboratory qualifiers	**X**	**X**
27	Results reporting forms	**X**	**X**
28	QC sample results	**X**	**X**
29	Corrective action reports	**X**	**X**
30	Raw data	**X**	
31	Electronic data deliverable	**X**	

Worksheet #35 – Data Verification Procedures
Worksheet #35 Contains 2 Page(s)

Records Reviewed	Required Documents	Process Description	Responsible Person, Organization
Field logbook	QAPP	Verify that records are present and complete for each day of field activities. Verify that all planned samples, including field QC samples, were collected and that sample collection locations were documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify the any required field monitoring was performed and results were documented.	Daily: Andy Vitolins Project Manager PIKA-MP JV Daily: Stefan Bagnato Assistant Project Manager PIKA-MP JV
Chain of custody forms	QAPP	All samples to be analyzed by the laboratory will be shipped via overnight delivery or will be sent via the laboratory courier service. Upon receipt, the laboratory sample custodian will check the integrity of the custody seals and will sign and date the COC to acknowledge sample receipt. The laboratory is responsible for verifying that the COC and containers agree and that the sample containers are received in good condition. The sample receipt form will be sent to the Project Chemist prior to preparation for analysis. The Laboratory Information Management System will provide evidence of sample custody from receipt by the laboratory until appropriate disposal.	Daily: Field Team Leader PIKA-MP JV Upon receipt: Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Upon receipt: Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA) At the conclusion of field activities: Kathleen Anthony Project Chemist PIKA-MP JV

Worksheet #35 – Data Verification Procedures
Worksheet #35 Contains 2 Page(s)

Records Reviewed	Required Documents	Process Description	Responsible Person, Organization
Laboratory corrective action and report procedure	QAPP	Routine corrective actions apply to all analytical quality control parameters and analytical system specifications as defined in the laboratory SOPs. Bench analysts have full responsibility and authority for performing routine corrective actions, which are documented as part of the analytical record. Defective processes, holding time violations, systematic errors and quality defects that occur are to be reported by the bench chemist to the laboratory supervisor and a non-conformance record initiated. The laboratory project manager will then notify the PIKA-Pirnie JV project chemist and/or project manager. All notifications must be made in a timely manner. The non-conformance record should become part of the analytical record.	Before release: Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Before release: Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA) Upon receipt: Kathleen Anthony Project Chemist PIKA-MP JV
Analytical Data Package - Laboratory	QAPP	All data produced by the laboratory will be required to undergo several levels of review, which will include two levels of management review at the laboratory. The laboratory will review the data packages internally for completeness and verify that all of the required forms and raw data are included for each data package type. The laboratory Quality Assurance Officer may also select to review randomly chosen data packages for additional audits.	Before release: Leslie Dimond QA Manager Katahdin Analytical Services (Scarborough, Maine) Before release: Melanie Levesque QA Manager Eurofins Air Toxics (Folsom, CA) Upon receipt: Kathleen Anthony Project Chemist PIKA-MP JV

Worksheet #35 – Data Verification Procedures
Worksheet #35 Contains 2 Page(s)

Records Reviewed	Required Documents	Process Description	Responsible Person, Organization
Analytical Data Package/Laboratory Quality Control	QAPP	The Project Chemist will verify that data have been received for all samples sent to the laboratory. An evaluation of this data will be performed to determine whether the laboratory met the QC requirements as stated in the analytical methods and laboratory SOPs.	Kathleen Anthony Project Chemist PIKA-MP JV

Worksheet #36: Data Validation Procedures

Steps IIa and IIb	Matrix[1]	Analytical Group	Data Purpose	Concentration Level	Validation Criteria[2]	Data Validator (title and organizational affiliation)[3]
IIa and IIb	Water	Volatile organic compounds (VOCs) Metals Total organic carbon (TOC) Dissolved gases Sulfide	Long-Term Monitoring	All	DoD Quality Systems Manual (QSM) control limits; Quality Assurance Project Plan (QAPP) criteria; and professional judgment	Kathleen Anthony Project Chemist PIKA-MP JV
IIa and IIb	Soil Vapor	VOCs	Long-Term Monitoring	All	DoD QSM control limits; QAPP criteria; and professional judgment	Kathleen Anthony Project Chemist PIKA-MP JV

Note:
[1] Long-term monitoring and system performance monitoring samples will be collected; however, data validation will not be required for these samples.
[2] Data will be reviewed for compliance with DoD QSM control limits and QAPP criteria.
[3] Data review will be performed by the PIKA-MP JV JV Project Chemist will oversee the data review the Data Usability Summary Report.

Worksheet #37: Usability Assessment

The Data Usability Assessment will be performed by the PIKA-MP JV for data associated with the Watervliet Arsenal (WVA) Installation Restoration Program(IRP) Monitoring Program. Documentation generated during the Data Usability Assessment will consist of a Data Usability Summary Report and a statement of overall data usability.

Data verification is the process by which laboratory results are checked to provide that the proper quality control (QC) steps were performed and key items have met QC objectives (both analytical and contractual). Key steps of the PIKA-MP JV data verification include:

- identifying sample collection, handling and analysis procedures
- documenting handling and analysis activities (e.g., QC checklist)
- verifying (internally, at the data generator level) all sampling, handling, on-site analytical laboratory data
- verifying laboratory data (e.g., laboratory-qualified data)
- verifying sampling, on-site analytical laboratory data
- verifying data package deliverable completeness
- reviewing the case narrative
- presenting all analytical results
- summarizing QC sample data
- evaluating applicable raw data

All required data deliverables must be present in the data package in order to proceed to the next step of data validation.

Data validation entails a review of the sample collection, handling, QC data, and the raw data to verify that the laboratory was operating within required limits, analytical results were correctly transcribed from the instrument read-outs, and which (if any) environmental samples were related to out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

The data quality indicators (DQIs) used to evaluate conformance with the project data quality objectives (DQOs) are presented below.

DQIs are generally defined in terms of six parameters:

1. representativeness

Worksheet #37: Usability Assessment

2. comparability
3. completeness
4. precision
5. accuracy
6. sensitivity

Each parameter is defined below. Specific objectives for the site actions are presented in other sections of this work plan as referenced below.

Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability and the variability of environmental media at the site. Actions have been designed to assess the presence of chemical constituents at the time of sampling. The work plan presents the rationale for sample quantities and location. This work plan presents field sampling and laboratory analytical methodologies. Use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in the IRP Work Plan and this QAPP, established quality assurance/quality control (QA/QC) procedures and use of appropriately trained personnel.

Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results. Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize

Worksheet #37: Usability Assessment

precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to established protocols presented in the work plan. Checks for analytical precision will include the analysis of matrix spike/matrix spike duplicates (MS/MSDs), laboratory duplicates and field duplicates. Checks for field measurement precision will include duplicate field measurements.

The precision of data will be measured by calculating the Relative Percent Difference (RPD) by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = Analytical result from one of two duplicate measurements.

B = Analytical result from the second measurement.

Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, MSs, blank spikes and surrogate standards will be used to assess the accuracy of the analytical data.

Accuracy will be calculated in terms of percent recovery as follows:

$$\%\ Recovery = \frac{A-X}{B} \times 100$$

Where:

A = Value measured in spiked sample or standard.

X = Value measured in original sample.

B = True value of amount added to sample or true value of standard.

Sensitivity

Sensitivity is a quantitative measurement to determine if the analytical laboratory's procedures/methodologies and their associated detection limits can satisfy the project requirements as they relate to the project action limits. Detection limits (DLs) are updated annually by the laboratory. The current DLs for the analytical laboratories are presented in Worksheet #15.

Worksheet #37: Usability Assessment

Field Data Review

Field data are generated from in-field measurement, which may include a geophysical survey, well development and groundwater sampling. The quality objective for the in-field measurement activities is to obtain accurate measurements of sample characteristics, including aqueous pH, conductivity, temperature, turbidity and dissolved oxygen, using appropriate equipment. Data are recorded in field logbooks or on field sampling sheets and calibration logs. Calibration logs will be reviewed by ARCADIS Field Managers with other field documentation to identify any potential impacts to data quality and usability. Field logbooks are reviewed as part of the QC inspections.

Reconciliation with Data Usability Requirements

Data results will be examined to determine the performance that was achieved for each data usability criterion. The performance will then be compared with the project objectives and DQOs. Deviations from objectives will be noted. Data that have been rejected will not be used. Data that have been qualified but not rejected will be considered useable (i.e., qualified as estimated) and definitive data. If there is an instance where further limitations must be placed on qualified data, the data will be additionally qualified with "X." This would indicate that the associated data are non-definitive data and should be used for screening purposes only.

Additional action may be warranted when performance does not meet performance objectives for critical data. Options for corrective action relating to incomplete information, questionable results or inconsistent data may include any or all of the following:

- retrieval of missing information
- request for additional explanation or clarification
- reanalysis of sample from extract (when appropriate)
- recalculation or reinterpretation of results by the laboratory

These actions may improve the data quality, reduce uncertainty and eliminate the need to qualify or reject data. If these actions do not improve the data quality to an acceptable level, the following additional actions may be taken:

- extrapolation of missing data from existing data points
- use of historical data
- evaluation of the critical/noncritical nature of the sample

If the data gap cannot be resolved by these actions, the data bias and potential for false negatives and positives can be evaluated. If the resultant uncertainty level is unacceptable, the following action must be taken:

Worksheet #37: Usability Assessment

- additional sample collection and analysis

Appendix A

Field SOPs

ARCADIS

Infrastructure, environment, facilities

Imagine the result

Indoor Air or Ambient Air Sampling and Analysis Using USEPA Method TO-15

SOP # 765199

Rev. #: 2

Rev Date: July 7, 2010

Approval Signatures

Prepared by: ______________________ Date: 07/07/2010
Mitch Wacksman and Andrew Gutherz

Approved by: ______________________ Date: 07/07/2010
Christopher Lutes and Nadine Weinberg

I. Scope and Application

This standard operating procedure (SOP) describes the procedures to collect indoor air or ambient air samples for the analysis of volatile organic compounds (VOCs) using United States Environmental Protection Agency (USEPA) Method TO-15 (TO-15). The TO-15 method uses a 6-liter SUMMA® passivated stainless steel canister. An evacuated SUMMA® canister (<28 inches of mercury [Hg]) will provide a recoverable whole-gas sample of approximately 5 liters when allowed to fill to a vacuum of 6 inches of Hg. The whole-air sample is then analyzed for VOCs using a quadrupole or ion-trap gas chromatograph/mass spectrometer (GS/MS) system to provide compound detection limits of 0.5 parts per billion volume (ppbv).

The following sections list the necessary equipment and provide detailed instructions for placing the sampling device and collecting indoor air samples for VOC analysis.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. ARCADIS field sampling personnel will be well versed in the relevant SOPs and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS personnel responsible for leading indoor air sample collection activities must have previous indoor air sampling experience.

III. Health and Safety Considerations

All sampling personnel should review the appropriate health and safety plan (HASP) and job safety analysis (JSA) prior to beginning work to be aware of all potential hazards associated with the job site and the specific task. The following are examples of hazards that are often encountered in conducting indoor air sampling:

- In crawl spaces, hazards often include low head room, limited light, poisonous insects, venomous snakes, and sharp debris.
- In residential buildings and neighborhoods unfamiliar dogs can pose a hazard. Even though proper permission for sampling may have been secured, it is still possible to encounter persons suspicious of or hostile to the sampling team.
- In occupied industrial buildings be aware of the physical hazards of ongoing industrial processes. Examples include moving forklifts and equipment pits.

IV. Equipment List

The equipment required for indoor air sample collection is presented below:

- 6-liter, stainless steel SUMMA® canisters (order at least one extra, if feasible);
- Flow controllers with in-line particulate filters and vacuum gauges (flow controllers are pre-calibrated by the laboratory to a specified sample duration [e.g., 8-hour]). Confirm with lab that flow controller is equipped with an in-line particulate filter and pressure gauge (order an extra set for each extra SUMMA® canister, if feasible);
- Appropriate-sized open-end wrenches (typically 9/16-inch);
- Chain-of-custody (COC) form;
- Building survey and product inventory form (example attached);
- Portable photoionization detector (PID) (for use identifying potential background sources during building survey described below);
- Sample collection log (attached);
- Camera if photography is permitted at sampling locations;
- Portable weather meter, if appropriate;
- Box, chair, tripod, or similar to hold canister above the ground surface; and
- Teflon sample tubing may be used to sample abnormal situations (i.e., sumps, where canisters must be hidden, etc.). In these situations ¼-inch Swagelok fittings or other methods may be appropriate to affix tubing to canister. Staff should check this before heading out into field.

V. Cautions

Care must be taken to minimize the potential for introducing interferences during the sampling event. As such, keep ambient air canisters away from heavy pedestrian traffic areas (e.g., main entranceways, walkways) if possible. If the canisters are not to be overseen for the entire sample duration, precautions should be taken to maintain the security of the sample (e.g., do not place in areas regularly accessed by the public, fasten the sampling device to a secure object using lock and chain, label the canister to indicate it is part of a scientific project, notify local authorities, place the canister in secure housing that does not disrupt the integrity/validity of the sampling event). Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens (sharpies), wear/apply fragrances, or smoke cigarettes before and/or during the sampling event.

Ensure that the flow controller is pre-calibrated to the proper sample collection duration (confirm with laboratory). Sample integrity can be compromised if sample collection is extended to the point that the canister reaches atmospheric pressure. Sample integrity is maintained if sample collection is terminated prior to the target duration and a measurable vacuum (e.g., 5–inches Hg) remains in the canister when sample collection is terminated.

VI. Procedure

Initial Building Survey for Indoor Air Samples (if applicable to project)

1. Complete the appropriate building survey form and product inventory form (e.g., state-specific form, USEPA form, or ARCADIS form, [Attachment A]) as necessary in advance of sample collection.

2. Survey the area for the apparent presence of items or materials that may potentially produce or emit constituents of concern and interfere with analytical laboratory analysis of the collected sample. Record relevant information on survey form and document with photographs.

3. Record date, time, location, and other relevant notes on the sampling form.

4. Items or materials that contain constituents of concern and/or exhibit elevated PID readings shall be considered probable sources of VOCs. Request approval of the owner or occupant to have these items removed to a structure not attached to the target structure at least 48 hours prior to sampling if possible.

5. Set a date and time with the owner or occupant to return for placement of SUMMA® canisters.

Preparation of SUMMA®-Type Canister and Collection of Sample

1. Record the following information on the sampling form (use a hand-held weather meter, contact the local airport or other suitable information source [e.g., weatherunderground.com] to obtain the following information):

   - ambient temperature;

- barometric pressure;
- wind speed; and
- relative humidity.

2. Choose the sample location in accordance with the sampling plan. If a breathing zone sample is required, place the canister on a ladder, tripod, box, or other similar stand to locate the canister orifice 3 to 5 feet above ground or floor surface. If the canister will not be overseen for the entire sampling period, secure the canisters as appropriate (e.g., lock and chain). Canister may be affixed to wall/ceiling support with nylon rope or placed on a stable surface. In general, areas near windows, doors, air supply vents, and/or other potential sources of “drafts” shall be avoided.

3. Record SUMMA® canister serial number and flow controller number on the sampling log and chain of custody (COC) form. Assign sample identification on canister ID tag, and record on the sample collection log (Attachment B), and COC form.

4. Remove the brass dust cap from the SUMMA® canister. Attach the flow controller with in-line particulate filter and vacuum gauge to the SUMMA® canister with the appropriate-sized wrench. Tighten with fingers first, then gently with the wrench. Use caution not to over tighten fittings.

5. Open the SUMMA® canister valve to initiate sample collection. Record the date and local time (24-hour basis) of valve opening on the sample collection log, and COC form. Collection of duplicate samples will include collecting two samples side by side at the same time.

6. Record the initial vacuum pressure in the SUMMA® canister on the sample log and COC form. If the initial vacuum pressure registers less than -25 inches of Hg, then the SUMMA® canister is not appropriate for use and another canister should be used.

7. Take a photograph of the SUMMA® canister and surrounding area, if possible.

8. Check the SUMMA canister approximately half way through the sample duration and note progress on sample logs.

Termination of Sample Collection

1. Arrive at the SUMMA® canister location at least 1-2 hours prior to the end of the sampling interval (e.g., 8-hour, 24-hour).

2. Stop collecting the sample when the canister vacuum reaches approximately 7 inches of Hg (leaving some vacuum in the canister provides a way to verify if the canister leaks before it reaches the laboratory) or when the desired sample time has elapsed.

3. Record the final vacuum pressure. Stop collecting the sample by closing the SUMMA® canister valve. Record the date, local time (24-hour basis) of valve closing on the sample collection log, and COC form.

4. Remove the particulate filter and flow controller from the SUMMA® canister, re-install brass cap on canister fitting, and tighten with wrench.

5. Package the canister and flow controller in the shipping container supplied by the laboratory for return shipment to the laboratory. The SUMMA® canister does not require preservation with ice or refrigeration during shipment.

6. Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with string).

7. Complete COC form and place requisite copies in shipping container. Close shipping container and affix custody seal to container closure. Ship to laboratory via overnight carrier (e.g., Federal Express) for analysis.

VII. Waste Management

No specific waste management procedures are required.

VIII. Data Recording and Management

Notes taken during the initial building survey will be recorded on the sample log, with notations of project name, sample date, sample time, and sample location (e.g., description and GPS coordinates if available) sample start and finish times, canister serial number, flow controller number, initial vacuum reading, and final vacuum reading. Sample logs and COC records will be transmitted to the Task Manager or Project Manager. A building survey form and product inventory form (Attachment A) may also be completed for each building within the facility being sampled during each sampling event as applicable.

IX. Quality Assurance

Indoor air or ambient air sample analysis will be performed using USEPA Method TO-15. This method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5 ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode.

Duplicate samples should be collected in the field as a quality assurance step. Generally, duplicates are taken of 10% of samples, but project specific requirements should take precedence.

Building Survey and Product Inventory Form

Directions: This form must be completed for each residence or area involved in indoor air testing.

Preparer's Name: ____________________________________

Date/Time Prepared: _________________________________

Preparer's Affiliation: ________________________________

Phone No.: ____

Purpose of Investigation: ____

1. OCCUPANT:

Interviewed: Y / N

Last Name: _________________________ First Name: _________________________

Address: ____

County: ___________________________________

Home Phone: _______________________ Office Phone: ________________________

Number of Occupants/Persons at this Location: _________________

Age of Occupants: ______________________

2. OWNER OR LANDLORD: (Check if Same as Occupant ___)

Interviewed: Y / N

Last Name: _________________________ First Name: _________________________

Address: ____

County: _________________________________

Home Phone: ____________________ Office Phone: ____________________

3. BUILDING CHARACTERISTICS:

Type of Building: (circle appropriate response)

Residential	School	Commercial/Multi-use
Industrial	Church	Other: ________________

If the Property is Residential, Type? (circle appropriate response)

Ranch		2-Family 3-Family
Raised Ranch	Split Level	Colonial
Cape Cod	Contemporary	Mobile Home
Duplex	Apartment House	Townhouses/Condos
Modular	Log Home	Other:______________

If Multiple Units, How Many? ___________

If the Property is Commercial, Type?

Business Type(s) ____________________________________

Does it include residences (i.e., multi-use)? Y / N If yes, how many? _________

Other Characteristics:

Number of Floors______ Building Age______

Is the Building Insulated? Y / N How Air-Tight? Tight / Average / Not Tight

4. AIRFLOW:

Use air current tubes or tracer smoke to evaluate airflow patterns and qualitatively describe:

Airflow Between Floors

____

____

____

Airflow Near Source

____

____

Outdoor Air Infiltration

____

Infiltration Into Air Ducts

____

____

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS: (circle all that apply)

a.	**Above grade construction:**	wood frame	concrete	stone brick
b.	**Basement type:**	full	crawlspace	slab other ________
c.	**Basement floor:**	concrete	dirt	stone other ________
d.	**Basement floor:**	uncovered	covered	covered with _______________
e.	**Concrete floor:**	unsealed	sealed	sealed with ________________
f.	**Foundation walls:**	poured	block stone	other ______________________
g.	**Foundation walls:**	unsealed	sealed	sealed with ________________
h.	**The basement is:**	wet	damp	dry moldy
i.	**The basement is:**	finished	unfinished	partially finished

j. Sump present? Y / N

k. Water in sump? Y / N / NA

Basement/lowest level depth below grade: ________(feet)

Identify potential soil vapor entry points and approximate size (e.g., cracks, utility ports, drains)

____

Are the basement walls or floor sealed with waterproof paint or epoxy coatings? Y / N

6. HEATING, VENTILATING, AND AIR CONDITIONING: (circle all that apply)

Type of heating system(s) used in this building: (circle all that apply – note primary)

Hot air circulation	Heat pump	Hot water baseboard
Space heaters	Stream radiation	Radiant floor
Electric baseboard	Wood stove	Outdoor wood boiler
Other __________		

The primary type of fuel used is:

Natural base	Fuel oil	Kerosene
Electric	Propane	Solar
Wood coal		

Domestic hot water tank fueled by: ______________________________

Boiler/furnace located in: Basement Outdoors Main Floor Other____________

Air conditioning: Central Air Window Units Open Windows None

Are there air distribution ducts present? Y / N

Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

____

____

____

7. OCCUPANCY:

Is basement/lowest level occupied? Full-time Occasionally Seldom Almost Never

General Use of Each Floor (e.g., family room, bedroom, laundry, workshop, storage):

Basement ____

1st Floor ____

2nd Floor ____

3rd Floor ____

4th Floor ____

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY:

a. Is there an attached garage? Y / N

b. Does the garage have a separate heating unit? Y / N / NA

c. Are petroleum-powered machines or vehicles stored in the garage (e.g., lawnmower, ATV, car)?

Y / N / NA Please specify: ____

d. Has the building ever had a fire? Y / N When? ______________________________

e. Is a kerosene or unvented gas space heater present? Y / N Where? ____________________

f. Is there a workshop or hobby/craft area? Y / N Where & Type? _________________

g. Is there smoking in the building? Y / N How frequently? ___________________________

h. Have cleaning products been used recently? Y / N When & Type? __________________

i. Have cosmetic products been used recently? Y / N When & Type? __________________

j. Has painting/staining been done in the last 6 months? Y / N Where & When? ____________

k. Is there new carpet, drapes or other textiles? Y / N Where & When? ________________

l. Have air fresheners been used recently? Y / N When & Type? _______________________

m. Is there a kitchen exhaust fan? Y / N If yes, where _________________________

n. Is there a bathroom exhaust fan? Y / N If yes, where vented?________________________

o. Is there a clothes dryer? Y / N If yes, is it vented outside? Y / N

p. Has there been a pesticide application? Y / N When & Type?______________________

q. Are there odors in the building? Y / N

If yes, please describe: ____

Do any of the building occupants use solvents (e.g., chemical manufacturing or laboratory, auto mechanic or auto body shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist) at work? Y / N

If yes, what types of solvents are used? ____

If yes, are their clothes washed at work? Y / N

Do any of the building occupants regularly use or work at a dry-cleaning service? (circle appropriate response)

Yes, use dry-cleaning regularly (weekly) No

Yes, use dry-cleaning infrequently (monthly or less) Unknown

Yes, work at a dry-cleaning service

Is there a radon mitigation system for the building/structure? Y / N

Date of Installation: ______________________

Is the system active or passive? Active/Passive

Are there any Outside Contaminant Sources? (circle appropriate responses)

Contaminated site with 1000-foot radius? Y / N Specify ________________________________

Other stationary sources nearby (e.g., gas stations, emission stacks, etc.): ___________________

____

Heavy vehicle traffic nearby (or other mobile sources): __________________________________

9. WATER AND SEWAGE:

Water Supply:	Public Water	Drilled Well	Driven Well	Dug Well	Other: _______
Sewage Disposal:	Public Sewer	Septic Tank	Leach Field	Dry Well	Other: _______

10. RELOCATION INFORMATION: (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: ____________________________________

____

b. Residents choose to: remain in home relocate to friends/family relocate to hotel/motel

c. Responsibility for costs associated with reimbursement explained? Y / N

d. Relocation package provided and explained to residents? Y / N

11. FLOOR PLANS:

Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:

First Floor:

12. OUTDOOR PLOT:

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s), and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

13. PRODUCT INVENTORY FORM:

Make and Model of field instrument used: ___________________________

List specific products found in the residence or area that have the potential to affect indoor air quality (e.g., gasoline or kerosene storage cans, glues, paints, cleaning solvents/products, polishes/waxes, new furniture/ carpet, nail polish/hairspray/cologne).

Location	Product Description	Size (units)	Condition*	Chemical Ingredients	Field Instrument Reading (units)	Photo** Y/N

ARCADIS

Indoor Air/Ambient Air Sample Collection Log

		Sample ID:	
Client:		**Outdoor/Indoor:**	
Project:		**Sample Intake Height:**	
Location:		**Tubing Information:**	
Project #:		**Miscellaneous Equipment:**	
Samplers:		**Time On/Off:**	
Sample Point Location:		**Subcontractor:**	

Instrument Readings:

Date	Time	Canister Vacuum (a) (inches of Hg)	Temperature (°F)	Relative Humidity (%)	Air Speed (mph)	Barometric Pressure (inches of Hg)	PID (ppb)

(a) Record canister information at a minimum at the beginning and end of sampling

SUMMA Canister Information:

Size (circle one):	**1 L** **6 L**
Canister ID:	
Flow Controller ID:	
Notes:	

General Observations/Notes:

Infrastructure, environment, facilities

Imagine the result

SOP: Soil Vapor Extraction and Treatment System Sampling

Rev. #: 1

Rev Date: February 19, 2010

Approval Signatures

Prepared by: ______________________ Date: February 19, 2010

Brian Millage
Staff Scientist

Reviewed by: ______________________ Date: February 19, 2010

Chris Lutes
Technical Review

Reviewed by: ______________________ Date: February 19, 2010

Quentin Moore
Project Engineer/ Certified Project Manager

I. Scope and Application

This standard operating procedure (SOP) describes the procedures to collect treatment system air samples using a 6-liter, stainless steel SUMMA® canister. The presence of volatile organic compounds (VOCs) will be analyzed by United States Environmental Protection Agency (USEPA) Method TO-14A (TO-14A) and USEPA Method 25C (25C) for total gaseous non-methane organic compounds (TGNMO) to satisfy permit conditions and provide baseline data for destruction efficiency calculations. In addition, all vapor samples collected quarterly will be submitted to the laboratory for the analysis of oxygen, carbon monoxide, carbon dioxide and methane in accordance with the American Society for Testing and Materials (ASTM) method D1946.

Sample collection discussed in this SOP is consistent with the standard TO-14A collection method. Both the TO-14A and 25C analysis will be performed from the same canister. The following sections list the necessary equipment and detailed instructions for collecting the treatment system samples.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, DOT/IATA Hazardous Materials training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. ARCADIS field sampling personnel will be well versed in the relevant SOPs and possess the required skills and experience necessary to successfully complete the desired field work. ARCADIS personnel responsible for leading treatment system air sample collection activities must have previous treatment system air sampling experience or be cross-trained by experienced personnel.

III. Equipment List

The equipment required for ambient air sample collection is presented below:

- 6-liter, stainless steel SUMMA® canisters (LAB SUPPLIED - order at least one extra if feasible);
- ¼” stainless steel Swagelok™ fittings for canisters
- Vacuum gauge capable of -30” Hg;
- ¼” Teflon tubing, tees and 3-way valves to purge sample train

- Peristaltic purge pump with required silicon tubing;
- MultiRAE™ Plus PID or equivalent (calibrated);
- Non fixed-open-blade-knife (FOBK) cutting tool for tubing;
- Appropriate-sized open-end wrench and kneeling pad;
- Chain-of-custody (COC) form and sample label tags;
- Field notebook, pens and camera;
- Sample collection log;
- Table or adequate surface to place and secure canisters
- Safety gear including eye, hand and heat protective PPE

IV. Cautions

Care must be taken to minimize the potential for introducing interferences during the sampling event such as any source pollutants or biological debris. Care must also be taken to keep the canister secured in place while collecting the sample. Sampling personnel should not handle hazardous substances (such as gasoline), permanent marking pens, wear/apply fragrances, or smoke cigarettes/cigars before and/or during the sampling event.

Sample integrity is maintained if some vacuum is present in the canister, but sample integrity can be compromised if the event is extended to the point that the canister reaches atmospheric pressure. The treatment system will be operational for a minimum of one hour before the collection of any treatment system samples.

A Shipping Determination must be performed, by DOT-trained personnel, for all environmental and geotechnical samples that are to be shipped, as well as some types of environmental equipment/supplies that are transported. Use laboratory courier to transport samples if there is any doubt regarding shipping methods.

V. Health and Safety Considerations

Field sampling equipment must be carefully handled to minimize the potential for injury and the spread of hazardous substances. Plan safe access routes if sampling points are near powered, heated or elevated equipment. Use a spotter when necessary.

VI. Sampling Procedure

SUMMA® Canister Sampling Train Setup

- The canister valve assembly can be directly leak tested by connecting the pressure gauge and sampling valve directly to the sample tank. Remove the brass dust cap from the SUMMA® canister. Check that the vacuum gauge is zeroed properly. Connect the vacuum gauge, open canister valve slightly and observe vacuum. The vacuum should be the same as the reported value supplied by the laboratory, approximately -29" Hg. Verify canister Identification, record results and allow the canister to sit for one minute. The leak check for the tank is acceptable if no vacuum change is noted. If the canister leaks, notify the laboratory and remove the canister from use.

- Prepare sampling equipment and sample train assembly on plastic sheeting or table to limit potential debris from entering the sample train or equipment.

- To incorporate the canister as part of the sample train, remove vacuum gauge and install a barb to the SUMMA® canister with the appropriate wrench. Tighten with fingers first, then gently with the wrench.

- Using Teflon tubing, place a 3-way valve in line from the sample port (source gas) to the canister and tubing from the remaining barb to a peristaltic purge pump. Install a tee downstream of the purge pump for PID screening and attach a length of tubing to the remaining barb open to the atmosphere for discharge gas. For safety, keep this length of tubing away from the breathing zone or from powered equipment.

- With the sample train now in place, evacuate using the peristaltic pump with the three-way valve initially open and purge an adequate length of time to assure source vapors fill the sample train. Log the PID readings. Note the condition of the gas stream for the presence of moisture or other matter. (Note: At no time should droplets be permitted to enter the sample canister).

- Once adequate purge has been achieved, close the three-way valve and stop the purge pump. The three-way valve should now be closed to the peristaltic pump and open towards the SUMMA® canister for sample collection.

Sample Collection

- With the sample port valve still open, and 3-way valve properly aligned, gently open the SUMMA® canister valve. Record in the field notebook the time sampling began and note conditions.

- Take photographs of the SUMMA® canister, sample location and surrounding area, as appropriate.

- Close the canister valve when the canister vacuum reaches approximately 5 inches of Hg (leaving some vacuum in the canister provides a way to verify if the canister leaks before it reaches the laboratory) or when the desired sample collection time has elapsed. Verify end vacuum reading and record on the appropriate form.

- Close the sample port valve and carefully disconnect the sample train assembly and purge PID of residual source gas.

VII. Sample Handling, Packing and Shipping

- Record the date and local time (24-hour basis) of valve closing in the field notebook, sample collection log, and COC form.

- Complete the appropriate forms and sample labels as directed by the laboratory (e.g., affix card with string), complete COC forms and place requisite copies in shipping container.

- Package the canister (and flow controller if supplied by the laboratory) in the shipping container for return shipment to the laboratory. The SUMMA® canister does not require any preservation methods for shipment.

- Seal shipping container by affixing custody seal to container closure. Keep trip blank with collected samples until laboratory courier arrives. Keep all samples away from objects that may impact results (i.e. car exhaust, contaminated media).

VIII. Waste Management

No specific waste management procedures are required. Properly dispose of used materials in a sealed plastic bag managed as Non-hazardous waste.

IX. Data Recording and Management

Measurements will be recorded in the field notebook at the time of measurement, with notations of project name, sample date, sample start and finish times, sample location (e.g., GPS coordinates if available), canister serial number and initial and final vacuum reading. Field sampling logs and COC records will be transmitted to the Project Manager.

X. Quality Assurance

Soil gas vapor sample analysis will be performed using USEPA Method TO-14A and USEPA Method 25C. The TO-14A method uses a quadrupole or ion-trap GC/MS with a capillary column to provide optimum detection limits. The GC/MS system requires a 1-liter gas sample (which can easily be recovered from a 6-liter canister) to provide a 0.5 ppbv detection limit. The 6-liter canister also provides several additional 1-liter samples in case subsequent re-analyses or dilutions are required. This system also offers the advantage of the GC/MS detector, which confirms the identity of detected compounds by evaluating their mass spectra in either the SCAN or SIM mode.

The Method 25C analysis for total non-methane organic compounds requires less than 1-liter volume for analysis. Both the TO-14A and 25C analysis can be performed from the same canister. Oxygen, carbon monoxide, carbon dioxide and methane fixed gases are analyzed in accordance with the American Society for Testing and Materials (ASTM) method D1946.

XI. Limitations

Please reference the documentation specific to the job site, including the permit conditions, to assure that the method testing is suitable for testing requirements and project target goals.

XII. References

Center for Environmental Research Information Office of Research and Development, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air - Second Edition, Compendium Method TO-14A Determination of Volatile Organic Compounds (VOCs) In Ambient Air Using Specially Prepared Canisters with Subsequent Analysis By Gas Chromatography*, U.S. Environmental Protection Agency, Cincinnati, OH 45268. January 1999.

Appendix B

Analytical Laboratory Quality Assurance Plans and SOPs

Title: Dissolved Gases in Groundwater RSK-175

Approval Signatures:

Kirstin L. Daigle Laboratory Director	Chris Callahan Department Manager
Sara S. Goff Quality Assurance Manager	Daniel W. Helfrich Health & Safety Coordinator

Approval Date: November 09, 2015

Facility Distribution No. Electronic **Distributed To: Facility Intranet**

The controlled copy of this SOP is the PDF copy of the SOP that is posted to the laboratory's SOP Directory. Printed copies of this SOP or electronic copies of this SOP distributed outside the facility are considered uncontrolled.

1.0 Scope and Application

This SOP describes the laboratory procedure for the determination of dissolved gases (methane, ethane, and ethene) and carbon dioxide in groundwater. This procedure determines the concentration of dissolved gas in headspace. This procedure does not provide total sample concentration (concentration in headspace + concentration in water).

This SOP provides the routine laboratory procedure; program specific or client specific requirements are not included in this SOP.

1.1 Analytes, Matrix(s), and Reporting Limits

The analytes that may be determined by this SOP and their associated reporting limits are:

Analyte	CAS Number	RL (ug/L)
Methane	74-82-8	2
Ethane	74-84-0	4
Ethene	74-85-1	3
Carbon Dioxide	124-38-9	1000

2.0 Summary of Method

Samples are collected without headspace in 40 mL VOA vials. Samples for methane, ethane, and ethene must be preserved with hydrochloric acid at the time of collection. Samples for carbon dioxide must be collected without preservation that would alter the pH of sample. Prior to analysis, a portion of sample is transferred to a 22 mL serum vial and headspace is created using nitrogen. Samples for methane, ethane, and ethene are loaded onto a headspace autosampler and analyzed by GC/FID. Samples for carbon dioxide are manually injected and analyzed by GC/TCD.

This procedure is based on the following reference method:

- Method RSK-175, Revision 0, August 1994.

If the laboratory has modified this procedure from the reference method, a list of such modifications will be provided in Section 16.0 of this SOP.

3.0 Definitions

A list of terms and definitions are provided in Appendix A.

4.0 Interferences

Non-target compounds from the sample matrix can cause interference, which may result in positive identifications of non-target compounds with retention times similar to those of target compounds. The extent of these interferences will vary depending on the nature of the samples.

5.0 Safety

Employees must abide by the policies and procedures in the Corporate Environmental Health and Safety Manual (CW-E-M-001) and this document. This procedure may involve hazardous material, operations and equipment. This SOP does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of the method to follow appropriate safety, waste disposal and health practices under the assumption that all samples and reagents are potentially hazardous. Safety glasses, gloves, lab coats and closed-toe, nonabsorbent shoes are a minimum.

5.1 Specific Safety Concerns or Requirements

The gas chromatograph contains zones that have elevated temperatures. The analyst must be aware of the locations of those zones, and must cool them to room temperature prior to working on them.

There are areas of high voltage in the gas chromatograph. Depending on the type of work involved, either turn the power to the instrument off, or disconnect it from its source of power

5.2 Primary Materials Used

The following table lists those materials that have a serious or significant hazard rating along with the exposure limits and primary hazards associated with that material as identified in the SDS. A complete list of materials used in the method can be found Section 7.0. The table does not include all materials used in the procedure. Employees must review the information in the SDS for each material before using it for the first time or when there are major changes to the SDS.

Material (1)	Hazards	Exposure Limit (2)	Signs and Symptoms of Exposure
Hydrochloric Acid	Corrosive Poison	5 ppm-Ceiling	Inhalation of vapors can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory failure, and death. Can cause redness, pain, and severe skin burns. Vapors are irritating and may cause damage to the eyes. Contact may cause severe burns and permanent eye damage
1- Always add acid to water to prevent violent reactions			
2- Exposure limit refers to the OSHA regulatory exposure limit.			

6.0 <u>Equipment and Supplies</u>

Catalog numbers listed in this SOP are subject to change at the discretion of the vendor. Analysts are cautioned to be sure equipment used meets the specification of this SOP.

6.1 Miscellaneous

- Syringes: 10µL - 5.0 mL gas tight syringes with Luer-Lock tip, or equivalent
- Supply of UHP argon, helium, hydrogen, and nitrogen
- Acetylene 1%, Matheson, or equivalent
- Summa® Canister

6.2 Analytical System

- GC Acquisition Platform- Hewlett-Packard ChemStation rev A.09.03[1417] or equivalent. Data Processing: TestAmerica Chrom and TestAmerica LIMS (TALS).
- GC-FID/TCD: Varian 3600 with FID and TCD
- Column: Alltech CTR-1, 6 ft x ¼ in. OD-SS (6 feet inner with porous polymer and 6 feet outer with molecular sieve).
- Column: Rt-Uplot, 30 m x 0.53 mmID
- Tekmar Headspace Autosampler, or equivalent
- Thermo Scientific Precision Heated Water Bath, or equivalent

6.3 Sample Containers

- Serum vials with crimp top, 22mL
- 40 mL VOA vials

7.0 Reagents and Standards

7.1 Reagents

- VOA Free Reagent Water
- Hydrochloric Acid

7.2 Standards

- Primary Source Stock Standard: Matheson Micromat 14 (Grace Davison cat. #M7035) Gas Mix or equivalent. The Matheson Micromat 14 Gas Mix is comprised of 1% methane, ethane, ethene, carbon dioxide, acetylene, and carbon monoxide in nitrogen. Note: 1% is equivalent to 10,000 ppmv.
- Primary Source Stock Standard: Matheson Micromat 14 (Grace Davison cat. #M7006) Bone Dry carbon dioxide or equivalent. This mix contains 99.8% carbon dioxide in nitrogen. Note: 99.8% is equivalent to 980,000 ppmv.

- Second Source Stock Standards: Purchase a different lot of the primary source standard from the manufacturer.

Use the primary and secondary source standards to prepare the calibration standards and QC samples. The recommended formulations for the calibration standards are provided in Section 10.2. The formulation to prepare the continuing calibration verification standard and QC samples are provided in Sections 10.0 and 11.0.

Prepare all standards as follows: Add reagent water to a 22 mL serum vial until brimming then cap the vial. Create headspace by injecting 4 mL of nitrogen or nitrogen w/ acetylene through the septum with a 5 mL gas-tight syringe. Invert the vial and inject the appropriate amount of standard through the septum into the water.

Nitrogen with Acetylene (0.5%): Using a gas tight syringe transfer 900 mL of 1% acetylene standard into a 6 L Summa canister. Pressurize the canister with nitrogen to 28.08092 psig, which corresponds to a final volume of 18.0 L.

Carbon Dioxide Working Standard (5%): Using a gas tight syringe transfer 700 mL of the primary source stock carbon dioxide standard into a 6 L Summa canister. Pressurize the canister with nitrogen to 19.5 psig, which corresponds to a final volume of 13.97 L. Use the same formulation to prepare the second source carbon dioxide working standard.

8.0 Sample Collection, Preservation, Shipment and Storage

The laboratory does not perform or arrange for sample collection therefore these procedures are not included in this SOP.

The laboratory requires that samples for analysis of methane, ethane, and ethene be collected in 40 mL VOA vials preserved with 1:1 HCL to a pH of less than 2 at the time of collection. Samples for analysis of carbon dioxide must be collected in 40 mL VOA vials without preservative that would alter the pH. Immediately following collection, samples should be cooled and stored at 4º C ± 2º C until the time of analysis.

Listed below are laboratory recommended minimum sample size for collection and the preservation and holding time requirements as listed in the reference method.

Analytes	Sample Container	Minimum Sample Size	Preservation	Holding Time	Reference
Methane, Ethane, Ethene	Glass 40mL VOA vial with Septa preserved with 1:1 HCl	3 vials	pH <2, chilled to 4℃	14 Days from collection	Method RSK-175
CO_2	Glass 40mL VOA vial with Septa, no preservative	3 vials	Chilled to 4℃	14 Days from collection	Method RSK-175

Unless otherwise specified by client or regulatory program, after analysis, samples are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

9.0 Quality Control

9.1 Sample QC

The laboratory prepares the following quality control samples with each batch of samples.

QC Item	Frequency	Acceptance Criteria
Method Blank (MB)	1 in 20 or fewer samples	See Table 1
Laboratory Control Sample (LCS)	1 in 20 or fewer samples	See Table 1
Matrix Spike(s) MS/MSD	Client Request	See Table 1

9.2 Instrument QC

The following instrument QC is performed:

QC Item	Frequency	Acceptance Criteria
Initial Calibration (ICAL)	Initially; when ICV or CCV fail	See Table 1
Second Source Calibration Verification (ICV)	Once, after each ICAL	See Table 1
Continuing Calibration Verification (CCV)	Daily, every 20 samples, end of sequence	See Table 1
Retention Time Window	As Needed, with ICAL	See Table 1

10.0 Procedure

10.1 Instrument Operating Conditions

The recommended instrument operating conditions are as follows:

FID

- Temperature Program: 40º for 3.5 minutes
- FID Temperature: 200ºC
- Injection Port Temperature: 50ºC
- Carrier Gas: Helium, 30 mL/min
- Hydrogen (FID) 30 mL/min
- Air (FID) 300 mL/min

TCD

- Temperature Program: 75º for 3.5 minutes
- TCD Temperature: 150ºC
- Injection Port Temperature: 50ºC
- Filament Temperature: 185ºC
- Carrier Gas: Hydrogen, 35 mL/min

Alternate operating conditions may be used however the operating conditions used for initial calibrations may not be changed until the next initial calibration.

10.2 Initial Calibration

Calibrate the instrument with a minimum of 6 calibration points for each analyte. The concentration of the lowest calibration standard must be less than or equal to established limit of quantitation (LOQ) for each analyte. Repeat initial calibration when the results of the initial or continuing calibration verification standard (ICV/CCV) indicate the calibration relationship is not valid.

The recommended concentration levels for each calibration level along with the corresponding volume of primary source standard needed to achieve these concentrations are as follows:

Concentration of ICAL Standards (ug/L)

CAL	Injection Volume (uL)	Methane	Ethane	Ethene
Level 1	4.7	1.7	3.2	3.0
Level 2	50	18	34	32
Level 3	200	73	136	127
Level 4	600	218	409	381
Level 5	1000	363	681	636

Concentration of ICAL Standards (ug/L)

CAL	Injection Volume (uL)	Carbon Dioxide
Level 1	200	1000
Level 2	500	2500
Level 3	1000	5000
Level 4	1500	7500
Level 5	2000	10000
Level 6	2000	50000

$$ug/L = PPMV\ of\ Parent\ Standard \times \frac{MW(g)}{24.47} \times \frac{Volume\ Added(mL)}{18mL}$$

Where: ppmv = percent stock standard concentration multiplied by 10,000

Compound	Molecular Weight
Methane	16
Ethane	30
Ethene	28
Carbon Dioxide	44

The data processing system calculates the Calibration Factor (CF), mean CF and Percent Relative Standard Deviation (%RSD). The %RSD for each target analyte must be ≤ 30% for the initial calibration to be considered acceptable. If criteria are not met, perform corrective action prior to further analysis. Recommended corrective actions are provided in Table 1.

Immediately following initial calibration, verify the accuracy of the initial calibration with a second source verification standard (ICV).

To prepare the ICV for methane, ethane and ethene, add 200 uL of the second source standard into a 22 mL vial that contains 18 mL of VOA free water and 4 mL of headspace to yield an ICV concentration equivalent to the mid-point of the calibration.

To prepare the ICV for carbon dioxide, inject 1000 uL of the second source standard into a 22 mL vial that contains 18 mL of VOA free water and 4 mL of headspace to yield an ICV concentration equivalent to the mid-point of the calibration.

If after successful analysis of the ICV, time remains in the 24 hour analytical window samples may be analyzed without analysis of a continuing calibration verification standard (CCV); otherwise a CCV must be performed.

Trouble shooting:

Check the following items in case of calibration failures:

- ICAL: Perform injection port maintenance, change septum, check column and reference flows, recondition column, check oven and detector temperatures. In extreme cases, install new column, particularly if the chromatography has degraded as evidenced by peak shapes.
- ICV: Check standards quality, recalibrate.
- CCV: Perform injection port maintenance, change septum, check column and reference flows, recondition column, check oven and detector temperatures. In extreme cases, install new column, particularly if the chromatography has degraded as evidenced by peak shapes.

10.2.1 Continuing Calibration Verification

Analyze a CCV each day before sample analysis and at the end of each analytical sequence. Prepare the CCV at a concentration equivalent to the mid-point of the calibration. The percent difference of the CCV must be ± 30%. If this criterion is not met, correct the problem and reanalyze the CCV. If that fails, recalibrate.

10.3 Sample Preparation

Remove the samples from the refrigerated storage and allow them to warm to room temperature.

Transfer the sample into a 22 mL vial with a crimp cap. Insert a 22-gauge needle into the septum. Using a 5 mL gas-tight syringe, inject 4 mL of UHP nitrogen or nitrogen with acetylene (methane, ethane and ethene) into the vial to create headspace. Withdraw the needle and syringe from the vial and place on wrist shaker for 5 minutes.

Check and record the pH of the sample used for analysis in the comment section of the run log or in the TALS batch. The pH for samples for methane, ethane and ethane should be <2. The pH for samples for carbon dioxide must be neutral. If pH is not within specifications, document the nonconformance with an NCM, notify the PM and wait for instruction. Do not proceed with analysis unless documented consent is received from the PM via the client.

To prepare a MS or MSD for methane, ethane, ethene, prepare two additional aliquots of the parent sample and add 200 uL of Matheson Micromat 14 Gas Mix into the headspace to yield a spike concentration equivalent to the mid-point of the calibration.

To prepare the method blank for methane, ethane, ethene, transfer 22 mL of VOA free reagent water into a 22 mL vial and seal with a crimp cap. Using a 5 mL gas-tight syringe, inject 4 mL of nitrogen with acetylene into the vial.

To prepare the LCS for methane, ethane, ethene, inject 200 uL of the second source standard into a 22 mL vial that contains 18 mL of VOA free water and 4 mL of headspace to yield an LCS concentration equivalent to the mid-point of the calibration.

To prepare a MS/MSD for carbon dioxide, prepare two additional aliquots of the parent sample and add 1 mL of 5% carbon dioxide working standard into the headspace to yield a spike concentration equivalent to the mid-point of the calibration.

To prepare the method blank for carbon dioxide, transfer 22 mL of VOA free reagent water into a 22 mL vial and seal with a crimp cap. Insert a 22-guage needle into the septum. Using a 5 mL gas-tight syringe, inject 4 mL of UHP nitrogen into the vial.

To prepare the LCS for carbon dioxide, inject 1 mL of the second source standard into a 22 mL vial that contains 18 mL of VOA free water and 4 mL of headspace to yield an LCS concentration equivalent to the mid-point of the calibration.

10.4 Analytical Sequence

An example analytical sequence including initial calibration is provided below. When samples are analyzed in the same analytical sequence as the initial calibration, an opening CCV is not required. When initial calibration is not part of the sequence, an ICV is not required; open the analytical window with a CCV followed by the LCS.

Injection Number	Lab Description
1	CAL LEVEL 1
2	CAL LEVEL 2
3	CAL LEVEL 3
4	CAL LEVEL 4
5	CAL LEVEL 5
6	ICV
7	LCS
8	Method Blank
9	SAMPLES
Final Injection	CCVC

Establish the instrument operating conditions and calibrate the instrument in accordance with Section 10. If an acceptable initial calibration already exists, begin the sequence with analysis of the CCV.

For GC/FID analysis (methane, ethane, ethene), place the standards, samples, and method blanks onto the Tekmar headspace autosampler and initiate the sequence. The autosampler equilibrates the sample's water and headspace phases at 40º C and injects 100 uL of sample headspace onto the GC column, where target analytes, if present, are detected by the FID.

For GC/TCD analysis (carbon dioxide), place the standards, samples, and method blanks into a Thermo Scientific heated water bath set at 26^{o} C for 10 minutes. Then manually inject 400 uL of the standards, samples, and method blanks directly onto the column. Sample injections must be separated by at least 6 minutes to allow the sample to fully elute off of the column.

11.0 Calculations / Data Reduction

11.1 Qualitative Identification

The data processing system identifies the target analytes by comparing the retention time of the peaks to the retention times of the initial calibration standards.

11.2 Quantification Identification

The data system calculates the concentration for each target analyte from the calibration curve using the equations given in Appendix B.

11.3 Calculations

See Appendix B.

11.4 Data Review

11.4.1 Primary Review (Performed by Primary Analyst)

Review the chromatography and quantitation in the data processing system to confirm quantitative and qualitative identification of each target analyte.

Upload the data files to TALS. Enter batch editor information and verify the standards and reagents in the TALS batch. Review the results against acceptance criteria. If acceptance criteria are not met, make arrangements to perform corrective action.

Check the results of samples analyzed immediately after high concentration samples for signs of carry-over. Reanalyze the sample if carry over is suspected.

Dilute and reanalyze samples whose results exceed the calibration range. The diluted analysis should result in a determination within the upper half of the calibration curve.

Set results to primary, secondary, acceptable or rejected as appropriate.

Verify corrective action was taken for all results not within acceptance criteria. If corrective action is not taken or was unsuccessful, record all instances where criteria are not met with a nonconformance memo (NCM). Be sure to provide explanation of your decision making in the internal comment section of the NCM. The internal comment section should list the reason the NCM is suspected, which action (if any) was taken and why and the outcome of the action taken.

Review project documents such as the Project Plan (PP), Project Memo or any other document/process used to communicate project requirements to ensure those project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Set the batch to 1st level review.

11.4.2 Secondary Review (Performed by Peer Reviewer)

Review the project documents such as the Project Plan (PP), Project Memo or any other document/process used to communicate project requirements and verify project requirements were met. If project requirements were not met, immediately notify the project manager (PM) to determine an appropriate course of action.

Review the TALS batch editor to verify information is complete. Review the batch to verify that the procedures in this SOP were followed. If discrepancy is found, resolve the discrepancy and verify any modifications to the SOP are documented and approved.

Spot-check 15% of samples in the batch to verify quantitative and qualitative identification.

If manual integrations were performed:

- Review each manual integration to verify that the integration is consistent and compliant with the requirements specified in laboratory SOP BR-QA-005.

- Check to ensure an appropriate technical reason code is provided for each manual integration. Acceptable technical reason codes are provided in laboratory SOP BR-QA-005.

- Generate a “before” and “after” chromatogram for every manual integration performed on an instrument performance check standard (Tune, ICAL, ICV, CCV), QC sample (MB, LCS) and for any manual integration performed on any surrogate or internal standard in any field sample.

- Generate the Manual Integration Summary Report. Document your review of manual integrations on the summary report and obtain any review signatures of integrations performed during secondary review as required.

  If the reviewer disagrees with the integration performed by the primary analyst, the secondary data reviewer should not change the integration. Instead, he/she should consult with the primary analyst that performed the integration and both the reviewer and the primary analyst should agree the integration should be changed. If consensus between the primary analyst and the peer reviewer cannot be achieved; both should consult with the Technical Manager or department management for resolution. Any changes to the integration should be performed by the primary analyst. If it is necessary for the secondary reviewer to perform the manual integration because the primary analyst is out of the office; the integration made by the peer reviewer must be reviewed by another peer reviewer or by department management to verify the integration was performed and documented in compliance to SOP BR-QA-005. If the original analyst that performed the integration is out of the office, the data reviewer may consult with the Department Manager (DM), Department

Supervisor (DS) or the Technical Manager (TM) to verify the change he/she thinks is needed is warranted and should be made.

Verify that the performance criteria for the QC items listed in Table 1 were met. If the results do not fall within the established limits verify that corrective actions were performed. If corrective action was not performed; verify the reason is provided and that the situation is properly documented with an NCM. Set samples to 2nd level review.

Run the QC checker and fix any problems found. Run and review the deliverable. Fix any problems found. When complete set the method chain to lab complete and forward any paperwork to report/project management.

11.5 Data Reporting

Data reporting and creation of the data deliverable is performed by TALS using the formatters set by the project manager during project initiation.

The following sections describe the default reporting scheme set for this method:

Analytical results above the reporting limit (RL) are reported as the value found. Analytical results less than the RL are reported as non-detect to the adjusted RL. The RL is adjusted for sample dilution/concentration. The unadjusted RL for each target analyte is provided in Section 1.

The laboratory does not report estimated values for this test method. Estimated values are results reported outside the established calibration range (results between the adjusted LOD and LOQ).

Electronic and hardcopy data are maintained as described in laboratory SOP BR-QA-014 Laboratory Records.

12.0 <u>Method Performance</u>

12.1 Detection Limit Study (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)

Perform a DL study and verification at initial method set-up and when there is a significant change in instrumentation or procedure that affects the sensitivity of the method. See SOP BR-QA-005 for the procedure and requirements.

12.2 Demonstration of Capabilities (DOC)

Perform a method demonstration of capability at initial set-up and any time there is a significant change in instrumentation or procedure.

12.3 Training Requirements

Any employee that performs any portion of the procedure described in this SOP must have documentation in their employee training file that they have read this version of this SOP.

Instrument analysts, prior to independent analysis of client samples, must also have documentation of demonstration of initial proficiency (IDOC) and annual on-going proficiency (ODOC) in their employee training files.

13.0 Pollution Control

It is TestAmerica's policy to evaluate each method and look for opportunities to minimize waste generated (i.e., examine recycling options, ordering chemicals based on quantity needed, preparation of reagents based on anticipated usage and reagent stability). Employees must abide by the policies in Section 13 of the Corporate Safety Manual for "Waste Management and Pollution Prevention."

14.0 Waste Management

Waste management practices are conducted consistent with all applicable rules and regulations. Excess reagents, samples and method process wastes are disposed of in an accepted manner. Waste description rules and land disposal restrictions are followed. Waste disposal procedures are incorporated by reference to BR-EH-001 *Hazardous Waste*.

The following waste streams are produced when this method is carried out:

- None

15.0 References / Cross-References

- Method RSK-175, Revision 0, August 1994.

16.0 Method Modifications

Laboratory uses a procedural calibration and quantification of samples versus a calculation based on Henrys Law. The procedural calibration involves the preparation and analysis of calibration points using lab water spiked with the dissolved gases and analyzed using the same process used for field samples. The initial calibration utilizes a maximum %RSD criteria as opposed to a linear regression correlation coefficient similar to options provided in other environmental methodologies. The laboratory uses a CCV criteria of 30%D versus 20%D as detailed in the guidance Method. The procedural calibration also addresses the differences between the guidance method and the laboratories automated process used for the heating and shaking the samples. Calibration standards, QC samples, blanks, and field samples are all processed the same way. All samples are analyzed by an automated process that heats and hold each sample at a constant temperature prior to analysis eliminating the need to verify sample temperature every 4 hours. The laboratory SOP provides for a closing CCV at the end of each 24 hour analytical sequence demonstrating system control.

17.0 Attachments

- Table 1: QC Summary and Recommended Corrective Action
- Appendix A: Terms and Definitions
- Appendix B: Equations
- Appendix C: DOD QSM 5.0 Quality Control Requirements
- Table 2: DOD QSM LCS and MS/MSD Limits

18.0 Revision History

BR-AT-006, Revision 15:
- Title Page: Updated approval signatures and copyright date.

- Section 10.2: Added 6th calibration point.
- Section 10.4: Added requirement to wait at least 6 minutes between CO2 injections to allow for full elution.

BR-AT-006, Revision 13.2:
- Section 10.3: Paragraph 2, Added placing samples on wrist shaker for 5 minutes.

BR-AT-006, Revision 13.1:
- Section 6.2: Added Thermo Scientific Precision Heated Water Bath
- Section 7.2: Updated Carbon dioxide working standard preparation.
- Section 10.4 Added procedure for warming standards, samples and method blanks for carbon dioxide analysis using heated water bath.
- Updated throughout the change from a 44 mL VOA vials to 42 mL VOA vials.
- Added Appendix C: DOD QSM 5.0 Quality Control Requirements
- Added Table 2: DOD QSM 5.0 LCS and MS/MSD Limits

BR-AT-006, Revision 13:
- Title Page: Updated approval signatures and copyright date
- Section 5.2: Updated Material Safety Data Sheet (MSDS) to Safety Data Sheet (SDS)
- Section 11.4: Clarified data review procedure, content and responsibility.

Table 1: QC Summary and Recommended Corrective Action (EPA RSK-175)

[1]*The recommended corrective action may include some or all of the items listed in this column. The corrective action taken may be dependent on project data quality objectives and/or analyst judgment but must be sufficient to ensure that results will be valid. If corrective action is not taken or is not successful, data must be flagged with appropriate qualifiers*

QC Item	Frequency	Acceptance Criteria	Recommended Corrective Action[1]
ICAL	Before sample analysis, when CCVs indicate calibration is no longer valid, after major instrument maintenance	CF:RSD <30%	Correct problem, reanalyze, repeat calibration.
ICV	After each initial calibration	%R (70-130)	Correct problem and verify second source standard. If that fails, repeat initial calibration.
CCV	Every 24 hours and at the end of the sequence	%D ± 30%	Re-analyze once, if still outside criteria perform corrective action, sequence can be re-started if two successive CCVs pass, otherwise repeat ICAL and all associated samples since last successful CCV, unless CCV is high and bracketed samples are nondetects
MB	Every 20 samples	<RL	Examine project DQO's and take appropriate corrective action, which may include re-analysis of MB, re-extraction of batch, and/or non-conformance memo (NCM). Corrective action must be documented on NCM. If there are no detects in samples, or if all detects are > 10 X MB level, re-prep and reanalysis may not be required
LCS	Every 20 samples	%R (70-130)	Examine project DQO's and take appropriate corrective action, which may include re-analysis of LCS, re-extraction of batch, and/or non-conformance memo (NCM). Corrective action must be documented on NCR. Flag all reported values outside of control limits.
SD	SD per client request	RPD < 30	Examine project DQO's and take appropriate corrective action, which may include re-analysis of LCS, re-extraction of batch, and/or non-conformance memo (NCM). Corrective action must be documented on NCM. Flag all reported values outside of control limits.

Appendix A: Terms & Definitions

Acceptance Criteria: specified limits placed on characteristics of an item, process or service defined in requirement documents.

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

Analyte: The specific chemicals or components for which a sample is analyzed. (EPA Risk Assessment Guide for Superfund, OSHA Glossary).

Batch: environmental samples, which are prepared and/or analyzed together with the same process, using the same lot(s) of reagents. A preparation/digestion batch is composed of one to 20 environmental samples of similar matrix, meeting the above criteria.

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material and the corresponding values realized by the standards.

Calibration Curve: the graphical relationship between the known values or a series of calibration standards and their instrument response.

Calibration Standard: A substance or reference used to calibrate an instrument.

Continuing Calibration Verification (CCV): a single or multi-parameter calibration standard used to verify the stability of the method over time. Usually from the same source as the calibration curve.

Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable occurrence in order to prevent recurrence.

Data Qualifier: a letter designation or symbol appended to an analytical result used to convey information to the data user. (Laboratory)

Demonstration of Capability (DOC): procedure to establish the ability to generate acceptable accuracy and precision.

Holding Time: the maximum time that a sample may be held before preparation and/or analysis as promulgated by regulation or as specified in a test method.

Initial Calibration: Analysis of analytical standards for a series of different specified concentrations used to define the quantitative response, linearity and dynamic range of the instrument to target analytes.

Intermediate Standard: A solution made from one or more stock standards at a concentration between the stock and working standard. Intermediate standards may be certified stock standard solutions purchased from a vendor and are also known as secondary standards.

Laboratory Control Sample (LCS): a blank matrix spiked with a known amount of analyte(s) processed simultaneously with and under the same conditions as samples through all steps of the procedure.

Matrix Spike: A field sample to which a known amount of target analyte(s) is added.

Matrix Spike Duplicate: A second replicate matrix spike.

Method Blank (MB): a blank matrix processed simultaneously with and under the same conditions as samples through all steps of the procedure. Also known as the preparation blank (PB).

Method Detection Limit (MDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific measurement system. The MDL is a statistical estimation at a specified confidence interval of the concentration at which relative uncertainty is ±100%. The MDL represents a range where qualitative detection occurs. Quantitative results are not produced in this range.

Non-conformance: an indication, judgment, or state of not having met the requirements of the relevant specification, contract or regulation.

Precision: The degree to which a set of observations or measurement of the same property, obtained under similar conditions, conform to themselves.

Preservation: Refrigeration and/or reagents added at the time of sample collection to maintain the chemical, physical, and/or biological integrity of the sample.

Quality Control Sample (QC): a sample used to assess the performance of all or a portion of the measurement system.

Reporting Limit (RL): the level to which data is reported for a specific test method and/or sample. The RL must be minimally at or above the MDL.

Appendix B: Equations

Percent Recovery (%R):

$$\%R = \frac{Cs}{Cn} \times 100$$

Where:
Cs = Concentration of the Spiked Field or QC sample
Cn = Nominal Concentration of Spike Added

Percent Recovery for MS/MSD (%R):

$$\%R = \frac{Cs - Cu}{Cn} \times 100$$

Where:
Cs = Concentration of the Spiked Sample
Cu = Concentration of the Unspiked Sample
Cn = Nominal Concentration of Spike Added

Relative Percent Difference (RPD):

$$RPD = \frac{C_1 - C_2}{\left(\frac{C_1 + C_2}{2}\right)} \times 100$$

Where:
C_1 = Measured Concentration of First Sample
C_2 = Measured Concentration of Second Sample

Calibration factor (CF):

$$CF_\chi = \frac{A_\chi}{C_\chi}$$

Where:

CF_χ = Calibration factor for analyte χ

A_χ = Peak area of analyte χ

C_χ = Concentration of analyte in standard

Mean Calibration Factor

$$\overline{CF} = \frac{\sum_{i=1}^{n} CF_i}{n}$$

Where: n= number of calibration levels

Standard Deviation of the Calibration Factor

$$SD = \sqrt{\frac{\sum_{i=1}^{n}\left(CF_i - \overline{CF}\right)^2}{n-1}}$$

Relative Standard Deviation of the Calibration Factor (%RSD)

$$\%RSD = \frac{SD}{\overline{CF}} \times 100$$

Percent Difference (CCV)

$$\%D = \frac{CF_V - \overline{CF}}{\overline{CF}} \times 100$$

Where: CF_v = Calibration Factor from the CCV

Sample Concentration

$$\text{Concentration} = \frac{A_X}{CF_{AV}} \times DF$$

Where:
A_X = Peak area of analyte
CF_{av} = Mean calibration factor

Appendix C: DOD QSM 5.0 Quality Control Requirements

QC Item	Frequency	Acceptance Criteria	Recommended Corrective Action
ICAL	Before sample analysis, when ICV or CCVs indicate calibration is no longer valid, after major instrument maintenance	CF:RSD <20% Linear regression: r2 < 0.99	Correct problem, reanalyze, repeat calibration.
Retention Time Window establishment	Once per ICAL and at the beginning of the analytical sequence.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA
Retention Time (RT) window width	At method set-up and after major maintenance (e.g., column change).	RT width is ± 3 times standard deviation for each analyte RT from the 72-hour study.	NA.
ICV	After each initial calibration and prior to sample analysis.	All reported analytes within established RT windows. %R (80-120)	Correct problem and verify second source standard. If that fails, repeat initial calibration.
CCV	Before sample analysis, after every 10 field samples, and at the end of the analytical sequence.	All reported analytes within established RT windows %D ± 20%	Immediately analyze two successive CCVs if both pass report samples without reanalysis, otherwise repeat ICAL and all associated samples since last successful CCV.
MB	Once per preparatory batch.	No analytes detected > ½ LOQ or > 1/10 the regulatory limit, whichever is greater.	Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank
LCS	Once per preparatory batch.	See Table 2, unless project limits are specified. If the analyte(s) are not listed, use in-house LCS limits.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.
Matrix Spike (MS)	One per preparatory batch.	See Table 2, unless project limits are specified. If the analyte(s) are not listed, use in-house LCS limits.	Examine the project specific requirements. Contact the client as to additional measures are to be taken.
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	One per preparatory batch.	See Table 2, unless project limits are specified. If the analyte(s) are not listed, use in-house LCS limits. RPD < 30 (between MS and MSD or sample and MD)	Examine the project specific requirements. Contact the client as to additional measures are to be taken.

Table 2: DOD QSM LCS and MS/MSD Limits

Analytes	CAS #	Lower Limit	Upper Limit	Units
Methane	74-82-8	73	125	%
Ethane	74-84-0	74	131	%
Ethylene	74-85-1	72	133	%

Appendix B

Data Management Plan

US Army Corps of Engineers

Data Management Plan

Watervliet Arsenal Installation Restoration Program Watervliet, New York

July 2016

Contract No.: W912DR-12-D-0007
Delivery Order No.: 0007

Prepared For:

U.S. ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT
10 South Howard Street
Baltimore, Maryland 21201-2536

Prepared By:

PIKA-MP JV LLC
12723 Capricorn Drive, Suite 500
Stafford, Texas 77477

Larry Jordan, PG
JV Program Manager

Andy Vitolins, PG
JV Project Manager

Data Management Plan

Installation Restoration Program
Watervliet, New York

Prepared for:

US Army Corps of Engineers
Contract No. W912DR-12-D-0007
Delivery Order 0007

Prepared by:

PIKA - MP JV LLC
12723 Capricorn Drive, Suite 500
Stafford, Texas 77477

Our Ref.:

06261067.0000

Date:

July 2016

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Tables

1. Introduction

The PIKA - MP JV, LLC[1] (hereinafter referred to as the JV) prepared this Data Management Plan (DMP) to document the roles, responsibilities, and procedures for data management, quality, and sharing for the Installation Restoration Program (IRP) at the Watervliet Arsenal, Watervliet, New York (the installation). The data management requirements are detailed in the performance work statement (PWS) from the United States (US) Army Corps of Engineers (USACE) Baltimore District, and all amendments and question and answer sets under the Multiple Award Environmental Services (MAES) contract, Award No. W912DR-12-D-0007, Delivery Order 0007. Work under this task order will be conducted pursuant to the approval of, and coordination with, the New York State Department of Environmental Conservation (NYSDEC) and United States Environmental Protection Agency (USEPA) Region 2 under a USEPA Administrative Order on Consent (Docket No. II RCRA-3008(h)-93-0210).

This Plan is supplemented by the Quality Assurance Project Plan (QAPP), which is being submitted concurrently to the USACE and NYSDEC as part of the IRP Work Plan. The QAPP contains both field and laboratory standard operating procedures (SOPs). The IRP Work Plan details the groundwater monitoring, well gauging, and soil vapor monitoring activities at the Site.

1.1 Project Background

On behalf of the USACE, the JV has responsibility for project execution (site remediation and/or assessment activities) at the sites included in the PWS. These sites are listed below.

[1] The PIKA-MP JV LLC Joint Venture is comprised of PIKA International, Inc. and its mentor ARCADIS-U.S. Inc.

Site	Scope
Siberia Area (WVAA-25)	Conduct annual groundwater sampling and analyses in accordance with the IRP Work Plan
Main Manufacturing Area (WVAA-32)	Conduct annual groundwater sampling and analyses in accordance with the latest revision of the IRP Work Plan
Main Manufacturing Area (WVAA-32)	Conduct Vapor Intrusion (VI) monitoring and operations in accordance with the IRP Work Plan

1.2 Data Management Objectives

This DMP documents the JV's data management program, which has been designed to meet the following objectives:

- Maintain data control, consistency, reliability, and reproducibility throughout the life of the project;
- Establish the process for consistent documentation of the quality and validity of field and laboratory data collected during the site investigations;
- Define specific roles and responsibilities for data management and project personnel;
- Define procedures for maintaining the quality of the data throughout the life cycle of the project;
- Manage data electronically, where feasible, to reduce the potential for errors and inaccuracies during the data transfer process; and
- Enable efficient sharing of information among stakeholders.

1.3 Data Management Roles and Responsibilities

The team members associated with the management of data and information collected during these activities are listed in Table 1.

2. Overall Data Flow Process

Based on the types of information that will be managed for Watervliet Arsenal, data flow processes have been developed. The JV project team will be responsible for maintaining accurate and complete data in the prescribed locations. General guidelines for the management of data flow are provided in the following sections.

2.1 Sample Identification Nomenclature

All samples will be identified using the naming convention defined in the QAPP (IRP Work Plan Appendix A).

2.2 Routine Reporting Schedule

As described in the IRP Work Plan, an annual Data Summary Report will be prepared and submitted to Watervliet Arsenal, USACE, and the NYSDEC. The JV will prepare an annual Data Summary Report and submit the report for review to the USACE - Baltimore District, Watervliet Arsenal, and the NYSDEC. The purpose of this report will be to present the field observations from that year's sampling event, figures and tables summarizing analytical results, operations and maintenance activities, and recommendations for any changes to the operation of SSDSs.

The JV team will use Access™ and Arc GIS for the management and presentation of data. Laboratory data will be delivered to the JV in the NYSDEC EQuIS format, which will facilitate the uploading of data into the NYSDEC's EQuIS™ database.

3. Data Warehousing

Analytical and other data will need to be warehoused for use by the project teams for reporting and data quality assessment tasks. A Microsoft Access™ database will store legacy and new analytical data.

JV data management staff will be able to access the database and perform data loading and reporting tasks. Other JV project team members can request access for querying and table generation, or request these from the data manager. The database tasks will be managed consistent with the roles and responsibilities outlined in Table 1.

Additional data and documents will reside on the server of the JV office in Clifton Park, New York. These data include:

- Field notes
- Boring logs
- Geophysical data
- Sampling logs
- Chain-of-custody records
- Airbills
- Equipment calibration logs,
- Field instrument maintenance logs
- Lab reports
- Data validation reports

A Watervliet Arsenal team web portal, using Microsoft SharePoint, has been established for collaboration on key documents and for document transfer between the JV and the USACE/Watervliet. SharePoint will include:

- All final reports and work plans
- Other information as requested by USACE and Watervliet Arsenal.

This Microsoft SharePoint site for the Watervliet Arsenal IRP is hosted and managed by the JV. Team members representing the JV, Watervliet Arsenal, and the US Army Corps of Engineers project managers currently have access to this web portal. New users can be provided access, when approved.

New data will be submitted to the to NYSDEC as described above in section 2.2.

4. Data Sources and Management

The WVA Access database has been in use for the IRP for many years, already includes the historical data, and is ready to accept new data.

The variety of data sources applicable to these investigations are discussed in the following sections. Some data sources require manual entry of data into an electronic format and /or analysis of the data by the project team. In all cases, manually-entered or analyzed data will be verified for accuracy by a person other than the one responsible for entering the data or conducting the analyses. The project manager shall be responsible for checking and approving the final presentation of reported data so that project-specific requirements are met.

4.2 Data Sources

4.2.1 Legacy data

Legacy analytical data for this project are housed in an Access database, on the project server in the Clifton Park, New York JV office.

4.2.2 New Analytical Data

Katahdin Analytical Laboratory and Eurofins Air Toxics will submit analytical results generated from the analysis of the groundwater and air samples collected during site investigations. Groundwater analytical data will be transmitted as both a lab report and a custom EDD to facilitate upload to the Access database.

4.2.3 Field Measurements

Field measurements include groundwater gauging, NAPL, and field parameter data to be collected during groundwater monitoring activities. Groundwater gauging and NAPL measurements will be reported on applicable field forms presented in Table 2. Field sample collection information and field parameters will be reported on applicable field forms presented in Table 3.

Field information will also include the parent sample for blind field duplicates, which is required for NYSDEC EQuIS™ entry.

The Data Manager will ensure that the gauging, NAPL, and field parameter data are properly archived to the file share of the JV office in Clifton Park, New York.

4.3 Other data sources

4.3.1 Historical and Ongoing Documentation

Historical and ongoing documentation will reside on the file share of the JV office in Clifton Park, New York. These data include:

- Field notes
- Boring logs
- Geophysical data
- Sampling logs
- Chain-of-custody records
- Airbills
- Equipment calibration logs,
- Field instrument maintenance logs
- Lab reports
- Data validation reports

Mission critical project documents, such as investigation reports and other documents, will also be uploaded to the file share of the JV office in Clifton Park, New York.

5. Data Validation and Usability

As described in the QAPP, only data review will be conducted for this project in accordance with the protocols defined in the QAPP. Once all data review is completed and data usability has been determined, the Data Manager will load the final analytical data into the Access™ database.

Tables

Table 1 – Data Management Roles and Responsibilities

Role	Company/Organization	Name	Responsibilities	E-Mail	Phone Number
Database Manager	PIKA-MP JV LLC	Danielle Giroux	Load EDDs to database; download/upload validated data; upload final data to EQuIS database ; generate final summary tables	Danielle.Giroux@arcadis-us.com	518.250.7327
NYSDEC Database Submissions	PIKA-MP JV LLC	Danielle Giroux	Create and submit EDDs in required NYSDEC format from the ARCADIS EQuIS database	Danielle.Giroux@arcadis-us.com	518.250.7327
GIS Coordinator	PIKA-MP JV LLC	Stephanie Sutton	Manage GIS team; QA/QC	stephanie.sutton@arcadis-us.com	803-431-6403
Primary Analytical Laboratory Contacts	Katahdin Analytical Services 600 Technology Way Scarborough, ME 04074	Jennifer Obrin	Analyze samples and provide EFWEDD and lab report to project team, data manager and data validator *Groundwater samples for VOCs, RCRA Metals, Chromium, Methane, Ethane, Ethene, DOC, Dissolved Sulfide, Dissolved Carbon Dioxide*	jobrin@katahdinlab.com	717.944.5541
	Eurofins Air Toxics, Inc. 180 Blue Ravine Rd, Suite B Folsom, CA 95630	Ausha Scott	Analyze samples and provide EFWEDD and lab report to project team, data manager and data validator *Air samples for VOCs*	AushaScott@eurofinsUS.com	916.985.1000

Table 2 - Example Groundwater and NAPL Data Entry Template

WELL	DATE	TIME	DEPTH TO WATER	DEPTH TO PRODUCT	PRODUCT THICKNESS	REMARKS
			feet	feet	feet	(well not accessible, sheen, etc.)

Table 3 - Example Field Parameter Data Entry Template

WELL	DATE	TIME	Start Depth	End Depth	Matrix	Sample ID	Field Duplicate Sample ID	Temperature	pH	ORP	Specific Conductance	Turbidity	DO	Fe2+
			ft	ft	(use list)	(updates by formula)	(for each Dup collected)	C	su	mV	uS/cm	ntu	mg/L	mg/L

Appendix C

Accident Prevention Plan and
Site Safety and Health Plan

US Army Corps of Engineers

Accident Prevention Plan

Watervliet Arsenal Installation Restoration Program Watervliet, New York

July 2016

Contract No.: W912DR-12-D-0007
Delivery Order No.: 0007

Prepared For:

U.S. ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT
10 South Howard Street
Baltimore, Maryland 21201-2536

Prepared By:

PIKA-MP JV LLC
12723 Capricorn Drive, Suite 500
Stafford, Texas 77477

Accident Prevention Plan

Watervliet Arsenal Installation Restoration Program
Watervliet, New York

Larry Jordan, PG
JV Program Manager

Andy Vitolins, PG
JV Project Manager

Prepared for:

US Army Corps of Engineers
Contract No. W912DR-12-D-0007
Delivery Order 0007

Prepared by:

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Our Ref.:

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Date:

July 2016

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Tables

Attachments

List of Acronyms and Abbreviations

Acronym	Definition
°F	degrees Fahrenheit
%	Percent
ACGIH	American Conference of Governmental Industrial Hygienists
AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
PIKA-MP JV	PIKA-MP JV, LLC
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CPR	cardiopulmonary resuscitation
CSP	Certified Safety Professional
EAS	Emergency Alert System
EM	Engineer Manual
H&S	Health and Safety
HAZWOPER	Hazardous Waste Operations and Emergency Response
HBV	Hepatitis B Virus
HSP	Health and Safety Procedures
HTRW	Hazardous, Toxic, and Radioactive Waste
IRP	Installation Restoration Program
L	Liter
LTM	Long Term Management
MAES	Multiple Award Environmental Services
MEC	Munitions and Explosives of Concern
MMA	Main Manufacturing Area
NYSDEC	New York State Department of Environmental Conservation
O&M	Operations and Maintenance
OSHA	Occupational Safety and Health Administration
PDB	Passive Diffusion Bag
PHSM	Project Health and Safety Manager
PM	Project Manager
PPE	Personal Protective Equipment
QA	Quality Assurance

List of Acronyms and Abbreviations

Acronym	Definition
QC	Quality Control
SDS	Safety Data Sheet
SSDS	Sub-Slab Depressurization System
SSHASP	Site-Specific Health and Safety Plan
SSHO	Site Safety Health Officer
TBD	To Be Determined
TRACK	Think, Recognize, Assess, Control the hazards, Keep H&S first
U.S.	United States
USACE	United States Army Corps of Engineers
VI	Vapor Intrusion
WBGT	Wet Bulb Globe Temperature
WVA	Watervliet Arsenal

INTRODUCTION

This Accident Prevention Plan (APP) has been prepared in accordance with:

- United States (U.S.) Army Corps of Engineers (USACE) Engineer Manual (EM) 385-1-1, Safety and Health Requirements Manual, 30 November 2014.

- Occupational Safety and Health Administration (OSHA) standards (including 29 Code of Federal Regulations [CFR] 1910 and 29 CFR 1926).

- US Army Regulation 385-10, The Army Safety Program, 27 December 2013

The contents of the APP are subject to review and revision as new information becomes available.

This APP establishes procedures to protect site personnel from potential health and safety hazards that may occur during the site field activities. This plan is not valid unless it is signed and dated by the Project Manager (PM) and authorized Health & Safety (H&S) staff. If additional activities are needed beyond those described in this document, an addendum to this document will be issued.

Watervliet Arsenal Installation Restoration Program
Accident Prevention Plan (APP)

Contract Number: W912DR-12-D-0007

a. Plan preparer (Qualified Person, Competent Person, such as corporate safety staff person, Quality Control [QC]). This APP has been prepared by a qualified, Competent Person, in Health and Safety as a Certified Industrial Hygienist (CIH) and Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals. Demonstration of competency is included in Attachment 3.

Grey Coppi, CIH, CSP, Designated H&S Plan Preparer
(908)-917-6948

b. Plan approved, by company/corporate officer authorized to obligate the company's, Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, PM or superintendent, project safety professional, project QC. This APP, has been prepared under the supervision of, and has been reviewed and approved by a qualified, Competent Person, in Health and Safety as a Certified Industrial Hygienist (CIH).

Sarosh Manekshaw, CIH, Designated H&S Plan Reviewer
(713) 412-9948

c. Plan concurrence (e.g., Chief of Operations, Corporate Chief of Safety, Corporate Industrial Hygienist, PM or superintendent, project safety professional, project QC).

Andrew Vitolins, PG, Project Manager
(518) 250-7359

2. Background Information

a. Contractor

The PIKA - MP JV, LLC[1] (hereinafter referred to as the JV) has been retained by the U.S. Army Corps of Engineers, Baltimore District.

b. Contract Number

This APP has been prepared by the JV under the Multiple Award Environmental Services (MAES) contract, Award No. W912DR-12-D-0007, Delivery Order 0007.

c. Project Name

The project is entitled:

Watervliet Arsenal Installation Restoration Program
Watervliet, New York

d. Project Description

2.d.1 Purpose

The purpose of this APP is to document the H&S risks associated with the planned site operations. All site operations will be performed in accordance with the latest version of the following applicable regulations: federal, state and local regulations and procedures; 29 CFR 1910.120 Occupational Safety and Health Standards; Army Regulation 385-10; USACE EM 385-1-1; and JV corporate safety programs.

[1] The PIKA-MP JV LLC Joint Venture is comprised of PIKA International, Inc. and its mentor ARCADIS-U.S. Inc.

2.d.2 Site Background

The WVA encompasses approximately 140 acres in, and around, the City of Watervliet, New York, approximately 3.5 miles northeast of the City of Albany (Figure 2-1). To the east of the WVA, Broadway Street and a six-lane interstate highway (I-787) separate the WVA from the Hudson River. To the west, the WVA extends beyond the limits of the City of Watervliet into the Town of Colonie. Residential areas border the WVA to the north and south. The WVA consists of two primary areas, the Main Manufacturing Area (MMA) and the Siberia Area (Figure 2-2). The MMA is approximately 125 acres in size and is where manufacturing and administrative operations occur. The Siberia Area is chiefly used for the storage of raw and hazardous materials and comprises about 15 acres. These areas are shown on Figure 1-2.

e. Location of Project

The project sites are scattered within the MMA, bounded by 10th Street, Parker Road, 8th Street, Broadway, and 13th Street (Figure 2-3), and along Watervliet Arsenal Road in the Siberia Area (Figure 2-4) in Watervliet, NY.

f. Phases of Work

The objective of this project is to conduct groundwater corrective measures performance monitoring and reporting in the Siberia Area and the MMA; operate and monitor the vapor intrusion (VI) mitigation systems at the MMA; and, potentially, the abandonment of monitoring wells that are no longer included in the monitoring program. A summary of activities that will be completed in order to meet the project's objectives are as follows:

- Preparation of this Plan
- Preparation of a comprehensive Work Plan
- Siberia Area (WVAA-25) Groundwater Corrective Measures Performance Monitoring and Reporting:
    - Annual low-flow and passive diffusion bags (PDB) groundwater sampling
    - Monitoring well inspection and maintenance
    - Annual reporting
    - Attend annual progress meeting

- MMA (WVAA-32) Groundwater Corrective Measures Performance Monitoring and Reporting:
    - Annual low-flow and PDB groundwater sampling
    - Monitoring well inspection and maintenance
    - Annual reporting
    - Attend annual progress meeting

- MMA (WVAA-32) Vapor Intrusion Monitoring, Systems Operation, and Reporting:
    - Monthly systems checks, including measurement of vacuum pressures, optimization of flow rates and number of extraction points, system balancing, and required maintenance
    - Effluent sampling for sub-slab depressurization systems (SSDSs) equipped with off-gas treatment with up to four sampling events per year

  - o Minor system repairs
  - o Annual indoor air sampling to assess mitigation system performance at meeting the corrective action objectives
  - o Annual reporting

- Well Abandonment
  - o Backfill appropriate wells with cement bentonite grout and remove surface completion

An Activity Hazard Analysis (AHA) has been prepared for each of the following activities and included with the SSHASP in Attachment 2:

- General Site Work
- Groundwater Sampling
- Indoor Air Sampling
- Remediation System O&M
- Well Repairs/Decommissioning

g. Contractor Safety Information

Table 2-1 below outlines the ARCADIS-US accident and safety record. The experience modification rate is less than 1.0, which is indicative of fewer injuries and claims. Lessons learned from past accident experience will be distributed internally and utilized on future projects.

Table 2-1: Accident and Safety Record (ARCADIS-US, Inc.)

Year	Total Recordable Incidence Rate	Days Away and Restricted Time Incident Rate	Lost Time Incident Rate	Occupational Safety and Health Administration (OSHA) Recordable	Experience Modification Rate
2009	0.49	0.17	0.17	17	0.73
2010	0.55	0.14	0.14	19	0.62
2011	0.48	0.12	0.12	25	0.83
2012	0.38	0.16	0.10	19	0.71
2013	0.43	0.08	0.06	21	0.66
2014	0.37	0.11	0.09	17	0.65
2015	0.33	0.13	0.11	15	0.61

Copies of OSHA Form 300A for the above referenced years are available upon request.

3. Statement of Safety and Health Policy

a. Policy

3.a.1 Health and Safety Vision

Through alignment of H&S with our other core values of Integrity, Entrepreneurship, and Agility; the JV is committed to being one of the safest and most healthful partnerships in our industry. Our commitment to prevent injuries and illnesses benefits our employees, clients, partners and all other stakeholders as we strive for zero incidents in everything we do.

3.a.2 JV Global Health and Safety Policy

The JV is committed to achieving this vision at all levels of the company and in all that we do by:

- Proactively assessing and controlling risks
- Complying with H&S requirements
- Promoting a positive H&S culture
- Demonstrating visible H&S leadership
- Assigning H&S responsibility and holding all accountable
- Including H&S in performance evaluations
- Assuring necessary H&S competencies
- Setting and reporting on achievable H&S objectives
- Regularly evaluating H&S programs to achieve zero incidents
- Working with partners that align with our H&S policy
- Assigning appropriate H&S training

- Sharing lessons learned and best practices.

b. Scope

The policy and associated procedures apply to all operations and activities conducted by the JV in all locations including all project sites.

4. Responsibilities and Lines of Authority

a. Responsibility

The JV management team is committed to providing employees with a safe and healthy work environment. The managers are responsible for implementing and fostering a positive and proactive regard for company H&S programs and policies. Employees are responsible for complying with company H&S policies and programs to ensure their own safety as well as the safety of their co-workers.

b. Corporate and Project Personnel

4.b.1 Corporate Personnel

JV Senior Leadership is responsible for the implementation of this APP. Within the JV, Senior leaders are responsible for stewarding H&S and developing a culture that allows the company to achieve its H&S vision and operate within the H&S Policy and H&S Procedures (HSP).

PMs are responsible for incorporating H&S into the project and project planning process. PMs are also responsible for knowing and following all applicable JV and client H&S requirements and for ensuring work is conducted in accordance with these requirements.

PM responsibilities also include:

- Communicating with and appropriately managing subcontractors;
- Verifying that employees have appropriate training and qualifications;
- Involving the appropriate JV H&S technical staff and project client staff, as necessary; and,
- Ensuring that all subcontractors have been communicated with concerning the minimum H&S requirements for the project.

Project H&S staff are responsible for facilitating the policy and procedure requirements in this HSP and for providing "hands-on" assistance to JV staff to ensure this procedure is implemented appropriately.

Managers and Supervisors have the responsibility to provide oversight management for the H&S of employees in their respective operations. Each will assure that appropriate time is provided to facilitate the implementation of the HSP. In addition, the managers and supervisors will assign appropriate training and involve themselves in any "Stop Work" issued by an employee as appropriate to assist in resolving the employee's concerns.

JV employees have the responsibility to adhere to the HSP and associated H&S plans, complete assigned training in a timely manner, ensure training certificates are up-to-date and on file, along with other requirements. They also are responsible for communicating H&S concerns, issues, and questions to their supervisor or H&S staff. In addition, all employees have the responsibility to:

- Use the Think, Recognize, Assess, Control the hazards, Keep H&S first (TRACK) process prior to any activity;
- Follow all JV and client requirements;
- Understand and appropriately utilize the "Stop Work Authority" concept;
- Complete and adhere to site-specific safety training; and
- Apply for and maintain valid Safety Permits for all site activities

4.b.2 Project Personnel

Project personnel who play a vital role in the project safety and health program are described in Table 4-1:

Table 4-1: Project Team H&S Responsibilities	
JV Project Team	**Responsibility and Tasks**
Andy Vitolins *PM*	• Ensure the best resources are applied to this project, • Ensure quality plans are implemented, • Ensure contractual requirements are met and issues are resolved quickly. • Ultimately responsible for implementing the APP for the project under their control, and for ensuring that subcontractors, suppliers and support personnel comply with all applicable H&S requirements as specified in their own approved plans. Specifically responsible with regard to the safe execution of the project and adherence to the APP; • Responsibilities include communicating with the Investigation Manager to monitor the implementation of the APP (as described below); • Safety reporting on the project includes exposure hours, incidents including near misses and recordable safety incidents.
Field Team Leader (will change based on task) *SSHO-all site work* *Alternates, if necessary, will be provided in site-specific addendums.*	• Reviews and works in accordance with the components of this APP; • Ensures that the Site Specific Health and Safety Plan (SSHASP) and this APP are available to and reviewed by all site personnel including subcontractors; • Ensures that necessary site-specific training is performed (both initial and "tailgate" safety briefings); • Ensures site visitors have been informed of the hazards related to PIKA-MP JV work, and have signed the Site Visitors Log; • Ensures that work is performed in a safe manner and has authority to stop work when necessary to protect workers and/or the public; • Coordinates activities during emergency situations; • Ensures that all necessary permits and safety information provided by the client is disseminated to other site personnel and is maintained in an organized manner; • Communicates with the PM, Client H&S Resource and/or the PHSM on H&S issues; • Reports all injuries, illnesses and near-misses to the PM, Client H&S Resource and PHSM; • Conducts and documents daily safety and occupational health inspections; • Ensures that necessary safety equipment is maintained and used at the site; • Ensures all H&S certificates are valid and maintained in an onsite file; • Coordinates access to sampling sites and Enclosures; and • Notifies Project Team of daily activities via e-mail

Table 4-1: Project Team H&S Responsibilities	
JV Project Team	**Responsibility and Tasks**
TBD *Site Workers* *Resumes and certifications will be provided in a site-specific memorandum*	• Reads and works in accordance with the components of the SSHASP and this APP; • Provide consultation and coordination for any anomaly encountered • Ensure all ordnance hazards are identified and controlled • Reports all unsafe working conditions to the SSHO; • Reports all injuries, no matter how minor, to the SSHO; • Works in a safe manner
Grey Coppi, CIH, CSP *PHSM*	The PHSM oversees all aspects of the site safety program, and prepares site-specific H&S guidance documents or addenda to this plan. The PHSM does not report to the PM, and is separately accountable to the PIKA-MP JV project team for site H&S. The PHSM acts as the primary contact to regulatory agencies on matters of H&S. Other responsibilities include: • Overall authority for H&S compliance and conformance with the SSHASP and this APP for the project; • General H&S program administration; • Conducts project H&S audits as warranted; • Determines the level of personal protection required; • Updates equipment or procedures based on information obtained during site operations; • Establishes air-monitoring parameters based on expected contaminants; and • Assists in injury, illness and near-miss investigations, and follow-up.

c. Competent/qualified personnel

The field team leader, which will change based on the task, will be the designated SSHO for the tasks at Watervliet Arsenal. In accordance with EM 385-1-1, the JV shall employ a minimum of one Competent Person at each project site to function as the SSHO, depending on job complexity, size and any other pertinent factors. The designated SSHO will have completed the OSHA 29 CFR 1910.120 40 hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training, 8-hour HAZWOPER refresher training, 8-hour Site Supervisor Training, and have current first aid/ cardiopulmonary resuscitation (CPR) certifications. The SSHO shall have a minimum one year of experience implementing safety and occupational health procedures at cleanup operations. The SSHO shall act as the Competent Person.

Grey Coppi will serve as the PHSM and will review and accept all qualifications of field personnel prior to commencing the field phases of work. Resumes are provided in Attachment 3: Resumes and Certifications.

The duties of the competent/qualified personnel for all project tasks are presented in Table 4-1.

d. Work Requirements

None of the tasks presented in Section 2.d will be performed unless an appropriate competent and/or qualified person, as designated in Section 4.c, is present on site. Safety permits, if applicable, will be obtained from the Installation Safety Office prior to the commencement of field activities.

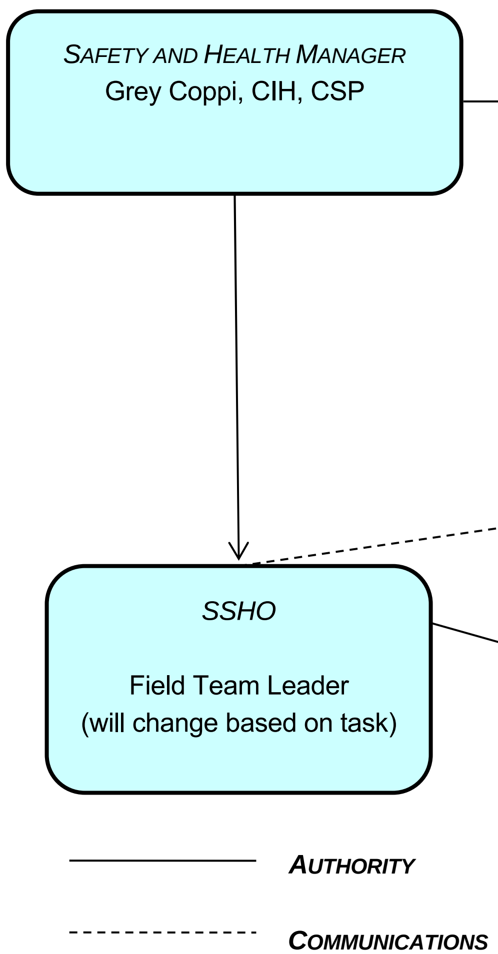
e. Pre-task safety and health analysis

AHAs have been developed to identify safety concerns. AHAs are provided with the SSHASP in Attachment 2. The SSHO will conduct daily tail gate meetings prior to starting work. Additionally, both safety and occupational health inspections will be conducted daily by the JV SSHO. As described in Section 7.a, these daily inspections will include the inspection of Personal Protective Equipment (PPE), site conditions, equipment, and/or other potential hazards applicable to the tasks planned for each day.

f. Lines of Authority

The project team is presented in Section 4.a and Table 4-1 of this APP and the lines of authority are presented on Figure 4-1 below.

Figure 4-1: Project Lines of Authority



g. Policy and procedures for non-compliance safety requirements

At a minimum, the JV will provide a verbal warning for first non-compliance of safety requirements, a written warning for the second non-compliance, and the field personnel will be removed from the Site for a third non-compliance of safety requirements. Non-compliance of safety requirements that could have caused a serious incident or injury will result in removal from the Site.

Employees must report all accidents, injuries, and unsafe conditions to their manager. No such report will result in any retaliation, penalty, or other disincentive. Management will take disciplinary action against any employee who willfully or repeatedly violates office safety rules, or who does not report unsafe conditions. This action may include written reprimands up to and including termination. Compliance with the H&S program is required of all employees as a condition of employment.

Employees are encouraged to call the Corporate H&S Department if they have any questions, comments, or suggestions on company H&S policies and programs.

h. Company accountability procedure

PMs have the responsibility and are accountable for incorporating H&S into the project and project planning process per the JV Project Management program. PMs also have the responsibility and are accountable for knowing and following all applicable JV and client H&S requirements to ensure work is conducted under the policy stated in the JV Health and Safety Manual, and in this APP and SSHASP. PMs are responsible for implementing the procedure requirements provided in this APP and SSHASP that pose hazards to JV employees or employees of its subcontractors, clients, and other organizations present in the vicinity of work controlled by the JV.

Supervisors and managers' performance metrics include accountability for safety performance. Senior Management will take disciplinary action against any supervisor or manager who willfully or repeatedly violates safety rules, or allows violations, or who does not report unsafe conditions, or correct if within their scope of responsibility. This action may include written reprimands up to and including termination. Compliance with the H&S program is required of all supervisors and managers as a condition of employment.

5. Subcontractors and Suppliers

a. Identification of subcontractors and suppliers

The JV will self-perform much of the work; however, subcontractors will be added if necessary to complete the Site work. If a subcontractor is necessary for a job site, the name and certifications of the selected subcontractors will be included in an addendum to this APP.

b. Safety responsibilities of subcontractors and suppliers

A copy of the site-specific APP will be provided to all subcontractors prior to the start of work so the subcontractor is informed of hazards at the site. While the JV site-specific APP will be the minimum H&S requirements for the work completed by the JV and its subcontractors, each subcontractor, in coordination with JV H&S personnel, is expected to perform its operations in accordance with its own SSHASP, policies and procedures unique to the subcontractor’s work to ensure that hazards associated with the performance of the work activities are properly controlled. Copies of any required safety documentation for a subcontractor's work activities will be provided to the JV for review prior to the start of on-site activities. Safety documentation must be current for all subcontractors.

In the event that the subcontractor’s procedures/requirements conflict with requirements specified in the site-specific APP, the more stringent guidance will be adopted after discussion and agreement between the subcontractor and JV project H&S personnel. Hazards not listed in this APP, but known to the subcontractor or known to be associated with the subcontractor's services, must be identified and addressed to the JV or associate manager and SSHO prior to beginning work operations.

Subcontractors are responsible for the H&S of their employees at all times, and have the authority to halt work if unsafe conditions arise. The JV is responsible for ensuring that the subcontractor complies with the APP and requirements.

6. Training Requirements

Prior to commencement of site activities, JV employees and subcontractors engaged in site operations will be informed of the nature and degree of exposure to chemical and physical hazards that are likely to result from participation in site operations. The JV will accomplish this by ensuring that personnel entering the site have received the appropriate site-specific training, prior to participation in site activities. Applicable training as described below will be conducted prior to site mobilization. Site-specific training will be held at the time of site mobilization and will be reinforced during the daily safety briefings, which all site workers will be required to attend. Site-specific training is described in Section 6.c.

a. New Hire Health and Safety Training

The JV requires all new hire employees to complete Hazard Communication, Office Emergency Response, Defensive Driving, and OSHA 29 CFR 1910.120 40-hour Standard (HAZWOPER) training, and 8-hour HAZWOPER refresher training (as applicable) prior to being mobilized to a Site. The OSHA 29 CFR 1910.120 40 hour HAZWOPER training, and 8-hour HAZWOPER training is provided as needed, to those employees that will be assigned to field work activities.

The JV will only permit trained employees onto job sites. Short service employees (less than six months of field experience) will be identifiable and will be accompanied by another JV employee.

b. Training and Certifications

Training of JV field personnel is provided in Table 6-1 below:

Table 6-1: Mandatory Training	
Training Required:	
☒ 40-hour HAZWOPER ☐ 24-hour HAZWOPER ☒ HAZWOPER site supervisor ☐ OSHA 30-hour Construction ☐ OSHA 10-hour Construction ☒ PPE ☐ Respiratory protection ☐ Chemical hygiene ☒ Hazard communication ☐ Hazardous waste ☒ First-aid/CPR ☒ Department of Transportation/International Association Hazmat Transportation ☒ Smith Driving System (on-line) ☒ Other: Site Supervisor	☐ Bloodborne pathogens ☐ Confined space ☐ Lockout/tagout ☐ Electricity ☒ Fire extinguishers ☐ Fall protection ☒ Noise exposure ☐ Forklifts ☐ Asbestos ☐ Lead ☐ Cadmium ☐ SPCC ☐ Radiation safety ☐ Client specific:
Medical Screening	
☒ Medical Surveillance Exam (HAZWOPER) ☐ Client required drug and/or alcohol Testing	☐ Blood and/or urine screening for other hazardous substances

c. Site Specific Training

Site-specific training will be given prior to the start of any field work.

6.c.1 Personal Protective Equipment Training

The SSHO will ensure that all field personnel have the proper PPE training by following the requirements in this document, reviewing proper PPE use/adjustments, limitations of the PPE, proper care and inspection of PPE, and disposal of PPE during the daily safety meeting.

All aspects of proper PPE use, including the selection of appropriate PPE; how properly to don, doff, adjust, and wear PPE; limitations of the PPE; and proper care, inspection, testing, maintenance, useful life, storage, and disposal of the PPE are a fundamental part of the OSHA 29 CFR 1910.120 40-hour HAZWOPER and 8-hour

HAZWOPER refresher training. As explained in Table 6-1, OSHA 29 CFR 1910.120 40 hour HAZWOPER training is mandatory for all JV staff. Additionally, JV staff gain extensive on-the-job training and experience in the proper use of PPE during assignment on hazardous waste site cleanup and investigative projects. Documentation of this experience will be presented in the staff resumes provided in Appendix 3.

The SSHO will monitor PPE use on site and recommend coaching/retraining as needed when there is reason to believe a worker does not have the required understanding or skill to properly use and maintain the PPE. These deficiencies will be tracked as described in Section 7.d.

6.c.2 Harmful Plants, Animals and Insects

The site orientation will include instruction in recognition of the dangerous animals and insects and their common nesting habits, aggressiveness, etc., (e.g., recognition of poisonous snakes and their common nesting habits, aggressiveness, and the proper first aid procedures for bites, recognition and identification of poisonous plants and the first aid procedures for exposure to them). Harmful plants, animals, and insects are described in Section 9.kk.

6.c.3 Hazard Communication

Hazard communication is mandatory as part of new hire training for all JV staff. This training will serve as the initial hazard communication training.

In accordance with Section 9h, the SSHO will review the hazard communication procedures on an activity/task-specific basis during the daily safety tailgate meetings and inspections.

6.c.4 Heat/Cold Stress

40-hour HAZWOPER training includes symptoms of heat-related illnesses and prevention techniques. The SSHO will review heat/cold stress prevention as appropriate based on conditions during the daily safety tailgate meetings and inspections. Heat and cold stress monitoring is addressed in Section 9.n of this APP.

d. Procedures for Periodic Health and Safety Training

Safety meetings will be conducted daily by the SSHO for all JV and visiting personnel and documented on the Daily Tailgate Safety Meeting Attendance Record form provided in Attachment 1 or in the daily quality control field logbook or field forms. The information and data obtained from applicable site characterization and analysis will be addressed in the safety meetings and used to update this APP and SSHASP, as necessary.

The SSHO will review all H&S training documentation prior to the Daily Safety Meeting to track when employees may need to become recertified in a particular H&S training.

e. Requirements for Emergency Response Training

As part of the site orientation, training will be provided for worker safety in case of fire or other emergency. Training will include:

- Procedures for reporting emergencies, evacuation, headcount and emergency system tests or drills (see Section 9.b.1);
- Spill plans for chemical or petroleum spills (see Section 9.b.2);
- Fire extinguisher and any additional firefighting plans (see Sections 9.b and 9 q);
- Posting of emergency telephone numbers (see Table 9-1); and
- Medical support includes first aid kits and procedures as well as procedures for more serious injuries of medical emergencies (see Section 9.b.6.1).

7. Safety and Health Inspections

Documentation of site personnel training is presented in Attachment 3.

a. General Inspection Requirements

Table 7-1 lists the general inspection requirements for this project. No external inspections/certifications will be required for the type of work being performed at this job site.

Table 7-1: **General Inspection Requirements**

Inspection	Who	When	Documentation
General Site Conditions	SSHO	Initial and Daily	Safety Inspection Checklist.
PPE	SSHO	Initial and Daily (when PPE is required)	Safety Inspection Checklist.
	User	Daily (when PPE is required)	None. Dispose of PPE if faulty.
Fire Extinguishers (minimum rating of 1-A:10-B:C)	SSHO	Upon initial arrival onsite and monthly thereafter	None. Use Inspection Tag.
First Aid Kit and Eye Wash	SSHO	Upon initial arrival onsite and weekly thereafter	Safety Inspection Checklist.

As part of any project, no matter how simple or complex, safety and occupational health inspections will be conducted daily by the SSHO. As a quality control measure for safety, the SSHO will conduct daily safety and health inspections. The SSHO will inspect PPE, site conditions, equipment, and safety supplies.

The information and data obtained from applicable site characterization and analysis will be addressed in the safety meetings and used to update this APP and SSHASP, as necessary.

b. Inspection Documentation

Inspections will be documented on the safety inspection form that is provided in Attachment 1: Deficiency Tracking / Follow Up, or in the daily quality control field logbook.

c. Deficiency Tracking/ Follow Up

Any deficiencies noted during inspections will prompt corrective actions and will be tracked using a deficiency log. Information on this log will include:

1. Date deficiency identified;
2. Description of deficiency;
3. Name of person responsible for correcting deficiency;
4. Projected resolution date;
5. Date actually resolved.

The JV PM or Associate PM will conduct a weekly safety call to review inspection documentation and field activity to ensure corrective measures are being implemented.

d. External Inspections

External inspection/certification is not required for the scope of work being performed.

8. Accident Reporting

a. Exposure Data

The PM or Associate PM will be responsible for providing exposure data (hours worked in the field) to Stephen Wood, the USACE PM, on a monthly basis (by the 15th of each month). Project hours are tracked as part of the JV project management system and available to the Associate PM.

b. Accident investigations, Reports, and Logs

The designated SSHO will report all injuries, illnesses and near-misses to the PM, USACE, the Installation Safety Office, PHSM, and assigned Watervliet Arsenal Environmental Office.

Employees will report all accidents, injuries, and unsafe conditions to their immediate manager, in accordance with EM 385-1-1, Section 01.E. No such report will result in any retaliation, penalty, or other disincentive.

The PM and/or Associate PM will report all accidents as soon as possible but not more than 24 hours afterwards to Stephen Wood, the USACE PM, and the Contracting Office Representative.

For lost time injuries, the PHSM or their designee will investigate the accident using the ENG FORM 3394 and will submit the form to the PM. The PM will submit the form to Stephen Wood, the USACE PM within 5 working days.

Corrective action will be assigned as part of the investigation. The SSHO will follow-up on the status of corrective action and report to the PM and PHSM corrective actions when corrective actions are completed and when they are not completed on time. The PM and PHSM will provide follow-up and support as needed to complete the corrective actions.

c. Accidents Requiring Immediate Notification

An accident that has, or appears to have, any of the consequences listed below must be immediately reported to the USACE PM and assigned Watervliet Arsenal Environmental Office:

1. A fatal injury;
2. A permanent total disability;
3. A permanent partial disability;
4. The hospitalization of three or more people resulting from a single occurrence;
5. Property damage of $200,000 or more; or
6. Arc flash incident.

9. Programs and Procedures

All site operations will be performed in accordance with the following applicable regulations: federal, state and local regulations and procedures; 29 CFR 1910 and 1926 Occupational Safety and Health Standards; Army Regulation 385-10; EM 385-1-1; and the JV's corporate safety program. Relevant aspects of these regulations are outlined below. The JV will provide the names and qualifications of assigned Competent and/or Qualified Persons to the Government for approval prior to any work being started for any necessary activity.

a. Layout Plans

Site-specific layout plans will be included in the site-specific memorandums, as necessary. Layout plans are not required if temporary construction buildings, fences, or access routes will not be installed as part of the field activities.

b. Emergency response plans (01.E):

An emergency is defined as a serious situation or occurrence that happens unexpectedly and demands immediate action. Field personnel will immediately stop work and report to the SSHO under the following situations:

- Medical emergency;
- Discovery of unanticipated hazards (e.g., drums, heavily contaminated materials, etc.); and
- Heat/cold-related injury or heat/cold stress requiring emergency medical support.
- The SSHO will review the emergency response plan with field personnel during daily safety meetings prior to starting work activities. This will include designating rally points for assembly in case of evacuation.

The SSHO will review emergency response procedures with the facility safety office and contact local emergency facilities listed in Table 9-1.

9.b.1 Procedures and Tests

Prior to work startup, personnel will be familiar with this Emergency Response Plan. A test of cellular phone coverage across the work areas will be conducted prior to mobilization to ensure that emergency services can be alerted in the event of an emergency. The SSHO will review the provisions of this plan during the pre-entry site briefing. The SSHO will make this plan available for review and photocopying. Emergency telephone numbers and directions to the nearest hospital are presented in this section.

Onsite emergencies will ultimately be handled by offsite emergency support personnel such as the local fire department, ambulance squad, or police, dependent on the nature of the emergency. Initial response and first aid treatment, however, will be available through trained onsite personnel.

In the event of an emergency, the information available at that time will be evaluated and the appropriate steps will be taken to implement the emergency response procedures. The SSHO will assume command of the situation. The SSHO will call the appropriate emergency services, evacuate personnel to the pre-designated evacuation location as needed, and take other steps necessary to gain control over the emergency.

JV personnel will give the following information when reporting an emergency:

- Name and location of person reporting;
- Location of accident/incident;
- Name and affiliation of injured party;
- Description of injuries;
- Status of medical aid and/or other emergency control efforts;
- Summary of accident, including suspected cause and time it occurred; and
- Temporary control measures taken to minimize further risk.

This information is not to be released to parties other than those listed in this section and emergency response team members. The PM will be notified immediately after emergency response agencies have been notified. Any worker with a medical emergency will be transported to the nearest medical emergency facility. If a neck or back injury is suspected, the victim will not be moved without medical personnel stabilizing the neck and back in accordance with first aid procedures. Then workers trained in first aid will move the injured worker so it is safe for emergency personnel to administer medical help to the injured worker.

To test emergency plans, “desktop drills” will be conducted periodically by the SSHO as part of the site safety meetings. A desktop drill involves an emergency scenario that is presented verbally, with the group discussing the course action they would take, and then critiquing their response.

9.b.2 Spills

In the case of a spill, the SSHO will stop work and clear the work area, assess the hazard, and use absorbents to control the spill if the hazard is not an immediate health risk. If the spill is an immediate health risk, the SSHO will evacuate the work area and contact the facility emergency responders. Emergency contact numbers (see Table 9-1) will be placed in field vehicles so all field personnel will have access to them. The SSHO will ensure that all field personnel are accounted for by meeting at a designated rally point. The daily tailgate sign-in sheet will be used to account for all personnel and subcontractors that day. Local emergency responders will provide rescue services.

9.b.3 Fires

Upon notification of a fire or explosion at the site, all personnel will evacuate the site. The fire department and the facility emergency responders shall be alerted. Emergency contact numbers will be placed in field vehicles so all field personnel will have access to them. The SSHO will ensure that all field personnel are accounted for by meeting at a designated rally point. The daily tailgate sign-in sheet will be used to account for all personnel and subcontractors that day. Local emergency responders will provide rescue services.

9.b.4 Posting of Emergency Telephone Numbers

Emergency phone numbers (see Table 9-1) will be available in the job site trailer.

9.b.5 Man Overboard

Not applicable – no work will be performed on or over water.

9.b.6 Medical Support

9.b.6.1 Bloodborne Pathogen Control

First Aid trained staff will be trained in and use Universal Precautions to prevent contact with blood or other potentially infectious materials; include gloves, masks or eye protection.

Exposure incident involving eye, mouth, other mucous membrane, non-intact skin, or parenteral contact with blood or other potentially infectious materials will be reported to the PHSM. If an exposure incident has taken place, the PHSM will initiate the post-exposure follow-up procedures in 29 CFR 1910.1030 and the JV Bloodborne Pathogens policy.

Post-Exposure evaluation and follow-up will be made available immediately following an exposure incident. The physician will be supplied with a description of the employee's duties as they relate to the exposure incident, the route and circumstances of exposure, the results of the source individual's testing if known and the employee's medical records including Hepatitis B (HBV) vaccination status if not already available to the physician.

The medical provider will supply his/her written medical opinion which will contain only that the employee has been informed of the results of the evaluation and has been told about any medical conditions that require further evaluation or treatment. The employee should receive a more detailed confidential medical evaluation from the medical provider.

Testing of the employee's blood will be done as soon as possible as recommended by the medical provider. If the employee decides to give consent for the blood to be drawn but not tested, the employee will have 90 days in which to change his/her mind as the sample must be preserved for 90 days.

Disinfectant wipes will be available in first aid kits.

Cleaning and decontamination of all surfaces by an appropriate disinfectant will be done as soon as possible after contact with blood or other potentially infectious materials.

Contaminated waste and/or laundry such as bloodied bandages or clothing will be placed in leak-proof containers or bags and labeled and the PHSM contacted to arrange for disposal.

The HBV vaccination series and post-exposure evaluation and follow-up will be made available to all First Aid Responders in accordance with the JV Bloodborne Pathogens Policy.

Bloodborne Pathogens training will be provided with initial first aid training and at least annually thereafter in accordance with 29 CFR 1910.1030.

9.b.6.2 On-Site First Aid Support

The JV will ensure that at least two field personnel will be first aid and CPR trained. This will include the SSHO and at least on additional field team member. All JV personnel who will work on site will be first aid and CPR trained, including the SSHO. These certifications are provided in Attachment 3: Resumes and Certifications.

Even though all JV field personnel are first aid/CPR trained, JV field personnel will contact Work Care at (800) 455-6155 in any case of injury-illness, regardless of severity. Per JV company policy, every non-emergency, work-related injury or illness is required to be called into Work Care via their reporting hotline number to ensure proper medical management of the injury. Work Care will provide instructions to the field personnel and inform them if the injured employee must receive emergency medical attention.

First aid kits will be available at areas most accessible to employees and in the proximity of those areas where accidents are most likely to occur. The SSHO will be responsible for keeping the first aid kits adequately supplied. First aid kits will be provided at a ratio of one for every 25 employees. The presence of fewer than 25 employees on site still warrants a first aid kit to be on site. The SSHO will ensure that first aid kits are available on the worksite and that these locations are known to all employees on the premises. As a measure to provide immediate first aid attention to personnel who suffer minor injuries, there shall be a minimum of two people with Red Cross first aid and CPR training present on site at all times.

A self-contained emergency eyewash unit will be readily available on site as the potential for an employee's eyes to be exposed to corrosives, strong irritants, or toxic chemicals exists. The self-contained unit will irrigate and flush both eyes simultaneously while the operator holds the eyes open. The emergency eyewash equipment will deliver at least 0.4 gallon (1.5 L) of water per minute for fifteen (15) minutes or more (minimum 6 gallons [22.7 L] water). The self-contained unit used at the site is designed to ensure the stored fluid is protected against airborne contaminants. Personal eyewash fluids will be visually inspected daily to ensure they remain sanitary with no visible sediments.

9.b.6.3 Off-Site Medical

The JV SSHO will coordinate with the facility emergency responders to gain an understanding of what needs to be done in the event of an emergency and to ensure emergency medical service information is accurate.

Emergency phone numbers are included in Table 9-1.

9.b.6.4 Hospital and Emergency Route Map

The SSHO will practice the route to the hospital to make sure the directions are correct.

The nearest medical facility to Watervliet Arsenal is Samaritan Hospital in Troy, NY. A route to the hospital is presented in Figure 9-1 and driving instructions are listed below.

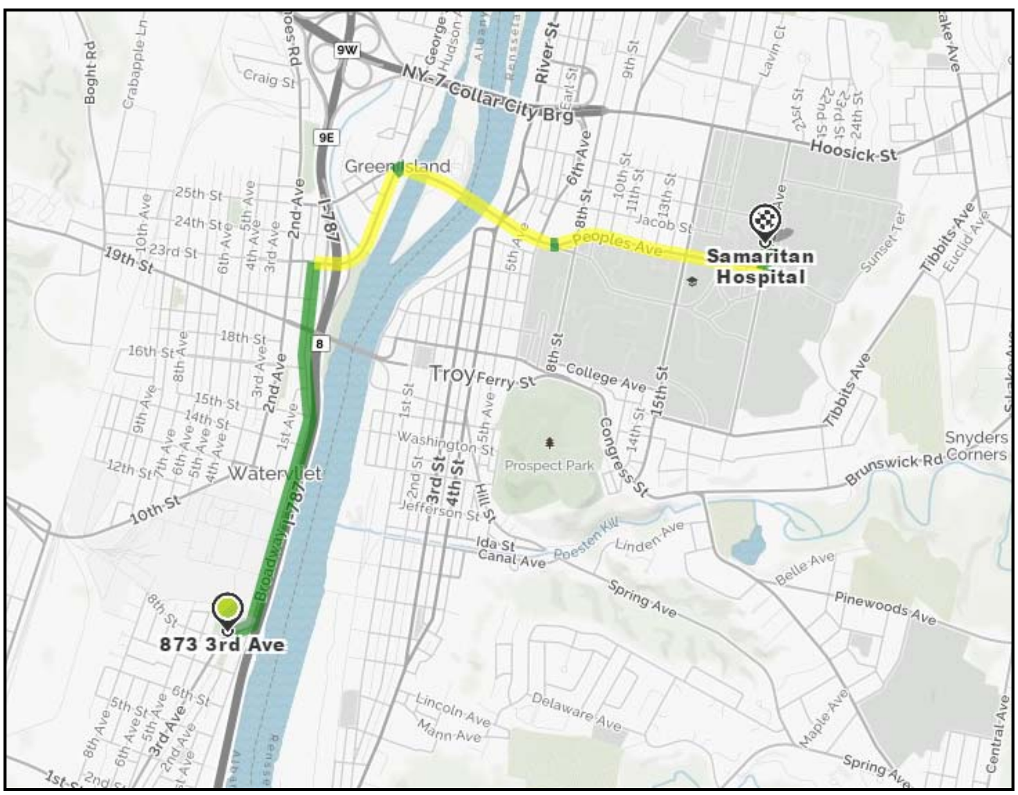
Hospital:	Samaritan Hospital
Address:	2215 Burdett Avenue
	Troy, NY 12180
Phone:	(518) 271-3285
Distance:	3 miles / Approximately 10 minutes

Directions to Samaritan Hospital:

1. Exit South Gate at 3rd Avenue
2. Turn left onto 3rd Avenue
3. 3rd Avenue turns into 8th Street
4. Turn left onto Broadway
5. Turn right onto 23rd Street
6. Continue onto Hudson Avenue
7. Continue onto Lower Hudson Avenue
8. Turn right onto Albany Avenue/Green Island Bridge
9. Continue onto Federal Street
10. Keep left to continue on Peoples Avenue
11. Turn left onto Burdett Avenue

End at Samaritan Hospital on the left.

Figure 9-1: Route to Samaritan Hospital



c. Plan for Prevention of Alcohol and Drug Abuse

The use and/or possession of alcoholic beverages and illegal drugs are not permitted on site. The use of such substances can significantly impair judgment in the field. Personnel under the influence of alcohol or illegal drugs will not be allowed on site. Personnel using prescription and over-the-counter drugs will inform the SSHO of any warnings listed on the drug container.

The plan for prevention of alcohol and drug abuse on site includes strictly adhering to the JV Drug and Alcohol Policy, which is a condition of employment. Additionally, the SSHO will monitor staff and subcontractors for obvious signs of intoxication such as slurred speech, poor balance, smell of alcohol/marijuana, dilated pupils, red/bloodshot eyes, and exaggerated/poor judgment. The JV Drug and Alcohol Policy is included as Attachment 4.

d. Site Sanitation Plan

The work crews will be mobile and will have transportation readily available to public toilet/washing facilities available at nearby on-site buildings. Bottled drinking water will be provided in coolers on the site.

Refuse containers or bags will be available on site. Food waste or other refuse that may attract pests or vermin will be removed from the site daily.

e. Access and Haul Road Plan

Additional access and haul roads are not planned to be built during the field activities; therefore, an access and haul road plan is not applicable.

f. Respiratory Protection Plan

This plan is not required because no activities requiring respiratory protection are required during the field activities.

g. Health Hazard Control Program

All operations, materials, and equipment will be evaluated to determine the presence of hazardous environments or if hazardous or toxic agents could be released into the work environment. These evaluations will be included in the AHAs, except for

Hazardous Waste Operations which require development and implementation of a SSHASP.

All field personnel will review the site-specific AHA, APP, and SSHASP prior to starting work activities. The SSHO will inspect all operations, materials, and equipment daily to ensure hazards or toxic agents are not released into the work area. The inspection will be documented on the inspection form provided in Attachment 1 or the daily quality control field logbook. The SSHO will ensure proper PPE is worn by conducting daily hazard assessments.

All project required chemicals must be handled in accordance with OSHA 29 CFR 1910.1200. Section 9.h provides an overview of the hazard communication plan for this project.

h. Hazard Communications Program

All project required chemicals must be handled in accordance with OSHA 29 CFR 1910.1200.

Table 9-2 lists all chemicals that will be brought, stored, and used on the site and the intended use. Safety Data Sheets (SDS) for chemicals brought on site are included in the SSHASP in Attachment 2. The SSHO will ensure all field personnel have reviewed the SDSs for specific safety and health protection procedures. Copies of SDSs will be onsite at all times, in the field vehicle, as attachments to the site-specific APP. Additionally, activity appropriate SDSs are attached to the AHAs provided with the SSHASP in Attachment 2.

Table 9-2: Chemical Inventory

Chemical Name	Use	Estimated Quantity	Chemical Storage Location
Alconox	Sampling equipment decontamination	≤ 5 pounds	Field vehicle
WD-40	Lubricate and clean system components	≤ 1 can	Field vehicle
Pipe cement	Repairing/replacing system piping	≤ 1 can	Field vehicle
Pipe primer	Repairing/replacing system piping	≤ 1 can	Field vehicle

Table 9-2: Chemical Inventory			
Chemical Name	**Use**	**Estimated Quantity**	**Chemical Storage Location**
Isobutylene in air	PID calibration	1 cylinder	Field vehicle
pH standards (4, 7, 10)	Water-quality meter calibration	≤ 1 gallon	Field vehicle
Conductivity standards	Water-quality meter calibration	≤ 1 gallon	Field vehicle

If any additional chemicals are brought on site, the APP will be appended to include the new SDSs.

All hazardous chemicals will be properly labeled and the label will list, at a minimum, the chemical identity, appropriate hazard warnings, and the name and address of the manufacturer, importer, or other responsible party. Chemicals will be used in the original container whenever possible. If it becomes necessary to transfer a chemical to a portable/temporary container, the following rules apply:

- If it will not be used immediately (e.g., used over several days or by various people), a label that identifies the hazards will be completed;
- Appropriate pictogram per GHS based on chemical property
- Hazard information from the manufacturer's hazard label will be used to complete the temporary label; and
- The temporary label will be affixed to the temporary/portable container and removed once the container is no longer being used.

At the commencement of the field activities the SSHO will review the hazard communication procedures associated with the project. Periodically, at the beginning of each new project phase, the SSHO will review the hazard communication procedures on an activity/task-specific basis during the daily safety tailgate meetings and inspections. This will ensure ongoing training on the following topics:

- Requirements and use of the hazardous communication program at the project;
- The location of all hazardous or toxic agents at the project;
- Identification and recognition of hazardous or toxic agents at the project;
- Physical and health hazards of the hazardous or toxic agents pertinent to project activities; and
- Protective measures employees can implement when working with project-specific hazardous or toxic agents.

i. Process Safety Management Plan

This project does not include processes which require a process safety management plan. Therefore, a Process Safety Management Plan is not applicable.

j. Lead Abatement Plan

This project does not include lead abatement; therefore, a Lead Abatement Plan is not applicable.

k. Asbestos Abatement Plan

This project does not include asbestos abatement; therefore, an asbestos abatement plan is not applicable.

l. Radiation Safety Program

Radiological activities will not be performed during the field activities; therefore, a radiation safety program is not applicable.

m. Abrasive Blasting

Abrasive blasting will not be performed during the field activities; therefore, an abrasive blasting plan is not applicable.

n. Heat/Cold Stress Monitoring Plan

9.n.1 Heat Stress

Heat stress hazards can occur even in temperatures not commonly considered “hot” due to the level of physical activity, the level of PPE the worker is wearing, or the physical condition of the worker.

40-hour HAZWOPER training includes symptoms of heat-related illnesses and prevention techniques. Personnel will be familiar with the signs and symptoms of heat stress.

Heat stress prevention techniques include:

- Resting frequently in a shaded or air conditioned area.
- Allowing workers who are not acclimatized to take additional breaks.
- Consuming large quantities of fresh potable water and/or electrolyte-replenishing drinks (more than amount needed to simply “quench thirst”). Drink at least eight ounces of water or diluted Gatorade every 15-20 minutes.
- Monitoring workers by measuring Wet Bulb, Globe Temperature (WBGT) heat stress index temperature.

WBGT index temperature readings will be initiated and taken at frequencies determined by the SSHO based on the condition of the employees, specific weather conditions, work tasks, and other environmental factors and conditions during field activities. A work/rest regimen will be implemented as necessary in accordance with the current American Conference of Governmental Industrial Hygienists (ACGIH) guidance table shown below.

Table 9-3: ACGIH Screening Criteria for Heat Stress Exposure (WBGT values in °F) for 8-hour work day five days per week with conventional breaks

Allocation of Work in a Work/Rest Cycle	Acclimatized				Unacclimatized			
	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
75-100%	87.8	82.4	--	--	82.4	77.0	--	--
50-75%	87.8	84.2	81.5	--	83.3	78.8	75.2	--
25-50%	89.6	86.0	84.2	82.4	85.1	80.6	77.9	76.1
0-25%	90.5	88.7	86.9	86.0	86.0	84.2	82.4	80.6

Notes:
°F = degrees Fahrenheit
Assumes 8-hour workdays in a 5-day work week with conventional breaks.
Threshold Limit Values assume that workers exposed to these conditions are adequately hydrated, are not taking medication, are wearing lightweight clothing, and are in generally good health.
Examples of workloads:
Rest - sitting (quietly or with moderate arm movements)
Light work - sitting or standing to control machines; performing light hand or arm work; occasional walking; driving
Moderate work - walking about with moderate lifting and pushing or pulling; walking at moderate pace
Heavy work - pick and shovel work, digging, carrying, pushing/pulling heavy loads; walking at fast pace
Very Heavy - very intense activity at fast to maximum pace
Adapted from: 2011 TLVs® and BEIs® - Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati: American Conference of Governmental Industrial Hygienists (ACGIH), 2011, p. 221.

Other factors, such as a worker's level of acclimation, level of physical fitness, and age, may increase or decrease their susceptibility to heat stress. Before assigning a task to an individual worker, these factors will be taken into account to ensure that the task will not endanger the worker's health. Sunscreens will be provided and used per manufacturer's recommendations.

If a heat-related illness is suspected or observed, the affected person will be moved to a cool or shaded area and given plenty of liquids to consume. If symptoms of a heat stroke are observed, the victim will be cooled and 911 will immediately be called.

9.n.2 Cold Stress

Prolonged exposure to excessive cold and/or wet conditions may cause excessive loss of body heat (hypothermia), frostbite, slurred speech, memory lapses, drowsiness, incoherence, shivering or severe shaking. Hypothermia occurs when the body cannot maintain a normal core temperature of 98.6 to 99.6 °F. Wind, physical exhaustion, and wet clothing, all make a person more prone to hypothermia. Air temperature alone is not enough to judge the cold hazard of an environment. Most cases of hypothermia develop in an air temperature of 36 to 50 °F. The SSHO will monitor for symptoms of hypothermia any time the ambient conditions indicate the risk of hypothermia exists (as described above). The SSHO will monitor for symptoms of frostbite anytime the ambient conditions (temperature and wind speed) reach those described in Table 9-4.

40-hour HAZWOPER training includes the signs and symptoms of cold stress.

Personnel exhibiting signs and symptoms of cold stress will be removed from the site and given appropriate first aid. Emergency medical services will be contacted if symptoms are severe (e.g., more than numbness of the extremities or shivering). When air temperatures are less than 36ºF, workers who become immersed in water or whose clothing becomes wet will be immediately provided a change of clothing and be treated for hypothermia.

Both the outdoor temperature and the wind velocity play a part in cold injuries. Wind chill is used to describe the chilling effect of moving air in combination with low temperatures. Table 9-4 shows wind chill in relation to temperature with the associated frostbite times.[2]

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[2] National Weather Service Wind Chill Chart. Effective date November 1, 2001. http://www.weather.gov/om/windchill/index.shtml

Table 9-4: National Weather Service Wind Chill Chart

Wind Chill Temperature Table																			
		Air Temperature (°F)																	
		40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Wind Speed (mph)	0	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
	5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
	10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
	15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
	20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
	25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
	30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
	35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
	40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
	45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
	50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95

Notes:

Green:	**LITTLE DANGER** (frostbite occurs in >2 hours in dry, exposed skin)
Yellow:	**INCREASED DANGER** (frostbite could occur in 45 minutes or less in dry, exposed skin)
Red:	**GREAT DANGER** (frostbite could occur in 5 minutes or less in dry, exposed skin)

Adapted from: Sustaining Health and Performance in Cold Weather Operations: United States Army Research Institute of Environmental Medicine. October 2001

Recommended actions for prevention of cold stress:

- Wear non-cotton undergarments to wick perspiration from the body;
- Wear additional layers of light clothing as needed for warmth. The layering effect holds in air, trapping body heat and some layers could be removed as the temperature rises during the workday. Caution: Wearing too much clothing will cause sweating, which may freeze next to the body, creating a hazard;
- Each worker must pay close attention to their body, and take the appropriate action to correct any symptoms of hypothermia (such as a break from work activity, move to rest area to warm up, and add additional clothing). Install a windbreak at the work site to break the cold winds from blowing directly on the crew; and
- Maintain good eating and drinking habits, enabling the body to operate at top capacity, (e.g., avoid caffeine and alcohol).

o. Crystalline Silica Monitoring Plan

This project does not include the use of crystalline silica therefore a crystalline silica monitoring plan is not applicable.

p. Night Operations Lighting Plan

Field work activities will not be performed at night; therefore, a night operations lighting plan is not applicable.

q. Fire Prevention Plan

The following are potential fire hazards during the field activities:

- Use of electrical compressors, batteries, and monitoring equipment that can have an electrical spark and cause fire; and

- Use of field vehicles that can leak and cause a fire if there is an ignition source.

Smoking is only permitted within designated areas within the facility.

The SSHO will inspect all equipment prior to use and document it on the inspection form provided in Attachment 1. If fire is noticed during work activities, the SSHO will evaluate to determine if the fire can be put out using a fire extinguisher. The SSHO and field personnel will have fire extinguisher training. Fire extinguisher training will be provided upon initial employment and at least annually thereafter. Training will be conducted in accordance with EM 385-1-1, Section 09.E.04.

If the fire cannot be put out using a fire extinguisher, the SSHO will evacuate field personnel and use the fire emergency plan discussed in section 9.b.3.

When generators or other non-vehicle powered equipment is in use, a B-C or A-B-C rated fire extinguisher will be readily available within 25 feet of the equipment.

An A-B-C fire extinguisher will be located in the job site trailer and in all field vehicles.

r. Wild Land Fire Management Plan

Wild land fire management will not be performed during the field activities; therefore, a wild land fire management plan is not applicable.

s. Hazardous Energy Control Plan (Lockout/Tagout)

If during the servicing and maintenance of machines and equipment, the unexpected startup or release of stored energy could cause injury to employees, measures will be taken for the Control of Hazardous Energy (Lockout/Tagout).

The Control of Hazardous Energy (Lockout/Tagout) is required when servicing or performing maintenance on equipment if personnel are required to remove or bypass a guard or other safety device, or required to place any part of their body in an area where a danger zone exists during a machine or equipment operating cycle.

For work on cord and plug connected electric equipment for which exposure to the hazards of unexpected energization or start up of the equipment is controlled by the unplugging of the equipment from the energy source and by the plug being under the exclusive control of the employee performing the servicing or maintenance, no additional precautions are required.

JV staff will perform Lockout/Tagout in accordance with the JV Control of Hazardous Energy (Lockout/Tagout) Procedure included as Attachment 5.

Lockout may only be performed by trained and authorized staff.

t. Critical Lift Plan

Critical lifts will not be performed during the field activities; therefore, a critical lift plan is not applicable.

u. Contingency Plan for Severe Weather

The SSHO will check weather reports daily; when the weather reports provide warnings or indications of impending severe weather (heavy rains, thunderstorms, damaging winds, tornados, hurricanes, floods, lightning, etc.), weather emergency notification will be monitored through the New York Emergency Alert System (EAS). EAS messages provide information during emergencies including severe weather and are disseminated via numerous radio stations in the vicinity.

Whenever unfavorable conditions arise, the Project Manager and SSHO will evaluate both the safety hazards and the ability of the employees to effectively perform given tasks under such conditions. Activities will be halted by the Project Manager at the discretion of the SSHO.

v. Float Plan

There will be no marine activities; therefore, a float plan is not applicable.

w. Fall Protection & Prevention Plan

Fall protection will not be used during the field activities; therefore, a fall protection plan is not applicable.

x. Demolition Plan

There will not be any demolition activities during the field activities; therefore, a demolition plan is not applicable.

y. Excavation/Trenching plan

There will be no excavation/trenching activities during the field activities; therefore, an emergency rescue plan is not applicable.

z. Emergency Rescue (Tunneling)

There will be no tunneling activities during the field activities; therefore, an emergency rescue plan is not applicable.

aa. Underground Construction Fire Prevention and Protection Plan

Underground construction will not be performed during the field activities; therefore, an underground construction fire prevention and protection plan is not applicable.

bb. Compressed Air Plan

The use of compressed gas cylinders for instrument calibration has the potential to expose employees to injury. 40-hour HAZWOPER training includes recognition of and protection from such injuries. The site orientation will include site specific information, and the SSHO will provide updates as needed based on changes in work location or conditions in daily safety briefings.

Task or location specific hazards and precautions will be addressed in the AHA.

cc. Formwork and Shoring Erection and Removal Plans

Formwork and shoring erection work activities will not be performed during the field activities. Therefore, a formwork and shoring erection and removal plan is not applicable.

dd. Precast Concrete Plan

Precast concrete work activities will not be performed during the field activities. Therefore, a precast concrete plan is not applicable.

ee. Lift Slab Plans

Lift slab work activities will not be performed during the field activities; therefore, a lift slab plan is not applicable.

ff. Steel Erection Plan

Steel erections will not be used during the field activities; therefore, a steel erection plan is not applicable.

gg. Site Safety and Health Plan for HTRW Work

JV staff will conduct site work in accordance with applicable OSHA regulations and the JV SSHASP in Attachment 2. Information, training and precautions will be provided in accordance with the Hazard Communication, Personal Protective Equipment, and other applicable sections of this APP.

hh. Blasting Plan

Blasting will not be performed during the field activities; therefore, a blasting safety plan is not applicable.

ii. Diving Plan

Diving activities will not be performed during the field activities; therefore, a diving plan is not applicable.

jj. Confined Space Program

Confined space activities are not anticipated during the field activities. However, if it becomes necessary to enter confined spaces, only JV staff with confined space awareness training (for non-permit required confined spaces) or permit required confined space training will be permitted to perform confined space activities. 40-hour HAZWOPER training includes recognition of such hazards. The site orientation will include site specific information, and the SSHO will provide updates as needed based on changes in work location or conditions in daily safety briefings.

Task or location specific hazards and precautions will be addressed in the AHA.

kk. Harmful Plants, Animals and Insects

Working in the field has the potential to expose employees to harmful plants, animals and insects. 40-hour HAZWOPER training includes recognition of and protection from harmful plants, animals and insects. The site orientation will include site specific information, and the SSHO will provide updates as needed seasonally or based on changes in work location or conditions in daily safety briefings.

For the Watervliet Arsenal site these hazards include poisonous plants (e.g., poison ivy), bees, ticks, spiders, mosquitoes, and snakes.

Task or location specific hazards and precautions will be addressed in the AHA.

General precautions include:

- Do not approach or agitate animals or pets. Notify the residents of any issues such as an aggressive or curious pet.
- Use insect repellant to avoid contact with ticks, mosquitoes, and other insects (disease carriers or poisonous), as necessary. Do not wear perfumes or colognes that may attract insects. Use a solid repellant to minimize potential contamination of field samples;
- If possible, avoid contact with poisonous snakes or other reptiles by using a stick to disturb areas with tall grass or bushes before walking in these areas. If snakes or other potentially dangerous creatures are encountered, quietly walk away and report the encounter to the SSHO. If bitten, seek medical assistance immediately.

- Avoid contact with stinging insects. Spray nests if located in a well casing.

- If known to be subject to severe reactions to bee stings (anaphylactic shock), report this condition to the SSHO prior to potential exposure.

ll. MEC Avoidance Plan

No MEC related issues or potential exposures are anticipated for this project; therefore, a MEC Avoidance Plan is not applicable.

mm. Earth Drilling Plan

Drilling activities will not be performed during the field activities; therefore, an Earth drilling plan is not applicable.

10. Risk Management Processes

The Site Specific AHA Worksheets are provided in with the SSHASP in Attachment 2 of this APP.

Before beginning each work activity involving a type of work presenting hazards not experienced in previous project operations or where a new work crew or subcontractor is to perform the work, an AHA will be developed.

The AHA shall be reviewed and modified as necessary to address changing site conditions, operations, or change of competent/qualified person(s). The SSHO will conduct a daily hazard assessment prior to starting work activities and AHAs will be modified as needed.

a. Hazardous or Toxic Agents and Environments

All operations, materials, and equipment will be evaluated to determine the presence of hazardous environments or if hazardous or toxic agents could be released into the work environment. These evaluations will be included in AHA, except for Hazardous Waste Operations which require development and implementation of a SSHASP.

b. Harmful Plants, Animals and Insects

Hazards and precautions for harmful plants, animals and insects are included in the AHA.

c. Personal Protective Equipment

If hazards are present, or are likely to be present, which necessitate the use of PPE an evaluation will be included in the AHA. The AHA will include the types of PPE that will protect workers from the hazards identified.

The minimum level of protection that is required of JV personnel and subcontractors at the site will be Level D, which is worn when activities do not involve potential dermal contact with contaminants and there is no indication that an inhalation hazard is present. Level D PPE for this project will consist of:

- Work clothing as prescribed by weather;

- Steel-toe work boots or study leather boots (dependent on activity);
- Safety glasses with side shields, or goggles;
- Heavy duty cloth or leather gloves for work (cut-resistant if handling potential sharp items);
- Nitrile gloves (if handling samples);
- Hearing protection (if noise levels exceed 85 decibels); and
- Safety/reflective vests, in areas of limited visibility, working in hunting areas during hunting season, or when exposed to moving equipment or traffic.

Table 9-1

Emergency Contact Information

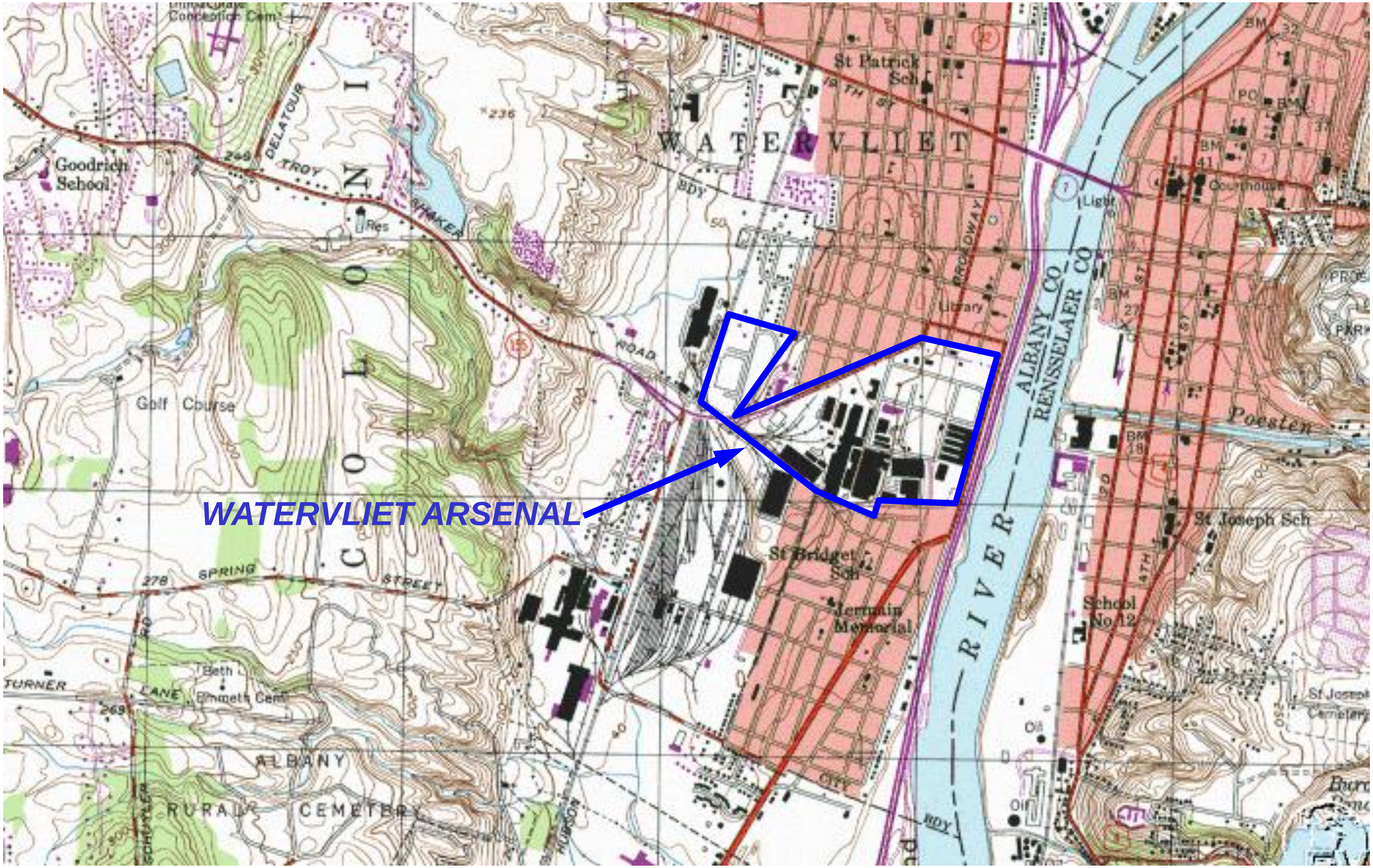
Table 9-1

WATERVLIET ARSENAL EMERGENCY CONTACT LIST

Organization	Telephone Number
All Base Emergency Calls – Police/ Fire/ Ambulance	**Dial 911**
WVA Guard/Fire/Ambulance (non-emergency)	518-266-5111
Upstate New York Poison Control Center	1-800-222-1222
New York State DEC Emergency Spill Response	1-800-457-7362
National Response Center (United States)	1-800-424-8802
CHEMTREE (Chemical Transportation Emergency Center)	1-800-424-9300
Samaritan Hospital – Troy, NY	518-271-3285 (Non-emergency calls – Dial 911 for emergency)

Organization/Title	Name	Telephone Number
WVA Site Contact/Client	Michael Wright	518-266-4785 (Office)
USACE Contracting Officer Representative	Tom Meyer	410-962-0032 (Office)
PIKA-MP JV Project Manager	Andy Vitolins	518-250-7359 (Office) 518-461-3145 (Cell)
PIKA-MP JV Associate Project Manager	Stefan Bagnato	518-250-7334 (Office)
PIKA-MP JV Program Managers	Larry Jordan Jennifer Buckels Mayers	443-831-0326 (Cell) 410-332-4805 (Office)
PIKA-MP JV Safety and Health Manager	Sarosh Manekshaw, CIH Grey Coppi, CIH, CSH	713-412-9948 887-649-2054

Figures



SCALE IN FEET

0 1000 2000 4000

SOURCE: U.S.G.S 7.5 MIN. TROY SOUTH QUADRANGLE

US Army Corps of Engineers
Baltimore District

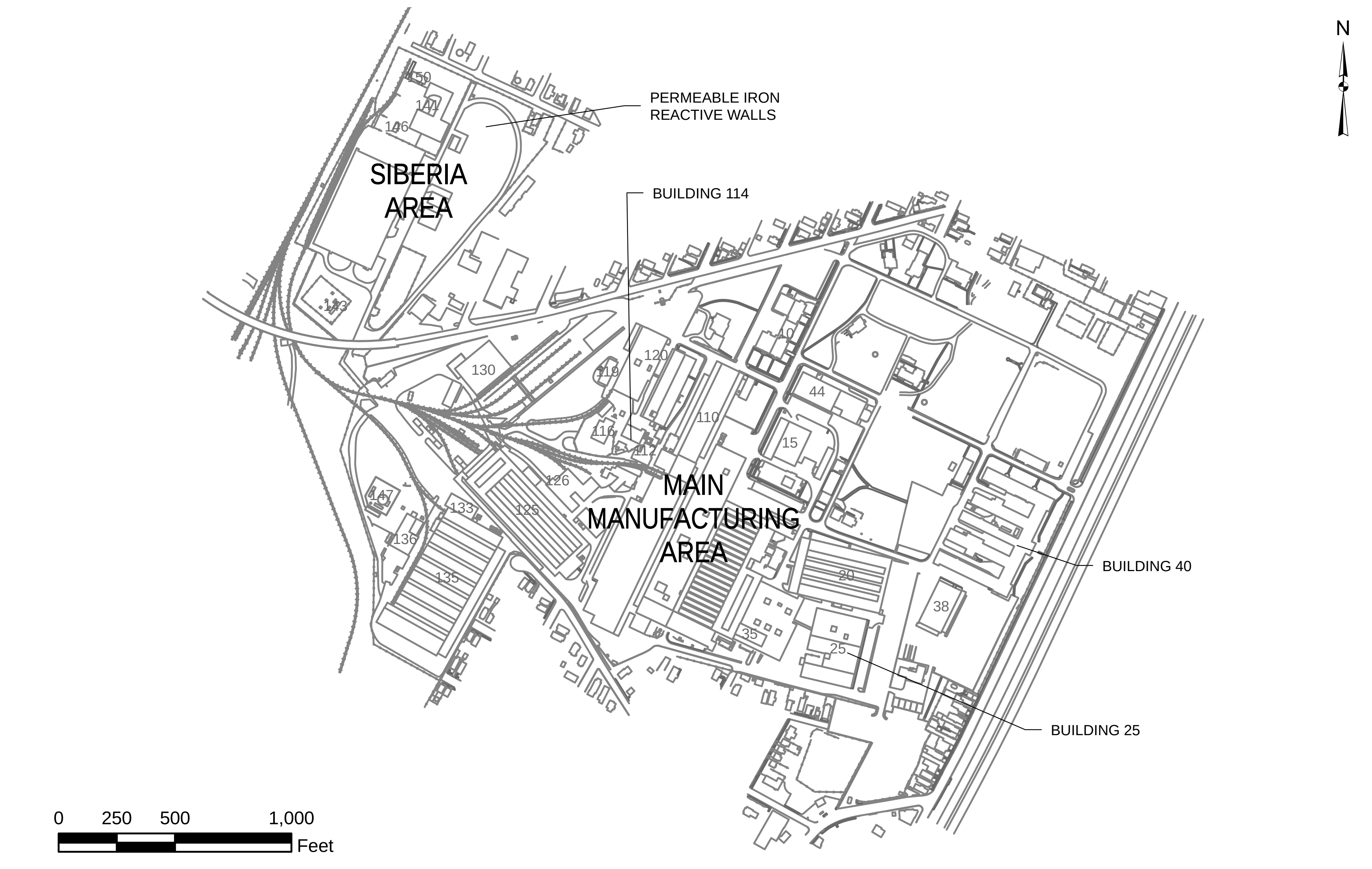
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

ACCIDENT PREVENTION PLAN

SITE LOCATION

FIGURE 2-1

\\ny05fp01\GISMOD\WatervlietArsenal\LTM\Figures\LTM Plan Update 2010\WVA Site Plan.mxd



US Army Corps of Engineers

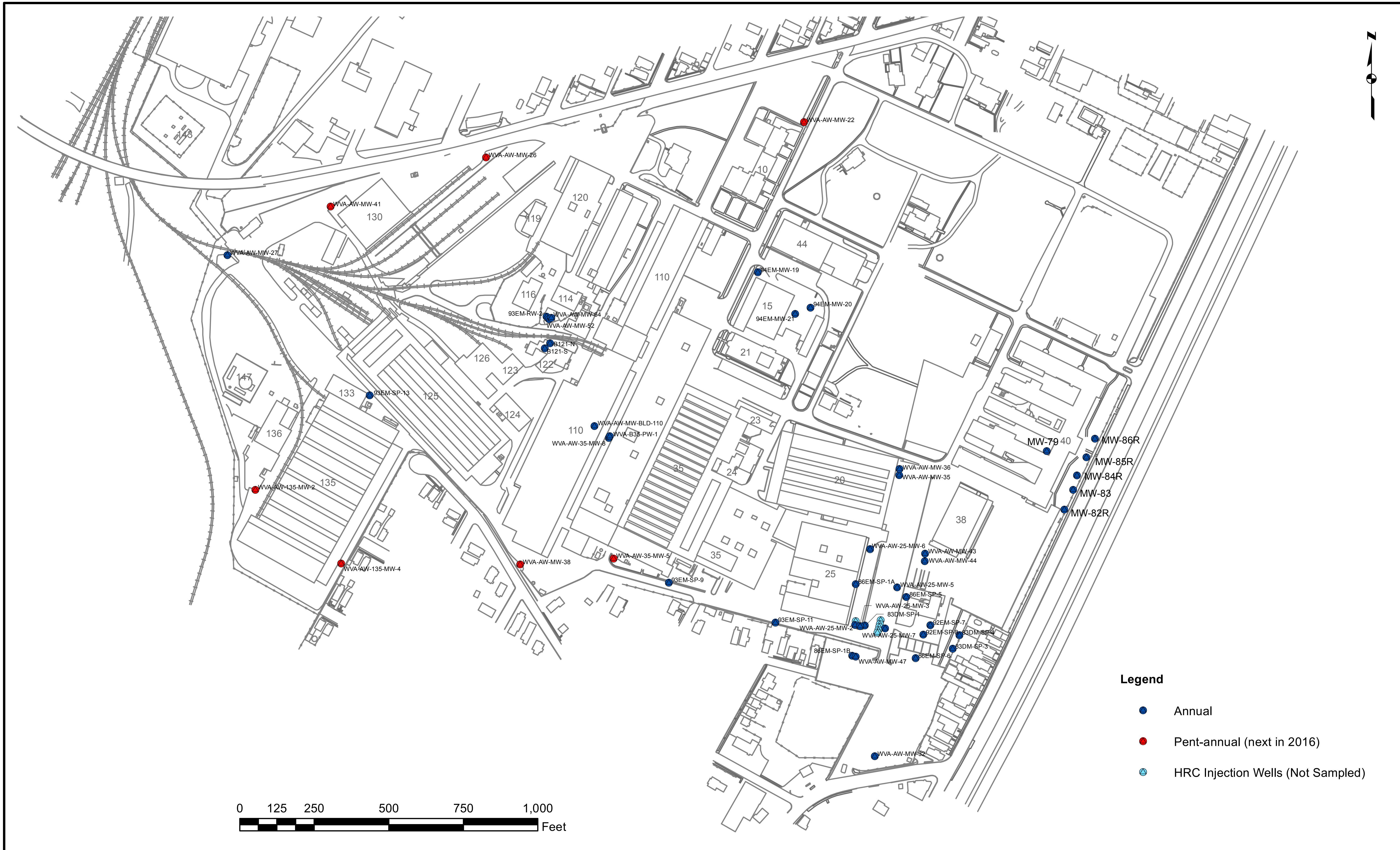
ACCIDENT PREVENTION PLAN
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

SITE MAP

PIKA-MP JV, LLC

JUNE 2016

FIGURE 2-2



US Army Corps of Engineers

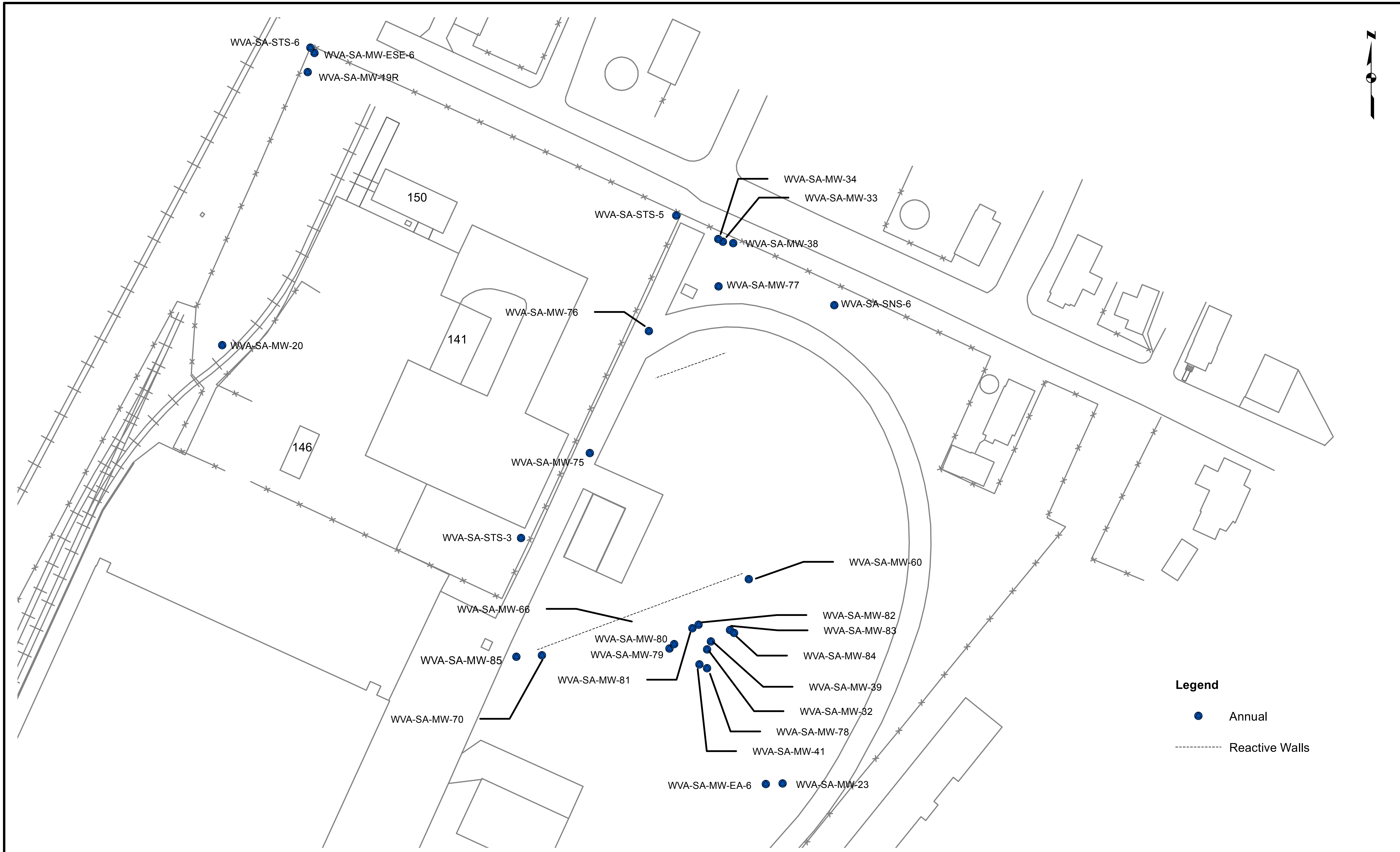
ACCIDENT PREVENTION PLAN
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

MAIN MANUFACTURING AREA GROUNDWATER MONITORING LOCATIONS

PIKA-MP JV, LLC

JUNE 2016

FIGURE 2-3



US Army Corps of Engineers

ACCIDENT PREVENTION PLAN
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

SIBERIA AREA
GROUNDWATER MONITORING LOCATIONS

PIKA-MP JV, LLC

JUNE 2016

FIGURE 2-4

Attachment 1

Accident Prevention Plan Forms

ARCADIS

Control Number:TGM - ______________________________

TGM + *project number plus date as follows: xxxxxxxx.xxxx.xxxxx - dd/mm/year*

TAILGATE HEALTH & SAFETY MEETING FORM

Project Name:			**Project Location:**
Date:	**Time:**	**Conducted by:**	**Signature/Title:**

Issues or concerns from previous day's activities:

Task anticipated to be performed today:

☐ Additonal permits or checklists attached

USE TRACK! Evaluate the hazards (h) for the tasks being performed today and rank as Low (L), Medium (M) or High (H). Use relevant JLAs, FHSHB, permit or other work standard to communicate controls (c) to be used to eliminate or mitigate identified hazards.

☐ Gravity (i.e., ladder, scaffold, trips) (L M H) h: ______ c: ______	☐ Motion (i.e., traffic, moving water) (L M H) h: ______ c: ______	☐ Mechanical (i.e., augers, motors) (L M H) h: ______ c: ______
☐ Electrical (i.e., utilities, lightning) (L M H) h: ______ c: ______	☐ Pressure (i.e., gas cyl., wells) (L M H) h: ______ c: ______	☐ Environment (i.e., heat, cold, ice) (L M H) h: ______ c: ______
☐ Chemical (i.e., fuel, acid, paint) (L M H) h: ______ c: ______	☐ Biological (i.e., ticks, poison ivy) (L M H) h: ______ c: ______	☐ Radiation (i.e., alpha, sun, laser) (L M H) h: ______ c: ______
☐ Sound (i.e., machinery, generators) (L M H) h: ______ c: ______	☐ Personal (i.e. alone, night, not fit) (L M H) h: ______ c: ______	☐ Driving (i.e. car, ATV, boat, dozer) (L M H) h: ______ c: ______

Comments:

Signature and Certification: I have read and understand the project specific HASP for this project.

Printed Name/Signature/Company	Sign In Time	Sign Out Time

I will STOP the job any time anyone is concerned or uncertain about health & safety or if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task hazard assessment.

I will be alert to any changes in personnel, conditions at the work site or hazards not covered by the original hazard assessments.

If it is necessary to **STOP THE JOB,** I will perform **TRACK**; and then amend the hazard assessments or the HASP as needed.

I will not assist a subcontractor or other party with their work unless it is absolutely necessary and then only after I have done TRACK and I have thoroughly controlled the hazard.

All site staff should arrive fit for work. If not, they should report to the supervisor any restrictions or concerns.

In the event of an injury, employees will call **WorkCare at 1.800.455.6155** and then notify the field supervisor.

Utility strike, motor vehicle accident or 3rd party protperty damage - field supervisor will immediately notify the Project or Task Manager

Place any additional signatures on the back of this form.

Daily Health and Safety Inspection Form

Date:________________________ *Time:* ____________________

Location: ____

Personnel Present: ____

*Visitors Present:*____

*Behavior, approach or practice that was found unacceptable:*________________________

*Possible risks, injuries, concerns, deviations from H&S Plan:*_______________________

Anticipated releases to environment or anticipated future Health and Safety risks: ________

*Analysis for, and Implementation of Corrective/Preventative Procedure to Prevent Future Occurrences (to be formulated by SSHO and FOM, approved by PM, and implemented by SSHO):*____

Report made by (Name): __________________________________

SSHP Organization Title: ____________________________

	Health and Safety Program **INCIDENT / NEAR MISS REPORT FORM**	Revision 1: Dec 2010

ADMINISTRATIVE INFORMATION (To be completed by Supervisor)

Corporate Communications US Site Code: Project/Order Number:

☐ **Sub Division**

RBU: SBU:

Region: SBE Director:

Client Sector: Program:

Site or Office: Location/Client Name:

Date/Time of Event: Time Work Started:

Date/Time Supervisor Notified: Employee Submitting Report:

Client Notification Completed (if required)? ☐ Yes ☐ No

TYPE OF EVENT (Check all applicable items)

Illness (Check one)
☐ Employee
☐ Subcontractor
☐ Other

Injury (Check one)
☐ Employee
☐ Subcontractor
☐ Other

Near Miss (Check the potential consequences):
☐ Injury
☐ Equipment Damage
☐ Property Damage
☐ Environmental release
☐ Other (describe)

Property Damage (Check one)
☐ Company (owned, leased, rented)
☐ Client/Customer
☐ Other

Vehicular Accident (Check one)
☐ Company (owned, leased, rented)
☐ Client/Customer
☐ Other

☐ Fire
☐ Explosion
☐ Flash

☐ Other (describe):

EVENT DESCRIPTION

Briefly state the facts contributing to the event. Attach additional pages and supporting information, as necessary. Avoid use of employees' names. *If this is an injury or illness, supply additional information as required on Page 2.*

ROOT CAUSE DETERMINATION

Root Cause (State the root or primary cause, then select the most appropriate cause category from Page 4):

CONTRIBUTING FACTORS

Contributing Causes (Describe any contributing causes, then select the applicable cause categories from Page 4):

CORRECTIVE ACTIONS

List methods of preventing/avoiding this type of incident/near miss in the future. There must be one or more corrective action for each root cause.

NOTE: If this is a near miss report, no further information is required. Submit only the first page of the form. The preferred method of distribution of near miss reports is by e-mail attachment in either Word or scanned to PDF. Forward near miss reports to your Project Manager.

Additional Distribution: ☐ Office/Site Manager ☐ Regional/SBE/SBU HSE Manager ☐ Office/Site HSE Representative

	Health and Safety Program **INCIDENT / NEAR MISS REPORT FORM**	Revision 1: Dec 2010

FOR INJURIES/ILLNESS ONLY

Employee Information (To be completed by affected employee)

Name of Injured/Ill Employee:

Employee Number: Contact Phone Number:

What was your location when the injury/illness occurred?

What were you doing when the injury/illness occurred? Describe the activity as well as the tools, equipment, or material you were using.

What happened? Describe how the injury/illness occurred.

What was the injury or illness? Describe the part of the body that was affected and how it was affected. Use the Body Part pick list on Page 4 to aid in your description.

What level of medical treatment did you receive? ☐ First Aid ☐ Clinic/Physician ☐ Emergency Room ☐ Refused/None

List witnesses and/or other employees involved. Attach statements where applicable.

Do you feel provided you with the proper safety instructions (including PPE usage) for the task you were performing at the time of the incident? ☐ Yes ☐ No (Explain below)

How do you think this type of incident could be prevented or avoided in the future?

Mark all PPE being used when the incident occurred:

☐ Safety Glasses	☐ Safety Goggles	☐ Face Shield	☐ Safety Shoes
☐ Half-face Respirator	☐ Full-face Respirator	☐ Protective Gloves	☐ Chemical Gloves
☐ Hard Hat	☐ Hearing Protection	☐ Other (describe):	

Employee Signature: Date:

Additional Sheets Attached? ☐ Yes ☐ No (Include photos, maps, and/or diagrams when possible.)

	Health and Safety Program **INCIDENT / NEAR MISS REPORT FORM**	Revision 1: Dec 2010

Supervisor Information (To be completed by affected employee's supervisor)

Describe any additional/different details other than those provided by employee. Avoid use of employees' names, where possible. Attach additional sheets, drawings, or photos, as needed.

Were the required tools available at the time of the injury? ☐ Yes ☐ No (Explain below)

At the time of the injury, was the employee using the correct tools for the task? ☐ Yes ☐ No (Explain below)

Was the employee sent for substance screening? ☐ Yes ☐ No (Explain below)

How do you think this type of incident could be prevented or avoided in the future?

Supervisor Signature: Date:

Additional Sheets Attached? ☐ Yes ☐ No (Include photos, maps, and/or diagrams when possible.)

HSE Representative Comments

Signature: Date:

Additional Sheets Attached? ☐ Yes ☐ No (Include photos, maps, and/or diagrams when possible.)

Site/Office Manager Comments

Signature: Date:

Additional Sheets Attached? ☐ Yes ☐ No (Include photos, maps, and/or diagrams when possible.)

DISTRIBUTION

NOTE: If this is a near miss report, no further information is required. Submit only the first page of the form. The preferred method of distribution of near miss reports is by e-mail attachment in either Word or scanned to PDF. Forward near miss reports to your Project Manager.

Additional Distribution: ☐ Program Manager ☐ Regional Manager
☐ Office HSE Representative

INCIDENT / NEAR MISS REPORT FORM

CAUSE CATEGORIES

Check all cause categories, which apply to the incident/near miss, then choose the root cause (or causes) category from the boxes checked. Enter where indicated on Page 1.

PHYSICAL/ENVIRONMENT
- ☐ Extreme cold/ice
- ☐ Extreme heat
- ☐ Working/walking surface unfavorable
- ☐ Inadequate lighting
- ☐ Excessive noise
- ☐ Chemical exposure
- ☐ Biological hazards (animal/plant)
- ☐ Other weather
- ☐ Other

SYSTEMS
- ☐ Inadequate training/instruction
- ☐ Inadequate management system
- ☐ Missing or incorrect procedures or planning
- ☐ Inadequate management emphasis on safety
- ☐ Corporate/operations procedures not communicated
- ☐ Other

PHYSICAL/EQUIPMENT, TOOLS, and PPE
- ☐ Failure due to improper maintenance
- ☐ Failure due to improper design
- ☐ Other

HUMAN
- ☐ Failure to adequately recognize hazards
- ☐ Failure to follow procedures
- ☐ Failure to recognize condition change
- ☐ Impaired state (drug, alcohol, other)
- ☐ Physical/psychological limitation for task
- ☐ Inadequate communications (i.e., supervisor/employee)
- ☐ Carelessness by affected person(s)
- ☐ Carelessness by other person(s)
- ☐ Improper selection of equipment/tool/PPE
- ☐ Improper use of equipment/tool/PPE
- ☐ Other

BODY PART PICK LIST

ANKLE/FOOT
- ☐ Ankle
- ☐ Foot
- ☐ Great Toe
- ☐ Toe(s)

BACK
- ☐ Back (All Other)
- ☐ Cervical
- ☐ Disc (Back)
- ☐ Disc (Neck)
- ☐ Low Back Area (Incl. Lumbar & Lumbo-Sacral)
- ☐ Lumbar and/or Sacral Vertebrae
- ☐ Multiple Neck Injury
- ☐ Soft Tissue-Neck
- ☐ Spinal Cord
- ☐ Upper Back Area (Thoracic Area)
- ☐ Vertebrae

EYE
- ☐ Eye(s)

HEAD/FACE
- ☐ Brain
- ☐ Ear(s)
- ☐ Face, Multiple Parts
- ☐ Facial Bones
- ☐ Head NEC
- ☐ Jaw
- ☐ Larynx
- ☐ Mouth
- ☐ Multiple Head Injury
- ☐ Nose
- ☐ Other facial soft tissue
- ☐ Scalp
- ☐ Skull
- ☐ Teeth

KNEE/LEG
- ☐ Knee
- ☐ Leg, Multiple
- ☐ Lower Leg
- ☐ Multiple Lower Extremities
- ☐ Upper Leg

MISCELLANEOUS
- ☐ Artificial Appliance (Braces, Etc.)
- ☐ Circulatory System
- ☐ Digestive System
- ☐ Insufficient Info to Identify; Unclassified
- ☐ Nervous System
- ☐ No Physical Injury
- ☐ Stress

MULTIPLE BODY PARTS
- ☐ Body Systems & Multiple Body Systems
- ☐ Multiple Body Parts
- ☐ Muscular-Skeletal System

RESPIRATORY
- ☐ Lung(s)
- ☐ Respiratory System
- ☐ Trachea

TRUNK
- ☐ Abdomen Including Groin
- ☐ Buttocks
- ☐ Chest (Incl. Ribs, Sternum & Soft Tissue)
- ☐ Heart
- ☐ Hip
- ☐ Internal Organs
- ☐ Multiple Trunk
- ☐ Pelvis
- ☐ Sacrum and Coccyx
- ☐ Uro-Genital

UPPER EXTREMITY
- ☐ Arm, Multiple
- ☐ Elbow
- ☐ Finger(s)
- ☐ Forearm
- ☐ Hand
- ☐ Lower Arm
- ☐ Multiple Upper Extremities
- ☐ Shoulder(s)
- ☐ Thumb
- ☐ Upper Arm (Incl. Clavicle & Scapula)
- ☐ Wrist
- ☐ Wrist(s) and Hand(s)

Health and Safety Citation Form

Date: ______________________________ *Time:* ___________________________________

Location: ____

____

Personnel Present: ____

____

____

Visitors Present: ____

____

Emergency or incident causing damage or injury _______________________________________

____

____

____

____

Behavior, approach or practice that was found unacceptable: ___________________________

____

____

____

Possible risks, injuries, concerns, deviations from H&S Plan: __________________________

____

____

____

____

Anticipated releases to environment or anticipated future Health and Safety risks: __________

____

____

____

Analysis for, and Implementation of Corrective/Preventative Procedure to Prevent Future Occurrences (to be formulated by SSHO, approved by PM, and implemented by SSHO): ____

____

____

____

____

____

____

____

Worker response / management disciplinary action to avoid future occurrences:

____

____

Worker Signature: ____

Report made by (Name): ____

SSHP Organization Title: ______________________________

(For Safety Staff only)	REPORT NO.	EROC CODE	UNITED STATES ARMY CORPS OF ENGINEERS ACCIDENT INVESTIGATION REPORT *(For Use of this Form See Help Menu and USACE Suppl to AR 385-40)*	REQUIREMENT CONTROL SYMBOL: CEEC-S-8(R2)

1. ACCIDENT CLASSIFICATION

PERSONNEL CLASSIFICATION	INJURY/ILLNESS/FATAL	PROPERTY DAMAGE	MOTOR VEHICLE INVOLVED	DIVING
GOVERNMENT ☐ CIVILIAN ☐ MILITARY	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ CONTRACTOR	☐	☐ FIRE INVOLVED ☐ OTHER	☐	☐
☐ PUBLIC	☐ FATAL ☐ OTHER		☐	

2. PERSONAL DATA

a. Name *(Last, First, MI)*	b. AGE	c. SEX ☐ MALE ☐ FEMALE	d. SOCIAL SECURITY NUMBER	e. GRADE

f. JOB SERIES/TITLE	g. DUTY STATUS AT TIME OF ACCIDENT	h. EMPLOYMENT STATUS AT TIME OF ACCIDENT
	☐ ON DUTY ☐ TDY ☐ OFF DUTY	☐ ARMY ACTIVE ☐ ARMY RESERVE ☐ VOLUNTEER ☐ PERMANENT ☐ FOREIGN NATIONAL ☐ SEASONAL ☐ TEMPORARY ☐ STUDENT ☐ OTHER *(Specify)* ______

3. GENERAL INFORMATION

a. DATE OF ACCIDENT *(month/day/year)*	b. TIME OF ACCIDENT *(Military time)* hrs	c. EXACT LOCATION OF ACCIDENT	d. CONTRACTOR'S NAME (1) PRIME: (2) SUBCONTRACTOR:

e. CONTRACT NUMBER	f. TYPE OF CONTRACT	g. HAZARDOUS/TOXIC WASTE ACTIVITY
______ ☐ CIVIL WORKS ☐ MILITARY ☐ OTHER *(Specify)* ______	☐ CONSTRUCTION ☐ SERVICE ☐ A/E ☐ DREDGE ☐ OTHER *(Specify)* ______	☐ SUPERFUND ☐ DERP ☐ IRP ☐ OTHER *(Specify)* ______

4. CONSTRUCTION ACTIVITIES ONLY *(Fill in line and corresponding code number in box from list - see help menu)*

a. CONSTRUCTION ACTIVITY	(CODE) #	b. TYPE OF CONSTRUCTION EQUIPMENT	(CODE) #

5. INJURY/ILLNESS INFORMATION *(Include name on line and corresponding code number in box for items e, f & g - see help menu)*

a. SEVERITY OF ILLNESS/INJURY (CODE) #	b. ESTIMATED DAYS LOST	c. ESTIMATED DAYS HOSPIT-ALIZED	d. ESTIMATED DAYS RESTRICTED DUTY

e. BODY PART AFFECTED	g. TYPE AND SOURCE OF INJURY/ILLNESS
PRIMARY ______ (CODE) #	TYPE ______ (CODE) #
SECONDARY ______ (CODE) #	SOURCE ______ (CODE) #
f. NATURE OF ILLNESS/INJURY ______ (CODE) #	

6. PUBLIC FATALITY *(Fill in line and correspondence code number in box - see help menu)*

a. ACTIVITY AT TIME OF ACCIDENT	(CODE) #	b. PERSONAL FLOATATION DEVICE USED? ☐ YES ☐ NO ☐ N/A

7. MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE	b. TYPE OF COLLISION	c. SEAT BELTS	USED	NOT USED	NOT AVAILABLE
☐ PICKUP/VAN ☐ AUTOMOBILE	☐ SIDE SWIPE ☐ HEAD ON ☐ REAR END	(1) FRONT SEAT			
☐ TRUCK ☐ OTHER *(Specify)* ______	☐ BROADSIDE ☐ ROLL OVER ☐ BACKING ☐ OTHER *(Specify)* ______	(2) REAR SEAT			

8. PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM	b. OWNERSHIP	c. $ AMOUNT OF DAMAGE
(1)		
(2)		
(3)		

9. VESSEL/FLOATING PLANT ACCIDENT *(Fill in line and correspondence code number in box from list - see help menu)*

a. TYPE OF VESSEL/FLOATING PLANT	(CODE) #	b. TYPE OF COLLISION/MISHAP	(CODE) #

10. ACCIDENT DESCRIPTION *(Use additional paper, if necessary)*

11. CAUSAL FACTOR(S) *(Read Instruction Before Completing)*

a. (Explain YES answers in item 13)

	YES	NO
DESIGN: Was design of facility, workplace or equipment a factor?	☐	☐
INSPECTION/MAINTENANCE: Were inspection & maintenance procedures a factor?	☐	☐
PERSON'S PHYSICAL CONDITION: In your opinion, was the physical condition of the person a factor?	☐	☐
OPERATING PROCEDURES: Were operating procedures a factor?	☐	☐
JOB PRACTICES: Were any job safety/health practices not followed when the accident occurred?	☐	☐
HUMAN FACTORS: Did any human factors such as, size or strength of person, etc., contribute to accident?	☐	☐
ENVIRONMENTAL FACTORS: Did heat, cold, dust, sun, glare, etc., contribute to the accident?	☐	☐

a. *(CONTINUED)*

	YES	NO
CHEMICAL AND PHYSICAL AGENT FACTORS: Did exposure to chemical agents, such as dust, fumes, mists, vapors or physical agents, such as, noise, radiation, etc., contribute to accident?	☐	☐
OFFICE FACTORS: Did office setting such as, lifting office furniture, carrying, stooping, etc., contribute to the accident?	☐	☐
SUPPORT FACTORS: Were inappropriate tools/resources provided to properly perform the activity/task?	☐	☐
PERSONAL PROTECTIVE EQUIPMENT: Did the improper selection, use or maintenance of personal protective equipment contribute to the accident?	☐	☐
DRUGS/ALCOHOL: In your opinion, was drugs or alcohol a factor to the accident	☐	☐

b. WAS A WRITTEN JOB/ACTIVITY HAZARD ANALYSIS COMPLETED FOR TASK BEING PERFORMED AT TIME OF ACCIDENT?

☐ YES *(If yes, attach a copy.)* ☐ NO

12. TRAINING

a. WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?	b. TYPE OF TRAINING.	c. DATE OF MOST RECENT FORMAL TRAINING.
☐ YES ☐ NO	☐ CLASSROOM ☐ ON JOB	(Month) (Day) (Year)

13. **FULLY EXPLAIN WHAT ALLOWED OR CAUSED THE ACCIDENT; INCLUDE DIRECT AND INDIRECT CAUSES** *(See instruction for definition of direct and indirect causes.) (Use additional paper, if necessary)*

a. DIRECT CAUSE

b. INDIRECT CAUSE(S)

14. ACTION(S) TAKEN, ANTICIPATED OR RECOMMENDED TO ELIMINATE CAUSE(S).

DESCRIBE FULLY:

15. DATES FOR ACTIONS IDENTIFIED IN BLOCK 14.

a. BEGINNING (Month/Day/Year)	b. ANTICIPATED COMPLETION (Month/Day/Year)		
c. SIGNATURE AND TITLE OF SUPERVISOR COMPLETING REPORT CORPS ______ CONTRACTOR ______	d. DATE *(Mo/Da/Yr)*	e. ORGANIZATION IDENTIFIER *(Div, Br, Sect)*	f. OFFICE SYMBOL

16. MANAGEMENT REVIEW *(1st)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

17. MANAGEMENT REVIEW *(2nd - Chief Operations, Construction, Engineering, etc.)*

a. ☐ CONCUR b. ☐ NON CONCUR c. COMMENTS

SIGNATURE	TITLE	DATE

18. SAFETY AND OCCUPATIONAL HEALTH OFFICE REVIEW

a. ☐ CONCUR b. ☐ NON CONCUR c. ADDITIONAL ACTIONS/COMMENTS

SIGNATURE	TITLE	DATE

19. COMMAND APPROVAL

COMMENTS

COMMANDER SIGNATURE	DATE

*U.S. GOVERNMENT PRINTING OFFICE: 1993-0-791-757

10. ACCIDENT DESCRIPTION *(Continuation)*

13a. DIRECT CAUSE *(Continuation)*

13b.	INDIRECT CAUSES *(Continuation)*

14.	ACTION(S) TAKEN, ANTICIPATED, OR RECOMMENDED TO ELIMINATE CAUSE(S) *(Continuation)*

GENERAL. Complete a separate report for each person who was injured, caused, or contributed to the accident (excluding uninjured personnel and witnesses). Use of this form for reporting USACE employee first-aid type injuries not submitted to the Office of Workers' Compensation Programs (OWCP) shall be at the descretion of the FOA commander. Please type or print legibly. Appropriate items shall be marked with an "X" in box(es). If additional space is needed, provide the information on a separate sheet and attach to the completed form. Ensure that these instructions are forwarded with the completed report to the designated management reviewers indicated in sections 16 and 17.

INSTRUCTIONS FOR SECTION 1 - ACCIDENT CLASSIFICATION

(Mark All Boxes That Are Applicable)

a. GOVERNMENT. Mark "CIVILIAN" box if accident involved government civilian employee; mark "MILITARY" box if accident involved U.S. military personnel.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in any government civilian employee injury, illness, or fatality that requires the submission of OWCP Forms CA-1 (injury), CA-2 (illness) or CA-6 (fatality) to OWCP; mark if accident resulted in military personnel lost-time or fatal injury or illness.

(2) PROPERTY DAMAGE - Mark the appropriate box if accident resulted in any damage of $1000 or more to government property (including motor vehicles).

(3) VEHICLE INVOLVED - Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY - Mark if the accident involved an in-house USACE diving activity.

b. CONTRACTOR.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in any contractor lost-time injury/illness or fatality.

(2) PROPERTY DAMAGE - Mark the appropriate box if accident resulted in any damage of $1000 or more to contractor property (including motor vehicles).

(3) VEHICLE INVOLVED - Mark if accident involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" or "PROPERTY DAMAGE" are marked.

(4) DIVING ACTIVITY - Mark if the accident involved a USACE Contractor diving activity.

c. PUBLIC.

(1) INJURY/ILLNESS/FATALITY - Mark if accident resulted in public fatality or permanent total disability. (The "OTHER" box will be marked when requested by the FOA to report an unusual non-fatal public accident that could result in claims against the government or as otherwise directed by the FOA Commander).

(2) VOID SPACE - Make no entry.

(3) VEHICLE INVOLVED - Mark if accident resulted in a fatality to a member of the public and involved a motor vehicle, regardless of whether "INJURY/ILLNESS/FATALITY" is marked.

(4) VOID SPACE - Make no entry.

INSTRUCTIONS FOR SECTION 2 - PERSONAL DATA

a. NAME - (MANDATORY FOR GOVERNMENT ACCIDENTS. OPTIONAL AT THE DISCRETION OF THE FOA COMMANDER FOR CONTRACTOR AND PUBLIC ACCIDENTS). Enter last name, first name, middle initial of person involved.

b. AGE - Enter age.

c. SEX - Mark appropriate box.

d. SOCIAL SECURITY NUMBER - (FOR GOVERNMENT PERSONNEL ONLY) Enter the social security number (or other personal identification number if no social security number issued).

e. GRADE - (FOR GOVERNMENT PERSONNEL ONLY) Enter pay grade. Example: 0-6; E-7; WG-8; WS-12; GS-11; etc.

f. JOB SERIES/TITLE - For government civilian employees enter the pay plan, full series number, and job title, e.g., GS-0810/Civil Engineer. For military personnel enter the primary military occupational specialty (PMOS), e.g., 15A30 or 11G50. For contractor employees enter the job title assigned to the injured person, e.g., carpenter, laborer, surveyor, etc.

g. DUTY STATUS - Mark the appropriate box.

(1) ON DUTY - Person was at duty station during duty hours or person was away from duty station during duty hours but on official business at time of the accident.

(2) TDY - Person was on official business, away from the duty station and with travel orders at time of accident. Line-of-duty investigation required.

(3) OFF DUTY - Person was not on official business at time of accident.

h. EMPLOYMENT STATUS - (FOR GOVERNMENT PERSONNEL ONLY) Mark the most appropriate box. If "OTHER" is marked, specify the employment status of the person.

INSTRUCTION FOR SECTION 3 - GENERAL INFORMATION

a. DATE OF ACCIDENT - Enter the month, day, and year of accident.

b. TIME OF ACCIDENT - Enter the local time of accident in military time. Example: 1430 hrs (not 2:30 p.m.).

c. EXACT LOCATION OF ACCIDENT - Enter facts needed to locate the accident scene, (installation/project name, building number, street, direction and distance from closest landmark, etc.).

d. CONTRACTOR NAME

(1) PRIME - Enter the exact name (title of firm) of the prime contractor.

(2) SUBCONTRACTOR - Enter the name of any subcontractor involved in the accident.

e. CONTRACT NUMBER - Mark the appropriate box to identify if contract is civil works, military, or other: if "OTHER" is marked, specify contract appropriation on line provided. Enter complete contract number of prime contract, e.g., DACW 09-85-C-0100.

f. TYPE OF CONTRACT - Mark appropriate box. A/E means architect/engineer. If "OTHER" is marked, specify type of contract on line provided.

g. HAZARDOUS/TOXIC WASTE ACTIVITY (HTW) - Mark the box to identify the HTW activity being performed at the time of the accident. For Superfund, DERP, and Installation Restoration Program (IRP) HTW activities include accidents that occurred during inventory, predesign, design, and construction. For the purpose of accident reporting, DERP Formerly Used DoD Site (FUDS) activities and IRP activities will be treated separately. For Civil Works O&M HTW activities mark the "OTHER" box.

INSTRUCTIONS FOR SECTION 4 - CONSTRUCTION ACTIVITIES

a. CONSTRUCTION ACTIVITY - Select the most appropriate construction activity being performed at time of accident from the list below. Enter the activity name and place the corresponding code number identified in the box.

CONSTRUCTION ACTIVITY LIST

1. MOBILIZATION	14. ELECTRICAL
2. SITE PREPARATION	15. SCAFFOLDING/ACCESS
3. EXCAVATION/TRENCHING	16. MECHANICAL
4. GRADING (EARTHWORK)	17. PAINTING
5. PIPING/UTILITIES	18. EQUIPMENT/MAINTENANCE
6. FOUNDATION	19. TUNNELING
7. FORMING	20. WAREHOUSING/STORAGE
8. CONCRETE PLACEMENT	21. PAVING
9. STEEL ERECTION	22. FENCING
10. ROOFING	23. SIGNING
11. FRAMING	24. LANDSCAPING/IRRIGATION
12. MASONRY	25. INSULATION
13. CARPENTRY	26. DEMOLITION

b. TYPE OF CONSTRUCTION EQUIPMENT - Select the equipment involved in the accident from the list below. Enter the name and place the corresponding code number identified in the box. If equipment is not included below, use code 24, "OTHER", and write in specific type of equipment.

CONSTRUCTION EQUIPMENT

1. GRADER	13. DUMP TRUCK (OFF HIGHWAY)
2. DRAGLINE	14. TRUCK (OTHER)
3. CRANE (ON VESSEL/BARGE)	15. FORKLIFT
4. CRANE (TRACKED)	16. BACKHOE
5. CRANE (RUBBER TIRE)	17. FRONT-END LOADER
6. CRANE (VEHICLE MOUNTED)	18. PILE DRIVER
7. CRANE (TOWER)	19. TRACTOR (UTILITY)
8. SHOVEL	20. MANLIFT
9. SCRAPER	21. DOZER
10. PUMP TRUCK (CONCRETE)	22. DRILL RIG
11. TRUCK (CONCRETE/TRANSIT MIXER)	23. COMPACTOR/VIBRATORY ROLLER
12. DUMP TRUCK (HIGHWAY)	24. OTHER

INSTRUCTIONS FOR SECTION 5 - INJURY/ILLNESS INFORMATION

a. SEVERITY OF INJURY/ILLNESS - Reference para 2-10 of USACE Suppl 1 to AR 385-40 and enter code and description from list below.

NOI	NO INJURY
FAT	FATALITY
PTL	PERMANENT TOTAL DISABILITY
PPR	ERMANENT PARTIAL DISABILITY
LWD	LOST WORKDAY CASE INVOLVING DAYS AWAY FROM WORK
NLW	RECORDABLE CASE WITHOUT LOST WORKDAYS
RFA	RECORDABLE FIRST AID CASE

b. ESTIMATED DAYS LOST - Enter the estimated number of workdays the person will lose from work.

c. ESTIMATED DAYS HOSPITALIZED - Enter the estimated number of workdays the person will be hospitalized.

d. ESTIMATED DAYS RESTRICTED DUTY - Enter the estimated number of workdays the person, as a result of the accident, will not be able to perform all of their regular duties.

e. BODY PART AFFECTED - Select the most appropriate primary and when applicable, secondary body part affected from the list below. Enter body part name on line and place the corresponding code letters identifying that body part in the box.

GENERAL BODY AREA	CODE	BODY PART NAME
ARM/WRIST	AB	ARM AND WRIST
	AS	ARM OR WRIST
TRUNK, EXTERNAL MUSCULATURE	B1	SINGLE BREAST
	B2	BOTH BREASTS
	B3	SINGLE TESTICLE
	B4	BOTH TESTICLES
	BA	ABDOMEN
	BC	CHEST
	BL	LOWER BACK
	BP	PENIS
	BS	SIDE
	BU	UPPER BACK
	BW	WAIST
	BZ	TRUNK OTHER
HEAD, INTERNAL	C1	SINGLE EAR INTERNAL
	C2	BOTH EARS INTERNAL
	C3	SINGLE EYE INTERNAL
	C4	BOTH EYES INTERNAL
	CB	BRAIN
	CC	CRANIAL BONES
	CD	TEETH
	CJ	JAW
	CL	THROAT, LARYNX
	CM	MOUTH
	CN	NOSE
	CR	THROAT, OTHER
	CT	TONGUE
	CZ	HEAD OTHER INTERNAL
ELBOW	EB	BOTH ELBOWS
	ES	SINGLE ELBOW
FINGER	F1	FIRST FINGER
	F2	BOTH FIRST FINGERS
	F3	SECOND FINGER
	F4	BOTH SECOND FINGERS
	F5	THIRD FINGER
	F6	BOTH THIRD FINGERS
	F7	FOURTH FINGER
	F8	BOTH FOURTH FINGERS
TOE	G1	GREAT TOE
	G2	BOTH GREAT TOES
	G3	TOE OTHER
	G4	TOES OTHER

GENERAL BODY AREA	CODE	BODY PART NAME
HEAD, EXTERNAL	**H1**	**EYES EXTERNAL**
	H2	**BOTH EYES EXTERNAL**
	H3	**EAR EXTERNAL**
	H4	**BOTH EARS EXTERNAL**
	HC	**CHIN**
	HF	**FACE**
	HK	**NECK/THROAT**
	HM	**MOUTH/LIPS**
	HN	**NOSE**
	HS	**SCALP**
KNEE	**KB**	**BOTH KNEES**
	KS	**KNEE**
LEG, HIP, ANKLE, BUTTOCK	**LB**	**BOTH LEGS/HIPS/ ANKLES/BUTTOCKS**
	LS	**SINGLE LEG/HIP ANKLE/BUTTOCK**
HAND	**MB**	**BOTH HANDS**
	MS	**SINGLE HAND**
FOOT	**PB**	**BOTH FEET**
	PS	**SINGLE FOOT**
TRUNK, BONES	**R1**	**SINGLE COLLAR BONE**
	R2	**BOTH COLLAR BONES**
	R3	**SHOULDER BLADE**
	R4	**BOTH SHOULDER BLADES**
	RB	**RIB**
	RS	**STERNUM (BREAST BONE)**
	RV	**VERTEBRAE (SPINE; DISC)**
	RZ	**TRUNK BONES OTHER**
SHOULDER	**SB**	**BOTH SHOULDERS**
	SS	**SINGLE SHOULDER**
THUMB	**TB**	**BOTH THUMBS**
	TS	**SINGLE THUMB**
TRUNK, INTERNAL ORGANS	**V1**	**LUNG, SINGLE**
	V2	**LUNGS, BOTH**
	V3	**KIDNEY, SINGLE**
	V4	**KIDNEYS, BOTH**
	VH	**HEART**
	VL	**LIVER**
	VR	**REPRODUCTIVE ORGANS**
	VS	**STOMACH**
	VV	**INTESTINES**
	VZ	**TRUNK, INTERNAL; OTHER**

f. NATURE OF INJURY/ILLNESS - Select the most appropriate nature of injury/illness from the list below. This nature of injury/illness shall correspond to the primary body part selected in 5e, above. Enter the nature of injury/illness name on the line and place the corresponding CODE letters in the box provided.

*** The injury or condition selected below must be caused by a specific incident or event which occurred during a single work day or shift.**

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
***TRAUMATIC INJURY OR DISABILITY**	**TA**	**AMPUTATION**
	TB	**BACK STRAIN**
	TC	**CONTUSION; BRUISE; ABRASION**
	TD	**DISLOCATION**
	TF	**FRACTURE**
	TH	**HERNIA**
	TK	CONCUSSION
	TL	LACERATION, CUT
	TP	PUNCTURE
	TS	STRAIN, MULTIPLE
	TU	BURN, SCALD, SUNBURN
	TI	TRAUMATIC SKIN DISEASES/CONDITIONS INCLUDING DERMATITIS
	TR	TRAUMATIC RESPIRATORY DISEASE
	TQ	TRAUMATIC FOOD POISONING
	TW	TRAUMATIC TUBERCULOSIS
	TX	TRAUMATIC VIROLOGICAL/ INFECTIVE/PARASITIC DISEASE
	T1	TRAUMATIC CEREBRAL VASCULAR CONDITION/STROKE
	T2	TRAUMATIC HEARING LOSS
	T3	TRAUMATIC HEART CONDITION
	T4	TRAUMATIC MENTAL DISORDER, STRESS; NERVOUS CONDITION
	T8	TRAUMATIC INJURY - OTHER (EXCEPT DISEASE, ILLNESS)

** A nontraumatic physiological harm or loss of capacity produced by systemic infection; continued or repeated stress or strain; exposure to toxins, poisons, fumes, etc.; or other continued and repeated exposures to conditions of the work environment over a long period of time. For practical purposes, an occupational illness/disease or disability is any reported condition which does not meet the definition of traumatic injury or disability as described above.

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
**NON-TRAUMATIC ILLNESS/DISEASE OR DISABILITY		
RESPIRATORY DISEASE	RA	ASBESTOSIS
	RB	BRONCHITIS
	RE	EMPHYSEMA
	RP	PNEUMOCONIOSIS
	RS	SILICOSIS
	R9	RESPIRATORY DISEASE, OTHER
VIROLOGICAL, INFECTIVE & PARASITIC DISEASES	VB	BRUCELLOSIS
	VC	COCCIDIOMYCOSIS
	VF	FOOD POISONING
	VH	HEPATITIS
	VM	MALARIA
	VS	STAPHYLOCOCCUS
	VT	TUBERCULOSIS
	V9	VIROLOGICAL/INFECTIVE/ PARASITIC - OTHER
DISABILITY, OCCU- PATIONAL	DA	ARTHRITIS, BURSITIS
	DB	BACK STRAIN, BACK SPRAIN
	DC	CEREBRAL VASCULAR CONDITION; STROKE

GENERAL NATURE CATEGORY	CODE	NATURE OF INJURY NAME
	DD	ENDEMIC DISEASE (OTHER THAN CODE TYPES R&S)
	DE	EFFECT OF ENVIRON-MENTAL CONDITION
	DH	HEARING LOSS
	DK	HEART CONDITION
	DM	MENTAL DISORDER, EMOTIONAL STRESS, NERVOUS
CONDITION		
	DR	RADIATION
	DS	STRAIN, MULTIPLE
	DU	ULCER
	DV	OTHER VASCULAR CONDITIONS
	D9	DISABILITY, OTHER
SKIN DISEASE OR CONDITION	SB	BIOLOGICAL
	SC	CHEMICAL
	S9	DERMATITIS, UNCLASSIFIED

g. TYPE AND SOURCE OF INJURY/ILLNESS (CAUSE) - Type and Source Codes are used to describe what caused the incident. The Type Code stands for an ACTION and the Source Code for an OBJECT or SUBSTANCE. Together, they form a brief description of how the incident occurred. Where there are two different sources, code the initiating source of the incident (see example 1, below). Examples:

(1) An employee tripped on carpet and struck his head on a desk.
TYPE: 210 (fell on same level) SOURCE: 0110 (walking/working surface).

NOTE: This example would NOT be coded 120 (struck against) and 0140 (furniture).

(2) A Park Ranger contracted dermatitis from contact with poison ivy/oak.
TYPE: 510 (contact) SOURCE: 0920 (plant)

(3) A lock and dam mechanic punctured his finger with a metal sliver while grinding a turbine blade.
TYPE: 410 (punctured by) SOURCE: 0830 (metal)

(4) An employee was driving a government vehicle when it was struck by another vehicle.
TYPE: 800 (traveling in) SOURCE: 0421 (government-owned vehicle, as driver)

NOTE: The Type Code 800, "Traveling In" is different from the other type codes in that its function is not to identify factors contributing to the injury or fatality, but rather to collect data on the type of vehicle the employee was operating or traveling in at the time of the incident.

Select the most appropriate TYPE and SOURCE identifier from the list below and enter the name on the line and the corresponding code in the appropriate box.

CODE	TYPE OF INJURY NAME
	STRUCK
0110	STRUCK BY
0111	STRUCK BY FALLING OBJECT
0120	STRUCK AGAINST
	FELL, SLIPPED, TRIPPED
0210	FELL ON SAME LEVEL
0220	FELL ON DIFFERENT LEVEL
0230	SLIPPED, TRIPPED (NO FALL)
	CAUGHT
0310	CAUGHT ON
0320	CAUGHT IN
0330	CAUGHT BETWEEN
	PUNCTURED, LACERATED
0410	PUNCTURED BY
0420	CUT BY
0430	STUNG BY
0440	BITTEN BY
	CONTACTED
0510	CONTACTED WITH (INJURED PERSON MOVING)
0520	CONTACTED BY (OBJECT WAS MOVING)
	EXERTED
0610	LIFTED, STRAINED BY (SINGLE ACTION)
0620	STRESSED BY (REPEATED ACTION)
	EXPOSED
0710	INHALED
0720	INGESTED
0730	ABSORBED
0740	EXPOSED TO
0800	TRAVELING IN

CODE	SOURCE OF INJURY NAME
0100	BUILDING OR WORKING AREA
0110	WALKING/WORKING SURFACE (FLOOR, STREET, SIDEWALKS, ETC.)
0120	STAIRS, STEPS
0130	LADDER
0140	FURNITURE, FURNISHINGS, OFFICE EQUIPMENT
0150	BOILER, PRESSURE VESSEL
0160	EQUIPMENT LAYOUT (ERGONOMIC)
0170	WINDOWS, DOORS
0180	ELECTRICITY
0200	ENVIRONMENTAL CONDITION
0210	TEMPERATURE EXTREME (INDOOR)
0220	WEATHER (ICE, RAIN, HEAT, ETC.)
0230	FIRE, FLAME, SMOKE (NOT TOBACCO)
0240	NOISE
0250	RADIATION
0260	LIGHT
0270	VENTILATION
0271	TOBACCO SMOKE
0280	STRESS (EMOTIONAL)
0290	CONFINED SPACE
0300	MACHINE OR TOOL
0310	HAND TOOL (POWERED; SAW, GRINDER, ETC.)
0320	HAND TOOL (NONPOWERED)
0330	MECHANICAL POWER TRANSMISSION APPARATUS
0340	GUARD, SHIELD (FIXED, MOVEABLE, INTERLOCK)

CODE	TYPE OF INJURY NAME
0350	VIDEO DISPLAY TERMINAL
0360	PUMP, COMPRESSOR, AIR PRESSURE TOOL
0370	HEATING EQUIPMENT
0380	WELDING EQUIPMENT
0400	VEHICLE
0411	AS DRIVER OF PRIVATELY OWNED/RENTAL VEHICLE
0412	AS PASSENGER OF PRIVATELY OWNED/RENTAL VEHICLE
0421	DRIVER OF GOVERNMENT VEHICLE
0422	PASSENGER OF GOVERNMENT VEHICLE
0430	COMMON CARRIER (AIRLINE, BUS, ETC.)
0440	AIRCRAFT (NOT COMMERCIAL)
0450	BOAT, SHIP, BARGE
0500	MATERIAL HANDLING EQUIPMENT
0510	EARTHMOVER (TRACTOR, BACKHOE, ETC.)
0520	CONVEYOR (FOR MATERIAL AND EQUIPMENT)
0530	ELEVATOR, ESCALATOR, PERSONNEL HOIST
0540	HOIST, SLING CHAIN, JACK
0550	CRANE
0551	FORKLIFT
0560	HANDTRUCK, DOLLY
0600	DUST, VAPOR, ETC.
0610	DUST (SILICA, COAL, ETC.)
0620	FIBERS
0621	ASBESTOS
0630	GASES
0631	CARBON MONOXIDE
0640	MIST, STEAM, VAPOR, FUME
0641	WELDING FUMES
0650	PARTICLES (UNIDENTIFIED)
0700	CHEMICAL, PLASTIC, ETC.
0711	DRY CHEMICAL - CORROSIVE
0712	DRY CHEMICAL - TOXIC
0713	DRY CHEMICAL - EXPLOSIVE
0714	DRY CHEMICAL FLAMMABLE
0721	LIQUID CHEMICAL - CORROSIVE
0722	LIQUID CHEMICAL - TOXIC
0723	LIQUID CHEMICAL - EXPLOSIVE
0724	LIQUID CHEMICAL - FLAMMABLE
0730	PLASTIC
0740	WATER
0750	MEDICINE
0800	INAMINATE OBJECT
0810	BOX, BARREL, ETC.
0820	PAPER
0830	METAL ITEM, MINERAL
0831	NEEDLE
0840	GLASS

CODE	SOURCE OF INJURY NAME
0850	SCRAP, TRASH
0860	WOOD
0870	FOOD
0880	CLOTHING, APPAREL, SHOES
0900	ANIMATE OBJECT
0911	DOG
0912	OTHER ANIMAL
0920	PLANT
0930	INSECT
0940	HUMAN (VIOLENCE)
0950	HUMAN (COMMUNICABLE DISEASE)
0960	BACTERIA, VIRUS (NOT HUMAN CONTACT)
1000	PERSONAL PROTECTIVE EQUIPMENT
1010	PROTECTIVE CLOTHING, SHOES, GLASSES, GOGGLES
1020	RESPIRATOR, MASK
1021	DIVING EQUIPMENT
1030	SAFETY BELT, HARNESS
1040	PARACHUTE

INSTRUCTIONS FOR SECTION 6 - PUBLIC FATALITY

a. ACTIVITY AT TIME OF ACCIDENT - Select the activity being performed at the time of the accident from the list below. Enter the activity name on the line and the corresponding number in the box. If the activity performed is not identified on the list, select from the most appropriate primary activity area (water related, non-water related or other activity), the code number for "Other", and write in the activity being performed at the time of the accident.

WATER RELATED RECREATION

1. Sailing
2. Boating-powered
3. Boating-unpowered
4. Water skiing
5. Fishing from boat
6. Fishing from bank dock or pier
7. Fishing while wading
8. Swimming/supervised area
9. Swimming/designated area
10. Swimming/other area
11. Underwater activities (skin diving, scuba, etc.)
12. Wading
13. Attempted rescue
14. Hunting from boat
15. Other

NON-WATER RELATED RECREATION

16. Hiking and walking
17. Climbing (general)
18. Camping/picnicking authorized area
19. Camping/picnicking unauthorized area
20. Guided tours
21. Hunting
22. Playground equipment
23. Sports/summer (baseball, football, etc.)
24. Sports/winter (skiing, sledding, snowmobiling etc.)
25. Cycling (bicycle, motorcycle, scooter)
26. Gliding
27. Parachuting
28. Other non-water related

OTHER ACTIVITIES

29. Unlawful acts (fights, riots, vandalism, etc.)
30. Food preparation/serving
31. Food consumption
32. Housekeeping
33. Sleeping
34. Pedestrian struck by vehicle
35. Pedestrian other acts
36. Suicide
37. "Other" activities

b. PERSONAL FLOTATION DEVICE USED - If fatality was water-related was the victim wearing a person flotation device? Mark the appropriate box.

INSTRUCTIONS FOR SECTION 7 - MOTOR VEHICLE ACCIDENT

a. TYPE OF VEHICLE - Mark appropriate box for each vehicle involved. If more than one vehicle of the same type is involved, mark both halves of the appropriate box. USACE vehicle(s) involved shall be marked in left half of appropriate box.

b. TYPE OF COLLISION - Mark appropriate box.

c. SEAT BELT - Mark appropriate box.

INSTRUCTIONS FOR SECTION 8 - PROPERTY/MATERIAL INVOLVED

a. NAME OF ITEM - Describe all property involved in accident. Property/material involved means material which is damaged or whose use or misuse contributed to the accident. Include the name, type, model; also include the National Stock Number (NSN) whenever applicable.

b. OWNERSHIP - Enter ownership for each item listed. (Enter one of the following: USACE; OTHER GOVERNMENT; CONTRACTOR; PRIVATE)

c. $ AMOUNT OF DAMAGE - Enter the total estimated dollar amount of damage (parts and labor), if any.

INSTRUCTIONS FOR SECTION 9 - VESSEL/ FLOATING PLANT ACCIDENT

a. TYPE OF VESSEL/FLOATING PLANT - Select the most appropriate vessel/floating plant from list below. Enter name and place corresponding number in box. If item is not listed below, enter item number for "OTHER" and write in specific type of vessel floating plant.

VESSEL/FLOATING PLANTS

1. ROW BOAT
2. SAIL BOAT
3. MOTOR BOAT
4. BARGE
5. DREDGE/HOPPER
6. DREDGE/SIDE CASTING
7. DREDGE/DIPPER
8. DREDGE/CLAMSHELL, BUCKET
9. DREDGE/PIPE LINE
10. DREDGE/DUST PAN
11. TUG BOAT
12. OTHER

b. COLLISION/MISHAP - Select from the list below the object(s) that contributed to the accident or were damaged in the accident.

COLLISION/MISHAP

1. COLLISION W/OTHER VESSEL
2. UPPER GUIDE WALL
3. UPPER LOCK GATES
4. LOCK WALL
5. LOWER LOCK GATES
6. LOWER GUIDE WALL
7. HAULAGE UNIT
8. BREAKING TOW
9. TOW BREAKING UP
10. SWEPT DOWN ON DAM
11. BUOY/DOLPHIN/CELL
12. WHARF OR DOCK
13. OTHER

INSTRUCTIONS FOR SECTION 10 - ACCIDENT DESCRIPTION

DESCRIBE ACCIDENT - Fully describe the accident. Give the sequence of events that describe what happened leading up to and including the accident. Fully identify personnel and equipment involved and their role(s) in the accident. Ensure that relationships between personnel and equipment are clearly specified. Continue on blank sheets if necessary and attach to this report.

INSTRUCTIONS FOR SECTION 11 - CAUSAL FACTORS

a. Review thoroughly. Answer each question by marking the appropriate block. If any answer is yes, explain in item 13 below. Consider, as a minimum, the following:

(1) DESIGN - Did inadequacies associated with the building or work site play a role? Would an improved design or layout of the equipment or facilities reduce the likelihood of similar accidents? Were the tools or other equipment designed and intended for the task at hand?

(2) INSPECTION/MAINTENANCE - Did inadequately or improperly maintained equipment, tools, workplace, etc. create or worsen any hazards that contributed to the accident? Would better equipment, facility, work site or work activity inspections have helped avoid the accident?

(3) PERSON'S PHYSICAL CONDITION - Do you feel that the accident would probably not have occurred if the employee was in "good" physical condition? If the person involved in the accident had been in better physical condition, would the accident have been less severe or avoided altogether? Was over exertion a factor?

(4) OPERATING PROCEDURES - Did a lack of or inadequacy within established operating procedures contribute to the accident? Did any aspect of the procedures introduce any hazard to, or increase the risk associated with the work process? Would establishment or improvement of operating procedures reduce the likelihood of similar accidents?

(5) JOB PRACTICES - Were any of the provisions of the Safety and Health Requirements Manual (EM 385-1-1) violated? Was the task being accomplished in a manner which was not in compliance with an established job hazard analysis or activity hazard analysis? Did any established job practice (including EM 385-1-1) fail to adequately address the task or work process? Would better job practices improve the safety of the task?

(6) HUMAN FACTORS - Was the person under undue stress (either internal or external to the job)? Did the task tend toward overloading the capabilities of the person; i.e., did the job require tracking and reacting to many external inputs such as displays, alarms, or signals? Did the arrangement of the workplace tend to interfere with efficient task performance? Did the task require reach, strength, endurance, agility, etc., at or beyond the capabilities of the employee? Was the work environment ill-adapted to the person? Did the person need more training, experience, or practice in doing the task? Was the person inadequately rested to perform safely?

(7) ENVIRONMENTAL FACTORS - Did any factors such as moisture, humidity, rain, snow, sleet, hail, ice, fog, cold, heat, sun, temperature changes, wind, tides, floods, currents, dust, mud, glare, pressure changes, lightning, etc., play a part in the accident?

(8) CHEMICAL AND PHYSICAL AGENT FACTORS - Did exposure to chemical agents (either single shift exposure or long-term exposure) such as dusts, fibers (asbestos, etc.), silica, gases (carbon monoxide, chlorine, etc.,), mists, steam, vapors, fumes, smoke, other particulates, liquid or dry chemicals that are corrosive, toxic, explosive or flammable, byproducts of combustion or physical agents such as noise, ionizing radiation, non-ionizing radiation (UV radiation created during welding, etc.) contribute to the accident/incident?

(9) **OFFICE FACTORS** - Did the fact that the accident occurred in an office setting or to an office worker have a bearing on its cause? For example, office workers tend to have less experience and training in performing tasks such as lifting office furniture. Did physical hazards within the office environment contribute to the hazard?

(10) **SUPPORT FACTORS** - Was the person using an improper tool for the job? Was inadequate time available or utilized to safely accomplish the task? Were less than adequate personnel resources (in terms of employee skills, number of workers, and adequate supervision) available to get the job done properly? Was funding available, utilized, and adequate to provide proper tools, equipment, personnel, site preparation, etc.?

(11) **PERSONAL PROTECTIVE EQUIPMENT** - Did the person fail to use appropriate personal protective equipment (gloves, eye protection, hard-toed shoes, respirator, etc.) for the task or environment? Did protective equipment provided or worn fail to provide adequate protection from the hazard(s)? Did lack of or inadequate maintenance of protective gear contribute to the accident?

(12) **DRUGS/ALCOHOL** - Is there any reason to believe the person's mental or physical capabilities, judgment, etc., were impaired or altered by the use of drugs or alcohol? Consider the effects of prescription medicine and over the counter medications as well as illicit drug use. Consider the effect of drug or alcohol induced "hangovers".

b. **WRITTEN JOB/ACTIVITY HAZARD ANALYSIS** - Was a written Job/Activity Hazard Analysis completed for the task being performed at the time of the accident? Mark the appropriate box. If one was performed, attach a copy of the analysis to the report.

INSTRUCTIONS FOR SECTION 12 - TRAINING

a. **WAS PERSON TRAINED TO PERFORM ACTIVITY/TASK?** - For the purpose of this section "trained" means the person has been provided the necessary information (either formal and/or on-the-job (OJT) training) to competently perform the activity/task in a safe and healthful manner.

b. **TYPE OF TRAINING** - Mark the appropriate box that best indicates the type of training; (classroom or on-the-job) that the injured person received before the accident happened.

c. **DATE OF MOST RECENT TRAINING** - Enter the month, day, and year of the last formal training completed that covered the activity task being performed at the time of the accident.

INSTRUCTIONS FOR SECTION 13 - CAUSES

a. **DIRECT CAUSES** - The direct cause is that single factor which most directly lead to the accident. See examples below.

b. **INDIRECT CAUSES** - Indirect causes are those factors which contributed to but did not directly initiate the occurrence of the accident.

Examples for section 13:

a. Employee was dismantling scaffold and fell 12 feet from unguarded opening.

Direct cause: failure to provide fall protection at elevation.
Indirect causes: failure to enforce USACE safety requirements; improper training/motivation of employee (possibility that employee was not knowledgeable of USACE fall protection requirements or was lax in his attitude towards safety); failure to ensure provision of positive fall protection whenever elevated; failure to address fall protection during scaffold dismantling in phase hazard analysis.

b. Private citizen had stopped his vehicle at intersection for red light when vehicle was struck in rear by USACE vehicle. (Note: USACE vehicle was in proper/safe working condition).

Direct cause: failure of USACE driver to maintain control of and stop USACE vehicle within safe distance.
Indirect cause: failure of employee to pay attention to driving (defensive driving).

INSTRUCTIONS FOR SECTION 14 - ACTION TO ELIMINATE CAUSE(S)

DESCRIPTION - Fully describe all the actions taken, anticipated, and recommended to eliminate the cause(s) and prevent reoccurrence of similar accidents/illnesses. Continue on blank sheets of paper if necessary to fully explain and attach to the completed report form.

INSTRUCTIONS FOR SECTION 15 - DATES FOR ACTION

a. **BEGIN DATE** - Enter the date when the corrective action(s) identified in section 14 will begin.

b. **COMPLETE DATE** - Enter the date when the corrective action(s) identified in section 14 will be completed.

c. **TITLE AND SIGNATURE** - Enter the title and signature of supervisor completing the accident report. For a GOVERNMENT employee accident/illness the immediate supervisor will complete and sign the report. For PUBLIC accidents the USACE Project Manager/Area Engineer responsible for the USACE property where the accident happened shall complete and sign the report. For CONTRACTOR accidents the Contractor's project manager shall complete and sign the report and provide to the USACE supervisor responsible for oversight of that contractor activity. This USACE supervisor shall also sign the report. Upon entering the information required in 15.d, 15.e and 15.f below, the responsible USACE supervisor shall forward the report for mangement review as indicated in section 16.

d. **DATE SIGNED** - Enter the month, day, and year that the report was signed by the responsible supervisor.

e. **ORGANIZATION NAME** - For GOVERNMENT employee accidents enter the USACE organization name (Division, Branch, Section, etc.) of the injured employee. For PUBLIC accidents enter the USACE organization name for the person identified in block 15.c. For CONTRACTOR accidents enter the USACE organization name for the USACE office responsible for providing contract administration oversight.

f. **OFFICE SYMBOL** - Enter the latest complete USACE Office Symbol for the USACE organization identified in block 15.e.

INSTRUCTIONS FOR SECTION 16 - MANAGEMENT REVIEW (1st)

1ST REVIEW - Each USACE FOA shall determine who will provide 1st management review. The responsible USACE supervisor in section 15.c shall forward the completed report to the USACE office designated as the 1st Reviewer by the FOA. Upon receipt, the Chief of the Office shall review the completed report, mark the appropriate box, provide substantive comments, sign, date, and forward to the FOA Staff Chief (2nd review) for review and comment.

INSTRUCTIONS FOR SECTION 17 - MANAGEMENT REVIEW (2nd)

2ND REVIEW - The FOA Staff Chief (i.e., FOA Chief of Construction, Operations, Engineering, Planning, etc.) shall mark the appropriate box, review the completed report, provide substantive comments, sign, date, and return to the FOA Safety and Occupational Health Office.

INSTRUCTIONS FOR SECTION 18 - SAFETY AND OCCUPATIONAL HEALTH REVIEW

3RD REVIEW - The FOA Safety and Occupational Health Office shall review the completed report, mark the appropriate box, ensure that any inadequacies, discrepancies, etc. are rectified by the responsible supervisor and management reviewers, provide substantive comments, sign, date and forward to the FOA Commander for review, comment, and signature.

INSTRUCTION FOR SECTION 19 - COMMAND APPROVAL

4TH REVIEW - The FOA Commander shall (to include the person designated Acting Commander in his absence) review the completed report, comment if required, sign, date, and forward the report to the FOA Safety and Occupational Health Office. Signature authority shall not be delegated.

Attachment 2

Site Specific Health and Safety Plan

ARCADIS Design & Consultancy for natural and built assets

Site Specific Health and Safety Plan

Revision 13c, 5/9/2016

Project Name:	Watervliet Arsenal- Longterm Monitoring and ICM O&M

Project Number:	06261067.0000
Client Name:	USACE - Baltimore
Date:	6/3/2016
HASP Expires	6/3/2017
Revision:	3

Approvals:

HASP Developer:	Bree Quaglieri
Project Manager:	Andy Vitolins
HASP Reviewer:	X

Emergency Information

Site Address: 873 3rd Avenue
Watervliet, NY 12189

Emergency Phone Numbers:

Emergency (fire, police, ambulance)		911
Emergency (facility specific, if applicable):		
Guard		518-266-5111
WVA Fire/Police		518-266-5111
Emergency Other (specify)	WVA Ambulance	518-266-5111
Client Contact	Michael Wright	518-266-4785
WorkCare (non-life-threatening injury/illness)		1-888-449-7787
Project H&S	Aaron Bobar	518-250-7300
Task Manager	Stefan Bagnato	518-250-7334
Project Manager	Andy Vitolins	518-250-7359
Corporate H&S Specialist	Julie Santaniello	978-551-0033
Corporate H&S Director	Denis Balcer	614-778-9171
Federal H&S Lead	Grey Coppi	908-917-6948

Hospital Name and Address: Samaritan Hospital
2215 Burdett Avenue
Troy, NY 12180

Hospital Phone Number: 518-271-3285

Incident Notification Process

1. Dial 911/Facility Emergency Number/WorkCare as applicable
2. Contact PM/Supervisor — Andy Vitolins
3. Contact Corporate H&S — Dennis Balcer and Grey Coppi
4. Contact Client — Michael Wright

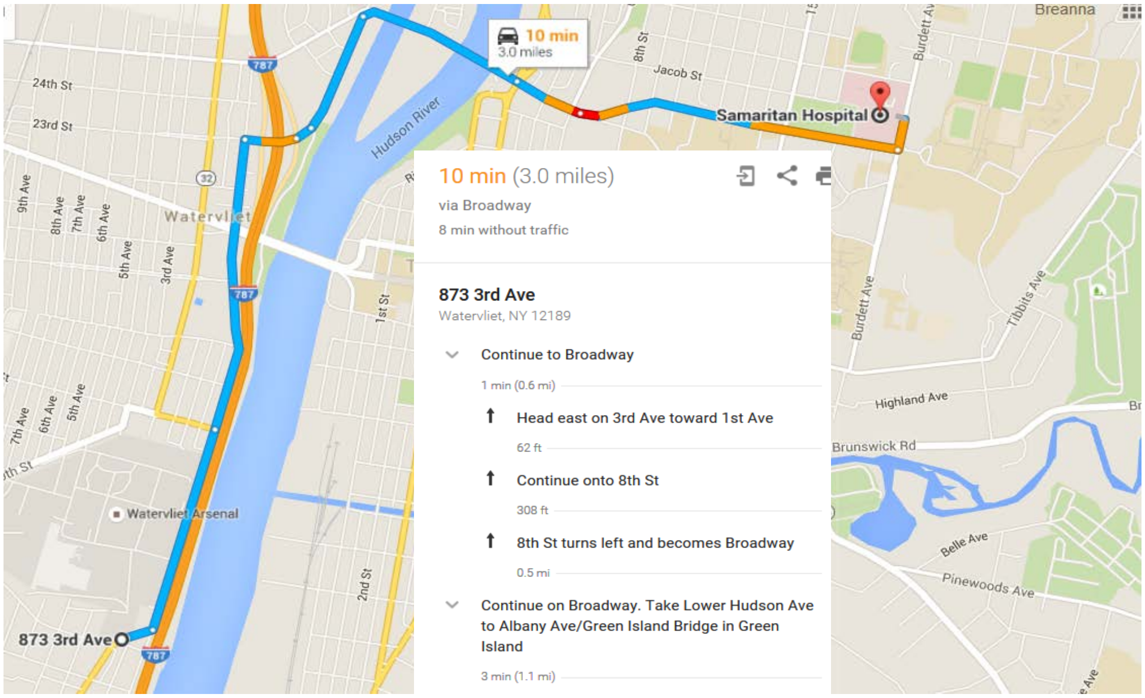
Complete below, as applicable, or clear cell contents:

Location of Assembly Area(s): Guard station near Route 32 entrance

Nearest AED location: Buildings 10, 20, 21, 22, 25, 40, 114, or 120 (choose closest)

Nearest Storm Shelter: Guard station near Route 32 entrance
Buildings 10, 20, 21, 22, 25, 40, 114, or 120 (choose closest)

Route to the Hospital



10 min (3.0 miles)

via Broadway

8 min without traffic

873 3rd Ave

Watervliet, NY 12189

Continue to Broadway

1 min (0.6 mi)

- Head east on 3rd Ave toward 1st Ave
  62 ft
- Continue onto 8th St
  308 ft
- 8th St turns left and becomes Broadway
  0.5 mi

Continue on Broadway. Take Lower Hudson Ave to Albany Ave/Green Island Bridge in Green Island

3 min (1.1 mi)

- Continue straight to stay on Broadway
  0.7 mi
- Turn right onto 23rd St
  0.1 mi
- Continue onto Hudson Ave
  213 ft
- Continue onto Lower Hudson Ave
  0.3 mi

Continue on Green Island Bridge. Take Peoples Ave to Burdett Ave in Troy

5 min (1.3 mi)

- Turn right onto Albany Ave/Green Island Bridge
  Continue to follow Green Island Bridge
  0.4 mi
- Continue onto Federal St
  0.2 mi
- Keep left to continue on Peoples Ave
  0.7 mi
- Turn left onto Burdett Ave
  Destination will be on the left
  384 ft

Samaritan Hospital

2215 Burdett Avenue, Troy, NY 12180

General Information

Site Type (select all applicable where work will be conducted):

- [x] Active
- [ ] Bridge
- [x] Buildings
- [ ] Commercial
- [ ] Construction
- [x] Military Installation
- [ ] Inactive Industrial
- [x] Active Industrial
- [ ] Landfill
- [ ] Marine
- [ ] Mining
- [ ] Parking Lot/Private Roadway
- [ ] Railroad
- [ ] Remote Area
- [ ] Residential
- [ ] Retail
- [ ] Roadway (public, including right-of-way)
- [ ] Water Treatment Plant
- [ ] Unknown
- [ ] Security Risk Site/Location
- [ ] Utility
- [x] Other (specify): Government manufacturing facility

Surrounding Area and Topography (select one):

- [ ] Surrounding area and topography are presented in the project work plan
- [x] Surrounding area and topography (*briefly describe*):
  Site is active military manufacturing facility. It is mostly level and paved. ICM work is mostly inside buildings in basements and storage closets, while LTM groundwater sampling is located in parking lots and storage areas.

Simultaneous Operations (SimOps)

- [x] Not applicable
- [ ] SimOps will exist on this project

Site Background (select one):

- [ ] Site background is presented in the project work plan
- [x] Site background (*briefly describe)* :
  The WVA is an active military manufacturing facility. Over the years it has produced small arms ammunition, cannon cartridges, and leather goods. Currently the Arsenal manufactures large caliber cannons and mortars. Past operations at the Arsenal included solvent degreasing of machined materials, chromium wastewater collection and treatment (from plating operations), and storage of metal chips coated with cutting oils. Contaminants of concern include chlorinated solvents (max conc. 2015 sampling 37,000 ug/l) and chromium (max concentration 2014 sampling event: 6.54 mg/l).

Project Tasks

The following tasks are identified for this project:

Examples: "Drilling/soil sampling", "Surveying", "General Inspections", "Construction Management/Inspections"

1 General Site Work
2 Groundwater Sampling
3 Indoor Air Sampling
4 Remediation System O&M
5 Well Repairs/Decomissioning

☐ Subcontractor H&S information is attached
☐ Utility clearance required.
☐ Journey Management Plan attached
☐ State specific H&S required:

☐ The following H&S Standards are attached:
Not applicable
Not applicable

Comments:

Roles and Responsibilities

	Name	*Role*	*Additional Responsibilities (Describe)*
1	Andy Vitolins	PM	
2	Stefan Bagnato	TM	SSO
3	Jeremy Wyckoff	TM	SSO
4	Bree Quaglieri	Field Team	
5	Emmanuel Sousa	Field Team	
6			

Training

All Arcadis employees are required to have the following training to be on site:	*Selected Arcadis employees are required to have the following additional training:*	Names or Numbers from above
H&S Program Orientation	First Aid/CPR	4,5
HAZCOM GHS/EAP	DOT HazMat #1	4,5
Defensive Driving - Smith On-Line	Confined Space Awareness	3,4,5
Hazwoper 40 Hour	Electrical NFPA 70E - includes Arc Flas	3
Hazwoper 8-Hour Annual Refresher	Lockout/Tagout - Authorized	3,5
Hazwoper 8-Hour Supervisor	None	
None	None	
None	None	
None	None	
None	None	
None	None	
None	None	
None	None	
Client specific:	None	
	None	
Other:	Other:	

Hazard Analysis

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Business Line
Environment

Business Unit
IRR

Task 1: General Site Work

Hazardous Activity #1

Field-Ambient environment - exposure heat, cold, sun, weather, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III I, III M

Biological	-	Chemical	-	Driving	M	Electrical	L
Environmental	L	Gravity	H	Mechanical	-	Motion	L
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium   Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK Field H&S Handbook (see ref. above) Secondary: H&S Standards Engineering Controls (specify below) Admin. Controls (specify below) Specialized Equipment (specify below) PPE (see HASP "PPE" section)

Enter Required Controls: Job breifing, site awareness

Hazardous Activity #2

Field-Inspections - facility audits

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III E, III F

Biological	-	Chemical	-	Driving	M	Electrical	-
Environmental	-	Gravity	L	Mechanical	-	Motion	L
Personal Safety	L	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Low   Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) Secondary: Client Training/Briefing Job Briefing/Site Awareness PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, JSAs

Hazardous Activity #3

General-Cutting - using fixed blades such as pocket knives, Leatherman, box cutters or scissors

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AD

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	-	Mechanical	M	Motion	-
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium   Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK Specialized Equipment (specify below) Secondary: Admin. Controls (specify below) JSAs PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, use the right tool for the job

Hazardous Activity #4

Field-Tools, hand - use of hammers, screwdrivers, wrenches, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AD

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	L	Mechanical	-	Motion	M
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium   Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) Inspections Secondary: H&S Standards Job Briefing/Site Awareness Admin. Controls (specify below) Specialized Equipment (specify below) Site AwarenessPPE (see HASP "PPE" section)

Enter Required Controls: TRACK, use of proper PPE, use the right tool for the job

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 2: Groundwater Sampling

Hazardous Activity #1

Field-Measurement - water levels and well sounding

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III E, III F

Biological	-	Chemical	L	Driving	-	Electrical	-
Environmental	-	Gravity	L	Mechanical	-	Motion	M
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Low Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Secondary: Job Briefing/Site Awareness PPE (see HASP "PPE" section)

Enter Required Controls: Job briefing, site awareness

Hazardous Activity #2

Field-Sampling - monitoring well sampling with electric, pneumatic or other non-manual pump

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AD, III AF

Biological	-	Chemical	L	Driving	-	Electrical	L
Environmental	-	Gravity	L	Mechanical	-	Motion	M
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Low Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) Inspections Secondary: Job Briefing/Site Awareness PPE (see HASP "PPE" section)

Enter Required Controls: Job briefing, site awareness

Hazardous Activity #3

Chemical-Corrosives - working with or exposure to corrosives in laboratory work, sample bottle preservatives, decon chemicals, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AG

Biological	-	Chemical	H	Driving	-	Electrical	-
Environmental	L	Gravity	-	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) Secondary: H&S Standards Job Briefing/Site Awareness Hazcom Training MSDS/SDS (see also HASP Hazcom/GHS section) Admin. Controls (specify below) Specialized Equipment (specify below) Housekeeping PPE (see HASP "PPE" section)

Enter Required Controls: PPE

Hazardous Activity #4

Field-Traffic - parking lots

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AM, V F

Biological	-	Chemical	-	Driving	M	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	H
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK STAR Plan Engineering Controls (specify below) Secondary: Job Briefing/Site Awareness

Enter Required Controls: Job briefing, site awareness

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 3: Indoor Air Sampling

Hazardous Activity #1

Field-Sampling - indoor and ambient air sampling

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III F, III AF, III AN

Biological	-	Chemical	L	Driving	-	Electrical	-
Environmental	-	Gravity	L	Mechanical	-	Motion	L
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Work Plan Secondary: TKI SOP (as applicable) Job Briefing/Site Awareness Engineering Controls (specify below) Admin. Controls (specify below) PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, PPE

Hazardous Activity #2

Field-Sampling - subslab vapor screening/sampling

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III F, III L, III S

Biological	-	Chemical	M	Driving	-	Electrical	M
Environmental	-	Gravity	L	Mechanical	M	Motion	L
Personal Safety	-	Pressure	L	Radiation	-	Sound	M

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) See HASP "Monitoring" section Secondary: Job Briefing/Site Awareness Admin. Controls (specify below) Work Plan PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, PPE

Hazardous Activity #3

Field-Tools, hand - use of hammers, screwdrivers, wrenches, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AD

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	L	Mechanical	-	Motion	M
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) Inspections Secondary: H&S Standards Job Briefing/Site Awareness Admin. Controls (specify below) Specialized Equipment (specify below) Site AwarenessPPE (see HASP "PPE" section)

Enter Required Controls: TRACK, PPE

Hazardous Activity #4

General-Cutting - using fixed blades such as pocket knives, Leatherman, box cutters or scissors

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AD

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	-	Mechanical	M	Motion	-
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK Specialized Equipment (specify below) Secondary: Admin. Controls (specify below) JSAs PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, PPE

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 4: **Remediation System O&M**

Hazardous Activity #1

Field-Remediation - system installation and/or decommissioning

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AA, III AB, III AD

Biological	-	Chemical	M	Driving	-	Electrical	M
Environmental	-	Gravity	M	Mechanical	M	Motion	M
Personal Safety	-	Pressure	-	Radiation	-	Sound	L

Overall Unmitigated Risk: Medium — Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Work Plan Engineering Controls (specify below) Inspections Secondary: Job Briefing/Site Awareness Specialized Equipment (specify below) TKI SOP (as applicable) PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, Work Plan

Hazardous Activity #2

Field-Walking - uneven or slippery terrain

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III E, III F

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	M	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium — Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK Secondary: Housekeeping PPE (see HASP "PPE" section)

Enter Required Controls: TRACK

Hazardous Activity #3

Field-Tools, hand - use of hammers, screwdrivers, wrenches, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AD

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	L	Mechanical	-	Motion	M
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium — Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) Inspections Secondary: H&S Standards Job Briefing/Site Awareness Admin. Controls (specify below) Specialized Equipment (specify below) Site AwarenessPPE (see HASP "PPE" section)

Enter Required Controls: TRACK, PPE

Hazardous Activity #4

General-Lifting and movement of equipment of varying weights at varying frequencies by manual methods

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AF

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	-	Mechanical	-	Motion	-
Personal Safety	M	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: High — Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK Engineering Controls (specify below) Job Rotation Secondary: JSAs Job Briefing/Site Awareness Specialized Equipment (specify below) Admin. Controls (specify below) Engineering Controls (specify below)

Enter Required Controls: TRACK, ask for help

Risk Assessment Matrix		Likelihood Ratings** (likelihood that incident would occur)			
Consequences Ratings*		A	B	C	D
People	Property	0 Almost impossible	1 Possible but unlikely	2 Likely to happen	3 Almost certain to happen
1 - Slight or no health	Slight or no damage	0 - Low	1 - Low	2 - Low	3 - Low
2 - Minor health effect	Minor damage	0 - Low	2 - Low	4 - Medium	6 - Medium
3 - Major health effect	Local damage	0 - Low	3 - Low	6 - Medium	9 - High
4 - Fatalities	Major damage	0 - Low.	4 - Medium.	8 - High	12 - High

Task 5: Well Repairs/Decomissioning

Hazardous Activity #1

Field-Construction- well repairs or decommissioning

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AD

Biological	-	Chemical	M	Driving	-	Electrical	-
Environmental	L	Gravity	M	Mechanical	M	Motion	M
Personal Safety	-	Pressure	L	Radiation	-	Sound	L

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Work Plan Engineering Controls (specify below) Secondary: Job Briefing/Site Awareness Specialized Equipment (specify below) PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, JSAs, work plan

Hazardous Activity #2

Field-Construction- general construction/renovation activities

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AD

Biological	-	Chemical	M	Driving	-	Electrical	H
Environmental	M	Gravity	-	Mechanical	-	Motion	M
Personal Safety	-	Pressure	-	Radiation	-	Sound	H

Overall Unmitigated Risk: Medium Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK H&S Standards 10 hr. Construction Training Engineering Controls (specify below) Secondary: JSAs Field H&S Handbook (see ref. above) Job Briefing/Site Awareness Cont./Emerg. Planning Admin. Controls (specify below) Specialized Equipment (specify below) Housekeeping Inspections PPE (see HASP "PPE" section)

Enter Required Controls: TRACK, JSAs, work plan

Hazardous Activity #3

Field-Tools, hand - use of hammers, screwdrivers, wrenches, etc

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III AD

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	L	Mechanical	-	Motion	M
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Low if utilizing:

Controls that should be Considered: Primary: TRACK JSAs Engineering Controls (specify below) Inspections Secondary: H&S Standards Job Briefing/Site Awareness Admin. Controls (specify below) Specialized Equipment (specify below) Site AwarenessPPE (see HASP "PPE" section)

Enter Required Controls: TRACK, PPE

Hazardous Activity #4

Field-Walking - uneven or slippery terrain

Hazard Types (unmitigated ranking H-High, M-Medium, L-Low): Suggested FHSHB Ref: III E, III F

Biological	-	Chemical	-	Driving	-	Electrical	-
Environmental	-	Gravity	M	Mechanical	-	Motion	-
Personal Safety	-	Pressure	-	Radiation	-	Sound	-

Overall Unmitigated Risk: Medium Mitigated Risk: Medium if utilizing:

Controls that should be Considered: Primary: TRACK Secondary: Housekeeping PPE (see HASP "PPE" section)

Enter Required Controls: TRACK

Hazard Communication (HazCom)/Global Harmonization System (GHS)

☐ HAZCOM/GHS for this project is managed by the client or general contractor

List the chemicals anticipated to be used by Arcadis on this project per HazCom/GHS requirements. (Modify quantities as needed)

	Preservatives	Qty		**Decontamination**	Qty		**Calibration**	Qty.
☑	Not applicable		☐	Not applicable		☐	Not applicable	
☐	Hydrochloric acid	<500 ml	☑	Alconox	≤ 5 lbs	☑	Isobutylene/air	1 cyl
☐	Nitric acid	<500 ml	☐	Liquinox	≤ 1 gal	☐	Methane/air	1 cyl
☐	Sulfuric acid	<500 ml	☐	Acetone	≤ 1 gal	☐	Pentane/air	1 cyl
☐	Sodium hydroxide	<500 ml	☐	Methanol	≤ 1 gal	☐	Hydrogen/air	1 cyl
☐	Zinc acetate	<500 ml	☐	Hexane	≤ 1 gal	☐	Propane/air	1 cyl
☐	Ascorbic acid	<500 ml	☐	Isopropyl alcohol	≤ 4 gal	☐	Hydrogen sulfide/air	1 cyl
☐	Acetic acid	<500 ml	☐	Nitric acid	≤ 1 L	☐	Carbon monoxide/air	1 cyl
☐	Isopropyl alcohol	< 4 gal.	☐	Other:		☑	pH standards (4,7,10)	≤ 1 gal
☐	Formalin (<10%)	< 4 gal.		____________		☑	Conductivity standards	≤ 1 gal
☐	Methanol	<500 ml		____________		☐	Other:	
☐	Sodium bisulfate	<500 ml		____________			____________	

	Fuels	Qty.		**Kits**		Qty.
☑	Not applicable		☐	Not applicable		
☐	Gasoline	≤ 5 gal	☐	Hach (specify):	____________	1 kit
☐	Diesel	≤ 5 gal	☐	DTECH (specify):	____________	1 kit
☐	Kerosene	≤ 5 gal	☐	Other:	____________	1 kit
☐	Propane	1 cyl		____________		
☐	Other:			____________	____________	
	____________			____________	____________	

	Remediation	Qty.		**Other:**	Qty.		Qty.
☑	Not applicable		☐	Not applicable		____________	
☐	____________		☐	Spray paint	≤ 6 cans	____________	
☐	____________		☑	WD-40	≤ 1 can	____________	
☐	____________		☑	Pipe cement	≤ 1 can	____________	
☐	____________		☑	Pipe primer	≤ 1 can	____________	
☐	____________		☐	Mineral spirits	≤ 1 gal	____________	
			☐	____________		____________	

(1) Attach applicable Materials of Trade (MOT) generic shipping determination. SDS not generally applicable to this category.

Safety Data Sheets (SDSs) must be available to field staff. Indicate below how SDS information will be provided:

- ☐ Not applicable
- ☐ Printed copy in company vehicle
- ☐ Printed copy in the project trailer/office
- ☑ Printed copy attached
- ☐ Electronic copy on field computer

- ☐ Contractor SDSs are not applicable
- ☐ Contractor SDSs are attached
- ☐ Contractor SDSs will be on site and located: ____________

☐ Bulk quantities of the following materials will be stored: ____________

Contact the project H&S contact for information in determining code and regulatory requirements associated with <u>bulk storage</u> of materials.

Monitoring

☐ Chemical air monitoring is not required for this project or is the responsibility of contractor.

For projects requiring air monitoring, list the relevant constituents representing a hazard to site workers.

Constituent	Max. Conc.	Units	TWA	Units	STEL	Units	IDLH	Units	LEL/UEL (%)	VD Air=1	IP (eV)
TCE	12	ppm	10	p	25	p	1000	p,N	8/10.5	NA	9.45
cis 1,2-Dichloroethene	19	ppm	200	p	NA	-	1000	p,N	5.6/12.8	NA	9.65
PCE	36	ppm	25	p	100	p	150	p,N	NA/NA	NA	9.32
Vinyl chloride	3	ppm	1	p	5	p,c,O	NA	0	3.6/33.0	2.21	9.99
Methane	23	ppm	1000	p	NA	-	NA	-	5.0/15	0.6	12.51
None			9999	-	0	-	0	-	0	0	0

Notes: TWAs are ACGIH 8 hr.-TLVs unless noted.

p-ppm m-mg/m3
s- skin c-ceiling
r- respirable i-inhalable

c2- ceiling (2 hr.) se-sensitizer
"9999" - NA O-OSHA PEL
N-NIOSH 10 hr. REL

A - Arcadis specific TWA*
"#N/A"-Manually enter

Monitoring Equipment and General Protocols

Air monitoring is required for any task or activity where employees have potential exposure to vapors or particulates above the TWA. Action levels below are appropriate for most situations. Contact the project H&S contact for all stop work situations. Select monitoring frequency and instruments to be used.

Monitoring Frequency: During sampling - when opening well cover

Indicator Tube/Chip Frequency: Indicator tube/chip monitoring not required

	Instrument	Action Levels			Actions
☑	Photoionization Detector		<	6.212	Continue work
		6.212	-	12.423	Sustained >5 min. continuous monitor, review eng. controls and PPE, proceed with caution
	Lamp (eV): 10.6		>	12.423	Sustained >5 min. stop work, contact SSO
☐	Flame Ionization Detector (FID)		<	0.0	Continue work
		0.0	-	0.0	Sustained >5 min. continuous monitor, review eng. controls and PPE, use caution
			>	0.0	Sustained >5 min. stop work, contact SSO
☐	LEL/O2 Meter	0-5% LEL			Continue work
		>5-10% LEL			Continuous monitor, review eng. controls, proceed with caution
		>10% LEL			Stop work, evacuate, contact SSO
		19.5%-23.5% O2			Normal, continue work
		<19.5% O2			O2 deficient, stop work, evacuate, cont.
		>23.5% O2			O2 enriched, stop work, evacuate, contact
☐	Indicator: ☐ tube ☐ chip	≤PEL/TLV			Continue work
		>PEL/TLV			Stop work, review eng. controls and PPE, contact SSO
	Compound(s):				
☐	Particulate Monitor (mists, aerosols, dusts in mg/m^3)		<	1.5	Continue work
		1.5	-	3.000	Use engineering controls, monitor continuous
			>	3.000	Stop work, review controls, contact SSO
☐	Other:	Specify:			Specify:

* Arcadis administrative TWAs ensure mixture component TWAs are not exceeded that would require additional monitoring or medical surveillance.

Personal Protective Equipment (PPE)

See JSA or Permit for the task being performed for required PPE *. If work is not conducted under a JSA or Permit, refer to the governing document for PPE requirements. At a minimum, the following checked PPE is required for <u>all tasks during field work</u> (outside of field office trailers and vehicles) not covered by a JSA or Permit on this project:*

Minimum PPE required to be worn by all staff on project:

			Specify Type:
☑ Hard hat	☐ Snake chaps/guards	☐ Coveralls:	
☑ Safety glasses	☐ Briar chaps	☐ Apron:	
☐ Safety goggles	☐ Chainsaw chaps	☐ Chem. resistant gloves:	
☐ Face shield	☐ Sturdy boot	☐ Gloves other:	
☐ Hearing protection	☑ Steel or comp. toe boot	☐ Chemical boot:	
☐ Rain suit	☐ Metatarsal boot	☐ Boot other:	
☐ Other:		☑ Traffic vest, shirt or coat:	Class II
		☐ Life vest:	

Task specific PPE: Nitrile Gloves: Sampling events
Leather Work Gloves: OMM

Comments:

Medical Surveillance (*check all that apply*)

☐ Medical Surveillance is not required for this project.
☑ HAZWOPER medical surveillance applies to all Arcadis site workers on the project.
☐ HAZWOPER medical surveillance applies to all subcontractors on the project.
☐ HAZWOPER medical surveillance applies to all site workers on the project except:

☐ Other medical surveillance required (describe type and who is required to participate):

☐ Client drug and/or alcohol testing required.

Hazardous Materials Shipping and Transportation (*check all that apply*)

☐ Not applicable, no materials requiring a Shipping Determination (SD) will be transported or shipped
☐ A SD has been reviewed and provided to field staff
☑ A SD is attached
☐ All HazMat will be transported under Materials of Trade by Arcadis (see generic MOT SD Form)
☐ Other (specify):

Roadway Work Zone Safety (*check all that apply*)

☐ Not applicable for this project
☐ All or portions of the work conducted under a TCP
☐ All or portions of the work conducted under a STAR Plan
☐ TCP or STAR Plan provided to field staff
☑ TCP or STAR Plan attached
☐ Other (specify):

Arcadis Commercial Motor Vehicles (CMVs)

This section is applicable to Arcadis operated vehicles only

☑ This project will **<u>not</u>** utilize CMV drivers ☐ This project will utilize CMV drivers

This project will NOT utilize vehicles (alone or in combination with a trailer) with a gross vehicle weight rating (GVWR) of 10,001 pounds or more. GVWR Truck + GVWR Trailer = <10,001 pounds

Site Control (*check all that apply*)

- [ ] Not applicable for this project.
- [ ] Site control protocols are addressed in JSA or other supporting document (attach)
- [x] Maintain an exclusion zone of 25 ft. around the active work area
- [ ] Site control is integrated into the STAR Plan or TCP for the project
- [ ] Level C site control - refer to Level C Supplement attached
- [ ] Other (specify):

Decontamination (*check all that apply*)

- [ ] Not applicable for this project.
- [ ] Decontamination protocols are addressed in JSA or other governing document (attach)
- [x] Wash hands and face prior to consuming food, drink or tobacco.
- [ ] Remove gloves and coveralls and contain, wash hands and face prior to consuming food, drink or tobacco. Ensure footwear is clean of site contaminants
- [ ] Respiratory protection- refer to the Level C supplement attached.
- [ ] Other (specify):

Sanitation *(check all that apply)*

- [ ] Mobile operation with access to off-site restrooms and potable water
- [x] Restroom facilities on site provided by client or other contractor
- [ ] Project to provide portable toilets (1 per 20 workers)
- [x] Potable water available on site
- [ ] Project to provide potable water (assume 1 gal./person/day)
- [ ] Project requires running water (hot and cold, or tepid) with soap and paper towels

Safety Briefings (*check all that apply*)

- [x] Safety briefing required daily
- [ ] Safety briefing required twice a day
- [ ] Safety briefings required at the following frequency: ______________________
- [x] Subcontractors to participate in Arcadis safety briefings
- [x] Arcadis to participate in client/contractor safety briefings
- [ ] Other (specify):

Safety Equipment and Supplies

Safety equipment/supply requirements are addressed in the JSA or Permit for the task being performed. *If work is not performed under a JSA or Permit, the following safety equipment is required to be present on site in good condition (Check all that apply):*

- [x] First aid kit
- [ ] Bloodborne pathogens kit
- [x] Fire extinguisher
- [ ] Eyewash (ANSI compliant)
- [x] Eyewash (bottle)
- [x] Drinking water
- [x] Other: Cell phone
- [x] Insect repellent
- [x] Sunscreen
- [ ] Air horn
- [x] Traffic cones
- [ ] 2-way radios
- [ ] Heat stress monitor

International Travel

☑ This project does not involve international travel
☐ This project involves international travel

Behavior Based Safety Program (*check all that apply*)

☑ TIP required at the following frequency on this project:
Select One: ______ mhrs __1__ time(s) ______ Define: __per quarter__
☐ H&S Field Assessment required at the following frequency on this project:
Select One: ______ mhrs ______ time(s) ______ Define: ______
☐ Other (specify):

Signatures

I have read, understand and agree to abide by the requirements presented in this health and safety plan. I understand that I have the absolute right to stop work if I recognize an unsafe condition affecting my work until corrected.

Printed Name	Signature	Date

Add additional sheets if necessary

You have an absolute right to STOP WORK if unsafe conditions exist!

Attachments

Job Safety Analysis

General

JSA ID	7268	**Status**	(3) Completed
Job Name	Environment-Remediation system O&M	**Created Date**	4/9/2012
Task Description	Remediation System Operations and Maintenance	**Completed Date**	04/18/2012
Template	True	**Auto Closed**	False

Client / Project

Client	ARCADIS-AGMI
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Coppola, Mija A		4/9/2012	Ebert, Joachim	☑
HASP Reviewer	Hubbard, Lauren M	4/23/2012	4/18/2012	Tremblay, Tony	☑
Quality Reviewer	Tischer, Steven P.	5/16/2012	5/16/2012	Guillette, Brian	☐

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	General Inspection	1	Slips trips and falls on wet surfaces , equipment, piping, or supplies.	Wear footwear with ankle support and good tread and anti-slip sole. Mark all hoses and piping in walkways with high visibility colored materials or paint, use signage if necessary, cover to prevent trip hazards.	
		2	Noise for system operation	Wear hearing protection appropriate for noise levels encountered. Increase distance from noise sources when practical.	
		3	Impaired visibility when going into structures on bright days or structures without illumination	Use auxiliary lighting when inspecting inside structures on bright days.	
		4	Burns to skin form contact with system components.	Wear protective gloves, allow system components to cool down before accessing.	
		5	Contact with product from improper system operation.	Review O&M plan prior to inspection to refresh shut down and start up sequence. Use LOTO for any component removed where product could be released. Bleed off any component under pressure	
		6	Insect hazards (wasps, poisonous spiders, etc.) in system structures	Be vigilant for and remove/avoid. Never reach into poorly lit and damp places on the system, especially systems located in buildings.	
2	System sample collection	1	Contact with sample preservatives	Wear protective gloves and eye protection, avoid breathing acid vapors by keeping open bottles away from face. Have baking soda or other acid neutralizer if acid gets on skin or clothing. Always assume acid residue is on outside of sample bottles, always wear gloves.	
		2	Cuts to hands from compromised sample bottles	Inspect bottles prior to use and do not use if bottle or lid appears compromised. Do not over-tighten lids. Wear cut proof gloves.	
		3	Awkward body positions collecting the sample	Plan sampling activity and take the time to set up properly. Use job rotation if filling large containers from a slow flowing port or valve.	
		4	Exposure to impacted media	Wear gloves appropriate for the chemical	

			or free product	hazards, and eye protection. If sample port has potential to be under pressure, bleed pressure off first. Wear face shield and protective suits or aprons if splash hazards from pressure or other cause exists.	
3	Pipe, meter, port, valve, gauge, cleaning or replacement	1	Working at height on tanks or edge of vaults	If over 6 ft high wear personal fall arrest devices approved and overseen by a Competent Person. See Working at Heights JSA template. Competent Person to inspect guard rails, stairs, ladders, if present, to ensure they are maintained in good condition.	
		2	Removal of vessel lids or covers causing overexertion or awkward twisting	Use buddy system to lift lids weighting >51 pounds or that cause awkward bending or twisting to open.	
		3	Exposure to carbon dusts, when dried	Maintain good housekeeping at all times and clean up spilled carbon while still wet. If dust is an issue from large spill, use respiratory protection (HEPA) filter.	
		4	Confined space hazards if tank or vault entry is required.	Follow ARCADIS Confined Space procedures.	
		5	Struck by hazards from hoisting carbon bags or change out equipment	Keep unnecessary workers clear of work area. Use tag lines if lifting over knee height, especially for large bags or objects being hoisted. See Cranes and Rigging JSA, hard hat required.	
		6	Heavy lifting of carbon material bags or placement hoses/piping.	Use buddy system to lift bags weighting >51 pounds or cause awkward bending or twisting to move. Use dollys, carts etc. to facilitate moving of supplies or bags. Use buddy system for bulky, awkward objects like large coiled hoses or long piping links.	
		7	Electrical hazards associated with system entry	Follow ARCADIS electrical procedures. Ensure gloves and footwear worn are electrical safety rated. Do not deviate from any O&M plan procedural requirements.	
		8	Delivery vehicle damage operating in tight area.	Use the ARCADIS spotter program in the defensive driving procedure. Coordinate moves/route with driver prior to operating the vehicle.	
4	Carbon or media change out	1	Cuts, contact stress to hands from hand tools	Wear protective gloves, but ensure glove used maintain ample dexterity to perform task.	
		2	Back strain from awkward twisting, opening housing, removing and replacing filters	Plan activity. Use buddy system if covers weigh >51 pounds or cause awkward twisting of body. Do not over-exert while moving, removing, or placing components and don't hurry through activity.	
		3	Electrical hazards associated with system entry	Follow ARCADIS electrical procedures. Ensure gloves and footwear worn are electrical safety rated. Do not deviate from any O&M plan procedural requirements.	
5	Bag filter change out	1	Entanglement hazards in blower components (hazardous energy)	Use LOTO to inactivate equipment, do not remove protective guards unless necessary to service blower. Wear tight fitted clothing and ensure shirt tails are tucked in.	
		2	Pinch points, scrapes to hands and fingers	Wear protective gloves that maintain dexterity to perform task. Identify pinch hazards and keep hands and fingers away from them.	
6	Blower maintenance and servicing	1	Entanglement hazards in blower components (hazardous energy)	Use LOTO to inactivate equipment, do not remove protective guards unless necessary to service blower. Wear tight fitted clothing and ensure shirt tails are tucked in.	ARCHHSS1004, Handbook section III Z
		2	Pinch points, scrapes to hands and fingers	Wear protective gloves that maintain dexterity to perform task. Identify pinch hazards and keep hands and fingers away from them.	

		3	Contact stress to knee/legs from kneeling on hard surfaces	Use padding if kneeling/sitting on hard surfaces.	
		4	Lifting hazards from blower components	Use proper lifting techniques and buddy system if components weigh >51 pounds. Use TRACK and plan lifts prior to attempting to move heavy objects.	
		5	Tool slip hazards form grease or oil surfaces	Take the time clean up excessive grease and oily areas on surfaces requiring maintenance or adjustment.	
		6	Push / pull muscle strain from blower housing component removal or replacement	Do not over exert or hurry through the task. Use buddy to help slide or move heavy objects.	
7	Product transfer	1	Fire, explosion hazards from static charges	Ensure all components of the transfer system are grounded and bonded per O&M plan or JSA.	ARHSFS006, Field H&S Handbook section IIIAA
		2	Trip hazards from hoses or piping	Avoid running hose or piping across aisle ways. Secure from movement or cover. Watch for and avoid walking over hoses and piping.	
		3	Slip hazards on spilled product	Keep spill control readily available during transfer activity. Promptly clean up all spills, no matter how small.	
		4	Skin, eye, inhalation exposure to free product	Wear PPE protective of skin and eyes, avoid breathing vapors and stay upwind, use air monitoring as required by HASP or O&M Plan.	
		5	Lifting buckets/containers of product can cause muscle strain	Use proper lifting techniques. If bucket is used to collect drips, replace bucket prior to becoming full to reduce weight needing to be lifted.	
8	Checks of electrical systems	1	Electrocution from contact with energized system components	Follow ARCADIS electrical procedure. Wear electrical rated gloves and footwear and make sure to inspect PPE prior to work activity.	ARHSFS006, FHSHB section IIIAA
		2	Pinch points, cuts, scrapes to hands from opening electrical panels	Electrical rated gloves worn to offer protection from these hazards	
		3	Burns from arc flash	Same as above	
9	Tank inspection	1	Exposure to chemical vapors (skin, eye, inhalation)	Wear eye protection and protective suits/apron. Be watchful for condensed liquid dripping from lids or caps as the liquid may be impacted with product. Keep face away from tank openings. Use air monitoring to ensure exposure limits are not exceeded.	ARCHSSF003 ARCHHSF007, Handbook section IIIbb, IVA
		2	Oxygen deficiency and confined space hazards	Follow ARCADIS confined space procedures. DO NOT stick head inside tanks under any circumstances.	
		3	Falls from heights from elevated tanks	Follow Working at Heights JSA and ARCADIS Fall Protection H&S Standard for any work over 6 ft high from next lower level.	
		4	Slip and falls on wet surfaces	Wear proper footwear with good tread, anti-slip soles and ankle support. Clean up wet areas where practical and maintain good housekeeping.	
		5	Pinch points, cuts, scrapes to hands from tank lids, doors, covers	Wear protective gloves, identify and keep hands/fingers clear.	
10	Removal of water from secondary containment	1	Slip and fall hazards on wet or icy surfaces	Wear proper footwear with good tread, anti-slip soles and ankle support. Clean up wet areas where practical and maintain good housekeeping. Use snow/ice removal methods to clear walking paths for activity.	
		2	Trip hazards over hoses or	Avoid running hoses or piping across aisle	

			piping	ways, secure from movement or cover, watch for and avoid walking over hoses and piping.	
11	Drum handling and management	1	Pinch / crush hazards to hands from drum rings and lids	Wear leather gloves with good grip capability. Use drum dollies or automated methods to move full drums. Space drums in staging areas where aisle maintained and sufficient space between drums to permit safe ring removal. Ease drums into position slowly using buddy system to extent practical. Identify ring and lid hazard during removal, placement and keep hands/fingers clear.	
		2	Foot crush hazards from drum movement	Steel toe boot with good tread and ankle support required. Watch foot placement during drum lowering/placement activities. Maintain adequate aisle space so worker can move freely when handling drums. Maintain good illumination and visibility of floor surface.	
		3	Injury from empty drum lid removal when drum under pressure from temperature changes - lid may blow off	Empty drums under pressure if subject to wide temperature ranges. Test for and bleed off any pressure by carefully loosening a bung prior to opening	
		4	Muscle strain from moving drums (empty or full)	Keep back straight when shifting full drums into position or rotating. Use buddy system to shift, rotate full drums. If automated methods are available, take the time to use the method instead of a quick manual movement.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	chemical protective suit (specify type)		Recommended
	long sleeve shirt/pants		Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	as specified in HASP	Required
	work gloves (specify type)	Leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Recommended
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required
Personal	eye wash (specify type)		Required
	sunscreen		Recommended
	water/fluid replacement		Recommended

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Hubbard, Lauren M HASP Reviewer Approve 4/18/2012	
Employee: **Role** **Review Type** **Completed Date**	Tischer, Steven P. Quality Reviewer NA 5/16/2012	A very thorough JSA that identifies all potential hazards on this O&M system.

Job Safety Analysis

General

JSA ID	6684	**Status**	(3) Completed
Job Name	Environmental-Air Monitoring	**Created Date**	1/24/2012
Task Description	Indoor Air Sampling	**Completed Date**	01/25/2012
Template	TRUE	**Auto Closed**	FALSE

Client / Project

Client	ARCADIS-AGMI
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Edwards, Lauren	5/22/2012	1/24/2012	Lenz, Mark	☑
HASP Reviewer	Edwards, Lauren	2/7/2012	1/25/2012	Lenz, Mark	☑
Quality Reviewer	Lee, Johannes	2/6/2012	2/6/2012	Proffitt, David	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Driving to and from sampling locations.	1	Striking or being struck by another object or vehicle	Follow the 5 Keys of Smith System Driving	FHSH Section III-U, Motor Vehicle Safety HS Standard ARCHSGE004, Driving JSA #15
2	Sample Canister - sampling prep, collection and shipping	1	Heavy Lifting	Use a dolly, when necessary, to move canisters to and from your vehicle. Practice good lifting techniques and keep your back straight. Avoid twisting or awkward movements/positions. Remove canisters from the box and transport individually. If the box or other equipment are too heavy, request assistance in lifting.	FHSB Section III-EE
		2	Cuts or lacerations from opening the box of canisters	Use appropriate cutting tools such as safety knives and cut away from your body when opening the box.	
		3	Pinch points	Use proper tools for adjusting canister valves. Wear gloves when necessary	
		4	Limited visibility - evening hours	Have a flashlight available or a head lamp for hands free light. Try and schedule work during daylight hours and end sampling events early enough to allow for clean up before dusk.	

3	Vapor sampling	1	Slips, trips, falls. Pinch points. Eye injury from debris. Injury from lifting and carrying equipment.	Wear work gloves when handling equipment/materials. Practice good housekeeping. Unload equipment as close to work area as possible. Keep equipment and supplies organized. Wear work gloves when handling equipment/materials. Use correct size wrenches when assembling sampling train. Use safety goggles. Practice good lifting techniques and keep your back straight. Avoid twisting or awkward movements/positions. Use two people to lift items heavier than 50 pounds.	FHSB Section III-AA,CC,L,Electrical Safety HSS, Hearing Conservation HSS
		2	Lacerations from cutting of sample tubing	Use appropriate cutting device and wear gloves when handling blades. Collect purged soil vapor in a Tedlar bag. Discharge purged soil vapor outside building.	
		3	Exposure to constituents in soil vapor	Collect purged soil vapor in a Tedlar bag. Discharge purged soil vapor outside building. Perform air monitoring to monitor exposure.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	faceshield		Required
	safety glasses		Required
	safety goggles	When using electric hammer drill	Required
Foot Protection	boots		Required
	steel-toe boots	w/ steel shank	Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)	Leather	Required
Head Protection	hard hat	If wearing does not cause hazard	Required
Hearing Protection	ear plugs		Required
Miscellaneous PPE	other	Fall protection when working at heights	Required
Respiratory Protection	full face respirator	When sampling friable asbestos	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Recommended
Personal	eye wash (specify type)		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Edwards, Lauren HASP Reviewer Approve 1/25/2012	
Employee: **Role** **Review Type** **Completed Date**	Lee, Johannes Quality Reviewer NA 2/6/2012	1. Reads like the possibility exists for the building structure to be unsound. If so, beware of trip and fall hazards that may be presented by poor flooring/floor cover conditiion. 2. If sampling involves access to attic spaces, will need to have adequate load-supporting temporary stepping platforms between ceiling joists.

Job Safety Analysis

General

JSA ID	45	**Status**	(3) Completed
Job Name	Environmental-Groundwater Sampling and free product recovery	**Created Date**	2/4/2009
Task Description	Groundwater sampling	**Completed Date**	02/06/2009
Template	True	**Auto Closed**	False

Client / Project

Client	ARCADIS-AGMI
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Coppola, Mija	6/12/2012	2/4/2009	Coates, Gary	☑
HASP Reviewer	Coppola, Mija	2/6/2009	2/6/2009	Coates, Gary	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Stage at pre-determined sampling location and set up work zone and sampling equipment	1	Personnel could be hit by vehicular traffic	Set up cones and establish work area. Position vehicle so that field crew is protected from site traffic. Unload as close to work area as safely possible.	
		2	Sampling equipment, tools and monitoring well covers can cause tripping hazard	Keep equipment picked up and use TRACK to assess changes.	
2	Open wells to equilibrate and gauge wells	1	When squatting, personnel can be difficult to see by vehicular traffic.	Wear class II traffic vest if wells are located proximal to vehicular traffic. Use tall cones and the buddy system if practicable.	
		2	Pinchpoints on well vault can pinch or lacerate fingers	Use correct tools to open well vault/cap. Wear leather gloves when removing well vault lids, and chemical protective gloves while gauging. Wear proper PPE including safety boots, knee pads and safety glasses.	
		3	Lifting sampling equipment can cause muscle strain	Unload as close to work area as safely possible; use proper lifting and reaching techniques and body positioning; don't carry more than you can handle, and get help moving heavy or awkward objects.	
		4	Pressure can build up inside well causing cap to release under pressure	Keep head away from well cap when removing. If pressure relief valves are on well use prior to opening well	
3	Begin Purging Well and Collecting Parameter Measurements	1	Electrical shock can occur when connecting/disconnecting pump from the battery.	Make sure equipment is turned off when connecting/disconnecting. Wear leather gloves. Use GFCIs when using powered tools and pumps. Do not use in the rain or run electrical cords through wet areas.	
		2	Purge water can spill or leak from equipment	Stop purging activities immediately, stop leakage and block any drainage grate with absorbent pads. Call PM to notify them of any reportable spill.	
		3	Water spilling on the ground can cause muddy/slippery conditions	Be careful walking in work area when using plastic around well to protect from spillage	
		4	Lacerations can occur when cutting materials such as plastic tubing	When cutting tubing, use tubing cutter. No open fixed blades should ever be used. When possible wear work gloves, leather type.	
		5	Purge water can splash into eyes	Pour water slowly into buckets/drums to minimize splashing. Wear safety glasses.	
4	Collect GW or Free Product Sample	1	Working with bailer rope can cause rope burns on hands.	Slowly raise and lower the rope or string for the bailer. Wear appropriate gloves for the task.	

4	Collect GW or Free Product Sample	2	Sample containers could break or leak preservative	Discard any broken sampleware or glass properly. Do not overtighten sample containers. Wear chemical protective gloves.	
5	Recovery of Free Product from well	1	Exposure to free product	Additional chemical protection may be necessary based on the type of product. Additionally, safety goggles, a faceshield, or respiratory protection may be required. Verify in the HASP.	
6	Staging of Well Purge water and/or Free Product	1	Muscle strains can occur when moving purge water or drums	If using buckets, do not fill buckets up to the top. Always keep lid on buckets when traveling or moving them to another location. Only half fill buckets so when dumping the buckets weigh less. See drum handling JSA for movement of drums.	Drum handling JSA

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants		Recommended
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	Nitrile	Required
	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Recommended
Miscellaneous PPE	other	Knee pads	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Decontamination	Decon supplies (specify type)	alconox, DI water, spray bottle	Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required
Personal	eye wash (specify type)	bottle	Required
	insect repellant		Recommended
	sunscreen		Recommended
Traffic Control	barricades		Recommended
	traffic cones		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Coppola, Mija HASP Reviewer Approve 2/6/2009	

Job Safety Analysis

General

JSA ID	166	**Status**	(3) Completed
Job Name	Environmental-Sample cooler handling	**Created Date**	5/1/2009
Task Description	Sample cooler handling	**Completed Date**	05/13/2009
Template	True	**Auto Closed**	False

Client / Project

Client	ARCADIS-AGMI
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Coppola, Mija	12/19/2011	5/11/2009	Coates, Gary	☑
HASP Reviewer	Moyers, Sam	5/25/2009	5/13/2009	Kundert, Brian	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Transfer field samples to sample packing area	1	Lifting heavy coolers may result in muscle strain especially to lower back.	Use proper lifting techniques and keep back straight. Use buddy system for large coolers, Use mechanical aids like hand trucks if readily available to move coolers. Do not over fill coolers with full sample containers for temporary movement to the sample prep area. Ensure an adequate supply of sample coolers are in field.	
		2	Hazards to hands from broken glass caused by over tightening lids or improper placement in cooler	Inspect all bottles and bottle caps for cracks/leaks before and after filling container. Do not over tighten sample lids. Clean up any broken bottles immediately, avoid contact with sample preservatives. Wear leather gloves when handling broken glass.	
		3	Exposure to chemicals (acid preservatives or site contaminants) on the exterior of sample bottles after filling.	Wear protective gloves for acid preservatives and safety glasses with side shields during all sample container handling activities (before and after filling), Once filled follow project specific HASP PPE requirements for skin and eye protection.	
		4	Samples containing hazardous materials may violate DOT/IATA HazMat shipping regulations	All persons filling a sample bottle or preparing a cooler for shipment must have complete ARCADIS DOT HazMat shipping training. Compare the samples collected to the materials described in the Shipping Determination for the Project and ensure consistent. Re-perform all Shipping determinations if free product is collected and not anticipated during planning.	
2	Sample cooler selection	1	Sample coolers with defective handles, lid hinges, lid hasps cracked or otherwise damaged may result in injury (cuts to hands, crushing of feet if handle breaks etc)	Only use coolers that are new or in like new condition, No rope handled coolers unless part of the manufacturer's handle design.	ARCADIS Shipping Guide US-001
		2	Selection of excessively large coolers introduces lifting hazards once the cooler is filled.	Select coolers and instruct lab to only provide coolers of a size appropriate for the material being shipped. For ordinary sample shipping sample coolers should be 48 quart capacity or smaller to reduce lifting hazards.	
3	Pack Samples	1	Pinch points and abrasions to hands from cooler lid closing unexpectedly	Beware that lid could slam shut; block/brace if needed; be wary of packing in strong winds. New coolers may be more prone to self closing, tilt cooler back slightly to facilitate keeping lid open.	

3	Pack Samples	2	Awkward body positions and contact stress to legs and knees when preparing coolers on irregular or hard ground surfaces.	Plan cooler prep activities. Situate cooler where neutral body positions can be maintained if practical, like truck tailgate. Avoid cooler prep on rough gravel surfaces unless knees and legs protected during kneeling.	
		3	Frostbite or potential for oxygen deficiency when packing with dry ice. Contact cold stress to fingers handling blue ice or wet ice	Dry ice temperature is -109.30F. Wear thermal protective gloves. DO NOT TOUCH with bare skin! Dry ice sublimates at room temp and could create oxygen deficiency in closed environment. Maintain adequate ventilation! Do not keep dry ice in cab of truck. Wear gloves when handling blue ice or gaging wet ice. Dry Ice is DOT regulated for air shipping, follow procedures in Shipping Determination.	
4	Sealing, labeling and Marking Cooler	1	Cuts to hands and forearms from strapping tape placement or removing old tape and labels	Do not use a fixed, open-blade knife to remove old tags/labels, USE SCISSORS or other safety style cutting device. Only use devices designed for cutting. Do not hurry through task.	
		2	Lifting and awkward body position hazards from taping heavy coolers, dropping coolers on feet during taping.	Do not hurry through the taping tasks, ensure samples in cooler are evenly distributed in cooler to reduce potential for overhanging cooler falling off edge of tailgate/table when taping.	
		3	Improper labeling and marking may result in violation of DOT/IATA HazMat shipping regulations delaying shipment or resulting in regulatory penalty	Do not deviate from ARCADIS Shipping Guide or Shipping Determination marking or labeling requirements.	
5	Offering sample cooler to a carrier or lab courier for shipment.	1	Lifting heavy coolers may result in muscle strain especially to lower back.	See lifting hazard controls above.	
		2	Carrier refusal to accept cooler may cause shipping delay and/or result in violation of DOT HazMat shipping regulations.	Promptly report all rejected and refused shipments to the ARCADIS DOT Program Manager. Do Not re-offer shipment if carrier requires additional labels markings or paperwork inconsistent with your training or Shipping Determination without contacting the ARCADIS DOT Compliance Manager.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Hand Protection	chemical resistant gloves (specify type)	nitrile	Required
	work gloves (specify type)	leather	Required

Supplies

Type	Supply	Description	Required
Miscellaneous	Other	Scissors	Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Moyers, Sam HASP Reviewer Revise 5/11/2009	Kevlar is required? Leather work gloves are listed. i suggest just leather gloves.
Employee: **Role** **Review Type** **Completed Date**	Moyers, Sam HASP Reviewer Approve 5/13/2009	

Job Safety Analysis

General

JSA ID	31	**Status**	(3) Completed
Job Name	General Industry-Ladders	**Created Date**	1/30/2009
Task Description	Ladders	**Completed Date**	07/28/2011
Template	True	**Auto Closed**	True

Client / Project

Client	ARCADIS-AGMI
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Coppola, Mija	12/20/2011		Coates, Gary	☑
HASP Reviewer	Coppola, Mija			Coates, Gary	☑
Quality Reviewer	Heavens, Mark	8/23/2011	8/23/2011	Mcburney, Lowell	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Ladder Selection	1	Improper ladder selection could result in ladder collapse	Select ladder with load rating appropriate for work being performed.	Field H&S Handbook section III JJ
		2	Improper ladder selection could result in Electrocution	Select non-conductive ladders if working near electrical wiring or other electrical hazard	
		3	Use of ladders that are in unsound operational condition may result in injury or death	Inspect all ladders prior to use, do not use a ladder marked "out of service." Check ladders for proper operation, good feet and free of oil grease or other slick substance on rungs. Check wood ladders for signs of cracking or splitting. Competent person to inspect all ladders regularly.	
2	Transport Ladder to Work Area	1	Lifting and carrying ladders	Use TRACK. Use buddy system when moving heavy ladders or long extension ladders. Don't carry ladders that obstruct view of path forward or use awkward body twist picking up ladders. Use proper lifting techniques.	
		2	Ladder hitting into other workers or objects during transport	Plan route with ladder, remember to check the rear when turning corners with ladder, use buddy system to carry longer ladders to maintain better control. Look up when moving shorter step ladders vertically.	
		3	Property damage, vehicle damage or injury from improperly securing ladders on vehicles and during transport	Make sure ladders are adequately secured and driver views are not impaired. Secure in manner that prevents forward or rear movement of ladder if mounted on top of vehicle. Inspect securing devices prior to moving/driving the vehicle. if ladder extends >4 ft from rear of vehicle, attach 18 square inch fluorescent red or orange flag to end.	
3	Working From Portable Ladders	1	Muscle strain setting up or taking down ladders	Use buddy system to place/remove heavy or long ladders. Avoid awkward twisting or bending during this activity.	
		2	Falls from ladders	Always maintain 3 points of contact, only one worker on ladder at time and ensure ladder extends at least 3 ft above level being accessed. Ensure extension ladder is at a 1ft horizontal to every 4 ft vertical rise to maintain proper angle. Follow all warning label requirements.	
		3	Tipping of ladders that are improperly secured	Ensure that ladders are secure and on firm and level ground. Ladders can be tied off at the top to prevent displacement.	

3	Working From Portable Ladders	4	Collapse of ladders that are over extended or over loaded.	Ensure ladder weight ratings are maintained. Maintain at least 3 ft of overlap on extension ladders or other overlap length per ladder instructions.	
		5	Struck by objects or debris dropped from ladders	Keep other workers away from overhead work from ladders.	
4	Working from Fixed Ladders	1	Falls from height causing injury or death	Always maintain 3 points of contact. Utilize ladder fall safety devices if ladder is equipped. Do not hurry when climbing fixed ladders, rest at any landings provided by the ladder.	
		2	Slips on wet or icy rungs creating impact injuries	Inspect for presence of hazard, clear if possible, do not attempt to climb ladders with ice on rungs. Use anti-slip footwear and gloves. Maintain 3 points of contact and climb in a slow methodical manner. Use Stop Work Authority for any condition making climbing unsafe.	
		3	Temperature stress to hands when contacting hot or cold ladder components.	Wear gloves with good dexterity and anti-slip coatings. Wear footwear with good tread and anti-slip soles. Rest at any landing provided by the ladder. If in one position of the ladder for an extended time, shift weight to other hand and foot periodically.	

PPE — Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Recommended
Foot Protection	boots		Required
Hand Protection	work gloves (specify type)	leather	Recommended

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fall protection (specify type)	if needed for task and ladder type	Recommended
	first aid kit		Required
	Other	securing devices for mounting on vehicle	Required
	Other	flags for transport	Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Heavens, Mark Quality Reviewer NA 8/23/2011	Thank you for posting this important JLA. Another consideration is applying TRACK to what you carry with you on a ladder. Unsecured tools and materials can be potentially lethal during a fall from a ladder

EXECUTIVE SUMMARY

This Health and Safety Standard (HSS) establishes procedures, provides compliance guidelines and outlines minimum training and competency requirements for ARCADIS employees, who potentially face a risk of electrical shock, arc flash, or related injuries, when they are working on or are in/and around energized electrical equipment. This Electrical HSS addresses electrical safety related work practices, safety-related maintenance requirements, and other administrative controls for employee workplaces that are necessary for the practical safeguarding of employees relative to the hazards associated with electrical energy during activities such as the installation, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways.

There are various physical controls protecting personnel from the hazards related to electricity including: insulation, guarding, grounding, de-energizing equipment and electrical protective devices. In addition, administrative procedures such as safe work-practices, employee training, routine maintenance, inspections and program audits also provide administrative controls to appropriately and adequately protect ARCADIS personnel.

This Electrical HSS applies to every project and operations conducted at ARCADIS offices, project sites, client facilities, and any other work-related location where ARCADIS employees carry-out activities that directly or indirectly expose these employees to the hazards of electricity.

The Electrical HSS identifies requirements for working within the limited approach boundary and for working within the arc flash boundary. Employees must review and understand these requirements before work can begin.

An Electrical Energy Control Procedure must be established for each project or activity where ARCADIS personnel (including subcontractors) perform work on devices with an electrical energy source. An effective way to prevent an electrical injury is to remove the source of electrical energy and eliminate the possibility of inadvertent energization. To do this, employees must identify all possible sources of electricity, locate the disconnecting means for each source and establish an electrically safe work condition. Where feasible, an electrically safe work condition must be established. When working on or near exposed de-energized parts, including the task of testing for the absence of voltage, they are to be treated as energized until proven otherwise, and the trained and Qualified employee must wear PPE suitable for the maximum degree of all associated electrical hazards.

Employees must not work on or near exposed energized electrical conductors unless they are trained and qualified to recognize and avoid contact. Employees must determine where a difference of 50 volts or more exists between exposed parts within arm's reach of the work task. Safety-related work practices must be employed by Qualified Persons to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits that are or may be energized (consistent with their training and with specific energy control procedures). These task specific safety-related work practices must be consistent with the nature and extent of the associated electrical hazards.

Unqualified employees are safe when they maintain a specified distance from the exposed energized conductors or circuit parts, including the longest conductive object being handled, so that they cannot contact or enter a specified air approach distance to the exposed energized electrical conductors or circuit parts. This safe approach distance is identified as the Limited Approach Boundary. Safe approach distances for both Qualified and Unqualified staff are detailed in Exhibit 5 Tables 5A and 5B.

The Arc Flash Boundary is intended to trigger the need for PPE to protect employees from the potential of thermal injury. Any body part that is closer to a potential arcing fault than the Arc Flash Boundary must be protected from thermal injury.

1. POLICY

The core criteria to this standard are as follows:

- Anything that is electrically connected to, or is, a source of voltage is considered to be energized until the employee has conducted a verification test and knows with certainty that it is no longer energized and is controlled with an appropriate lockable device, when applicable, and cannot be energized during the time ARCADIS staff is in contact with or in the vicinity of that item.

- Appropriate safe work practices and controls, as required by this standard and associated ARCADIS standards, are employed to prevent electric shock, arc flash burns or other injuries resulting from either direct or indirect electrical contacts. Specific work practices and controls are to be consistent with the nature and extent of the associated electrical hazards.

- All servicing of electrical equipment shall be performed by Qualified Persons who operate in strict compliance with ARCADIS electrical safety requirements, including Lockout/Tagout (LOTO), arc-flash, and shock hazard safety requirements. Qualified individuals shall possess working knowledge of the various systems upon which work is being performed.

- Routine work is planned carefully, following the ARCADIS TRACK process, and scheduled well in advance. Work assignments are planned to include the trained and Qualified Personnel to perform the work. All electrical work will only be performed once all appropriate equipment has been procured, including all required Personal Protective Equipment (PPE) and testing equipment (appropriately-rated digital voltmeter, etc.) and LOTO equipment, as appropriate.

- When emergency work is required (including trouble-shooting), electrical safety is not compromised in favor of maintaining the project schedule or budget. Equipment outages (including de-energization and LOTO) are scheduled in lieu of working on energized equipment, whenever possible. When power shutdown is not possible, a signed Energized Electrical Work Permit from a Qualified Employee must be provided (**Exhibit 2**).

  Note: Testing, troubleshooting and voltage measuring is excluded from the permit requirement, but this work must only be conducted by Qualified Persons.

- No ARCADIS employee works on energized electrical conductors or circuit parts or installs electrical equipment that requires electrical power source of equal to or greater than 600 volts, unless appropriately qualified for the specified task and approved by ARCADIS Corporate H&S.

- This Electrical Safety Standard does not include design requirements for electrical equipment and/or work on or directly associated with electrical generation, transmission, or distribution installations. The design of Programmable Logic Control (PLC) panels that ARCADIS designs/builds are excluded from this standard as this work is covered by other standard requirements established by the ARCADIS Technical Knowledge and Innovation (TKI) group.

- ARCADIS clearance requirements for working around and under overhead power lines is addressed in the ARCADIS Utility Clearance Standard ARC HSFS019.

2. PURPOSE AND SCOPE

2.1 Purpose

2.1.1 Prevention
The basic purpose of the ARCADIS electrical safety Health and Safety Standard (HSS) is to prevent accidents, injuries and equipment damage. Electrical accidents are caused by a combination of the following controllable factors:

- Insufficient training or knowledge of the hazards and hazard controls
- At-risk behaviors or work practices
- Inappropriate equipment and/or installation
- Workplaces made unsafe by the environment
- Insufficient preparation for the expected task

There are various physical controls protecting personnel from the hazards related to electricity including: insulation, guarding, grounding, de-energizing equipment and electrical protective devices. In addition, administrative procedures such as safe work-practices, employee training, routine maintenance, inspections and program audits also provide administrative controls to appropriately and adequately protect ARCADIS personnel. This HSS sets forth minimum requirements for ARCADIS personnel to conduct work involving electricity.

2.1.2 Defining Hazards
This HSS addresses electrical work as the hazardous energy source. As applicable, employees covered by this standard must also follow the ARCADIS Control of Hazardous Energy LO/TO HSS (ARC HSFS004) and the ARCADIS Power and Hand Tool HSS (ARC HSFS008).

2.1.3 Providing Guidance
This HSS establishes procedures, provides compliance guidelines and outlines minimum training and competency requirements for ARCADIS employees, who potentially face a risk of electrical shock, arc flash, or related injuries, when they are working on or are in/and around energized electrical equipment.

2.2 Scope

This Electrical HSS addresses electrical safety related work practices, safety-related maintenance requirements, and other administrative controls for employee workplaces that are necessary for the practical safeguarding of employees relative to the hazards associated with electrical energy during activities such as the installation, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways.

This HSS covers electrical safety-related work practices and procedures for employees who are exposed to an electrical hazard in the workplace.

This standard applies to every project and operations conducted at ARCADIS offices, project sites, client facilities, and any other work-related location where ARCADIS employees carry-out activities that directly or indirectly expose these employees to the hazards of electricity.

2.2.1 Conditions Providing Acceptable Risk

The risk associated with normal operation of electrical equipment is minimal, given the following conditions:

- The equipment is properly installed, in accordance with applicable industry codes and standards including the manufacturer's instructions.
- The equipment is properly maintained, in accordance with the manufacturer's instructions and applicable industry codes and standards.
- The equipment doors are closed and secured.
- All the equipment's covers are in place and secured.
- There is no evidence of impending failure, such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.
- The equipment is used in accordance with the manufacturer's instructions and its listing.

Under such conditions the risks of an employee being shocked, electrocuted, or injured by an arc flash or blast or from fire caused from the use of electricity is minimal and considered acceptable.

2.2.2 Safety Related Work Practices Not Covered by this HSS

This standard does not cover safety-related work practices associated with:

- Installations in ships, watercraft other than floating buildings, railway rolling stock, aircraft, or automotive vehicles other than mobile homes and recreational vehicles

- Installations of railways for generation, transformation, transmission, or distribution of power used exclusively for operation of rolling stock or installations used exclusively for signaling and communications purposes

- Installations of communications equipment under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations

- Installations under the exclusive control of an electric utility.

3. DEFINITIONS

There are a number of definitions associated with this standard. These definitions are presented in **Exhibit 1** of this document.

4. RESPONSIBILITY

4.1 Project Managers and Task Managers

Are responsible for implementing this HSS on any project that poses electrical hazards to ARCADIS employees or employees of its subcontractors, clients, and other organizations present in the vicinity of work controlled by ARCADIS. These individuals are responsible for communicating and appropriately managing subcontractors, ensuring that employees have appropriate training and qualifications, and for reviewing all opportunities of electrical work performed by or supervised by ARCADIS as specified in this standard. These individuals are responsible for involving the appropriate ARCADIS H&S Staff as needed.

In those instances where ARCADIS is considered the Host Employer, we must communicate with our subcontractors concerning the minimum H&S requirements for the activity involving electricity including:

Known hazards that are covered by this HSS, that are related to the subcontractor's work, and that might not be recognized by the contract employer or its employees.

Information about the employer's installation that the contract employer needs to conduct a hazard assessment.

4.2 Division HS Directors

Are responsible for communicating with Project Managers, Task Managers, H&S Coordinators, Authorized Employees and Corporate Services Managers within ARCADIS to notify them of this HSS and to assist and guide staff with regards to effective implementation of this HSS.

4.3 Operations Managers and Supervisors

Operations managers and supervisors that have oversight management for the health and safety of employees in their respective operations must ensure that appropriate time is provided to facilitate the development of electrical control procedures and for personnel training.

4.4 ARCADIS Employees

ARCADIS employees are responsible for implementing the **TRACK** (**T**hink through the task, **R**ecognize the hazard, **A**ssess the risk, **C**ontrol the risk and **K**eep H&S first in all things) process before any and all work related to electricity and adhere to this electrical standard and associated electrical procedures set forth by ARCADIS Corporate H&S and communicate H&S concerns, issues and questions to their supervisor or their respective Health and Safety contact prior to initiating work.

ARCADIS employees that do not meet the qualification standards outlined in this HSS must not work on energized electrical conductors or circuit parts or be exposed to an electrical hazard in the workplace covered by this HSS.

5. STANDARDS AND PRACTICES

5.1 Procedure

The following elements support this ARCADIS Electric Safety HSS. Each element, briefly described below, has its own detailed procedure and is associated with this standard.

The ARCADIS electrical safety standard identifies requirements for working within the limited approach boundary and for working within the arc flash boundary. Employees must review and understand these requirements before work can begin.

Unqualified employees are safe when they maintain a specified distance from the exposed energized conductors or circuit parts, including the longest conductive object being handled, so that they cannot contact or enter a specified air approach distance to the exposed energized electrical conductors or circuit parts. This safe approach distance is identified as the Limited Approach Boundary. Safe approach distances for both Qualified and Unqualified staff are detailed in Exhibit 5 Tables 5A and 5B. At no time are Unqualified employees allowed to be exposed to an electrical work place hazard.

The ARCADIS electrical safety standard principles include, but are not limited to, the following:

- Inspect/evaluate the electrical equipment

- Consider the condition of maintenance of electrical equipment and systems (Without proper maintenance, the equipment cannot be depended on to perform its required safety functions, such as interrupting fault currents within its characteristic time–current curves. Proper maintenance can be achieved by following the manufacturer's instructions or the recommendation included in NFPA 70B)

- Maintain the electrical equipment's insulation and enclosure integrity

- Pre-plan every job and document first-time procedures using the Job Safety Analysis (JSA) process

- De-energize and LOTO, if possible
- Anticipate unexpected events (Use the TRACK process)
- When working on or near exposed de-energized parts, including the task of testing for the absence of voltage, they are to be treated as energized until proven otherwise, and the trained and Qualified employee must wear PPE suitable for the maximum degree of all associated hazards.
- Identifying the electrical hazards and reduce the associated risk
- Employees will protect themselves from shock, burn, blast, and other hazards due to the working environment by minimizing exposure and using proper PPE
- Using the right tools for the job
- Assess employee's abilities, project management approach and H&S principles by using the Task Improvement Process (TIP)

5.1.1 Electrical Energy Control Procedure

An Electrical Energy Control Procedure is established for each project or activity before ARCADIS personnel (including ARCADIS subcontractors) are exposed to an electrical hazard. This consists of energy control procedures (including the identification of the hazardous energy sources as required by the Control of Hazardous Energy Standard - ARC HSFS004), employee training requirements, and periodic inspections to ensure that before any employee performs any servicing (trouble-shooting, and includes the testing of equipment during the build-out) or maintenance on a machine or equipment where the unexpected energizing, startup or release of stored energy could occur and cause injury, the machine or equipment shall be isolated from the energy source and rendered inoperative. The Electrical Energy Control Program also includes a general section on installation requirements and safeguards. Refer to ARCADIS Control of Hazardous Energy (Lockout/Tagout) Procedure ARC HSFS004 for an Equipment Specific LO/TO Procedure template.

5.1.2 Protective Devices

Protective Devices (e.g. locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware) are provided to staff. These devices are used for isolating, securing or blocking of machines or equipment from electrical energy sources.

PPE as specified by NFPA 70E is provided to ARCADIS staff and staff are advised that PPE must be used for the intended part of the body to be protected and for the work to be performed. PPE requirements shall be specified in the Electrical Task Hazard Assessment sheet (refer to template in **Exhibit 8**), and must be used by ARCADIS personnel. PPE is used during servicing (trouble-shooting) of equipment, and as specified in the THA developed.

5.1.3 Demonstrated Skills Assessment Procedure

ARCDIS uses the TIP process for task specific performance assessments of Qualified employees. These assessments, which are to be conducted periodically (at least annually) for each Qualified employee who employs Electrical Energy Control Procedure(s), will ensure that the Electrical Energy Control Procedure(s) and the requirements of the ARCADIS Electrical Energy Control Program are being followed. Details on the control of hazardous energy are outlined in the ARCADIS Control of Hazardous Energy (Lockout/Tagout) Procedure ARC HSFS004.

5.1.4 Outside Personnel

Whenever outside servicing personnel (Contractors/Subcontractors) are to be engaged in activities covered by the control of hazardous energy sources (re: Control of Hazardous Energy Standard - ARC HSFS004) and this

HSS, ARCADIS and the outside servicing employer shall inform each other of their respective energy control procedures.

When ARCADIS contracts with a subcontractor to perform electrical work, in some cases we may serve as the Host Employer and have certain responsibilities and will inform the subcontractor of:

- Known electrical hazards that are related to the subcontractor's work, and that might not be recognized by the subcontractor or its employees. If work is being performed by a subcontractor on client owned and operated equipment, ARCADIS will coordinate communication to verify that the electrical subcontractor has the required information.
- Information about ARCADIS' installation that the subcontractor needs to make the appropriate electrical hazard assessments and analyses.

In addition, ARCADIS will report observed subcontractor-related issues related to electrical safety, to the Project Manager and Subcontractor management, as appropriate.

In those instances where ARCADIS is considered the host employer, the PM or TM must verify that a documented meeting with our electrical subcontractor(s) occurs. This could be accomplished by subcontractor participation in a documented tailgate safety meeting where task specific hazards, including electrical hazards and controls, will be discussed. The direct sharing of information leading to employee safety is the intended function of this meeting so that ARCADIS, when considered the host employer, can fully meet our responsibilities and the subcontractor can ensure that their employees are qualified for the tasks that will be performed.

The ARCADIS subcontractor will:

- Ensure that each of its employees is instructed in the hazards communicated to it by ARCADIS in addition to ensuring that its employees meet all training and qualification requirements of NFPA 70E and OSHA.

- Ensure that each of its employees follow the work practices required by the NFPA 70E standard and the project HASP.

- Advise ARCADIS of:

  - Any unique hazards presented by the subcontractor's work.

  - Any hazards identified during the course of the work by the subcontractor that were not communicated by ARCADIS.

  - The measures the subcontractor took to correct any issues identified or raised by ARCADIS to the subcontractor and to prevent them from occurring again.

5.2 Establishing an Electrically Safe Work Condition

An effective way to prevent an electrical injury is to remove the source of electrical energy and eliminate the possibility of inadvertent energization. To do this, employees must identify all possible sources of electricity, locate the disconnecting means for each source and establish an electrically safe work condition.

The process of establishing an electrically safe work condition can expose employees to electrical hazards. Depending on the integrity of the equipment, circuit, and overcurrent device, an employee could be exposed to arc flash, arc blast, shock, electrocution, and flying parts and pieces. Until the electrically safe work condition has been established, including the task of testing for the absence of voltage, the trained and Qualified employee must wear PPE suitable for the maximum degree of all associated hazards. When working on or near exposed de-energized parts, including the task of testing for the absence of voltage, they are to be treated as energized until proven otherwise.

Equipment rated as arc resistant by a manufacturer provides assurance to the employee that when the switch operating handle is moved from one position to another, an internal arcing fault within the arc-resistant equipment would not expose the employee to effects from the fault, as long as the equipment doors are closed and latched. Employees must recognize that when the door is less than fully latched or a cover is removed, the arc-resistant nature of the equipment no longer exists.

5.2.1 Process of Achieving an Electrically Safe Work Condition

If an electrically safe work condition is achieved and verified, no electrical energy is in the immediate vicinity of the work task(s) and all danger of injury from an electrical hazard has been removed, PPE is not needed, and unqualified persons can perform non-electrical work such as cleaning and painting near electrical equipment. Unqualified employees may perform non-electrical work on equipment after an electrically safe work condition has been established, however, they must understand technical aspects of the work task so as to not create an electrical hazard when the equipment is re-energized and must be capable of executing the task(s) in a manner that will not create unacceptable risk from electrical hazards.

Refer to the ARCADIS Standard Operating Procedure ARC HSFS004 - Control of Hazardous Energy for LOTO requirements.

An electrically safe work condition is not achieved until all six of the following steps have been completed:

1. Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.

2. After properly interrupting the load current, open the disconnecting device(s) for each source.

   Note: Before operating any disconnecting device, it should be verified whether or not the device is capable of opening the load current. When the rating of a disconnect device is not sufficient to interrupt the load current, the load must be interrupted by another action prior to opening the device. Otherwise, the disconnecting device might be destroyed, initiating a significant failure that could escalate to an arcing fault within the equipment.

3. Wherever possible, visually verify that all blades of the disconnecting devices are fully open or that drawout-type circuit breakers are withdrawn to the fully disconnected position.

4. Apply LOTO devices in accordance with AUS Control of Hazardous Energy Standard (ARC HSFS004).

5. Use an adequately rated test instrument to test each phase conductor or circuit part to verify they are de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.

6. When the possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit parts before touching them. Where it could be reasonably anticipated that the conductors or circuit parts being de-energized could contact other exposed energized conductors or circuit parts, apply ground connecting devices rated for the available fault duty.

5.3 Work With Electrical Hazards

This Electrical Energy Control procedure provides general information and work requirements for ARCADIS employees working on projects. A project-specific Electrical Energy Control Program, which includes an electrical safety analysis to be performed as part of the HASP development, is established for each project site where ARCADIS' personnel perform work on hazardous energy sources.

Energized work by ARCADIS staff shall be permitted only:

- Where it can be demonstrated that de-energizing equipment introduces additional hazards or increased risk (de-energizing equipment could result in creating additional hazard elsewhere, result in a potential chemical release or result in creation of a hazardous atmosphere for example).

- Where it can be demonstrated that the task to be performed is infeasible in a de-energized state due to equipment design or operational limitations (diagnostic analysis and testing - measuring voltage or load current, for instance, can only be performed with the circuit energized and operating).

- Where energized electrical conductors and circuit parts operate at less than 50 volts and when any overcurrent protection between the energy source and the worker are considered and it is determined that there will be no increased exposure to electrical burns or to explosion due to electric arc.

  Note: Under normal condition, electrical conductors energized at a voltage level less than 50 volts do not present an electrical shock hazard. However, a thermal hazard can exist in circuits that have a significant capacity to deliver energy, even when the voltage level is less than 50 volts. For instance, battery installations can be connected so that arcing resulting from a short circuit could present a significant thermal hazard. Note that control circuits may operate at a voltage less than 50 volts. Creating an open circuit or short circuit in one of these control circuits could result in a different type of hazard – for example, an interruption or other unintended action that could result in exposure to a chemical hazard or creation of an unacceptable environmental condition.

Employees must not work on or near exposed energized electrical conductors unless they are trained and qualified to recognize and avoid contact. Employees must determine where a difference of 50 volts or more exists. Power limited circuits are not normally considered to be an electrical hazard, and electrical equipment energized at less than 50 volts is not normally considered to be an arc flash hazard. However, the effects of an arcing fault are related to available incident energy. In some instances, an arcing fault hazard might be significant at this lower voltage. If exposure to an electric arc exists, an electrically safe work condition and PPE in accordance with the requirements of this HSS may be necessary.

Employees must complete and reference the task specific hazard assessment sheet (refer to **Exhibit 8** link) and JSAs before working on or near exposed energized electrical conductors. A qualified employee must generate the task specific hazard assessment sheet and the document must be reviewed and approved.

As defined within the task specific hazard assessment sheets or JSA, employees are required to wear PPE that was selected to protect employees from hazards associated with the overall job. The PPE must be inspected before each use to ensure the integrity of the equipment and to ensure it has been maintained in usable condition.

5.3.1 General Requirements

Exposure Limitation: Employees shall minimize the amount of time spent around high energy equipment; Identify the potential exposure hazard pathway and stand off to the side; don't loiter.

Distance: Employees must always stay as far away as possible from energized equipment, unless there is a need to be there.

Mass: Try to keep some type of sturdy material between you and a potential arc blast.

Protective Clothing: Arc Rated clothing offers some protection to minimize burns resulting from arc blasts. Refer to Exhibit 6B and Exhibit 6C for guidance on minimum personal protective equipment requirements by task.

Energized electrical conductors or circuit parts to which an employee may be exposed shall be put into an electrically safe work condition before an employee performs work if either of the following conditions exist:

- The employee is within the limited approach boundary.
- The employee interacts with equipment where conductors or circuit parts are not exposed, but an increased likelihood of injury from an exposure to arc flash hazard exists.

Exception: Where a disconnecting means or isolating element that has been properly installed and maintained is operated, opened ,closed, removed, or inserted to achieve an electrically safe work condition for connected equipment or to return connected equipment to service that has been placed in an electrically safe work condition, the equipment supplying the disconnecting means or isolating element shall not be required to be placed in an electrically safe work condition provided a risk assessment is performed and does not identify an unacceptable risks for the task.

If the exposed energized electrical conductors or circuit parts are not de-energized (for reasons of increased or additional hazards, system inspection/trouble-shooting or infeasibility), other safety-related work practices must be used to protect employees who may be exposed to the electrical hazards involved.

5.3.2 Work While Exposed to Electrical Hazards

Safety-related work practices must be employed by Qualified Persons to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits that are or may be energized (consistent with their training and with specific energy control procedures). These task specific safety-related work practices must be consistent with the nature and extent of the associated electrical hazards. Refer to the Task Hazard Assessment Sheet template in **Exhibit 8**.

Before an ARCADIS employee works within the Limited Approach Boundary, energized electrical conductors and circuit parts to which an employee might be exposed shall be put into an electrically safe work condition, unless work on energized components is justified (refer to Section 5.3 for these instances).

Only Qualified Persons will be permitted to work on electrical conductors or circuit parts that have not been put into an electrically safe work condition. Unqualified Persons are not permitted to perform any task with potential exposure to an electrical hazard.

The acts of opening a disconnecting means, measuring for absence of voltage and visually verifying a physical break in the power conductors could pose a risk of injury. These activities are necessary to create an electrically safe work condition, and until they are completed, employees must be wearing PPE based on the degree of hazard. Refer to the Task Hazard Assessment Sheet template in **Exhibit 8**.

Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists if movement of the door, hinged panel, and the like is likely to create a hazard.

Supervisors, Project Managers and/or Task Managers must ensure that employees are reminded to be alert at all times when inside the Limited Approach Boundary.

Employees are not permitted to work within the Limited Approach Boundary of energized electrical conductors or circuit parts operating at 50 volts or more, or where other electrical hazards exist, while their alertness is recognizably impaired due to illness, fatigue or other reasons.

Employees shall use the TRACK process and review the JSA and/or Task Hazard Analysis Sheet prior to entering into the Limited Approach Boundary in order to identify situation(s) that could result in person working outside the electrically safe work condition or expose the employee to hazards not addressed in the JSA or Task Hazard Assessment Sheets. Employees will use Stop Work Authority to address changed conditions and to re-assess hazards not initially addressed or controlled.

Employees must not reach blindly into areas that are not directly visible as it may contain exposed energized electrical conductors or circuit parts.

Employees may not enter spaces containing exposed energized parts, unless illumination is provided that enables the employee(s) to perform the work safely. Where lack of illumination or an obstruction precludes observation of the work to be performed, employees may not perform tasks near exposed energized parts. Employees may not reach blindly into areas which may contain energized parts.

Conductive articles of jewelry and clothing (such a watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear or metal frame glasses) shall not be worn within the Restricted Approach Boundary or where they present an electrical contact hazard with exposed energized electrical conductors or circuit parts.

For conductive materials and equipment that are in contact with any part of an employee's body, employees are instructed (through daily tailgate meetings, job briefings, review of the health and safety plan, etc.) to handle these materials/equipment in a manner that will prevent them from contacting exposed energized conductors or circuit parts. If an employee must handle long dimensional conductive objects (such as ducts, pipes, tubes, conductive hose, metal scaffold parts, chains, etc.) in areas with exposed energized electrical conductors or circuit parts, specific work practices will be evaluated (use of the TRACK process) and instituted (such as the use of insulation, guarding, and material handling techniques) to minimize the hazard.

When working within a confined or enclosed space that contains exposed energized electrical conductors or circuit parts operating at 50 volts or more, or where an electrical hazard exists, employees will use protective shields, barriers or insulating materials as necessary to avoid inadvertent contact with these parts and the effects of the electrical hazards.

ARCADIS clearance requirements for working around and under overhead power lines is addressed in the ARCADIS Utility Clearance Standard ARC HSFS019

5.3.3 Energized Electrical Work Permit

When energized work is permitted (detailed in Section 5.3 of this HSS), an energized electrical work permit shall be required under the following conditions:

- When work is performed within the Restricted Approach Boundary
- When the employee interacts with the equipment when conductors or circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists.

The energized electrical work permit shall include, but not be limited to, the following items:

- A description of the circuit and equipment to be worked on and their location
- Justification for why the work must be performed in an energized condition
- A description of the safe work practices to be employed
- Results of the shock risk assessment including: Voltage to which personnel will be exposed; Limited Approach Boundary; Restricted Approach Boundary; and necessary personal and other protective equipment to safely perform the assigned task.
- Results of the arc flash risk assessment including: Available incident energy at the working distance or arc flash PPE category; necessary personal protective equipment to protect against the hazard; and Arc Flash boundary.
- Means employed to restrict the access of Unqualified Persons from the work area

- Evidence of completion of a job briefing, including a discussion of any job-specific hazards (daily tailgate meeting form or similar)
- Energized work approval (authorizing or responsible management, safety officer, or owner, etc.) signature(s)

Refer to **Exhibit 2** for an example Energized Electrical Work Permit.

Exemptions to Energized Electrical Work Permit Requirements. An energized electrical work permit shall not be required if a qualified person is provided with and uses appropriate safe work practices and PPE in accordance with NFPA 70E and this HSS under any of the following conditions:

- Testing, troubleshooting, and voltage measuring;
- Thermography and visual inspections if the restricted approach boundary is not crossed;
- Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed; or
- General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed.

5.3.4 Risk Assessment Procedure

Using values from NFPA 70E, ARCADIS has developed a Task Hazard Assessment template (refer to **Exhibit 8**) that serves as a baseline to document the shock and arc flash risk assessment for various tasks/voltage to which ARCADIS personnel may be exposed. The Task Hazard Assessment document shall be used to identify the Limited Approach, Restricted Approach, and Arc Flash boundary requirements and the PPE necessary in order to reduce employee exposure to shock, arc flash and other electrical hazards.

The ARCADIS Task Hazaard Analysis and/or Job Safety Analysis (JSA) should include a risk evaluation to determine if and when a second person is required and the training and equipment that person should have when a Qualified Electrical employee is working within the Restricted Approach Boundary.

5.3.5 Approach Boundaries for Energized Electrical Conductors or Circuit Parts

The shock protection boundaries identified as Limited Approach Boundary and Restricted Approach Boundary are applicable to the situation in which approaching personnel are exposed to energized electrical conductors or circuit parts. Reference information from OSHA 1910.333 Table S-5 and NFPA 70E Table 130.4(D)(a) for alternating-current systems and 130.4(D)(b) for the distances associated with direct-current voltage Systems is included as **Exhibit 5**.

The dimensions associated with the shock protection boundaries (Limited and Restricted) depends on the maximum voltage to which an employee might be exposed.

The Limited Approach Boundary is the closest approach distance for an unqualified employee, unless additional protective measures are used. When the nominal system voltage is 750 V or less, an unqualified employee must maintain at least a 3 ft 6 in. (1.0 m) clearance distance from an energized fixed circuit part for shock protection.

Note: When Unqualified person(s) are working at or close to the Limited Approach Boundary, the Qualified Person in charge of the work where the electrical hazard exists shall advise Unqualified person(s) of the electrical hazard and warn them to stay outside of the Limited Approach Boundary.

Note: In some instances, an Unqualified person might be required to work within the Limited Approach Boundary. If this case arises, the Qualified Person must advise the Unqualified Person about the location of all exposed energized electrical conductors and that the risk of shock or electrocution exists, The Qualified Person must escort the Unqualified Person at all times within the Limited Approach Boundary.

Note: If an Unqualified person is inside the limited approach boundary or in an area where an arc flash boundary is considered to exist but is outside the restricted approach boundary, this person needs to be continuously escorted by a qualified person to perform such activities and wear appropriate PPE if an arc flash boundary is considered to exist, and an Energized Electrical Work Permit (EEWP) is not required. For a qualified person performing such activity, they do not need to be escorted, and an EEWP is not required.

No qualified person shall approach or take any conductive object closer to exposed energized electrical conductors or circuit parts operating at 50 volts or more than the restricted approach boundary set forth in Table 130.4(D)(a) and Table 130.4(D)(b) of NFPA 70E unless one of the following conditions applies:

1. The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at 50 volts or more. Insulating gloves or insulating gloves and sleeves are considered insulation only with regard to the energized parts upon which work is being performed. If there is a need for an uninsulated part of the qualified person's body to contact exposed energized electrical conductors or circuit parts, a combination of part 1, 2 and 3 shall be used to protect the uninsulated body parts.

2. The energized electrical conductors or circuit part operating at 50 volts or more are insulated from the qualified person and from any other conductive object at a different potential.

3. The qualified person is insulated from any other conductive object.

If the conductors are placed into an electrically safe work condition, approach boundaries no longer exist and Unqualified employees can then approach the conductor without risk of injury.

The Arc Flash Boundary is intended to trigger the need for PPE to protect employees from the potential of thermal injury. Any body part that is closer to a potential arcing fault than the Arc Flash Boundary must be protected from thermal injury. In certain instances, the Arc Flash Protection Boundary might be a greater distance from the exposed energized electrical conductors or circuit parts than the Limited Approach Boundary. The Shock Protection Boundaries and the Arc Flash Hazard Boundary are independent of each other.

The Arc Flash Boundary for systems 50 volts and greater shall be the distance at which the incident energy equals 5 J/cm^2 (1.2 cal/cm^2).

As outlined in NFPA 70E, ARCADIS has used the alternative method to determine the necessary PPE through the use of the Hazard/Risk (H/R) Category tables in NFPA 70E 130.7(C)(15) and (C)(16) to develop the Task Hazard Assessment Sheets in **Exhibit 8**.

The development of Task Hazard Assessment Sheets using default values from NFPA 70E table 130.7(C)(15)(A)(a) and 130.7(C)(15)(A)(b) does not preclude ARCADIS from using appropriate calculations to estimate incident energy and arc flash boundary distances to modify the Task Hazard Assessment values.

5.3.6 Personal Protective Equipment and Other Protective Equipment

To determine the appropriate PPE necessary to conduct electrical work on energized equipment, it is necessary to complete an electrical hazard risk assessment of the equipment as discussed in section 5.3.5. As required, this hazard analysis will be conducted on projects where exposed energized equipment will be encountered, require maintenance or troubleshooting. The documented task specific incident energy analysis shall determine the incident energy exposure of the worker (in calories per square centimeter) and shall be used to select arc-rated (AR) clothing and other PPE.

Arc-rated clothing or equipment indicates that it has been tested for exposure to an electric arc. Flame resistant clothing without an arc rating has not been tested for exposure to an electric arc. All arc-rated clothing is also flame resistant.

There are two methods for determining the arc-rated PPE required to performing a task safely when energized electrical equipment is involved:

1. The arc flash PPE categories method uses Table 130.7(C)(15)(A)(a), 130.7(C)(15)(A) (b), Table 130.7(15)(B), and Table 130.7(C)(16) of NFPA 70E to determine when PPE is required, the category of PPE required, and the arc flash boundary. It is important to note that even when this method is used, all of the requirements included in Article 130 of NFPA 70E are still applicable. It is necessary to review all the applicable sections in Article 130 and determine if additional PPE not indicated in the tables is required.

2. The incident energy level method consists of a variety of possible calculation approaches. It is up to the Qualified Employee to determine which ones are applicable, under what conditions they are applicable, and which calculation method should be used. The information in Informative Annex D of NFPA 70E may be of assistance in this regard. Each of the available methods should be applied within their designated parameters. Neither method should be applied when determined values are outside of the allowable parameter ranges. It should be noted that Table 130.7(C)(15)(B) is only applicable to open-air situations, not to arc-in-a-box situations.

For the majority of ARCADIS tasks conducted in/around energized electrical conductors or circuit parts, ARCADIS uses Table 130.7(C)(15)(A)(a), 130.7(C)(15)(A) (b), Table 130.7(15)(B), and Table 130.7(C)(16) to determine when arc flash PPE is required, the category of PPE required, and the arc flash boundary. Based on category review of these tables, the appropriate PPE will be specified for the job as detailed in the table shown in **Exhibit 3**.

The Electrical Task Hazard Assessment template, included as **Exhibit 8**, shall be generated for ARCADIS staff activities associated with energized electrical equipment. These Electrical Task Hazard Assessments detail the Shock Protection Boundaries (Limited and Restricted), Arc Flash protection boundary, Arc Flash PPE Category, need for Voltage-Rated Tools or Gloves, and required PPE, including AR clothing rating and can be used in lieu of a shock and arc flash risk assessment.

When equipment exposes a worker to incident energy levels greater than 167.4 J/cm 2 (40 cal/cm 2), calculated at the distance for working on the energized electrical conductors or circuit parts, then that equipment shall only be worked on with the circuit placed in an electrically safe work condition.

Nonmelting, flammable fiber garments shall be permitted to be used as underlayers in conjunction with AR garments in a layered system for added protection. If nonmelting, flammable fiber garments are used as underlayers, the system arc rating shall be sufficient to prevent breakopen of the innermost AR layer at the expected arc exposure incident energy level to prevent ignition of flammable underlayers. Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric underlayers (underwear) next to the skin.

Note: An incidental amount of elastic used on nonmelting fabric underwear or socks is permitted.

Employees working in areas where there are potential electrical hazards will be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.

Employees working within the Arc-Flash Boundary must wear protective clothing and other PPE based upon the hazard analysis documented in the Task Hazard Analysis sheet. All parts of the body inside the Arc Flash Boundary must be protected. Arc-rated clothing must cover all ignitable clothing and allow for movement and visibility.

Employees must:

- Wear non-conductive head protection whenever there is a danger of head injury from electric shock or burns due to contact with energized electrical conductors or circuit parts or from flying objects resulting from electrical explosion. Employees must wear electrically rated (Type II, Class E or G) hard hats to protect their heads from flying parts and pieces.

- Wear non-conductive protective equipment for the face, neck and chin whenever there is a danger of injury from exposure to electrical arcs or flashes or from flying objects resulting from electrical explosion.

- Wear protective equipment for the eyes whenever there is danger of injury from electric arcs, flashes, or from flying objects resulting from electrical explosion.

- Wear hearing protection whenever working within the Arc Flash Boundary.

- Wear arc-rated clothing wherever there is possible exposure to an electric arc flash above the threshold incident energy level for a second degree burn [5 J/cm^2 (1.2 cal/cm^2)].

- Wear rubber insulating gloves with leather protectors where there is a danger of hand injury from electrical shock due to contact with energized electrical conductors or circuit parts. Employees must wear rubber insulating gloves with leather protectors and rubber insulating sleeves where there is a danger of hand and arm injury from electric shock due to contact with energized electrical conductors or circuit parts. Rubber insulating gloves must be rated for the voltage for which the gloves will be exposed.

- Wear hand and arm protection when there is possible exposure to arc flash burn. Where the employees hands are within the arc flash boundary, rubber insulating gloves must not be worn without leather protectors. If shock protection is not deemed necessary, heavy-duty leather gloves (minimum thickness of 0.03 inch) are acceptable for arc flash protection.

- Where insulated footwear is used as protection against step and touch potential, dielectric overshoes are required. Insulated soles must not be used as primary electric protection. Electrical Hazard (EH) shoes meeting ASTM F2413 can provide a secondary source of electric shock protection under dry conditions.

Protective equipment must be maintained in a safe, reliable condition. The protective equipment must be stored in a manner to prevent damage from physically damaging conditions from moisture, dust, or other deteriorating agents and visually inspecting protective equipment before each use. In addition, protective equipment shall be inspected immediately following any incident that could reasonably be suspected of having caused damage.

Insulating gloves shall be given an air test, along with each inspection. Rubber gloves must be subjected to electrical tests before first issue and then every 6 months thereafter (If the insulating equipment has been electrically tested but not issued for service, it is not permitted to be placed into service unless it has been electrically tested within the previous 12 months).

Arc-rated clothing must be cleaned and maintained in accordance with the clothing manufacturer's instructions. Pay special note that certain arc-rated materials cannot be washed with bleaching additives. Also, be aware of the protective equipment use limitations.

Note: It has been reported that some brands of cotton flame resistant garments (FRG) can exothermically react with bleach solutions to produce enough heat to burn skin and give off toxic gasses. Nomex garments do not appear to react similarly. Therefore, employees must review manufacturer specification sheet and use limitations, to verify that the cotton FRG will not result in an adverse exothermic reaction where bleach and other strong oxidizers are present/in use.

Garments worn as outer layers over arc-related clothing, such as jackets, safety vests or rainwear must also be made from arc-rated material.

Tight fitting clothing must be avoided. Loose-fitting clothing provides additional thermal insulation because of the air spaces.

Arc flash protective equipment shall be used as needed (when specific body parts are within the arc flash boundary) and includes:

- Arc Flash suits must be designed for easy and rapid removal
- Complete protection for the head (arc-rated balaclava in conjunction with arc-rated face shield or an Arc-rated hood)
- Face shields with a wrap-around guarding to protect the face, chin, forehead, ears and neck area
- Heavy duty leather gloves or arc-rated gloves
- Heavy-duty leather shoes (shoes with an arc rating are not currently available, however, heavy-duty rated leather footwear with safety toe will normally offer some level of protection.

5.3.7 Equipment Labeling

Electrical equipment maintained, inspected or accessed by ARCADIS employees such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked with a label containing all the following information:

- At least one of the following:
  - Available incident energy and the corresponding working distance or the arc flash PPE category in Table 130.7or Table 130.7(C)(15)(B) detailed in NFPA 70E for the equipment, but not both
  - Minimum arc rating of clothing
  - Site-specific level of PPE
- Nominal system voltage
- Arc flash boundary

The method of calculating and data to support the information for the label shall be documented. Where the review of the arc flash hazard risk assessment identifies a change that renders the label inaccurate, the label shall be updated.

The label must provide sufficient information for an employee to determine the equipment that is necessary for protection. Although owners are responsible for providing the necessary label on equipment containing an arc flash hazard, ARCADIS is responsible to ensure that our employees are protected as required by the work task and shall ensure that energized equipment being maintained by ARCADIS is labeled accordingly.

Labels applied prior to September 30, 2011 are acceptable if they contain the available incident energy or require level of PPE.

5.3.8 Insulated Tools and Materials

Only insulated tools or handling equipment, or both, shall be used when working within the Restricted Approach Boundary of exposed energized electrical conductors or circuit parts where tools or handling equipment might make accidental contact.

Note: An unqualified person within the limited approach boundary is considered likely to contact an exposed energized electrical conductor and therefore must be using insulated tools and materials.

Insulated tools shall be protected from damage to the insulating material.

Insulated tools shall be rated for the voltages on which they are used.

Insulated tools shall be designed and constructed for the environment to which they are exposed and the manner in which they are used.

Insulated tools and equipment shall be inspected for damage to the insulation or damage that can limit the tool from performing its intended function or could increase the potential for an incident prior to each use.

Fuse, fuse holder handling equipment, or fuse holder handling equipment, insulated for the circuit voltage, shall be used to remove or install a fuse if the fuse terminals are energized.

Ropes and hand-lines used within the Limited Approach Boundary of exposed energized electrical conductors or circuit parts operating at 50 volts or more, or used where an electrical hazard exists, shall be nonconductive.

Portable ladders used for electrical work shall have nonconductive side rails.

5.3.9 Working Space about Electric Equipment

Sufficient access in the vicinity of and working space is provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment. See the most current National Electric Code (NEC) for working clearance requirements.

The dimension of the working space in the direction of access to energized electrical conductors or circuit parts operating at 600 volts or less and likely to require examination, adjustment, servicing, or maintenance while energized may not be less than indicated in Table A below. In addition to the distances shown in Table A, workspace may not be less than 30 inches wide in front of the electric equipment. Working space is not required in back of assemblies such as dead-front switchboards or motor control centers where there are no renewable or adjustable parts such as fuses or switches on the back and where all connections are accessible from locations other than the back.

Table A - Working Clearances

	Minimum Clear Distance for Condition (ft)		
Nominal voltage to ground	a	b	c
0-150	3	3	3
151-600	3	3 ½	4

Conditions a, b, and c, are as follows:

a Exposed energized electrical conductors or circuit parts on one side and no live or grounded parts on the other side of the working space, or exposed energized electrical conductors or circuit parts on both sides of the work space that are effectively guarded by insulating material. According to the OSHA Electrical Standard (29 CFR 1910.303), insulated wire or insulated bus-bars operating at not over 300 volts are not considered energized electrical conductors or circuit parts.

b Exposed energized electrical conductors or circuit parts on one side of the working space and grounded parts on the other side of the working space. Concrete, brick, or tile walls shall be considered as grounded.

c Exposed energized electrical conductors or circuit parts on both sides of the workspace *[not guarded as provided in Condition a]* with the operator between.

5.3.10 Guarding of Energized electrical conductors or circuit parts

Except as required or permitted elsewhere, energized electrical conductors or circuit parts of electric equipment operating at 50 volts or more are guarded against accidental contact by approved cabinets or other forms of approved enclosures. This guarding is to be accomplished by suitable permanent, substantial partitions or screens so arranged that only Qualified Persons will have access to the space within reach of the energized electrical conductors or circuit parts. Any openings in such partitions or screens are so sized and located that persons are not likely to come into accidental contact with the energized electrical conductors or circuit parts or to bring conducting objects into contact with them.

5.3.11 Alerting Techniques

Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards that might endanger them. Such signs and tags shall meet the requirements of ANSI Z535, *Series of Standards for Safety Signs and Tags*, given in Table 130.7(F) of NFPA 70E.

Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas containing energized conductors or circuit parts. Conductive barricades shall not be used where it might increase the likelihood of exposure to an electrical hazard. Barricades shall be placed no closer than the limited approach boundary given in Table 130.4(D)(a) and Table 130.4(D)(b) of NFPA 70E. Where the arc flash boundary is greater than the limited approach boundary, barricades shall not be placed closer than the arc flash boundary.

If signs and barricades do not provide sufficient warning and protection from electrical hazards, an attendant shall be stationed to warn and protect employees. The primary duty and responsibility of an attendant providing manual signaling and alerting shall be to keep unqualified employees outside a work area where the unqualified employee might be exposed to electrical hazards.

5.3.12 Portable and Vehicle-Mounted Generators

Under the following conditions, the frame of a portable generator need not be grounded and may serve as the grounding electrode for a system supplied by the generator:

- The generator supplies only equipment mounted on the generator and/or cord- and plug-connected equipment through receptacles mounted on the generator, and
- The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame.

Under the following conditions the frame of a vehicle may serve as the grounding electrode for a system supplied by a generator located on the vehicle:

- The frame of the generator is bonded to the vehicle frame, and
- The generator supplies only equipment located on the vehicle and/or cord- and plug-connected equipment through receptacles mounted on the vehicle or on the generator, and
- The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame, and
- The system complies with all other provisions of the OSHA wiring, design and protection.

Only the receptacles (plug sockets) mounted on the generator or vehicle are used to provide power to cord connected tools or equipment.

Generators greater than 5kW single phase shall have a connection to ground (earth).

125V, 15A and 20A receptacles on portable generators must be provided with GFCI protection. Generators manufactured before January 1, 2015 may use a portable GFCI to provide the protection. Under certain instances, OSHA regulations do not require GFCI's on a generator. The generator must meet all three of the following conditions to qualify for the GFCI exemption:

1. The generator must be two-wire, single phase;
2. The generator must not be over 5 kW; and
3. The circuit wires must not be connected to the generator frame, case or other grounded surfaces.

However, this GFCI exemption was removed in the 2002 Edition of the National Electrical Code. As a result, local electrical inspectors, as the "Authorities Having Jurisdiction" will no longer accept the OSHA GFCI exemption and will require the use of GFCI's on portable generators.

5.4 Safety Related Maintenance

All electrical equipment used on the project or activity must be listed by a national testing laboratory for the specific application for which it is used.

Note: Installations that comply with the NEC, that meet the installation instructions of the equipment manufacturer and that are maintained appropriately are considered safe when operating normally. However, when electrical equipment changes state, such as being switched from energized to de-energized or vice versa; an overload relay is reset; a door is opened or closed; a circuit breaker is reset; or other condition where physical movement occurs, the result might be an initiation of an arcing fault. Depending on the state and condition of the equipment and the functional circuit protective devices, an employee could be exposed to this arcing fault.

All electrical equipment, which is routinely serviced or is being troubleshooted while energized by ARCADIS or an ARCADIS subcontractor, must be inventoried and listed in the project HASP.

If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item must be removed from service, and no employee may use it until repairs and tests necessary to render the equipment safe have been made. If the equipment is not owned by ARCADIS, we shall then notify the client/owner of the need to remove equipment from service and that ARCADIS employees/subcontractors will not work on/around the equipment until the equipment is made safe.

All electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, motor control centers that are in other than dwelling units, and are likely to require examination, adjustment, servicing or maintenance while energized, must be labeled (NFPA 70E compliant) to warn Qualified Persons and others of the potential electrical shock and arc flash hazards. The marking label will be located on the equipment so that the label is clearly visible to those qualified person(s) performing work or those who are not qualified. Examples of NFPA 70E compliant marking labels are provided in **Exhibit 1**.

Note: Exempted from arc and shock labeling requirements are equipment or appliances which are equipped with a cord and disconnectable plug which operate on 120V alternating current (AC) or less. Such equipment is to be serviced in the totally de-energized state by unplugging the AC cord.

System enclosures containing multiple energy sources are required to be appropriately labeled with a label warning of multiple energy sources, and directing operation personnel to the procedure for eliminating all alternate sources of energy.

Visual inspection of portable cord and plug connected equipment and flexible cord sets (extension cords) is conducted before use on any shift for external defects (such as loose parts, deformed and missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage (such as pinched or crushed outer jacket). Cord and plug connected equipment and flexible cord sets (extension cords) that remain connected once they are put in place and are not exposed to damage need not be visually inspected until they are relocated.

When an attachment plug is to be connected to a receptacle (including on a cord set), the relationship of the plug and receptacle contacts shall first be checked to ensure that they are of proper mating configurations.

When working outside or in damp or wet environments, only Ground Fault Circuit Interrupters (GFCI) or GFCI protected receptacles shall be used.

5.4.1 Disconnecting and Over-current Protection Requirements

All circuits are protected from over-current conditions based upon the current-carrying capacity of the conductors being used.

Note: The only grounded conductor that can be opened without opening all other phase conductors is the control circuit neutral of a starter via an auxiliary contact of the overload but only if the overload relay and motor contactor are in the same enclosure.

No overcurrent devices are incorporated into any permanently grounded conductor unless the device opens all conductors simultaneously.

Overcurrent protection devices, circuit breakers, and disconnect switches are placed so that they are readily accessible for maintenance and use, reasonably protected from physical damage, and located, shielded, or enclosed to prevent personal injury from arcing, moving parts, or accidental operation. No easily ignitable materials are placed in the vicinity of any overcurrent protection devices.

Circuit breakers and disconnect switches are clearly labeled to indicate the energized and de-energized positions, as well as the equipment or circuit it supplies. All circuit breaker panels fuse boxes, and control panels are securely mounted and constructed with close fitting doors or panels to prevent unauthorized access or injury.

All circuit breaker fused switches and non-fused switches used as a disconnect means shall be capable of being locked in the off position.

All electrical panels, devices, and boxes located out of doors or in wet locations are placed in a weatherproof enclosure or cabinet.

Maintenance, tests and inspection of overcurrent protective devices must be documented.

5.4.2 Grounding Requirements

All electrical circuits are grounded in accordance with NEC and National Electric Safety Code (NESC) regulations. Any conductor used as a ground is clearly identifiable and distinguishable from all other conductors.

Any grounded conductor or grounding terminal on a receptacle, cord, or device is not utilized for any purpose other than grounding.

NEC 250.52(A)(5) states: “Rods and pipe electrodes shall not be less than 2.44 m (8 ft.) in length.

NEC 250.52(A) (5)(b) states, “Grounding electrodes of stainless steel and copper or zinc coated steel shall be at least 15.87 mm (5/8 in.) in diameter, unless listed and not less than 12.70 mm (1/2 in.) in diameter.” Listing agencies CSA, ETL, MET, UL, etc., will only list rods that are greater than ½ inch in diameter and that have the correct minimum amount of copper or zinc (galvanized) mil thickness coating.

All grounding rods are tested after installation with a suitable earth/ground resistance tester to ensure minimal resistance (25 ohms or less). If the resistance measurement is greater than 25 ohms, an additional grounding rod must be installed at least 6 feet from the original grounding rod, and bonded together (with the correct size bonding jumper according the sizing table of Article 250) to create one grounding electrode.

Equipment grounding conductors shall be sized not less than the minimum conductor size listed in the equipment grounding conductor sizing table of Article 250 of the latest edition of the NEC. *Equipment grounding conductors are sized based on the overcurrent protective device and not the ungrounded conductor size.*

When temporarily bonding and grounding equipment, the leads are attached to the grounding point first. When disconnecting temporary bonding or grounding leads, disconnect the grounding point last. Appropriate PPE must be worn according to NFPA 70E safe work practices.

The equipment end is attached and removed using insulated tools or similar means.

Prior to use, all equipment, receptacles, electrical power tools, portable light strings, cord-sets, etc., are inspected and instrument tested by a qualified person to ensure ground circuit continuity.

Additional tests are performed prior to returning equipment to service following repairs, or an incident that may have caused damage, or at intervals not to exceed three months. All tests are recorded, including equipment type and number, repairs made, and date of test. No equipment, tool, or devices are put into service if damaged.

All portable tools, lights, or devices utilize three-conductor, grounded cord-sets unless protected by an approved system of double insulation. All temporary 120-volt, single phase, 15-, 20- and 30-ampere receptacles are installed with GFCI for personal protection. GFCI receptacles shall be tested to ensure proper operation. If the test button does not trip the receptacle, a portable *in-line* GFCI protective device shall be used.

Where permanent receptacles are installed without GFCI protection, in-line GFCI receptacles are utilized between the permanent receptacle and the portable powered device.

5.4.3 Temporary Wiring Requirements

As required by NEC and/or local code requirements, a certified, licensed electrician must install temporary wiring.

Any portable lighting units will have a protective guard surrounding the light bulb.

Spent light bulbs are replaced promptly and disposed of according to federal, state, provincial, local jurisdiction, or client requirements.

No exposed or empty sockets are permitted.

If any receptacles are required for use in wet locations, they are contained in a weatherproof enclosure. The integrity of the weatherproof enclosure is not affected when a plug is inserted.

Extension cords are not fastened with staples, hung from nails, or suspended by wire.

Temporary light strings are not suspended by their cords unless specifically designed for that purpose. Each lamp is equipped with a suitable guard.

All temporary lighting exposed to wet or hazardous conditions in confined spaces are operated at a maximum of 12 volts and protected by an approved switch near the entrance to interrupt the power in the event of an emergency.

Extension cords are placed so as not to be damaged by sharp objects, moving equipment, or excessive heat. *Note:* Multiple extension cords should not be used to extend the overall length. An extension cord current rating is based on the cord's length. A short cord will have smaller conductors for a given current rating than a longer cord of the same current rating. This is due to the impedance of the conductor. A shorter cord has less impedance. The manufacturer picks a conductor size at the cord length that when the rated current is applied to the cord, the voltage drop is insignificant. If the cord is extended by plugging in another cord, the impedance goes up and in order to have no appreciable voltage drop, the current, must be less. If the same current were applied to the extended cord, it could overheat. Therefore, a cord should be selected with the length needed for the current rating needed. Longer cords for a given current rating have larger conductors than shorter cords for the same current rating.

Connectors are placed above ground and protected from water, and cords are either suspended above walkways or covered to eliminate tripping hazards and protect the cord from damage.

Cords are not suspended by conductive material.

All cord sets used in wet locations will have approved plugs molded to the cord insulation, and all receptacles used in wet locations are contained in a weatherproof enclosure that is not affected when a cord-set is inserted.

5.5 Voltage Meters

5.5.1 Work Practice Controls

This section identifies general work practice controls that employees are expected to comply with while using handheld electrical measurement tools (voltage meters). ARCADIS Electrical Safety standard controls include, but are not limited to, the following:

- Only Qualified Persons shall perform testing work within the Limited Approach Boundary of energized electrical conductors or circuit parts operating at 50 volts or more.
- Every electrical conductor or circuit part must be considered energized until proven otherwise.
- No bare-hand contact is to be made with exposed energized electrical conductors or circuit parts above 50 volts to ground.
- De-energizing an electrical conductor or circuit part and making it safe to work on is in itself a potentially hazardous task.
- Use a logical approach to determine potential hazard(s) of task.
- Assess the environment before taking the measurement.
- Do not work alone in hazardous areas.
- Wear appropriate PPE in accordance with NFPA 70E. Refer to the Electrical Task Hazard Assessment sheets in **Exhibit 8**.
- Make sure your volt meter is rated for the measurement environment.
- Be familiar with and know how to use your test equipment prior to any hazardous measurements.
- Inspect your meter prior to every use: check for a broken case, worn test leads or a faded display. Use the meter's own continuity testing function to check for internal breaks and check test lead resistance:
    1. Insert lead in V/Ω and COM inputs.
    2. Select Ω, touch probe tips. Good leads are 0.1 – 0.3 Ω
- Use the meter's own test capability to ensure that the fuses are in place and working right:
    1. Plug test lead in V/Ω input. Select Ω
    2. Insert probe tip into mA input. Read value.
    3. Insert probe tip into A input. Read Value.

A good fuse should show a value close to zero. Check your voltage meter manual for the specified range of acceptable readings.

It is a good practice to measure voltage at the point of the lowest available energy. For example, if you are measuring voltage on a breaker panel, identify the lowest-rated breaker available, and make your measurement there. This way, you have more protection between yourself and the potential hazard.

Effective steps should be taken to obtain the best reading within the necessary envelope of safety. If conditions require that both of your hands remain free for a safe measurement, set the instrument down; use the instrument's bail stand (if it has one). Better yet, use a magnetic hanger to hang the unit at eye level on the edge of the panel. Don't try to watch the meter while you make your measurement - always keep your eyes on your test probes.

When taking single-phase measurements, always connect the neutral lead first, the hot lead second. After taking your reading, disconnect the hot lead first, the grounded lead second.

When testing for voltage, use the three point test method:

1. Test a similar known live circuit first

2. Test the "circuit to be tested"

3. Re-test the first known live circuit.

This process verifies your test instrument is working properly - an important part of your personal safety.

When making measurements in or around high energy three phase distribution panels, use test probes with a minimum amount of exposed metal at the probe tips, such as .12 in (4 mm) metal tip probes. This reduces the risk of an accidental arc flash from probe tips being inadvertently shorted together between phases.

Keep one hand in your pocket or out of the panel and the measurement circuit. You don't want to offer a closed circuit. Whenever possible, use a properly rated alligator clip to attach the black test lead to the circuit under test. This gives you a free hand to probe with the red test lead.

ARCADIS has completed various task related electrical hazard assessments for employee review and reference. If a hazard assessment has not been conducted, employees must use Stop Work Authority and complete a Hazard Analysis before proceeding. Refer to **Exhibit 8** for the available Electrical Task Hazard Assessment Sheets.

5.5.2 Voltage Meter Requirements

Voltage meters used by employees must be certified as meeting IEC 61010-1 by third party independent testing laboratories. Recognized independent third party testing laboratories include the Canadian Standards Association (CSA), Technischer Überwachungsverein (TUV), or Underwriters Laboratory (UL). The independent testing laboratory's mark shall appear on the exterior of the instrument.

Note: Instruments for use in North America shall be UL listed and CSA certified to the following standards:

- UL 3111-1 "Standard for Safety for Electrical Measuring and Test Equipment, Part 1" – General Requirements

- UL 3111-2-031 "Handheld Probe Assemblies for Electrical Measurement and Test"

- UL 3111-2-032 "Standard for Safety for Handheld Current Clamps for Electrical Measurement and Test"

- CSA C22.2.1010 "Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – General Requirements"

- ISA/ANSI 82.01 "Safety Standard for Electrical and Electronic Test Measuring, Controlling, and Related Equipment – General Requirements"

Note: Instruments for use in Europe shall be CE marked and listed by third party independent testing laboratories.

Voltage testing equipment for general use must be a Category III meter rated at 600 Volts for protection against transient voltages (IEC 61010-1). Instruments used outdoors or in outbuildings shall be at least IEC 61010-1 Category IV at 600 Volts. Dependent on the application, it may be necessary to specify instruments capable of measuring higher voltages. All handheld electrical measurement tools used by employees shall be rated for the nominal voltage of the system or component being measured (refer to **Exhibit 4**).

As specified in IEC 61010-1, section 9.5.2, overcurrent protection shall be provided within the instrument, and not in the probes or leads. Overcurrent protection shall not be incorporated in instrument probes, so as to prevent a false negative reading while measuring energized equipment. Overcurrent protection may be in the form of fuses, circuit breakers, thermal cutouts, and impedance–limiting circuits or similar means to prevent excessive energy from being drawn into the instrument.

The design of the instrument probes shall minimize the potential for contact with exposed energized parts while performing measurements. Handheld electrical measurement tools shall be equipped with spring-loaded, retractable covers on the instrument probes or flared finger guards. The maximum exposed probe length shall not exceed ¾ inch (1.90 cm).

Handheld electrical measurement tools shall be inspected before each use for damaged insulation on leads and other obvious physical damage. Damaged test instruments shall not be used until authorized repairs have been completed.

All handheld electrical measurement tools shall be tested prior to, and after use, with a known energized electrical source to ensure that the instrument is functioning correctly (Live-Dead-Live approach).

Handheld electrical measurement tools shall not be modified without the written consent of the original equipment manufacturer. The replacement of any defective components must be with identical components to the original or as authorized by the original equipment manufacturer.

5.6 Program Auditing

On occasion, the ARCADIS electrical safety program will be audited (Task Improvement Process - TIP Observations or similar) to help ensure that the principles and procedures of the electrical safety program are being followed. The frequency of audit shall be determined by Project Managers, based on the complexity of the procedures and the type of work being covered. Where the audit determines that the principles and procedures of the electrical safety program are not being followed, appropriate corrective actions/revisions will be made.

6. TRAINING

The training requirements contained in this section shall apply to employees exposed to an electrical hazard when the risk associated with that hazard is not reduced to a safe level by the applicable electrical installation requirements. Such employees shall be trained to understand the specific hazards associated with electrical energy. They shall be trained in safety-related work practices and procedural requirements, as necessary, to provide protection from the electrical hazards associated with their respective job or task assignments. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury.

The training required by this section shall be approved by Corporate H&S and includes classroom, online, or on-the-job, or a combination of these. The type and extent of the training provided shall be determined by the risk to the employee. Qualified electrical training shall be classroom and/or on-the-job type training. The degree and extent of training shall be determined by the degree of risk to the employee. The training may involve some customization to reflect the scope of work performed within project or type of equipment (e.g. PCL cabinets, etc.).

Training is performed before the employee is assigned duties involving work around or on electrical systems (including trouble-shooting).

6.1 Unqualified Person

Unqualified employees who do not work within the Limited Approach Boundary of energized electrical conductors or circuit parts operating at 50 volts or more to ground, but work around or must understand the hazards of electricity shall be trained in, and be familiar with, any electrical safety related practices necessary for their safety, including information about compliance with the Limited Approach Boundaries for shock protection. Generally, this will be accomplished by Unqualified employees receiving electrical awareness training, referencing task specific JSA, being provided site specific instruction and use of the TRACK process.

6.2 Emergency Procedures Training

6.1.1 Contact Release

Employees exposed to shock hazards and those employees responsible for taking action in case of emergency shall be trained in methods of release of victims from contact with exposed energized electrical conductors or circuit parts. Refresher training on this topic shall occur annually.

6.1.2 First Aid, Emergency Response and Resuscitation

Employees designated to respond to medical emergencies shall be trained in first aid and emergency procedures. Employees responsible for responding to medical emergencies shall be trained in first aid and emergency procedures, cardiopulmonary resuscitation (CPR) and in the use of automatic external defibrillator (AED), if the ARCADIS Emergency Response plan includes the use of an AED. Refresher training for Qualified Electrical staff shall occur annually.

6.3 Qualified Person

ARCADIS provides Electrical Safety Training to include the arc flash safety training to appropriate personnel to ensure that the purpose and function of the Electrical Energy Control Program and Procedures are understood and that the knowledge and skills required for the safe operation (including, servicing, maintenance, inspection and installation) are acquired.

In addition, this standard applies to Infrastructure and Buildings staff that provides oversight of System/Electrical Installs: There will be situations where engineers and/or construction oversight personnel will need to be within the arc flash boundary to perform inspections/oversight of work completed by subcontractors or Qualified Personnel. These staff will need the NFPA 70E training as well and must wear all appropriate PPE as outlined within this HSS and NFPA 70E.

ARCADIS Electrical Qualified Persons are qualified to work on energized power systems and controls up to 600 VAC providing an Energized Electrical Work Permit is completed (excluding troubleshooting activities) and approved and appropriate PPE and safe work practices are employed. This includes motor controls, switchgear and variable frequency drives of 600 VAC or less.

A qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

Such persons shall also be familiar with the proper use of the special precautionary techniques; applicable electrical policies and procedures, PPE, insulating and shielding materials; and insulated tools and test equipment. A person can be considered qualified with respect to certain equipment and methods but still be unqualified for others.

Employees must be authorized by Corporate H&S or designee to take the Qualified Person training curriculum:

- Complete evaluation with Corporate H&S (will include confirmation of completion of LO/TO Authorized Person and annual First Aid/CPR training ;
- Complete a 2 or 3 day NFPA 70E Classroom course as determined by Corporate H&S;
- Confirm that the following have been completed:
  - Review of the ARCADIS Electrical Safety Standard;
  - An electrically-related TIP as the Observee; and
  - Development of relevant electrical THAs

Then, based on successfully completing the Qualified Electrical training curriculum, employees will be qualified to work on energized electrical conductors or circuit parts up to 600 volts. No ARCADIS employee may work on energized electrical conductors or circuit parts or installs electrical equipment that requires electrical power source of equal to or greater than 600 volts, unless appropriately qualified for the specified task and approved by ARCADIS Corporate H&S.

Such qualified persons permitted to work within the Limited Approach Boundary of exposed energized electrical conductors and circuit parts operating at 50 volts or more shall, at a minimum, be additionally trained in all of the following:

- Skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment.

- Skills and techniques necessary to determine the nominal voltage of exposed electrical conductors and circuit parts.

- Approach distances specified in Table 130.4(D)(a) and Table 130.4(D)(b) of NFPA 70E and the corresponding voltages to which the qualified person will be exposed.

- Decision-making process necessary to be able to do the following:

  - Perform the job safety planning

  - Identify electrical hazards

  - Assess the associated risk

  - Select the appropriate risk control methods from the hierarchy of controls identified in Table 110.1(G) of the NFPA 70E Standard including elimination, substitution, engineering controls, awareness, administrative controls and personal protective equipment

An employee who is undergoing on-the-job training for the purpose of obtaining the skills and knowledge necessary to be considered a qualified person and who, in the course of such training demonstrates an ability to perform specific duties safely at his or her level of training, and who is under the direct supervision of a qualified person, shall be considered to be a qualified person for the performance of those specific duties.

Employees shall be trained to select an appropriate test instrument and shall demonstrate how to use a device to verify the absence of voltage, including interpretation indications provided by the device. The training shall include information that enables the employee to understand all limitations of each specific test instrument that might be used.

Tasks that are performed less often than once per year shall require on-the-job retraining before the performance of the work practices involved and the employee shall participate as an observee in a documented TIP.

ARCADIS shall determine, through regular supervision or through inspections conducted on at least an annual basis (TIP observation), that each employee is complying with the safety-related work practices required and outlined in the standard and detailed in the task hazard assessment sheet(s).

6.4 Retraining

Retraining of Qualified Electrical staff in safety-related work practices and applicable changes in this standard shall be performed at intervals not to exceed three (3) years. Employee(s) shall receive additional training (or retraining) ifr any of the following conditions exists:

- If the supervisor or during annual assessment inspection (TIP observation) indicate that the employee is not complying with the safety-related work practices
- If new technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use
- If employee must employ safety-related work practices that are not normally used during his or her regular job duties

Retraining includes but is not limited to on-the-job training, classroom or online instruction or a combination of both.

6.5 Training Documentation

ARCADIS shall document that each employee has received the appropriate level of electrical safety training. ARCADIS electrical qualified employees will not be added to the Qualified Employees list until an employee has successfully completed the Qualified Electrical training curriculum.

The training documentation shall contain the content of the training, each employee's name, and dates of training along with the evaluation form completed by Corporate H&S or designee.

Training documentation records shall be maintained for the duration of the employee's employment.

7. REFERENCE DOCUMENTS AND ASSOCIATED STANDARDS

7.1 National Electrical Code (NEC) - NFPA 70

The NEC is the accepted standard for protection of persons and property from electrical installations. Familiarization with NFPA 70 is required for any one whose responsibility is designing, installing, verifying and maintaining safe and compliant electrical systems. Information can be found through the NFPA website with a membership or printed and electronic versions of the code can be purchased from NFPA and other suppliers.

7.2 National Electrical Installation Standards (NEIS)

The NEIS gives definition to "neat and workmanlike manner" as required by the National Electrical Code. Each standard is submitted for approval by the American National Standards Institute (ANSI).

7.3 National Electrical Safety Code (NESC)

The NESC is a product of the Institute of Electrical and Electronics Engineers (IEEE). This code provides information on the installation, operation, and maintenance of electrical systems. The intent of the publication is the safeguarding of persons performing the work. Information, like the NEC, is available with IEEE membership or by buying a printed or electronic version of the code.

7.4 National Fire Protection Association (NFPA)

The NFPA is the definitive source for everything related to fire protection. The association has developed numerous standards that have been adopted by federal, state, and local jurisdictions as enforceable standards. The NFPA website has plenty of free information but more specific information is restricted to members only.

7.5 National Institute for Occupational Safety and Health (NIOSH)

NIOSH is similar in mission to OSHA but differs by the singular perspective that NIOSH is the federal agency responsible for the prevention of work related disease and injury, and is part of the Centers for Disease Control and Prevention.

7.6 Occupational Health and Safety Administration (OSHA)

OSHA is the main governmental source for effective safety practices. The OSHA website is a vast, readily accessible information resource with a thorough search engine. Refer to 29 CFR 1910 Subpart S – Electrical and 29 CFR 1926 Subpart K – Electrical for details on OSHA electrical safety requirements.

7.7 NFPA 70E: Standard for Electrical Safety in the Workplace

This standard addresses electrical safety-related work practices for employee workplaces that are necessary for the practical safeguarding of employees relative to the hazards associated with electrical energy during activities such as the installation, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways. The standard also includes safe work practices for employees performing other work activities that can expose them to electrical hazards as well as safe work practices for the following:

Installation of conductors and equipment that connect to the supply of electricity

Installations used by the electric utility, such as office buildings, warehouses, garages, machine shops, and recreational buildings that are not an integral part of a generating plant, substation, or control center

7.8 Other related ARCADIS Documents:

Control of Hazardous Energy Procedure (ARC HSFS004)

Confined Space Entry (ARC HSFS003)

Hot Work (ARC HSCS013) - ARCADIS' minimum requirements for the conduct of activities that could result in ignitions, sparks and/or fire

First Aid/CPR (ARC HSGE004)

Exhibit 2 – Energized Electrical Work Permit

8. RECORDS

- Audit Records
- Inspection and testing records

- Complete Energized Electrical Work Permits

9. APPROVALS AND HISTORY OF CHANGE

Approved by: Tony Tremblay, CSP – Corporate H&S, Director of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
26 March 2007	01	Mike Thomas/Pat Vollertsen	Original document
28 June 2007	02	Mike Thomas/Pat Vollertsen	Enhanced for regulatory requirement additions
6 September 2007	03	Mike Thomas/Pat Vollertsen	Changing over to new template format
25 February 2008	04	Sue Byers	Template change
10 March 2009	05	Mike Thomas/Mija Coppola	Modified to address elements of NFPA 70E and based on review of procedure. Process improvements
6 September 2010	06	Tony Tremblay/Mija Coppola	Changed author from Mike Thomas to Tony Tremblay. Electrical Task Hazard Assessment Sheets inserted; NFPA 70E reference tables added; Energized Electrical Work Permit requirement clarified; Grounding Rod information added; LO/TO program reference included; Tagging of defective equipment language added; Reference to hand/power tools HS Standard added; Level III Qualified Electrical person definition modified; Volt Meter Specific Information added.
14 April 2011	07	Tony Tremblay	Section 5.8 Program Auditing added and clarified use of NFPA 70E compliant labels on equipment
30 March 2012	08	Tony Tremblay	Update Standard to be compliant with NFPA 70E 2012; Updates to definitions; specifically include inspection activities as included in electrical hazard activities; eliminate use of the term “live electrical” and replace with energized electrical conductors and circuit parts; Insert labeling language; reformat section 5; Insert shock boundary and arc flash boundary information; Revise Task Hazard Analysis sheets

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
12 February 2013	09	Amanda Tine/Tony Tremblay	Added references to utility clearance standard regarding minimum clearance distances when working around overhead power lines; Section 5.3.numbering corrected; Clarified that when working on or near exposed de-energized parts, including the task of testing for the absence of voltage, they are to be treated as energized until proven otherwise; clarified that safe approach distances for both Qualified and Unqualified staff are detailed in Exhibit 5 Tables 5A and 5B.
5 March 2014	10	Tony Tremblay	Header/Footer format updated; History of change table reformatted to track party responsible for revisions; Corrected Exhibit 8 hyperlink to THA for Panelboards Rated at 240 Volts or Less - Working on Energized Electrical Conductors and Circuit Parts, Including Voltage Testing
7 April 2015	11	Andrew McDonald/Tony Tremblay	NFPA 70E_2015 revisions – work shoes replaced by footwear; arc flash risk assessment replaces arc flash hazard analysis; shock risk assessment replaces shock hazard analysis; electrical hazard risk assessment replaces electrical hazard analysis; arc flash PPE category replaces hazard/risk category (HRC); all references to HRC deleted; Added *safety related maintenance requirements and other administrative controls* to the Scope; In the not covered by standard section, deleted outdated reference to Installations underground in mines and self-propelled mobile surface mining machinery and its attendant electrical trailing cable (MSHA has determined that *NFPA 70E* applies to the mining industry workplace); Section 2.2.1 Conditions Providing Acceptable Risk added; Work Related Activities not covered by HSS placed into Section 2.2.2; Section 5.3.11 Alerting Techniques and Section 5.3.12 Portable and Vehicle-Mounted Generators added ; Section 6 training and retraining clarified; definition updates including removal of Prohibited Approach Boundary definition; Exhibit 3, 5, 6 and 8 revised
20 April 2015	12	Pat Vollertsen	Added additional information to section 6.3 in regard to what is required to be a Qualified Individual

EXHIBIT 1 - DEFINITIONS

Following are terms and definitions used in the electrical safety standard and associated procedures.

Affected Employee - An employee/worker whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lock-out/tag-out, or whose job requires him/her to work in an area where servicing or maintenance is being performed. An affected employee is not allowed to apply or remove locks or tags.

Arc Flash Hazard – A dangerous condition associated with the possible release of energy caused by an electric arc. An arc flash hazard may exist when energized electrical conductors or circuit parts are exposed or when they are within equipment in a guarded or enclosed condition, provided a person is interacting with the equipment in such a manner that could cause an electric arc. Under normal operating conditions, enclosed energized equipment that has been properly installed and maintained is not likely to pose an arc flash hazard. Refer to NFPA 70E Table 130.7 (C)(15)(A)(a) for examples of activities that could pose an arc flash hazard.

Arc flash risk assessment – A study investigating a worker's potential exposure to arc flash energy, conducted for the purpose of injury prevention and the determination of safe work practices, arc flash protection boundary, and the appropriate levels of PPE.

Arc Flash Suit – A complete arc-rated (AR) clothing and equipment system that covers the entire body, except for the hands and feet. An arc flash suit may include pants or overalls, a jacket or a coverall, and beekeeper-type hood fitted with a face shield.

Arc Rating (AR) - The value attributed to materials that describes their performance to exposure to an electrical arc discharge. The Arc Rating is expressed in cal/cm^2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of breakopen threshold (E_{BT}) (should a material system exhibit a breakopen response below the ATPV value). Arc Rating is reported as either ATPV or E_{BT}, whichever is the lower value.

Informational Note 1: Arc-rated clothing or equipment indicates that it has been tested for an exposure to an electrical arc. Flame Resistant (FR) clothing without an arc rating has not been tested for exposure to an electrical arc. All arc-rated clothing is also flame-resistant.

Informational Note 2: Breakopen is a material response evidenced by the formation of one or more holes in the innermost layer of arc rated material that would allow for flame to pass through the material.

Information Note 3: ATPV is defined in ASTM F1959/F1959M, *Standard Test Method for Determining the Arc Rating of Materials for Clothing*, as the incident energy (cal/cm^2) on a material or a multi-layer system of materials that results in 50 percent probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of second degree skin burn injury based on the Stoll curve, cal/cm^2.

Information Note 4: E_{BT}, is defined in ASTM F1959/F1959M, *Standard Test Method for Determining the Arc Rating of Materials for Clothing*, as the incident energy (cal/cm^2) on a material or a multi-layer system of materials that results in 50 percent probability of breakopen. Breakopen is defined as a hole with an area of 1.6 cm^2 (0.5 in^2) or an opening of 2.5 cm (1.0 in) in any dimension.

Authorized Employee - An employee/worker who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. Only authorized employees may apply or remove locks or tags.

Bonding - Bonding is the conductive connection of all non-current-carrying metal parts for the purpose of providing a low-resistance, effective fault-current path from the point of a fault back to the source of electricity, which is the closest transformer upstream from the faulted circuit. Connected to establish electrical continuity and conductivity.

Because of the water factor, it is very important to bond ALL non-circuit metal parts together to form a single bonding path back to the source of electricity.

Boundary, Arc Flash – When an arc flash hazard exists, an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur.

Information Note: A second degree burn is possible by an exposure of unprotected skin to an electric arc flash above the incident energy level of 5 J/cm^2 (1.2 cal/cm^2).

The Arc Flash Boundary is the boundary determined either through calculation or through the use of NFPA 70E Table 130.7 (C)(15)(A)(b) and 130.7 (C)(15)(B), which separates an area in which a person is potentially exposed to a second-degree burn injury from an area in which the potential for injury does not include a second-degree burn. All body parts closer to an arc flash hazard than the arc flash boundary must be protected from the potential thermal effects of the hazard. The Arc Flash Boundary is established at the point where the amount of incident energy that an employee could be exposed to is 1.2 cal/cm^2 or greater. If the incident energy is less than 1.2 cal/cm^2, burns could occur, but they will not be second-degree or worse.

The Arc Flash Boundary defines the point at which arc-rated PPE is necessary to avoid a second-degree burn. All of an employee's body parts inside of an Arc Flash Boundary must be protected. If an employee's head is within the Arc Flash Boundary, the employee's head (including the back of the head) must be protected from the thermal hazard.

Boundary, Limited Approach – An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists. The Limited Approach Boundary is not related to arc flash or incident energy. The Limited Approach Boundary is a shock protection boundary intended to define the approach limit for unqualified employees and to eliminate the risk of contact with an exposed energized electrical conductor. The limited approach boundary is the closest approach distance for an *unqualified* employee,unless additional protective measures are used.When an employee, including the longest conductive object being handled by the employee, is closer than this minimum distance, special considerations are necessary for protection.

Boundary, Restricted Approach – An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part. Restricted Approach Boundaries may be found in NFPA 70E Table 130.4(D)(a) and (b). This shock protection boundary is the approach limit for qualified employees. The arc flash boundary may be greater than, less than, or equal to the restricted approach boundary. A qualified employee required to cross the restricted approach boundary must be protected from unexpected contact with the conductors or circuit parts that are energized and exposed. Qualified employees should have the knowledge and ability to avoid unexpected contact with an exposed energized conductor or circuit part. A complete and authorized energized electrical work permit is required before employees are allowed to work within the restricted approach boundary, except as exempted within this HSS.

Cabinet - An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.

Certified - Equipment is "certified" if it (a) has been tested and found by a nationally recognized testing laboratory (e.g. UL certified) to meet nationally recognized standards or to be safe for use in a specified manner, or (b) is of a kind whose production is periodically inspected by a nationally recognized testing laboratory, and (c) it bears a label, tag, or other record of certification.

Circuit breaker - A device designed to open and close a circuit by non-automatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating. The automatic opening means can be integral, direct acting with the circuit breaker, or remote from the circuit breaker.

Conductor

- **Bare** - A conductor having no covering or electrical insulation whatsoever.

- **Covered** - A conductor encased within material of composition or thickness that is not recognized by NFPA 70E as electrical insulation.

- **Insulated** - A conductor encased within material of composition and thickness that is recognized by NFPA 70E as electrical insulation.

De-energized - Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth. The term de-energized describes an operating condition of electrical equipment. De-energized does not describe a safe condition.

Device - A unit of an electrical system, other than a conductor, that carries or controls electric energy as its principal function.

Disconnecting Means - A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply.

Electrical Hazard – A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.

Note: Class 2 power supplies, listed low-voltage lighting systems, and similar sources are examples of circuits or systems that are not considered an electrical hazard.

Electrically Safe Work Condition – A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with AUS Control of Hazardous Energy (Lockout/Tagout) Standard (ARC HSFS004), tested to ensure the absence of voltage, and grounded if determined necessary.

Note: Establishing an *electrically safe work condition* is the only work practice that ensures that an electrical injury cannot occur. However, workers should recognize that operating disconnecting means and verifying absence of voltage might in themselves be hazardous work tasks. Until the electrically safe work condition exists, a risk of injury from electrical energy exists.

Enclosed - Surrounded by a case, housing, fence or walls which will prevent persons from accidentally contacting energized parts.

Enclosure - The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized electrical conductors or circuit parts or to protect the equipment from physical damage.

Energized - Electrically connected to, or is, a source of voltage.

Energized Electrical Conductors and Circuit Parts – Safe Work Condition: Before an employee works within the Limited Approach Boundary, energized electrical conductors and circuit parts to which an employee might be exposed shall be put into an electrically safe work condition,, unless work on energized components can be justified according to section 130.2 (A) of the NFPA 70E Standard. Refer to the ARCADIS LO/TO Program.

Energized Electrical Conductors and Circuit Parts – Unsafe Work Condition: Only “Qualified Persons” shall be permitted to work on electrical conductors or circuit parts that have not been put into an electrically safe work condition.

Energy Isolating Device - A mechanical device that physically prevents the transmission or release of energy, including but not limited to a manually operated electrical circuit breaker, a disconnect switch, a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors and no pole can be operated independently, a line valve, a block, and any similar device used to block or isolate energy. Push buttons, selector switches, interlocks, and other control circuit-type devices are not energy-isolating devices.

Energy Source - Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy source.

Equipment - A general term including fittings, devices, appliances, luminaires, apparatus, machinery and the like, used as a part of, or in connection with, an electrical installation.

Exposed - (As applied to energized electrical conductors or circuit parts) Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to electrical conductors or circuit parts that are not suitably guarded, isolated, or insulated.

Note: Conductors that are unguarded and/or uninsulated are considered to be exposed. Some electrical equipment contains conductors that are uncovered and guarded only by the enclosure. If the equipment has ventilation openings, wires and tools, for example, could be inserted through ventilation opening and come into contact with an energized conductor, therefore, the level of exposure is determined based on the situation/task and the associated tools and equipment.

Exposed - (As applied to wiring methods.) On or attached to the surface or behind panels designed to allow access.

Ground – The Earth.

Grounded (Grounding) – Connected (connecting) to ground or to a conductive body that extends the ground connection.

Grounded conductor - A system or circuit conductor that is intentionally grounded.

Ground-fault circuit-interrupter (GFCI) - A device intended for the protection of personnel that functions to deenergize a circuit or portion thereof within an established period of time when a current to ground exceeds the values established for a Class A device.

Informational Note: Class A ground-fault-circuit-interrupters trip when the current to ground is 6 mA or higher and do not trip when the current to ground is less than 4 mA. For further information, refer to ANSI/UL 943, *Standard for Ground Fault Circuit Interrupters.*

Grounding conductor, **equipment** (**EGC)-** The conductive paths that provide a ground-fault current path and connects normally non-current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both.

Informational Note 1: It is also recognized that the equipment grounding conductor also performs bonding.

Information Note 2: See NFPA 70, 250.118 (National Electrical Code) for a list of acceptable equipment grounding conductors.

Grounding electrode conductor - A conductor used to connect the system grounded conductor or the equipment to a grounding electrode or to a point on the grounding electrode system.

Guarded - Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger.

Hazard – A source of possible injury or damage to health.

Hazardouts – Involving exposure to at least one hazard.

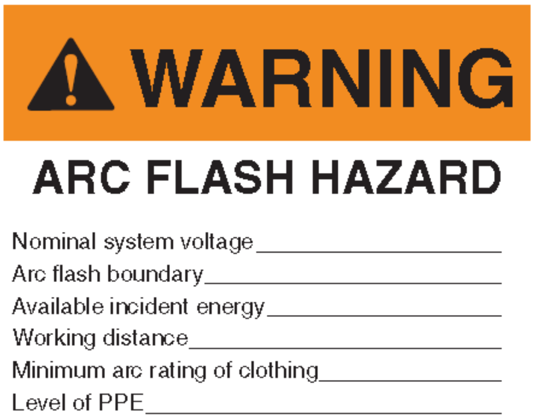
Incident Energy – The amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. Incident energy is typically expressed in calories per square centimeter (cal/cm^2).

Insulated – Separated from other conducting surfaces by a dielectric (including air space) offering a high resistance to the passage of current.

Isolated (as applied to location) - Not readily accessible to persons unless special means for access are used.

Labeled - Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

NFPA-70E Example Label:



Listed - Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or services meets appropriate designated standards or has been tested and found suitable for a specified purpose..

Lock-out - The placement of a lock-out device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lock-out device is removed.

Lock-out/Tag-out (LOTO) – The placement of a lock-out device and associated identifying tag on an energy-isolating device, in accordance with an established procedure, to ensure that this device and the equipment being controlled cannot be operated until the lock-out device and associated tag is removed.

Lock-out Device - A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.

Low Voltage – less than (<) 600 Volts.

Motor Control Center – An assembly of one or more enclosed sections having a common power bus and principally containing motor control units. A motor control center typically contains starters, disconnect switches, power panels, solid-state drives, and similar components.

Outlet - A point on the wiring system at which current may be taken to supply utilization equipment.

Overcurrent - Any current level that is in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload (see definition), short circuit, or ground fault.

Overload - Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload.

Other Employees - Personnel other than authorized or affected employees whose work is or may be in an area where lock-out and tag-out procedures may be used.

Personal Protective Equipment (PPE) - Rated protective equipment, including personal protective equipment for eyes, face, head, and extremities; protective clothing; respiratory devices; and protective shields and barriers. Such equipment must be provided, used, and maintained in a sanitary and reliable condition wherever necessary by reason of hazards of processes or environment, chemical hazards, electrical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through adsorption, inhalation or physical contact.

Panelboard - A single panel or group of panel units designed for assembly in the form of a single panel; including buses, automatic overcurrent devices, and with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition or other support, and accessible only from the front.

Qualified Person - One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoid the hazards involved.

Whether an employee is considered to be a "qualified person" will depend upon various circumstances in the workplace. It is possible and, in fact, likely for an individual to be considered qualified" with regard to certain equipment in the workplace, but "unqualified" as to other equipment.

Readily accessible - Capable of being reached quickly for operation, renewal, or inspections, without requiring those to whom ready access is requisite to actions suchs as to use tools, to climb over or remove obstacles or to resort to portable ladders, chairs, etc.

Receptacle - A receptacle is a contact device installed at the outlet for the connection of an attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.

Risk - A combination of the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that results from a hazard.

Risk Assessment - An overall process that identifies hazards, estimates the potential severity of injury or damage to

health, estimates the likelihood of occurrence of injury or damage to health, and determines if protective measures are required.

Informational Note: As used in this HSS, *arc flash risk assessment* and *shock risk assessment* are types of risk assessments.

Service Point - The point of connection between the facilities of the serving utility and the premises wiring.

Informational Note: The service point can be described as the point of demarcation between where the serving utility ends and the premises wiring begins. The serving utility generally specifies the location of the service point based on the conditions of

Servicing and/or Maintenance - Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, maintaining and/or servicing machines or equipment, including troubleshooting . These activities include but are not limited to lubrication, cleaning or un-jamming of machines/equipment, and making adjustments or tool changes that creates employee exposure to unplanned energizing or startup of equipment, or the release of hazardous energy.

Setting Up - Any work performed to prepare a machine or equipment for its normal production operation.

Shock Hazard - A dangerous condition associated with the possible release of energy caused by contact or approach to energized electrical conductors or circuit parts.

Switchboard - A large single panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments. These assemblies are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets.

Switchgear, Metal-Clad - A switchgear assembly completely enclosed on all sides and top with sheet metal, having drawn out switching and interrupting devices, and all live parts enclosed within grounded metal compartments.

Switchgear, Metal-Enclosed - A switchgear assembly completely enclosed on all sides and top with sheet metal (except for ventilating openings and inspection windows), containing primary power circuit switching, interrupting devices, or both, with buses and connections. This assembly may include control and auxiliary devices. Access to the interior of the enclosure is provided by doors, removable covers, or both. Metal-enclosed switchgear is available in non-arc-resistant or arc-resistant constructions.

Tag-out -The placement of a tag-out device on an energy isolating device in accordance with an established procedure to ensure that the energy isolating device and the equipment being controlled cannot be operated.

Tag-out Device - A prominent warning device, including a tag and a means of attachment that can be securely fastened to an energy isolating device in accordance with an established procedure to indicate that the energy isolating device and the equipment being controlled may not be operated.

Testing – Determining that machinery, equipment, or equipment parts are de-energized through the proper application of approved test equipment designed to test for the presence or absence of voltage.

Verify - Operating equipment controls for the purpose of determining that equipment cannot be restarted after an energy-isolating procedure has been performed and before maintenance or repair work is initiated.

Voltage, nominal - A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (as 120/240 volts, 480Y/277 volts, 600 volts, etc.). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

Working on (energized electrical conductors or circuit parts) -Intentionally coming in contact with energized electrical conductors or circuit parts with the hands, feet, or other body parts, with tools, probes, or with test equipment, regardless of the personal protective equipment a person is wearing. There are two categories of “working on”: *Diagnostic (testing)* is taking readings or measurements of electrical equipment with approved test equipment that does not require making any physical chance to the equipment; *repair* is any physical alteration of electrical equipment (such as making or tightening connections, removing or replacing components, etc.).

EXHIBIT 2 – ENERGIZED ELECTRICAL WORK PERMIT

Energized Electrical Work Permit

Part 1. To be completed by the requester:________________________ Project Number___________________________

Description of circuit/equipment/job location:____

Description of work to be done:____

Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next schedule outage:

____

____

____

Requester/Title____Date____________________________

Part 2. To be completed by the electrically Qualified Persons doing the work:

Detailed Job Description procedure to be used in performing the above detailed work: ____________________________

____

____

Description of the Safe Work Practices to be employed:____

____

Results of the Shock Risk Assessment:

Voltage to which personnel will be exposed:____
Limited Approach Boundary:____
Restricted Approach Boundary:____
Necessary shock personal and other PPE required to safely perform assigned task:__________________
____

Results of the Arc Flash Risk Assessment:

Available incident energy at the working distance or arc flash PPE category:________________________
Arc Flash Boundary:____
Necessary arc flash personal and other PPE required to safely perform assigned task:________________
____

Means employed to restrict the access of Unqualified Persons from the work area:____________________________

____

Evidence of completion of a Job Briefing including discussion of any job-related hazards:________________________

____

Do you agree the above described work can be done safely? ☐ Yes ☐ No
(if *no*, return to the requester)

Electrically Qualified Person(s):____Date:______________________

Electrically Qualified Person(s):____Date:______________________

Part 3: Approval(s) to perform the work while electrically energized:

Project Manager:___________________________Task Manager:______________________________________

Safety Manager:____________________________Electrically Knowledgeable Person:_______________________

Date:_____________________________________

Note: Once the work is complete, place into the Project Folder (electronic copy is acceptable) for review and retention.

EXHIBIT 3 - PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS FOR WORK WITHIN THE ARC FLASH BOUNDARY

	Arc Flash PPE Category			
PPE	**1**	**2**	**3**	**4**
Heavy duty leather gloves	X❶	X❶		
Insulated rubber gloves with leather protectors			Depends on activity	Depends on activity
Arc-rated gloves			X (min arc rating of 40)❶	X❶ (min arc rating of 40)
Long sleeve shirt ❷				
Long pants❷				
Arc-rated coveralls	X (min arc rating of 4) **OR**	X (min arc rating of 8) **OR**	As Required ❺	As Required ❼
Arc-rated Long sleeve shirt /Arc-rated long pants	X (min arc rating of 4)	X (min arc rating of 8)	As Required ❺	As Required ❼
Arc-rated flash suit jacket and pants			As Required ❺	As Required ❼
Arc-rated face shield	X (min arc rating of 4) **OR**	X (min arc rating of 8)❸ **OR**		
Arc flash suit hood	X (min arc rating of 4)	X (min arc rating of 8)	X ❺	X ❼
Safety glasses or Goggles	X❹	X❹	X❹	X❹
Balaclava (Sock hood)		X		
Hearing protection	X (ear canal inserts)	X (ear canal inserts)	X (ear canal inserts)	X (ear canal inserts)
Electrically rated Hardhat (Class E or G)	X	X	X	X
AR Hardhat Liner	As Needed ❻	As Needed ❻	As Needed ❻	As Needed ❻
Leather footwear	As Needed	X	X	X
Arc-rated jacket, parka, or rainwear	As Needed	As Needed	As Needed	As Needed

Notes:
All Arc Rating values are cal/cm^2
If work is being done outdoors, may need arc-rated coats, rainwear, etc.;
Underlayers. Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric underlayers (underwear) next to the skin.
Specific Notes:
❶If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement. Where insulating rubber gloves are used for shock protection, leather protectors shall be worn over the rubber gloves. Employees shall wear rubber insulating gloves with leather protectors where there is a danger of hand injury from electric shock due to contact with energized electrical conductors or circuit parts. Employees shall wear rubber insulating gloves with leather protectors and rubber insulating sleeves where there is a danger of hand and arm injury from electric shock due to contact with energized electrical conductors or circuit parts. Rubber insulating gloves shall be rated for the voltage for which the gloves will be exposed.
❷ Layering. Nonmelting, flammable fiber garments shall be permitted to be used as underlayers in conjunction with arc-rated garments in a layered system. If nonmelting, flammable fiber garments are used as underlayers, the system arc rating shall be sufficient to prevent breakopen of the innermost arc-rated layer at the expected arc exposure incident energy level to prevent ignition of flammable underlayers. Garments that are not arc rated shall not be permitted to be used to increase the arc rating of a garment or of a clothing system.
❸Face shields are to have wrap-around guarding to protect not only the face but also the forehead, ears, and neck, or, alternatively, an arc-rated arc flash suit hood is required to be worn.
❹Selection required. See NFPA 70E
❺ Arc rated clothing selected so that the system arc rating meets the required minimum arc rating of 25 cal/cm^2
❻ As required based on activity. See NFPA 70E
❼ Arc rated clothing selected so that the system arc rating meets the required minimum arc rating of 40 cal/cm^2

Arc Rating is defined in NFPA 70E Article 100 and can be either the arc thermal performance value (ATPV) or energy of break open threshold (EBT). ATPV is defined in ASTM F 1959, *Standard Test Method for Determining the Arc Thermal Performance Value of Materials for Clothing*, as the incident energy on a material, or a multilayer system of materials, that results in a 50 percent probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll curve, in cal/cm^2. EBT is defined in ASTM F 1959 as the incident energy on a material or material system that results in a 50 percent probability of breakopen. Arc rating is reported as either ATPV or EBT, whichever is the lower value.

EXHIBIT 4 - INTERNATIONAL ELECTROTECHNICAL COMMISSION 61010 VOLT METER CATEGORIES

Transient Overvoltage Category (<1,000 Volts)		
Overvoltage Category	Brief Description	Examples
CAT IV	Three phase at utility connection, any outdoor conductors	• Refers to the origin of the installation, i.e., where low-voltage connection is made to utility power. • Electric meters, primary overcurrent protective equipment • Outside and service entrance, service drop from pole to building, run between meter and panel • Overhead line to detached building, underground line to well pump
CAT III	Three phase at distribution including single-phase commercial lighting	• Equipment in fixed installations, such as switchgear and polyphase motors • Bus and feeder in industrial plants • Feeders and short branch circuits, distribution panel devices • Lighting systems in large buildings • Appliance outlets with short connections to service entrance
CAT II	Single phase receptacle connected loads	• Appliance, portable tools, and other household similar loads • Outlet and long branch circuits • Outlets more than 10 meters (30 feet) from Cat III sources • Outlets at more than 20 meters (60 feet) from Cat IV sources
CAT I	Electronics	• Protected electronic equipment • Equipment connected to (source) circuits in which measures are taken to limit transient overvoltages to an appropriate low level • Any high-voltage, low-energy source derived from a high-winding resistance transformer, such as the high-voltage section of a copier

EXHIBIT 5A - APPROACH BOUNDARIES TO ENERGIZED ELECTRICAL CONDUCTORS OR CIRCUIT PARTS FOR SHOCK PROTECTION FOR ALTERNATING-CURRENT SYSTEMS (ALL DIMENSIONS ARE DISTANCE FROM ENERGIZED ELECTRICAL CONDUCTOR OR CIRCUIT PART TO EMPLOYEE.)

	Limited Approach Boundary[b]		
Nominal System Voltage Range, Phase to Phase[a]	Exposed Movable Conductor[c]	Exposed Fixed Circuit Part	Restricted Approach Boundary[b]; Includes Inadvertent Movement Adder
<50 V	Not specified	Not specified	Not specified
50 V–150 V[d]	3.0 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	Avoid contact
151 V–750 V	3.0 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.3 m (1 ft 0 in.)
751 V–15 kV	3.0 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.7 m (2 ft 2 in.)
15.1 kV–36 kV	3.0 m (10 ft 0 in.)	1.8 m (6 ft 0 in.)	0.8 m (2 ft 7 in.)
36.1 kV–46 kV	3.0 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	0.8 m (2 ft 9 in.)
46.1 kV–72.5 kV	3.0 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 3 in.)
72.6 kV–121 kV	3.3 m (10 ft 8 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 4 in.)
138 kV–145 kV	3.4 m (11 ft 0 in.)	3.0 m (10 ft 0 in.)	1.2 m (3 ft 10 in.)
161 kV–169 kV	3.6 m (11 ft 8 in.)	3.6 m (11 ft 8 in.)	1.3 m (4 ft 3 in.)
230 kV–242 kV	4.0 m (13 ft 0 in.)	4.0 m (13 ft 0 in.)	1.7 m (5 ft 8 in.)
345 kV–362 kV	4.7 m (15 ft 4 in.)	4.7 m (15 ft 4 in.)	2.8 m (9 ft 2 in.)
500 kV–550 kV	5.8 m (19 ft 0 in.)	5.8 m (19 ft 0 in.)	3.6 m (11 ft 10 in.)
765 kV–800 kV	7.2 m (23 ft 9 in.)	7.2 m (23 ft 9 in.)	4.9 m (15 ft 11 in.)

Note: For arc flash boundary, see NFPA 70E,130.5(A).
Note: All dimensions are distance from exposed energized electrical conductros or circuit parts to employee
[a] For single-phase systems, select the range that is equal to the system's maximum phase-to-ground voltage multiplied by 1.732.
[b] See definition in NFPA 70E Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.[c] Exposed movable conductors describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
[d] This includes circuits where the exposure does not exceed 120V.

EXHIBIT 5B - APPROACH BOUNDARIES[a] TO ENERGIZED ELECTRICAL CONDUCTORS OR CIRCUIT PARTS FOR SHOCK PROTECTION, DIRECT-CURRENT VOLTAGE SYSTEMS

Nominal Potential Difference	Limited Approach Boundary: Exposed Movable Conductor[b]	Limited Approach Boundary: Exposed Fixed Circuit Part	Restricted Approach Boundary; Includes Inadvertent Movement Adder
<100 V	Not specified	Not specified	Not specified
100 V–300 V	3.0 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	Avoid contact
301 V–1 kV	3.0 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.3 m (1 ft 0 in.)
1.1 kV–5 kV	3.0 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.5 m (1 ft 5 in.)
5 kV–15 kV	3.0 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.7 m (2 ft 2 in.)
15.1 kV–45 kV	3.0 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	0.8 m (2 ft 9 in.)
45.1 kV– 75 kV	3.0 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 2 in.)
75.1 kV–150 kV	3.3 m (10 ft 8 in.)	3.0 m (10 ft 0 in.)	1.2 m (4 ft 0 in.)
150.1 kV–250 kV	3.6 m (11 ft 8 in.)	3.6 m (11 ft 8 in.)	1.6 m (5 ft 3 in.)
250.1 kV–500 kV	6.0 m (20 ft 0 in.)	6.0 m (20 ft 0 in.)	3.5 m (11 ft 6 in.)
500.1 kV–800 kV	8.0 m (26 ft 0 in.)	8.0 m (26 ft 0 in.)	5.0 m (16 ft 5 in.)

[a]All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.
[b]This terms describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.

EXHIBIT 6A - ARC FLASH HAZARD IDENTIFICATION FOR ALTERNATING CURRENT (AC) AND DIRECT CURRENT SYSTEMS

Task	Equipment Condition*	Arc Flash PPE Required
Reading a panel meter while operating a meter switch	Any	No
Normal operation of a circuit breaker (CB), switch, contactor, or starter	All of the following: The equipment is properly installed The equipment is properly maintained All equipment doors are closed and secured All equipment covers are in place and secured There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes
For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing	Any	Yes
For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing	Any	Yes
Voltage testing on individual battery cells or individual multi-cell units	All of the following: The equipment is properly installed The equipment is properly maintained Covers for all other equipment are in place and secured There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes
Removal or installation of CBs or switches	Any	Yes
Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts	All of the following: The equipment is properly installed The equipment is properly maintained There is no evidence of impending failure	No
	Any of the following: The equipment is not properly installed The equipment is not properly maintained There is evidence of impending failure	Yes
Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers.	Any	Yes

(continues)

Task	Equipment Condition*	Arc Flash PPE Required
Removal of battery intercell connector covers	All of the following: The equipment is properly installed. The equipment is properly maintained Covers for all other equipment are in place and secured There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes
Opening hinged door(s) or cover(s) (to expose bare energized electrical conductors and circuit parts)	Any	Yes
Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.	Any	No
Application of temporary protective grounding equipment after voltage test	Any	Yes
Work on control circuits with exposed energized electrical conductors and circuit parts, 120 volts or below without any other exposed energized equipment over 120 V including opening of hinged covers to gain access	Any	No
Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 V	Any	Yes
Insertion or removal of individual starter buckets from motor control center (MCC)	Any	Yes
Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed	Any	Yes
Insertion or removal of plug-in devices into or from busways	Any	Yes
Insulated cable examination with no manipulation of cable	Any	No
Insulated cable examination with manipulation of cable	Any	Yes
Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center	Any	Yes
Insertion and removal of revenue meters (kW-hour, at primary voltage and current)	Any	Yes
For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an enclosure	Any	Yes
For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack	Any	No

Task	Equipment Condition*	Arc Flash PPE Required
For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack	Any	No
For dc systems, work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source	Any	Yes
Arc-resistant switchgear Type 1 or 2 (for clearing times of <0.5 sec with a prospective fault current not to exceed the arc-resistant rating of the equipment) and metal enclosed interrupter switchgear, fused or unfused of arc resistant type construction, tested in accordance with IEEE C37.20.7: •Insertion or removal (racking) of CBs from cubicles •Insertion or removal (racking) of ground and test device •Insertion or removal (racking) of voltage transformers on or off the bus	All of the following: The equipment is properly installed The equipment is properly maintained All equipment doors are closed and secured All equipment covers are in place and secured There is no evidence of impending failure	No
	One or more of the following: The equipment is not properly installed The equipment is not properly maintained Equipment doors are open or not secured Equipment covers are off or not secured There is evidence of impending failure	Yes
Opening voltage transformer or control power transformer compartments	Any	Yes
Outdoor disconnect switch operation (hookstick operated) at 1 kV through 15 kV	Any	Yes
Outdoor disconnect switch operation (gang-operated, from grade) at 1 kV through 15 kV	Any	Yes

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

*The phrase *properly installed*, as used in this table, means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendations. The phrase *properly maintained*, as used in this table, means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. The phrase *evidence of impending failure*, as used in this table, means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

EXHIBIT 6B - ARC FLASH HAZARD PPE CATEGORIES FOR ALTERNATING CURRENT (AC) SYSTEMS

Equipment	Arc Flash PPE Category	Arc-Flash Boundary
Panelboards or other equipment rated 240 V and below Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)	1	485 mm (19 in.)
Panelboards or other equipment rated >240 V and up to 600 V Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)	2	900 mm (3 ft)
600-V class motor control centers (MCCs) Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)	2	1.5 m (5 ft)
600-V class motor control centers (MCCs) Parameters: Maximum of 42 kA short-circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 455 mm (18 in.)	4	4.3 m (14 ft)
600-V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 455 mm (18 in.)	4	6 m (20 ft)
Other 600-V class (277 V through 600 V, nominal) equipment Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 455 mm (18 in.)	2	1.5 m (5 ft)
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4	12 m (40 ft)
Metal-clad switchgear, 1 kV through 15 kV Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4	12 m (40 ft)
Arc-resistant switchgear Type 1 or 2 [for clearing times of < 0.5 sec (30 cycles) with a perspective fault current not to exceed the arc-resistant rating of the equipment], and metal-enclosed interrupter switchgear, fused or unfused of arc-resistant-type construction, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV	N/A (doors closed)	N/A (doors closed)
Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4 (doors open)	12 m (40 ft)
Other equipment 1 kV through 15 kV Parameters: Maximum of 35 kA short-circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 910 mm (36 in.)	4	12 m (40 ft)

Note: For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting circuit breakers sized at 200 amperes or less, the arc flash PPE category can be reduced by one number but not below arc flash PPE category 1.

EXHIBIT 6C - ARC FLASH HAZARD PPE CATEGORIES FOR DIRECT CURRENT (DC) SYSTEMS

Equipment	Arc Flash PPE Category	Arc-Flash Boundary
Storage batteries, dc switchboards, and other dc supply sources 100 V > Voltage < 250 V Parameters: Voltage: 250 V Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)		
Short-circuit current < 4 kA	1	900 mm (3 ft)
4 kA ≤ short-circuit current < 7 kA	2	1.2 m (4 ft)
7 kA ≤ short-circuit current < 15 kA	3	1.8 m (6 ft)
Storage batteries, dc switchboards, and other dc supply sources 250 V ≤ Voltage ≤ 600 V Parameters: Voltage: 600 V Maximum arc duration and working distance: 2 sec @ 455 mm (18 in.)		
Short-circuit current 1.5 kA	1	900 mm (3 ft)
1.5 kA ≤ short-circuit current < 3 kA	2	1.2 m (4 ft)
3 kA ≤ short-circuit current < 7 kA	3	1.8 m (6 ft.)
7 kA ≤ short-circuit current < 10 kA	4	2.5 m (8 ft)

Note: Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:
(1) Be evaluated for electrolyte protection in accordance with ASTM F1296, *Standard Guide for Evaluating Chemical Protective Clothing*
(2) Be arc-rated in accordance with ASTM F1891, *Standard Specification for Arc Rated and Flame Resistant Rainwear*, or equivalent

Employees shall use insulated tools or handling equipment, or both, when working inside the restricted approach boundary of exposed energized electrical conductors or circuit parts where tools or handling equipment might make accidental contact. Insulated tools shall be protected from damage to the insulating material.

EXHIBIT 7 –HAZARD ANALYSIS

Note: Italicized text represents information used during the risk assessment process

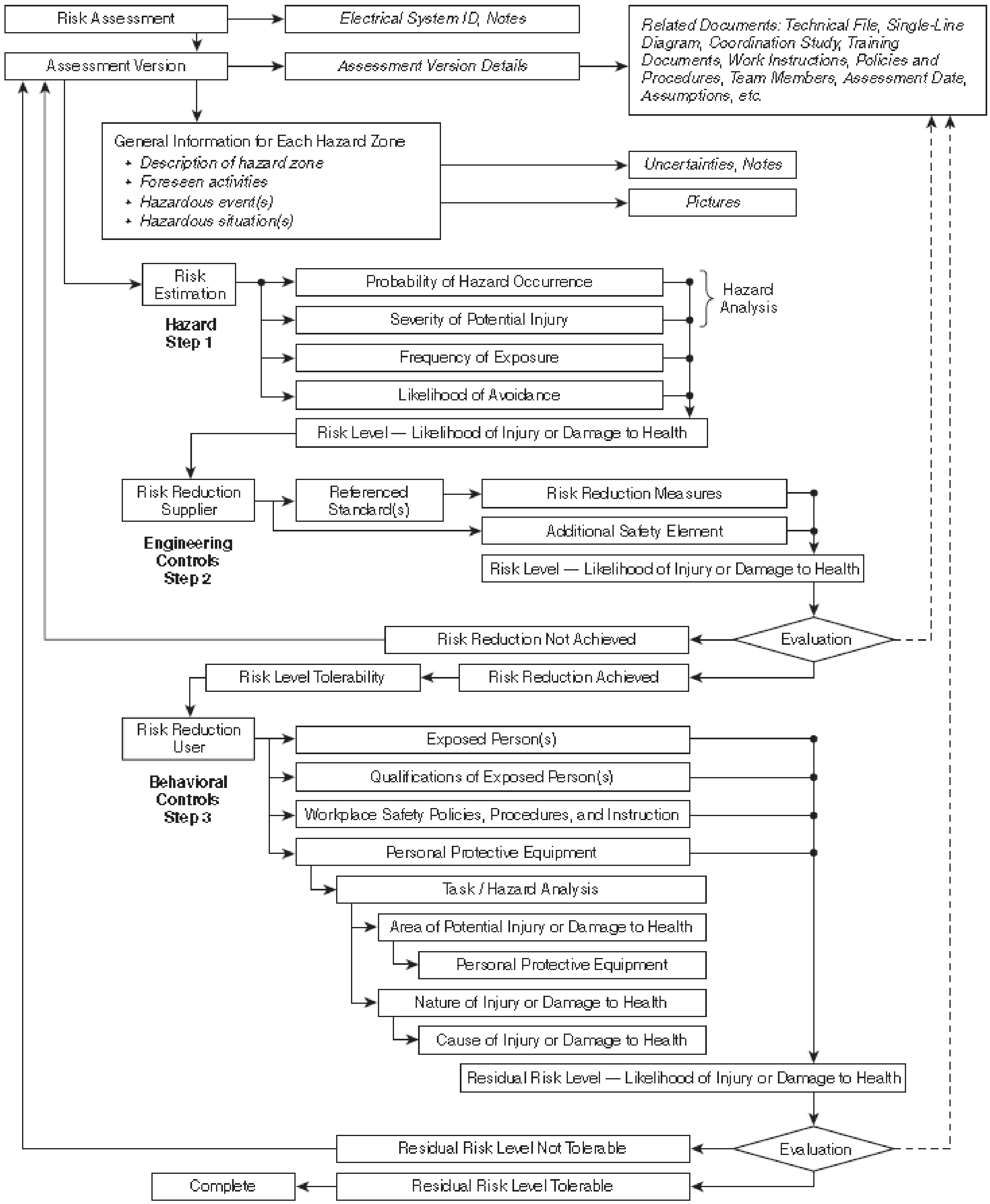


EXHIBIT 8 - ELECTRICAL TASK HAZARD ASSESSMENT WORKSHEET TEMPLATE

ARCADIS

ELECTRICAL TASK HAZARD ASSESSMENT FORM

Project #:		Project Location:	
Date:		Completed By:	
Emerg #:		Site Contact:	

Think through the Task

Equipment:		Equipment ID:	
System Voltage Rating:	Short-Circuit Current:	Fault Clearing Time:	Working Distance:
Diagrams available?	Secondary Voltage?	Unusual work condition:	
Voltage Source(s) Identified:			
Select Task from drop-down list: *(A separate THA sheet is required for each individual task)*			

Recognize the hazard(s) and Assess the Risks

Equipment Condition	*Choose one response for each line*	Response
	The equipment is properly installed	
	The equipment is properly maintained	
	All equipment doors are closed and secured	
	All equipment covers are in place and secured	
	There is no evidence of impending failure	
	Covers for all other equipment are in place and secured	
	According to NFPA 70E Table 130.7 (C)(15)(A)(a) Arc Flash Hazard Identification, is Arc Flash PPE required?	

Refer to NFPA 70E Table 130.7 (C)(15)(A)(a) Arc Flash Hazard Identification for details on equipment condition as there are some tasks where equipment condition is not a driver to determine whether or not Arc Flash PPE is required

Shock Protection Boundary	Limited Approach Boundary	Exposed Movable Conductor		Exposed Fixed Circuit Part	
	Restricted Approach Boundary				

Refer to NFPA 70E Table 130.4 (D)(a) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection for Alternating-Current Systems and 130.4(D)(b) Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection, Direct-Current Voltage Systems

Control the hazards

Arc-Flash Hazard PPE Categories for Alternating Current Systems, if Arc Flash PPE is required according to NFPA 70E Table 130.7 (C)(A)(a)

Equipment (choose from drop down list)			
Arc Flash PPE Category		Arc Flash Boundary	

Arc-Flash Hazard PPE Categories for Direct Current Systems, if Arc Flash PPE is required according to NFPA 70E Table 130.7 (C)(A)(a)

Equipment (choose from drop down list)			
Arc Flash PPE Category		Arc Flash Boundary	

NFPA 70E Table 130.7(C)(16) lists the requirements for PPE based on the arc flash PPE categories 1 through 4 (reference table to list appropriate PPE below)

Arc-Rated Clothing, Minimum Arc Rating Required (cal/cm^2)		Protective Equipment	
Arc-rated long-sleeve shirt and pants		Safety glasses or safety goggles	Required
Arc-rated coverall		Hearing protection (ear canal inserts)	Required
Arc-rated arc flash suit jacket		Heavy duty leather gloves	
Arc-rated arc flash suit pants		Leather footwear	
Arc-rated face shield			
Arc-rated face shield and balaclava			
Arc-Rated flash suit hood			
Arc-rated gloves			
Arc-rated jacket			
Arc-rated parka			
Arc-rated rainwear			
Arc-rated hat liner			

Are insulated tools or handling equipment required? (required when working inside restricted approach boundary of exposed energized electrical conductors or circuit parts where tools or handling equipment might make accidental contact)	

Note: Only qualified and experienced subject matter experts are permitted to perform incident energy and arc flash boundary calculations. Only after a properly documented arc flash hazard analysis has been conducted and approved by Corporate H&S or other designated subject matter expert, can the default Hazard/RiskArc Flash PPE category detailed in this hazard assessment sheet be modified.
Information that will be required for the incident energy analysis includes:
- Equipment Class, Gap between Conductors (mm); Grounding Type; Working Distance (mm); Available 3 Phase Bolted Current (kA); and System Voltage

Keep H&S first in all things

Can the equipment be de-energized?
Do staff have the appropriate 70E Qualified Electrical training to complete task?
Be sure to conduct a daily tailgate (job briefing) meeting to discuss the details and limits of the expected work task
When the work task cannot be executed as planned, STOP WORK until the task hazard analysis is reviewed/revised as necessary. A change in the condition or work environment that was not a part of the original plan might result in unanticipated exposure to an electrical hazard
Is a stand-by person required? Have you arranged for a site contact to check-in on you or have you established a defined / routine call-in schedule with the Project Manager or SSO?
If stand-by person is determined to be required, are they First Aid/CPR trained?
Does stand-by person or others aware of power shut-off location/procedure?
Verify that host employer has disclosed known hazards related to contract employers work and installation information to allow contract employer to plan their work activities

Signature and Certification Section - Site Staff and Contract Employees

Name/Company/Signature	Date	I have read, understand and will complete work in accordance with this THA

I will STOP the job any time anyone is concerned or uncertain about health & safety or if anyone identifies a hazard or additional mitigation not recorded in the site, project, job or task hazard assessment.

I will be alert to any changes in personnel, conditions at the work site or hazards not covered by the original hazard assessments.

If it is necessary to STOP THE JOB, I will perform TRACK; and then amend the hazard assessments as needed.

I will not assist a subcontractor or other party with their work unless it is absolutely necessary and then only after I have done TRACK and I have thoroughly controlled the hazard.

ARCADIS	ARCADIS HS Procedure Name Ladder Safety Standard	Revision Number 03
Implementation Date 25 January 2011	ARCADIS HS Procedure No. ARC HSFS016	Revision Date 5 October 2014

EXECUTIVE SUMMARY

This Health and Safety Standard (HSS) sets forth minimum requirements for ARCADIS personnel to conduct work safely with the use of ladders. There are many different types of ladders that have a variety of uses and applications. The work environment should be considered when selecting a ladder, including the physical size restrictions, length of the ladder, duty rating and intended use. This standard provides guidance on these types of ladders, their designated uses and the practices to adequately protect ARCADIS personnel. See the Ladder Fact Sheet for a quick reference guide to ladder safety.

- A ladder shall be provided to all points of access where there is a break in elevation of 19 inches or more.
- The proper type and size of ladder should be selected and used based on the specific conditions and requirements of the job.
- Ladders shall not be loaded beyond the maximum intended load for which they were built, or beyond their manufacturer's rated capacity.
- Ladders shall be set up and positioned so that it has level and adequate anti-slip support.
- Ladders shall be secured if there is a potential for slipping sideways or backwards motion.
- The ladder should be set up close to the work to eliminate the need to over reach.
- Only one person at a time is permitted on ladders unless the ladder is specifically designed for multiple occupants.
- Ladder users shall face the ladder and utilize three points-of-contact technique when ascending or descending ladders.
- Items and objects shall not be carried in the user’s hands when ascending or descending a ladder.
- A ladder must never be placed upon other objects such as boxes, barrels, scaffolds, or other unstable bases in an effort to obtain additional height.
- Ladders shall be inspected prior to use. A thorough inspection by a competent person must also be made on a frequent and regular basis and after any occurrence that could affect their safe use.
- Employees must be trained by a course selected and approved by Corporate H&S. The purpose of training is to recognize hazards associated with ladders, and receive instruction to minimize these hazards.
- Retraining is required whenever there is indication that an employee does not have the necessary knowledge or skills to safely work on or around ladders.

1. POLICY

It is ARCADIS policy to minimize the hazards involved with working above a safe working surface. ARCADIS recognizes that our work will at times require the use of ladders to complete our work. In those cases, this work will be conducted using the appropriate type of ladder for the work and only by trained and competent staff. Ladders will be in safe working condition at all times. Ladders are only to be used for accessing an elevated work area for short term work tasks.

2. PURPOSE AND SCOPE

2.1 Purpose

The basic purpose of the ARCADIS ladder safety standard is to prevent accidents, injuries and equipment damage.

This standard addresses safe ladder use. Potential falls from elevations are the principal hazards associated with using ladders.

The standard and designated procedures provide guidance and minimum training and competency requirements for ARCADIS employees, who potentially face a risk of injuries associated with ladder use. Administrative procedures such as safe ladder use, proper care and inspections of ladders, and training are addressed in this Standard.

2.2 Scope

This HSS for ladders applies to all ARCADIS US operations. This includes any work conducted at ARCADIS offices, project sites, client facilities, and any other work-related location where ARCADIS employees carry out activities that directly or indirectly expose them to potential falls or hazards associated with ladders.

3. DEFINITIONS

There are several definitions associated with this HSS. These definitions are presented in **Exhibit 1** of this document.

4. RESPONSIBILITIES

4.1 **Project Managers, Task Managers and Site Safety Officers**

Project Managers, Task Managers, and Site Safety Officers (SSO) are responsible for implementing this HSS on any project in which ARCADIS employees and/or subcontractors use ladders. These individuals are responsible for communicating and appropriately managing ARCADIS subcontractors, ensuring that employees and ARCADIS subcontractors, as applicable, have appropriate training in safety, providing the appropriate ladder(s) for the project, and ensuring ladders are inspected and maintained in accordance with this HSS.

4.2 Division HS Directors

Division HS Directors are responsible for communicating with all PICs, PMs, APMs, Location Leaders, and Corporate Services Managers within ARCADIS and ensuring that they are aware of this HSS and for ensuring that this standard is updated as necessary.

4.3 Operations Managers and Supervisors

Operations Managers and Supervisors are responsible for ensuring that ARCADIS personnel are knowledgeable of the safe use of ladders and comply with the procedures, including proper care and maintenance of ladders. They are responsible for reinforcing safe work practices, and if necessary, implementing disciplinary procedures to those employees who do not comply with ladder safety procedures.

4.4 ARCADIS Employees

ARCADIS employees are responsible for implementing the TRACK (**T**hink through the task, **R**ecognize the hazard, **A**ssess the risk, **C**ontrol the risk, **K**eep H&S first in all things) process before any and all work involving ladder use. Employees are responsible for adhering to ladder safety standards set forth by ARCADIS Corporate H&S. They should communicate H&S concerns, issues and questions to their supervisor or their respective H&S contact prior to initiating work.

4.5 Competent Person

Is responsible for conducting frequent and regular inspections of ladders, and tagging or removing defective ladders from service. Duties pertaining to ladders include the use of the TRACK process and Stop-Work Authority.

5. PROCEDURE

5.1 Basic Ladder Safety

Basic safety procedures that apply to all ladders are addressed below. Specific ladder type requirements are addressed in **Section 5.3**.

5.1.1 General

- A ladder shall be provided to all points of access where there is a break in elevation of 19 inches or more.
- A Double-Cleat Ladder or two or more separate ladders shall be provided when ladders are the only means of access or exit from a working area for 25 or more employees, or when one ladder serves simultaneous two-way traffic.
- When a building or structure has only one point of access between levels, that point of access shall be kept clear to permit free passage of employees.
- When work must be performed such that access is restricted, a second point of access shall be provided and used.

5.1.2 Proper Use

- Ladders should not be used by personnel who feel tired, dizzy, or who are otherwise likely to lose their balance.
- Ladders shall not be used during inclement weather conditions, such as high winds or storms.
- Ladder users shall wear slip-resistant shoes.
- Ladders shall not be placed in front of closed doors that can be opened toward the ladder. The door must be blocked open, locked, or guarded.
- Only one person at a time is permitted on ladders unless the ladder is specifically designed for multiple occupants.
- Safety information labels shall remain on all commercially purchased ladders.
- Jumping or sliding down from a ladder is prohibited.
- Ladder users shall utilize three points-of-contact techniques when ascending or descending ladders. During ascent or descent, the climber shall face the ladder and have two hands and one foot, or two feet and one hand in contact with the ladder at all times.
- In order to prevent sideways tipping due to over-reaching, the user must climb or work with the body near the middle of the steps. The ladder should be set up close to the work. Never attempt to move the ladder without first descending, relocating the ladder, and then re-climbing.
- In an effort to avoid losing balance and falling off the ladder, the user must not step or stand higher than the step indicated on the label marking the highest standing level. The user must also not step or stand on the top cap or bucket/pail shelf of step ladders.
- Do not attempt to carry objects in the hands while climbing up or down a ladder.
- The anti-slip feet at the bottom of the ladder side rails must be present and in good condition prior to using the ladder. The ladder must not be used on ice, snow or slippery surfaces unless suitable means are employed to prevent slipping.
- A ladder must never be placed upon other objects such as boxes, barrels, scaffolds, or other unstable bases in an effort to obtain additional height.
- Ladders must not be tied or fastened together with any other type of ladder to provide a longer length.
- When portable ladders are used for access to an upper landing surface, the ladder side rails shall extend at least three feet above the upper landing surface to which the ladder is used to gain access; and the ladder shall be secured at its top to prevent displacement.
- Portable ladders shall be setup with a 1:4 ratio (height to horizontal distance).

- Note: The correct angle can be determined by placing your feet at the bottom of the ladder and with your arms straight out in front of you; can touch the ladder with your hands.

5.1.3 Proper Care

- Ladders shall be inspected by a competent person on a frequent and regular basis and after any occurrence that could affect their safe use. Ladder users should also inspect ladders prior to use.
- Remove ladders from service that are exposed to excessive heat, corrosive substances, or any other item that causes a reduction in strength.
- Ladders with bent or broken side rails must be destroyed.
- Damaged or defective ladders shall be tagged with "Do Not Use" until repaired or destroyed and removed from the job site.
- Wood ladders shall not be coated with any opaque covering, except for identification or warning labels which may be placed on one face only of a side rail.

5.2 Choosing the Right Ladder

- The work site environment should be considered when selecting a ladder.
- If working near sources of electricity, metal ladders shall not be used since they are conductors of electricity.
- The proper length of the ladder should be selected.
- The duty rating of the ladder should also be considered. Ladders shall not be loaded beyond the maximum intended load for which they were built, or beyond their manufacturer's rated capacity.
- The duty rating can be found on the ladder's specifications label. There are five categories of ladder duty ratings:
  - Type IAA (Extra Heavy Duty) 375 pounds
  - Type IA (Extra Heavy Duty) 300 pounds
  - Type **I** (Heavy Duty) 250 pounds
  - Type **II** (Medium Duty) 225 pounds
  - Type **III** (Light Duty) 200 pounds

5.3 Proper Use of Ladder Types

The following requirements apply to specific types of ladders. Labeled diagrams of ladder types are provided in **Exhibit 2**.

5.3.1 Stepladders

- A Stepladder requires level ground support for all four of its side rails. If the worksite does not have level ground, a Stepladder should not be selected for the job.
- A Stepladder must not be used unless its base is spread fully open and the spreaders are locked. Stepladders are not to be used as single ladders or in the partially open position.
- The braces on the rear of a Stepladder are not intended for climbing or standing and must not be used for that purpose. Note, however, that special Stepladders are available with steps on both the front and rear and are intended for two users at the same time.
- Step ladders shall not exceed 20 feet in length (measured by length of the front rail).

5.3.2 Single Ladders

- A Single Ladder requires only two level ground support points in addition to a top support. Ladder levelers may be used to achieve equal rail support on uneven surfaces. The top support also allows the opportunity to secure or tie off the top of the ladder to increase stability.
- Single Ladders shall be erected at a 1:4 ratio (height to horizontal distance).
- The top of a Single Ladder must be placed with the two side rails equally supported.
- The length of a single ladder shall not exceed 30 feet.

5.3.3 Articulated Ladders

- An instruction label appears on each Articulated Ladder illustrating the locking joints in both the locked and unlocked positions. Each Articulated Ladder manufacturer has a unique locking hinge design and each lock must visibly indicate whether it is locked or unlocked.
- Never attempt unlocking or repositioning any of the hinges while standing on the ladder.
- The hinges of an Articulated Ladder require periodic lubrication. The hinges should be lubricated upon receipt of the ladder and then annually or more frequently, depending upon use.
- An on-product label should illustrate all the acceptable configurations for a given Articulated Ladder. Configurations not illustrated on the label are not to be used.
- The size of an Articulated Ladder is determined when it is set up in the stepladder configuration by measuring along the front side rail from the bottom to the center of the hinge at the top of the ladder. When set up in the stepladder configuration, Articulated Ladders range in size from 3 to 15 feet maximum. When set up as a Single or Extension Ladder, Articulated Ladders may have a length of no more than 30 feet.
- All four feet of an Articulated Ladder are covered with a slip-resistant material which must be present and in good condition before the ladder is used.

5.3.4 Combination Ladders

- An instruction label appears on each Combination Ladder to either illustrate the locking mechanism or provide instructions for the locking mechanism
- Never attempt unlocking or repositioning any of the joints while standing on the ladder.
- An on-product label should illustrate all the acceptable uses and positions for a given Combination Ladder. Configurations not illustrated on the label are not to be used.
- Combination Ladders used in the single, extension, or stepladder mode should follow the corresponding requirements listed in **Section 5.3**.

5.3.5 Extension Ladders

- An Extension Ladder requires only two level ground support points in addition to a top support.
- The top of an Extension Ladder must be placed with the two side rails equally supported.
- The top of the ladder shall be secured or tied off to prevent displacement.
- Extension Ladders should be erected at a 1:4 ratio (height to horizontal distance).
- Extension Ladders may be equipped with rope and pulley systems to assist the user when extending the fly sections.
- Adjustment of Extension Ladders must be made by the user when standing at the base of the ladder so that proper engagement of the rung locks can be observed.
- Two-section ladders shall not exceed 48 feet in length.

5.3.6 Extension Trestle Ladders

- An Extension Trestle Ladder requires level ground support for all four of its side rails. If this worksite condition does not exist, an Extension Trestle Ladder should not be selected for the job.
- An Extension Trestle Ladder must not be used unless its base is spread fully open and the spreaders are locked.
- Extension Trestle Ladders are not to be used as Single Ladders or in a partially opened position.
- When the extension section has previously been used as a Single Ladder, care should be exercised in properly reassembling it into the base section to ensure that the interlocking guides or brackets are properly engaged before further use.

5.3.7 Fixed Ladders

- Inspections of Fixed Ladders and Ladder Safety Systems must be made at least annually to identify signs of rust, corrosion and deterioration.
- The inspection must include all the major components including, but not limited to, rungs, side rails, supports, fasteners, anchors, Ladder Safety System, backside and front side clearances/obstructions, hatches, hatch opening arms, grab bars, platforms, and side-rail extension anchors.
- The Fixed Ladder must not be used if any bolts or welds are not secure or are missing or if the joints between the rungs and the side rail are not tight.
- Where structural defects are identified, the ladder shall be taken out of service, blocked, fenced or removed until repairs are completed by a competent person. Repair materials should be at least the equivalent of the original construction.
- Records of annual or regularly scheduled inspections, as well as repairs, should be kept.
- If electrical grounding protection has been provided for the ladder, a continuity inspection of the ground connection(s) must be performed at least annually.
- Cages for fixed ladders shall conform to OSHA requirements listed in 29 CFR 1910.27(d).
- Where the total length of a climb equals or exceeds 24 feet, Fixed Ladders shall be equipped with one of the following:
  - Ladder safety devices such as a Rigid or Flexible Cable Carrier.
  - Self-retracting lifelines, and rest platforms at intervals not to exceed 150 feet.
  - A cage or well, and multiple ladder sections. Each ladder section shall not exceed 50 feet and shall be offset from adjacent sections with rest platforms.
- Ladder safety devices, self-retracting lifelines, and related support systems shall be inspected, tested, and conform to OSHA's fall protection requirements and the manufacturer's recommendations.

5.3.8 Job-Made Wooden Ladders

All Job-Made Ladders, landings, and security attachments must be inspected at least once each week. Any defects that have developed must be corrected immediately, or the ladder must be taken out of service.

Inspection records must be maintained. The records must reflect the date of inspection, the identification or location of the ladder and any remedial action required.

Routine maintenance must be carried out each day the Job-Made Ladder is in use.

Protective coatings on Job-Made Ladders must not include any opaque material that obscures the structural integrity of the wood from visual inspection. Only transparent coatings or wood preservatives may be used.

Job-Made Wooden Ladders shall be constructed in accordance with the following specifications:

- Ladder component surfaces shall be finished to avoid injury to employees and to prevent snagging of clothing.
- The working length of Job-Made Wooden Ladders shall not be more than 24 feet.
- Fasteners shall be driven full length and countersunk not more than one-eighth inch.
- Rails and cleats shall be nominal 2 x 4 stress-grade dimension lumber.
- The minimum clear distance between rails shall be uniform throughout the length of climb and at least:
    - 16 inches but not greater than 20 inches for Single-Cleat Ladders
    - 18 inches but not greater than 22 inches for Double-Cleat Ladders
- If splicing is required to obtain the necessary ladder length, the resulting side rail shall not have more than one splice, located as close to the top point of bearing as possible and shall be equivalent in strength to a one-piece side rail made of the same material.
- If splicing of side rails is required, they shall be spliced using bolts with a nut and lock washer below the bolt. Bolts shall be either common steel bolts with a one-inch diameter, 3/32 inch thick steel washer under the bolt head, or one-half inch carriage bolts.
- Cleats shall be parallel and level when the ladder is in position to be used and evenly spaced throughout the length of the ladder from the base to the top point of bearing.
- Filler blocks shall be used between cleats. Side rails shall not be cut to inset cleats.
- Filler blocks shall be the same thickness as the cleats, butted tightly against the underside of each cleat, and attached to the side rails by 3 1/4 inch long 12-d common nails, or an equivalent set of fasteners.
- The distance from the top of a cleat to the top of an adjacent cleat shall be at least eight inches but not greater than 12 inches.

5.3.9 Mobile Ladder Stands and Platforms

- Users of Mobile Ladder Stands and Platforms are required to read and understand the user instructions before use.
- These instructions must address visual inspection procedures, general maintenance, and proper tightening directions for threaded fasteners.

- Prior to each use, the Mobile Ladder Stand and Platform must be visually inspected for damage, such as unusual wear, deterioration or corrosion. Any loose bolts, nuts or connections must be tightened.
- Units that are damaged or weakened from any cause are not to be used until repairs are completed.
- General maintenance of a Mobile Ladder Stand or Platform includes cleaning, lubrication, painting, and the replacement of on-product labels and markings as well as wheels, casters and rubber pads.
- Ladder Stands and Ladder Stand Platforms must never be moved while occupied.
- Units must not be loaded beyond their Rated Load capacity.
- Materials and/or equipment must not be stored on the Steps or Platform of a unit.
- Additional height must not be gained by the addition of any type of extension or object being placed upon the unit.
- Users must remove foreign materials, such as mud or grease, from their shoes prior to climbing or mounting.
- Handrails, when provided, should be used while ascending or descending.
- Always place the unit in close proximity to the work. Overreaching while on a unit can cause instability and result in a fall.
- Use Ladder Stands and Ladder Stand Platforms only on level surfaces.
- Users are not permitted to stand on components of the unit other than the steps or platform.

5.3.10 Rope Ladders

ARCADIS recognizes that in some instances, the use of a rope ladder might be the only option to access a certain work area. ARCADIS advises that other more feasible ladder options be considered before attempting to use a rope ladder on the job site.

A rope ladder can be used to gain access to a work area if all the following conditions are met:

- Staff must understand and comply with manufacturer use and limitation requirements;
- Staff must have a Job Safety Analysis in place that identifies the hazards and necessary controls associated with climbing wire rope and/or rope ladders. The hazard assessment must include but not necessarily be limited to fatigue hazards, falling hazards, slipping and tripping hazards, cuts and abrasion hazards, as well as hazards presented by the specific installation;
- The ladder shall be capable of supporting four times the maximum intended load without failure;

- The rungs, cleats or steps of the ladder shall be uniformly spaced not less than 10 inches (25cm) apart nor more than 14 inches (36cm) apart, as measured along the ladder's side rails;
- The minimum clear distance between the side rails of the ladder shall be eleven and one half inches (29 cm);
- The components of the ladder shall be surfaced so as to prevent injury to an employee from punctures or lacerations, and to prevent snagging of clothing;
- The employee climbing the ladder shall always wear a body harness connected to a rope grab that is attached to an independently rigged lifeline, a retractable lifeline or similar. The lifeline would have to be kept taut;
- The ladder shall be equipped with and used with "stand offs";
- All connecting hardware shall be approved for fall protection or lifting and shall be stronger than the ladder rails. Slings used to connect the ladder to the anchorage (anchorage sling) shall be connected in such a fashion so as to have a minimum working load limit of 6.89 kN (1,550 lbs). If used, all hooks should be double locking;
- The anchorage shall have a minimum ultimate strength of 11.03 kN (2,480 lbs) per rail connected to it. The anchorage for the ladder should be separate from the required fall protection anchor. If the same anchorage must be used the ultimate strength of the combined anchorage shall be 44.13 kN (9,920 lbs);
- An identification tag shall be attached to each ladder. The tag shall contain the name of the ladder manufacturer, the date on which the ladder was made, a serial number, and a working load statement;
- The ladder shall be installed such that the rails remain vertical through the entire length of the suspension. There shall be a minimum 46 cm (18”) horizontal distance between the rungs and a wall or other obstacle that would impede the climber from ascending or descending the ladder;
- Only one worker at a time shall be allowed on the ladder; and
- The requirements, as applicable, set forth in OSHA Standards 29 CFR 1926.1051-1926.1053 shall be complied with.

6. TRAINING

6.1 Employee Training

Employees shall review this HSS, receive on-the-job training, as required, and complete a ladder safety course selected and approved by Corporate H&S. It should be noted that if staff have completed the 10 or 30 Hour Construction Safety course, then the ladder training course requirement has been satisfied (e.g., a separate ladder safety course is not required).

The purpose of ladder safety training is to teach employees to recognize hazards associated with ladders, and receive instruction to minimize these hazards. Areas of training include, but are not limited to:

- Nature of fall hazards in the work area.
- Proper use, placement, and care in handling of all ladders.
- Maximum intended load-carrying capacities of ladder use.
- Procedures for use of fall protection systems.
- Familiar with the ladder standard.

6.2 Training Timeframe

Training shall be performed before the employee is assigned duties involving work around or on ladders.

6.3 Retraining

Retraining and refresher training is required whenever inspections indicate that an employee does not have the necessary knowledge or skills to safely use ladders. Retraining shall also be performed when policies or procedures change and/or new equipment or systems are introduced into the work area.

7. REFERENCES

7.1 Occupational Safety and Health Administration (OSHA)

29 CFR 1910.25 - Portable Wood Ladders

29 CFR 1910.26 - Portable Metal Ladders

29 CFR 1910.27 - Fixed Ladders

29 CFR 1926.1050-1060 - Stairways and Ladders

7.2 American National Standards Institute (ANSI)

ANSI E1.1-2012 - Entertainment Technology Construction and Use of Wire Rope Ladders

ANSI 14.1 – Portable Wood Ladders

ANSI 14.2 – Portable Metal Ladders

ANSI 14.3 – Fixed Ladders

ANSI 14.4 – Job Made Wooden Ladders

ANSI 14.5 – Portable Reinforced Plastic Ladders

ANSI 14.7 – Mobile Ladder Stands and Mobile Ladder Stand Platforms

8. RECORDS

Records of Ladder Training will be kept by the Employee and copies of these records kept by the ARCADIS corporate training group.

9. APPROVALS AND HISTORY OF CHANGE

Approved By: Tony Tremblay, CSP – Corporate H&S, Director of Technical Programs

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
25 January 2011	01	Brent Oakeson / Sam Moyers	Original document
1 August 2014	02	Tony Tremblay/Sam Moyers/Andrew McDonald	Section 5.3.10 Rope Ladders added to the ladder standard; Articulated Ladder diagram and Wire Rope Ladder diagram added into Exhibit 2
5 October 2014	03	Tony Tremblay	Standard HS Procedure No. corrected to HSFS016 in header

Exhibit 1 - Definitions

Following are terms and definitions used in the ladder safety policy and associated procedures.

Articulated Ladder: A portable ladder with one or more pairs of locking articulated joints which allow the ladder to be set up in several configurations such as a single or extension ladder, with or without a stand-off, a stepladder, a trestle ladder, scaffold or work table.

Cleat: A ladder crosspiece of rectangular cross section placed on edge upon which a person may step while ascending or descending a ladder.

Combination Ladder: A portable ladder capable of being used as a Stepladder, or as a Single or Extension Ladder. It may also be capable of being used as a Trestle Ladder or as a Stairwell Ladder. Its components may be used as Single Ladders. This type of ladder can be designed with either steps or rungs, and the inclusion of a pail shelf is optional. When steps are present, the ladder should be erected so that the step surfaces are horizontal. Either spreaders or a locking device can be used to securely hold the front and rear sections in the open position.

Competent Person: means one who, through education, training, and/or experience, is capable of identifying existing and predictable hazards or working conditions which are unsanitary, hazardous, or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them. The competent person must have knowledge and experience in:

- Nature of fall hazards in the work area.
- Proper use, placement, and care in handling of all ladders.
- Maximum intended load-carrying capacities of ladder use.
- Procedures for use of fall protection systems.
- Familiar with the ladder standard.

Double-Cleat Ladder: A ladder similar in construction to a single-cleat ladder, but with a center rail to allow simultaneous two-way traffic for employees ascending or descending.

Duty rating: The indication of the maximum weight capacity the ladder can safely carry.

Extension Ladder: A non-self-supporting portable ladder that is adjustable in length. It consists of two or more sections that travel in guides or brackets arranged to permit length adjustment. It is intended for use by one person.

Extension Trestle Ladder: A self-supporting portable ladder that is adjustable in length, consisting of a Trestle Ladder base and a vertically adjustable extension section with a means for locking the ladders together. It is intended for use by one person.

Fixed Ladder: A non-self-supporting ladder that is non-adjustable in length and permanently attached to a structure at a pitch ranging from 60 degrees to 90 degrees from the horizontal. The preferred pitch of a Fixed Ladder is between 75 degrees and 90 degrees from the horizontal. A Fixed Ladder is considered to be of “Substandard Pitch” if it is installed at an angle between 60 degrees and 75 degrees from the horizontal. Fixed Ladders having a pitch greater than 90 degrees are not allowed.

Job-Made Wooden Ladder: A custom-made ladder built to fit specific job situations during construction or demolition operations. Their primary purpose is to provide access to or egress from a work area. They are not intended to serve as a workstation. They are temporary in nature and serve only until a particular phase of work is completed or until permanent stairways or Fixed Ladders are ready for use. They are not to exceed 24 feet in working length. In the event the required ladder length exceeds 24 feet, then two or more separate Job-Made Ladders are to be used in conjunction with platforms that are protected with railings.

Maximum intended load: The total load of all employees, equipment, tools, materials, transmitted loads, and other loads anticipated to be applied to a ladder component at any one time.

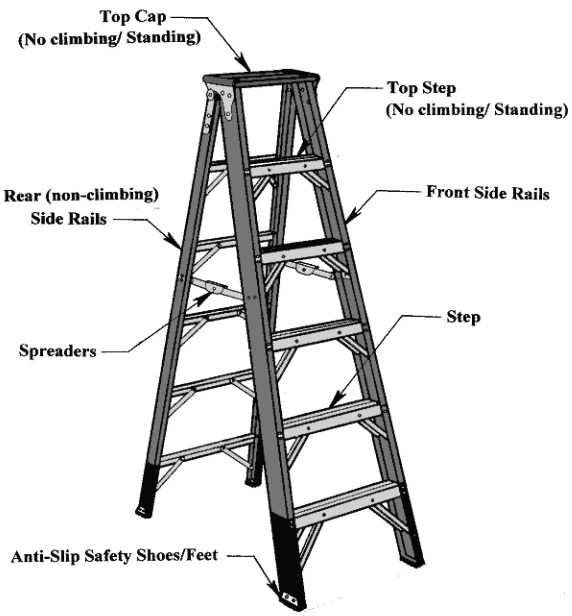
Mobile Ladder Stand: A movable, fixed height, self-supporting ladder consisting of wide flat treads in the form of steps which give access to a top step. The assembly may include handrails and is intended for use by one person.

Portable ladder: A ladder that can be readily moved or carried.

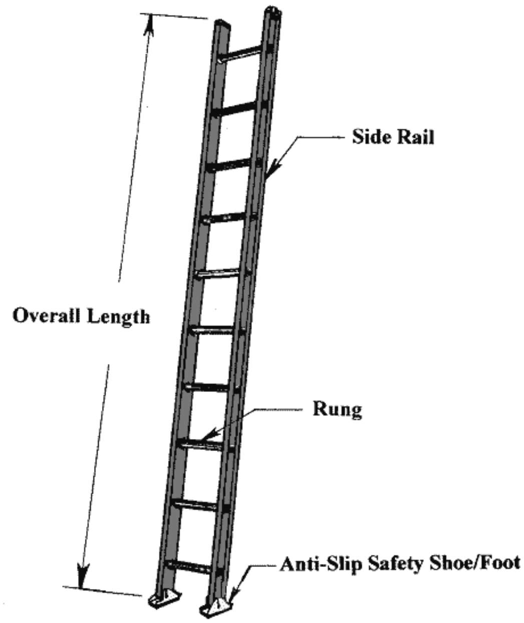
Single Ladder: A non-self-supporting portable ladder that is non-adjustable in length, consisting of one section. It is intended for use by one person. A Single Ladder is also referred to as a Single-Cleat Ladder.

Stepladder: A self-supporting portable ladder that is non-adjustable in length, with flat steps and a hinged design for ease of storage.

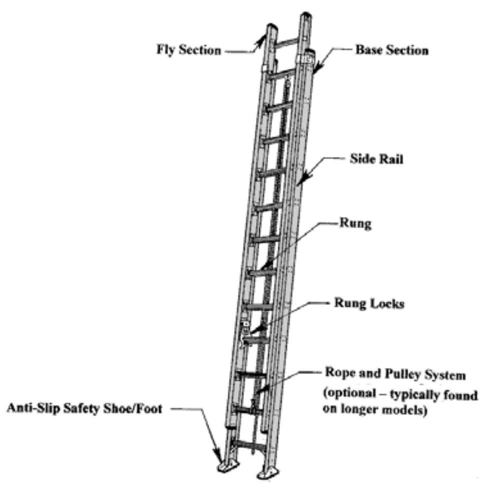
Exhibit 2 - Ladder Diagrams



Step ladder



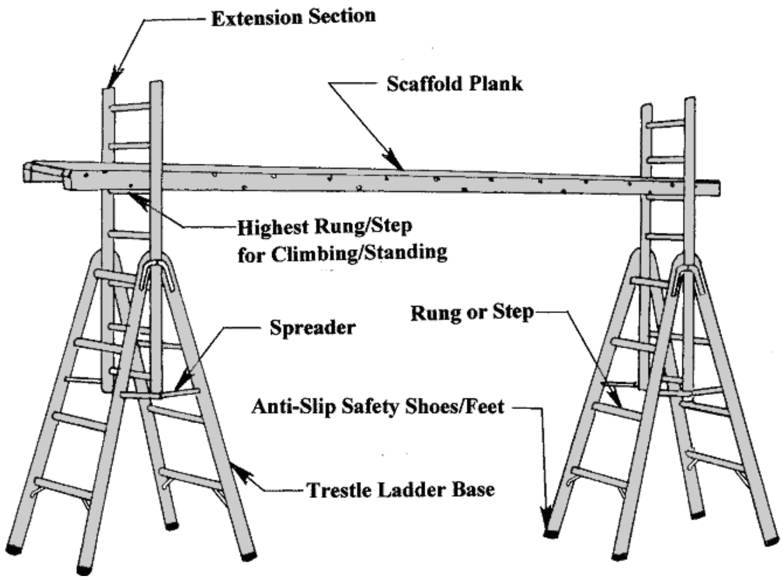
Single Portable or Straight Ladder



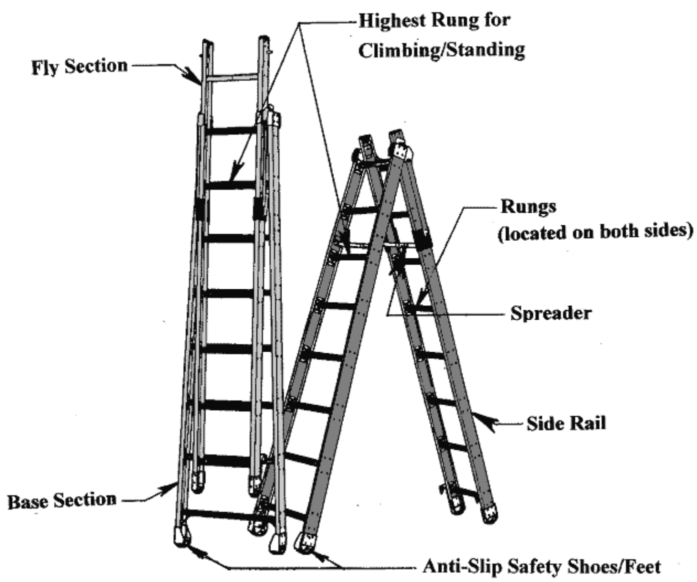
Extension Ladder

Articulated Ladder

Exhibit 2 - Ladder Diagrams (Cont.)



Extension Trestle Ladder



Combination Ladder

Exhibit 2 - Ladder Diagrams (Cont.)

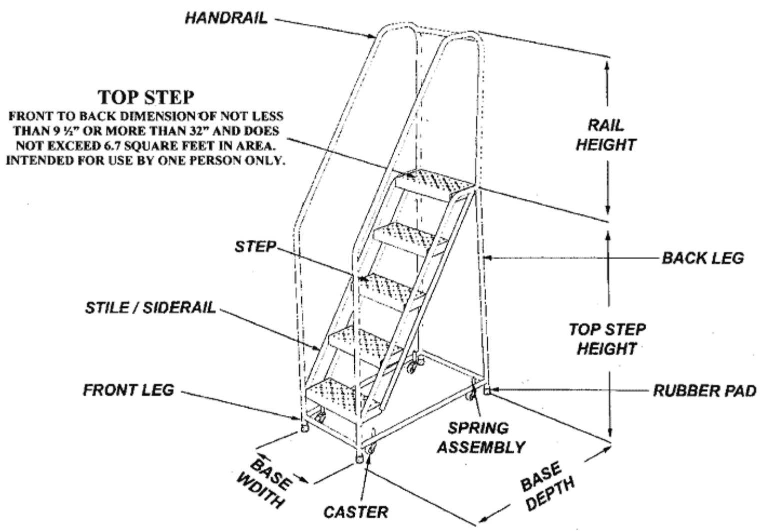
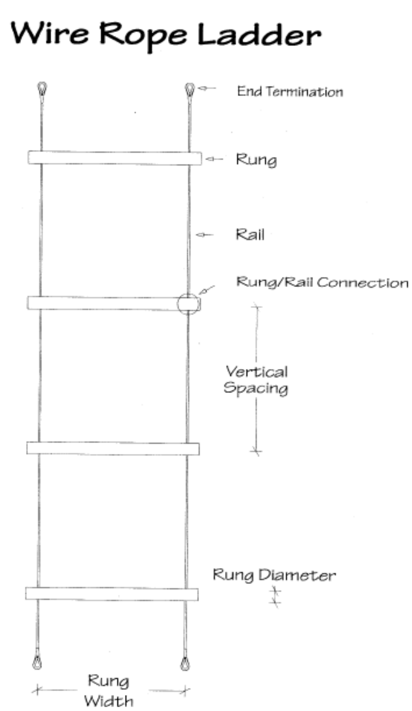


Fig. 1: Mobile Ladder Stand
Component identification



EXECUTIVE SUMMARY

This Health and Safety Standard (HSS) sets forth minimum requirements for ARCADIS personnel to conduct work that involves stored energy sources, and to prevent employees from injuries by controlling the associated hazardous energy and unexpected start-up of equipment by means of Lockout/Tagout (LO/TO) procedures.

This Standard applies:

- To hazardous energy including but not limited to kinetic, electrical, chemical, thermal, hydraulic, gravitational, and pneumatic.
- When servicing or performing maintenance on equipment.
- When required to remove or bypass a guard or other safety device.
- When required to place any part of their body in an area where a danger zone exists during a machine or equipment operating cycle.

Through this standard, ARCADIS requires:

- Development of a LO/TO plan prior to initiating the energy isolation process.
- ARCADIS staff to use the Permit to Work process, as outlined in Exhibit 3.
- Use of a lockout device and an attached tag on all isolating devices capable of being locked out or accepting lockout devices.
- At a minimum, the use of a tagout system designed to provide full employee protection against equipment start-up, if an energy isolating device is not capable of being locked out.
- Only Authorized personnel are to initiate Lockout/tagout isolation procedures.
- Notification of all affected personnel prior to equipment deactivation and isolation, and also prior to equipment reactivation after isolation measures have been removed.
- Those authorized to perform energy isolation will use their own locking device.
- Authorized Person(s) are to conduct a periodic inspection of their energy control procedure(s) **at least annually** to ensure that the requirements of the established energy control procedure and the LO/TO standard are being followed. The periodic inspection (LO/TO Task Improvement Process – TIP) shall be performed by an authorized employee other than the ones(s) utilizing the energy control procedure being inspected.
- Awareness level training of all affected employees who work in areas or with equipment where Lockout/Tagout will be performed, in order to recognize the hazards of energized and locked or tagged out equipment, and to understand the basic requirements of Lockout/Tagout.

1. POLICY

It is ARCADIS policy to be proactive in the identification, assessment and control of health and safety hazards and associated risks. To those means, any equipment that utilizes or stores hazardous energy will be controlled following this standard at any time ARCADIS staff or its subcontractors must perform maintenance on this equipment. Whenever possible, ARCADIS will de-energize equipment before performing maintenance, troubleshooting, or other activities where hazardous energy is present. When controlling hazardous energy, this standard, at a minimum will be strictly followed.

When fulfilling the Authorized Employee role, ARCADIS will provide the necessary equipment to isolate, secure or block unexpected energization of equipment. This equipment includes but is not limited to locks, tags, chains, wedges, key blocks, plug lockouts, adapter pins, self locking fasteners or other hardware for isolating, securing or blocking of machines or equipment to prevent incidents involving hazardous energy.

2. PURPOSE AND SCOPE

2.1 Purpose

This Health & Safety standard (HSS) details the administration and necessary provisions for protecting employees from injuries associated with hazardous energy release, and unexpected start-up of equipment.

2.2 Scope

This standard applies to all ARCADIS employees and on all projects where equipment that utilizes hazardous energy is present and maintained by ARCADIS staff. ARCADIS subcontractors must have LO/TO programs that meet the minimum requirements of this standard.

Only trained and authorized personnel are permitted to use procedures outlined here for locking or tagging out equipment to ensure it does not unexpectedly energize and/or start while an Authorized person is performing maintenance or service activities. This standard applies specifically to employees that operate, service or maintain equipment requiring the removal or by-passing of a machine guard or protective enclosure. In addition, it applies to personnel who must place any part of their body in a place where the accidental energization of equipment, release of stored energy, or release of stored hazardous materials may cause injury.

ARCADIS US staff who design and develop equipment and processes that require energization, must do so to allow for LO/TO and include information as to how to LO/TO such equipment or processes.

If any device must be worked on in an electrically energized capacity, the work will be done following the ARCADIS Electrical Safety Standard (ARC HSFS006). If other energized equipment must be worked on in an energized state, contact Corporate H&S or the client H&S resource for guidance.

3. DEFINITIONS

Definitions relating to LO/TO can be found in **Exhibit 1**.

4. RESPONSIBILITIES

4.1 Corporate H&S with Division and Practice Experts

On an annual basis, review and update, as necessary, this standard. In addition, corporate health & safety along with division and practice expert staff shall:

- Review LO/TO procedures in the field periodically using the Task Improvement Process (TIP) to ensure conformance to this standard;
- Provide and/or coordinate the initial LO/TO training and retraining, and/or recommend qualified training provider, to staff based on needs;
- Provide technical assistance regarding LO/TO processes; and
- As requested, assess project-specific LO/TO programs for compliance with this HSS.

4.2 Principal in Charge (PIC), Project Manager (PM), and Task Manager (TM)

Are responsible to:

- Verify that LO/TO protocols are properly identified and addressed within the project work plan, project health & safety plan, and/or other project-related documents.
- Verify that their project team employees have received the proper LO/TO training provided by Corporate Health & Safety or qualified training source prior to conducting LO/TO activities.
- Verify that the proper LO/TO equipment, including PPE, electrical testing equipment and safety equipment, is available for use by their project employees.

4.3 Health and Safety Plan Writers and Reviewers

Reference this standard as guidance and regulatory requirements to ensure the appropriate identification, assessment and control of equipment with hazardous energy for documentation in project HASPs.

4.4 Authorized Employees

Authorized employees must have training and instruction in their duties and responsibilities regarding LO/TO. Authorized employees must:

- Recognize the hazards which may be faced during LO/TO activities.
- Develop an equipment specific LO/TO procedure for the specific LO/TO work to be done.
- Conduct a periodic inspection of energy control procedure **at least annually** to ensure that the requirements of the established energy control procedure and the LO/TO standard are being followed:

- The periodic inspection shall be performed by an authorized employee other than the ones(s) utilizing the energy control procedure being inspected;

- The periodic inspection shall be conducted to correct any deviations or inadequacies identified;

- Where lockout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized employee, of that employee's responsibilities under the energy control procedure being inspected; and

- Where tagout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized and affected employee, of that employee's responsibilities under the energy control procedure being inspected, and the elements set forth in the standard.

Note: The Authorized Person conducting the inspection must document that the periodic inspections have been performed. This certification shall identify the machine or equipment on which the energy control procedure was being utilized, the date of the inspection, the employees included in the inspection, and the authorized person performing the inspection. The periodic inspection documentation can be achieved by using the TIP (task observation) process, Project H&S Conformance Assessement form or similar.

- Follow the requirements of this HSS, the project HASP, JSAs and any other specific LO/TO procedures applicable to the work being done.

- Use the appropriate and applicable PPE and testing equipment that has been provided.

- Conducting periodic inspections using the TIP process.

Information about ARCADIS Authorized LO/TO staff can be obtained from the ARCADIS Training Team.

4.5 Affected Employees

Affected Employees are responsible to:

- Understand the hazards of energized and de-energized equipment.

- Follow the instructions provided by supervisors and authorized employees who are conducting LO/TO work.

- Acknowledge LO/TO hazardous energy control work by reviewing and signing the Permit to Work.

- Not tamper with or remove LO/TO devices.

- Not perform servicing or maintenance on a machine or piece of equipment which is locked or tagged out. Servicing or maintenance work on a piece of equipment that is locked out/tagged out can only be conducted by an Authorized Employee.

4.6 All ARCADIS Employees

Use the TRACK process regularly and frequently. In addition, read and understand all hazard identification and risk assessments conducted using the HARC process as documented in HASPs, JSAs, and other written plans that are associated with their work. ARCADIS employees will:

- Participate in entry operations only if trained and authorized to do so;
- Never tamper with equipment that is under LO/TO control; and
- Never attempt to work on energized or de-energized equipment without appropriate training and authorization

5. PROCEDURE

LO/TO procedures are used to control energy hazards associated with service and maintenance of equipment which uses hazardous energy to operate. This Standard applies to all types of energy including kinetic, potential, electrical, chemical, thermal, hydraulic, gravitational, and pneumatic. The HSS applies when servicing or performing maintenance on equipment and during normal production operations if personnel are:

- Required to remove or bypass a guard or other safety device, or
- Required to place any part of their body in an area where a danger zone exists during a machine or equipment operating cycle.

Note: Requirements of this standard do not apply when Work on cord and plug connected electric equipment for which exposure to the hazards of unexpected energization or start up of the equipment is controlled by the unplugging of the equipment from the energy source and by the plug being under the exclusive control of the employee performing the servicing or maintenance.

5.1 General Requirements

An Energy Control Program is developed to ensure that before service or maintenance of equipment is performed, the equipment is isolated from its energy source and made inoperable so that unexpected energizing, startup or release of stored energy during equipment service and maintenance is prevented. This program can be developed as part of the project HASP, a JSA, or specific LO/TO procedure to include the requirements of this Standard and our clients.

Prior to initiating the LO/TO process, ARCADIS employees will complete and use the Permit to Work (refer to Exhibit 3).

5.2 Equipment List

5.2.1 Hardware

ARCADIS will provide, as necessary to execute project work, locks, tags, chains, wedges, key blocks, plug lockouts, adapter pins, self locking fasteners or other hardware for isolating, securing or blocking of machines or equipment to control energy sources.

5.2.2 Lockout/Tagout Devices

Lockout devices and tags are color coded and issued by ARCADIS, and are the only device(s) used for controlling energy. LO/TO Locks and tags must not be used for other purposes. All locks and tags provided by ARCADIS are capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected. Locks and tags are of substantial construction in order to prevent inadvertent or accidental removal. All tags are required to be marked to identify the employee applying the lock(s)/tag(s).

5.2.3 Lockout/Tagout Tags

Only standard “Danger – Do Not Operate” (black, red and white) tags will be used. Tags are constructed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible. Tags will warn against hazardous conditions if the machine or equipment is energized, and will include a legend such as the following: “Do Not Start,” “Do Not Open,” “Do Not Close,” “Do Not Energize,” or “Do Not Operate,” depending on application. Used tags are to be destroyed and the tags will not be re-used unless designated for re-use.

5.2.4 Energy Isolating Devices

When replacement or major repair, renovation, or modification of a machine or equipment is performed, and when new machines or equipment are installed, energy-isolating devices designed to accept a lockout device for such machines or equipment will be installed. If equipment for de-energizing is in a confined space, the confined space will be cleared of all employees prior to testing the energy source for de-activation.

5.3 Safety Procedures for Lockout/Tagout and Isolation

ARCADIS requires the use of a lockout device and an attached tag on all isolating devices capable of being locked out or accepting lockout devices. If an energy isolating device is not capable of being locked out, ARCADIS requires the use of a tagout system designed to provide full employee protection against equipment start-up. When a tagout device is used on an energy-isolating device, the tag shall be attached at the same location that the lockout device would have been attached. Additional precautions will be implemented to provide a level of safety equivalent to that obtained by using a lockout device. Additional safety measures may include such steps as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or removal of a valve handle to reduce the likelihood of inadvertent energization.

Lockout/tagout isolation procedures will be initiated only by authorized personnel. Personnel not trained in lockout/tagout procedures are not authorized to install, inspect, repair, adjust, remove, maintain or service equipment where the potential for injury due to accidental start-up, energization, or release of stored energy exists.

All affected personnel must be notified prior to equipment deactivation and isolation and must be notified prior to equipment reactivation after isolation measures have been removed. Personnel involved with lockout/tagout isolation of equipment shall receive information concerning the specific type and magnitude of energy or hazardous material involved, the hazards involved, and the method of control to be utilized.

Authorized personnel shall de-energize equipment by following a procedure developed specifically for the equipment involved and consistent with this Standard and OSHA 29 CFR 1910.147 or other applicable laws and client requirements.

Prior to performing any work on equipment, all isolation devices shall be in place. Locks and tags shall be affixed to each energy-isolating device by authorized personnel. These must secure the isolated equipment in the “off” position. Each person involved with servicing the isolated equipment shall attach a lock to the isolating device. In situations involving two or more persons, multiple lock hasps shall be utilized. **Tags shall be attached with all locks and must identify the authorized individual responsible for each lock, must be signed, dated and must have the name of the contractor with which the employee is employed.**

All potentially stored or residual energy must be released, relieved or disconnected. If there is a potential of accumulation, verification of isolation shall be conducted and documented throughout the project (see the next section).

Prior to work, authorized personnel shall verify and document that the equipment has been disengaged, de-energized, and isolated. Release of lockout/tagout isolation includes (see Template for Equipment Specific LO/TO Procedure in **Exhibit 2**) :

- The work area and equipment shall be inspected to ensure that non-essential items (i.e., tools) are not left in the work area and that the equipment is intact

- The work area shall be checked to ensure that all personnel are clear. Before lockout/tagout devices are removed, affected personnel shall be notified

- Removal of lockout/tagout devices shall be performed by the authorized personnel who attached the devices

If a machine must be re-energized after initial isolation (i.e., for testing or repositioning), then lockout/tagout procedures must be followed as outlined to re-isolate the equipment.

During shift or personnel changes, transfer of control will occur between authorized personnel only. If an authorized person must leave the site, then he/she must remove his/her locks and tags. The new authorized person will then immediately place his/her locks and tags on the equipment and complete the entire lockout/tagout procedure as outlined above.

Use of tagout procedures without the use of locks can only be utilized if the equipment to be de-energized will not accept a lock and the following conditions are met:

- Tagout procedures will provide protection to personnel equivalent to the use of locks

- Additional measures, sufficient to ensure protection of employees, are taken to prevent accidental start-up or energization

- If equipment for de-energizing is in a confined space, the confined space will be cleared of all employees prior to testing the energy source for deactivation

5.4 General Lockout Tagout

Specific LO/TO procedures will be developed for each piece of energized equipment requiring maintenance or service. These specific procedures can be developed on the form found in Exhibit 2 of this Standard. If a client has specific written lockout/tagout procedures for its facility equipment with which employees of ARCADIS are working, the procedure will be reviewed and used or revised by ARCADIS, as appropriate.

The following information provides general LO/TO procedures to be used for the development of equipment specific procedures.

5.4.1 Lockout/Tagout Sequence

- The authorized employee(s) shall notify all affected employees prior to the shutdown and isolation of the equipment/machine. Affected employees should be informed of the reason for shutdown and approximate length of time required for servicing or maintenance.

- The authorized employee(s) shall review the type(s) and magnitude(s) of energy present and the hazards present.

- If the machine/equipment is operating, the authorized employee(s) shall have the machine/ equipment operator explain the standard shutdown procedure and then shut it down according to the procedure.

- The energy isolating devices shall be deactivated so the machine/equipment is isolated from the energy source(s).

- Each isolating device shall be locked out and tagged out. If lockout is not feasible, only tagout of the isolating device will be conducted, and additional precautions will be required to provide employee protection equivalent to the protection provided when lockout procedures are utilized. Each authorized person conducting activities on the equipment/machine shall attach a(n) [individually assigned] safety lock to each isolating device. A standard tag shall also be attached to each individual's lock that identifies, by name, the authorized employee responsible for each lock. Stored or residual energy must be released or dissipated from each system to reach a zero energy state. Visual inspection shall be made to confirm that all moving parts have stopped. Any stored or residual energy shall be drained, blocked, repositioned, restrained, or bled. Electrical circuits shall be grounded to discharge electricity stored in capacitors.

- To ensure that the equipment is completely isolated from the energy source(s), it is necessary to test the equipment to make certain that it will not operate. The following methods shall be used to test the equipment.

- Check the area and equipment to assure that no personnel are exposed to the start-up of equipment

- Activate all start-up devices and operating controls

- Use tic-tracers or voltage indicators to test electrical circuits

- Return all operating control(s) to the neutral or off position after verifying the isolation of the equipment

5.4.2 Release of Lockout/Tagout and Return of Equipment to Service

When the equipment/machine is ready to be returned to service at the conclusion of work activities, the following steps shall be taken to safely return equipment to service:

- Check the machine/equipment and immediate area to ensure that non-essential items and tools have been removed
- Check to ensure that all guards and covers have been replaced
- Check to ensure that all employees are safely positioned or have left the area
- Check to ensure that all operating controls are in the neutral or off position
- All authorized employees shall personally remove their individual locks and tags from the isolation devices and destroy used danger tags unless tags are designed for reuse
- All affected employees must be notified that the work activities are completed and the equipment/machine is ready for use

If work activities are not completed prior to a shift ending (or other personnel change), then the procedures in "Transfer of Lockout/Tagout During Shift and Personnel Changes" (below) must be followed.

5.4.3 Transfer of Lockout/Tagout During Shift and Personnel Changes

The supervisor shall designate an authorized employee who shall control the lockout/tagout devices at the end of a shift and shall be responsible for transferring lockout/tagout authority to the next shift.

The designated authorized employee shall not remove his/her lock from any of the isolation devices until at least one of the arriving authorized employees has locked out and tagged out all of the isolation devices.

If the arriving authorized employees assuming responsibility for lockout/tagout do not attach locks prior to the previous shift employees removing all of their locks, then the employees assuming lockout/tagout authority shall repeat the entire lockout/tagout sequence.

5.5 Group Lockout/Tagout

Authorized employees shall obtain specific site lockout instructions from the project manager or designee and shall coordinate extended lockout requirements with the project manager or designee. When more than two employees are involved in work activities on the machine or equipment covered by this Standard, each authorized employee will attach a lock to a multi-lock hasp on each isolation device.

When group lockout/tagout is used, the last authorized employee with a lock attached to isolation devices will be responsible for removing the isolation devices and restoring equipment to use conditions according to the equipment-specific or general HSS.

When more than one crew, trade, or contractor, etc, is used on a project that requires equipment lockout/tagout, one specific employee shall be designated to coordinate affected work forces and to ensure continuity of protection.

5.6 Employee Unavailable to Unlock

If the employee who installed a locking device is not available, the following procedure shall be used to unlock the device(s).

- The individual requesting device removal will attempt to contact the authorized employee via cell phone, hotel phone or home phone and request the employee return to remove the device. If the authorized employee is contacted but can not come in, the status of the locked equipment will be documented and the requesting entity notified of the equipment status. All of the above to include unanswered attempts at contact will be documented. If contact is not made, a message will be left to indicate that the locking device will be removed. Upon removal a red warning tag will be left where the device was placed indicating to the authorized employee that the device was removed and the equipment is now energized.

- The Project Manager or designee will verify that the authorized employee is not at the facility and is not potentially in harms way relative to the affected equipment.

- The Project Manager or designee will notify the Division Director of H&S or the client H&S resource of the reason for device removal and the status of the affected employee.

- The device shall be removed after verifying that no employees are in harms way.

- The entire sequence of events will be documented in the form of a memorandum addressed to the Division Director of H&S.

5.7 Additional Precautions

- All energy sources must be isolated and locked out. Be aware that there can be more than one energy source.

- Additional safety precautions must be taken in situations where only a tag can be used.

- Stored energy must be released or isolated after applying lockout/tagout devices.

- Make sure that all tools and equipment are removed from the work area prior to removing lockout/tagout devices and restoring energy.

6. TRAINING

All affected employees who work in areas or with equipment where or on which LO/TO will be performed will be trained in awareness level training as provided by ARCADIS in order to recognize the hazards of energized and locked or tagged out equipment and to understand the basic requirements of LO/TO.

Training provided to Authorized Employees will be offered as approved by the Corporate H&S Training Department. In addition, staff who wish to be considered as an Authorized Employee must obtain equipment specific hands-on instruction from an Authorized person for the equipment he or she will work on, and participate in a lockout/tagout TIP as the Observee to verify that they understand the concepts and requirements of lockout/tagout.

Documentation of training certification received by attendance at any training course including externally provided training courses will be kept by the employee with copies provided to the Training Department.

Retraining is required when there is a change in job assignments, machines, or the energy control procedures, or a new hazard is introduced. Documentation of this retraining is accomplished by working with the vendor or supplier to complete or revise Exhibit 2 for the relevant piece of equipment. This revised form is then attached to the Lockout/Tagout Permit to Work and both are reviewed with applicable staff prior to LOTO activity.

7. REFERENCES

- ARCADIS Health and Safety Standard ARC HSFS010– Health and Safety Planning
- ARCADIS Health and Safety Standard ARC HSFS003 – Confined Space Entry
- ARCADIS Health and Safety Standard ARC HSFS006 – Electrical Safety
- OSHA 29 CFR 1910.147, The Control of Hazardous Energy

8. RECORDS

- Training records will be kept by the individual employee with copies of such certificates kept by the ARCADIS Training Team.
- Specific LO/TO procedures and JSAs will be kept with project files or in the 4 Sight database.
- Copies of all HASPs that document LO/TO procedures will be kept in the project files.
- Completed Permit(s) to Work detailing hazardous energy control shall be kept readily available for examination at the project location and thereafter shall be kept on file for a period of 1 year.
- Lockout/Tagout Inspection Checklists will be kept in the project files.

9. APPROVALS AND HISTORY OF CHANGE

Approved By: Tony Tremblay, CSP - Infrastructure Division Director of Health & Safety

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
1 October 2008	01	Mike Thomas / Michael Ramer	Original document
26 February 2009	02		Corrected title and document number in the Exhibit
6 October 2010	03		Addition to section 6.0
28 February 2011	04		Reviewed and Updated to new Standards Format. Added Executive Summary Section.
1 August 2011	05		Updated training section to reflect live offering
14 March 2012	06	Brent Oakeson/ Tony Tremblay	Standard Reviewed; Section 5.6, bullet 3 reference changed to Authorized Employee; Definitions moved to Exhibit 1
13 April 2012	07	Tony Tremblay	Replaced terminology JLA to JSA
16 October 2012	08	Pat Vollertsen/Tony Tremblay	Section 5 - clarified that plug connected electric equipment may be exempt from this LO/TO HSS; Revision of section 6.0; LO/TO Permit to Work (refer to Exhibit 3) process instituted; Permit to Work record keeping detailed in Section 8; Exhibit 5 Exchange of Information form added
15 February 2013	09	Tremblay/Vollertsen	Inserted statement that Authorized Person(s) to conduct a periodic inspection of their energy control procedure(s) at least annually into Executive Summary, Section 4.4 and Exhibit 2 – Equipment Specific LO/TO Procedure; Added reference to locating information about Authorized LO/TO staff from the Training Team into Section 4.4
20 February 2013	10	Pat Vollertsent/Tony Tremblay	Section 6 Retraining clarified

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
25 November 2013	11	Tony Tremblay	Section 1 Policy, Clarified that when fulfilling the Authorized Employee role, ARCADIS will provide the necessary equipment to isolate, secure or block unexpected energization of equipment; Section 4.5 Affected Employee, now includes anote that Affected Employees CAN NOT service or maintain a piece of equipment that has been locked out/tagged out; Section 5.2 bullets renumbered; Section 7 OSHA Control of Hazardous Energy reference - hyperlink added; Exhibit 1: Clarified Affected Employee definition, so staff understand that they CAN NOT service or maintain a piece of equipment that has been locked out/tagged out; Authorized Employee definition includes more detail; Servicing or Maintenance definition added
13 August 2014	12	Tony Tremblay	Removed references to Qualified Employee and replaced with Authorized Employee to match terminology with OSHA standard. Exhbit 3 and 5 references to Qualified Employee changed to Authorized Employee; Authorized Employee definition had training requirments added

Exhibit 1 – Definitions

Affected Employee operates or uses equipment that is subject to lockout/tagout procedures or works around or in the vicinity of equipment subject to lockout/tagout processes.

Note: An affected employee becomes an authorized employee when the affected employee's duties are enlarged to include performing servicing or maintenance on a machine or piece of equipment which must be locked or tagged out. See the definition of an *Authorized employee* below. Before performing service or maintenance on a piece of equipment that is locked or tagged, that employee must receive the training detailed in Section 6 of this standard.

Authorized Employee is someone who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. Each authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control. ARCADIS Training Team maintains a list of LO/TO Authorized Employees.

Energy Isolation Device is a mechanical device that physically prevents the transmission or release of energy. It does not include control circuit type devices, but rather physical devices that control circuit operation designed to accept a lockout device. They are installed when replacement or major repair, renovation, or modification of a machine or equipment is performed, and when new machines or equipment are installed.

Hazardous Energy covered by this standard includes, but is not limited to:

- Electrical
- Mechanical
- Hydraulic
- Pneumatic
- Chemical
- Thermal
- Gravitational (stored)
- Pressure (stored)
- Hazardous materials

Lockout Device is a device that utilizes a positive means, such as a lock, chain, block, etc. to hold an energy-isolating device in a safe position ensuring that the energy isolating device and equipment cannot be operated.

Servicing and/or maintenance are workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the *unexpected* energization or startup of the equipment or release of hazardous energy.

Tagout Device is a prominent warning device, such as a tag, to indicate that the isolating energy device and equipment may not be operated.

Exhibit 2 – Template for Equipment Specific LO/TO Procedure

LOCKOUT/TAGOUT PROCEDURE

ARCADIS Office: ________________________________

Written By (Name/Job Title): _______________________ Date Written:___________________

Revised By (Name/Job Title): ______________________ Date Revised:__________________

INTRODUCTION

This procedure is specific to machines/equipment with an energy source and covers the safety rules and procedures to follow while installing, servicing or performing maintenance on any equipment or machines in which unexpected energization or start up, or release of stored energy could cause injury to employees. This procedure includes the following machine(s)/equipment(s):

- **[machine/equipment name or description]**
- **[machine/equipment name or description]**
- **[machine/equipment name or description]**

The circuits that energize the equipment or machines will be locked with a personally assigned lock and a disposable tag per the ARCADIS Control of Hazardous Energy (Lockout/Tagout) Standard-ARC HSFS004.

PURPOSE

This procedure establishes the minimum requirements for the lockout of energy isolating devices whenever maintenance or servicing is performed on machines or equipment. It shall insure that the machine or equipment is stopped, isolated from all potentially hazardous energy sources and locked out before any servicing or maintenance where the unexpected energization or start-up of the machine or equipment or releases of stored energy could cause injury.

Prior to initiating the LO/TO process, ARCADIS employees will complete and use the Permit to Work.

COMPLIANCE

All employees are required to comply with the limitations and restrictions imposed on them during the use of this lockout/tagout procedure. The authorized employees are required to perform the lockout/tagout in accordance with this standard. All employees, upon observing a machine or piece of equipment which is locked/tagged out to perform servicing or maintenance shall not attempt to use that machine or equipment. This standard is written in accordance with the Occupational Safety and Health Administration (OSHA) Standard 1910.147.

Any person who willfully violates this standard is subject to disciplinary action including termination.

An Authorized Person shall conduct a periodic inspection of this energy control procedure **at least annually** to ensure that the requirements of this energy control procedure and the LO/TO standard are being followed.

SEQUENCE OF LOCKOUT/TAGOUT

Prior to removing a **machine/equipment** from service for servicing or maintenance the following steps shall be taken.

1. Notify all affected employees that servicing or maintenance is required on a machine or piece of equipment and that the machine or equipment must be shut down and locked/tagged out to perform the servicing or maintenance. In addition, all other employees, whose work operations are or may be in an area where energy control procedures may be utilized, shall be instructed about the procedure and about attempts to restart or energize machines or equipment which are locked out or tagged out.

2. The authorized employees (e.g.__________________) shall refer to the manufacturer's manual to identify the type and magnitude of the energy source that the machine or equipment utilizes, shall understand the hazards of the energy source, and shall know how to control the energy.

3. If the machine or equipment is operating, shut it down through the normal procedures as specified in the manufacturer's manual.

4. Deactivate the electrical energy isolating device so that the machine or equipment is isolated from the energy source. Most equipment and machines that require this procedure have a separate circuit box that can be locked/tagged out for that specific piece of equipment or machine.

5. Lock/tag out the energy isolating device with an assigned individual lock and disposable red tag. The (e.g.__________________) will place the first lock followed by the mechanical assembly supervisor or designee.

6. Any stored or residual electrical energy must be dissipated or restrained by the (e.g.__________________) first and then the (e.g.__________________).

7. Ensure that the equipment is disconnected from its energy source. Make sure no personnel are or will be exposed; then verify the isolation of the equipment by attempting to operate through the normal controls. CAUTION: The operating controls must be returned to the neutral or "off' position after verification of isolation.

8. The machine/equipment is now locked/tagged out and servicing or maintenance can proceed.

RESTORING EQUIPMENT TO SERVICE

1. After servicing or maintenance is completed and the **machine/equipment** is ready to be returned to normal operation, the following steps shall be taken.

2. Check the **machine/equipment** and the area immediately around the **machine/equipment** to ensure that non-essential items have been removed and the **machine/equipment** and/or components are operationally intact.

3. Check the area to ensure that all non-essential personnel are in a safe place or are well clear of the area.

4. Verify that all operating controls are in the "off" position or are in neutral.

5. Remove the lock/tag out devices. The (e.g.__________________) will remove his lock first

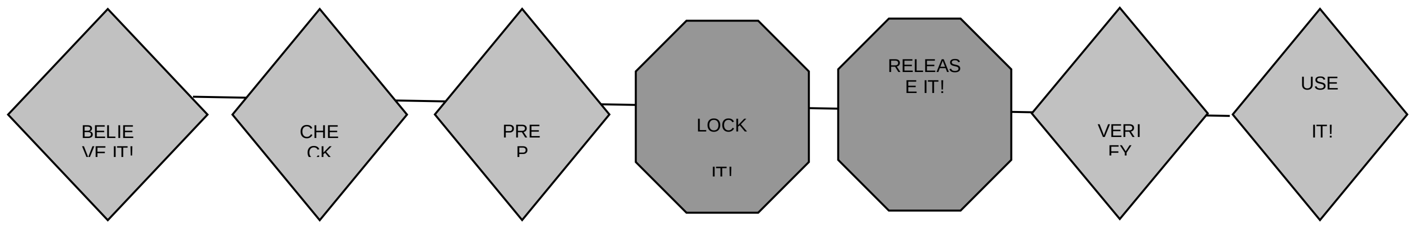
followed by the (e.g.__________________).

6. Notify affected employees that the servicing or maintenance has been completed and that the **machine/equipment** is ready for use.

7. Re-energize the **machine/equipment.**

ARCADIS
Infrastructure, environment, facilities

Lockout / Tagout Equipment-Specific Energy Control Procedure



Equipment Identification:

____

____

Hazardous Energy Source		Isolation Device			Verifying Lockout
Type and Magnitude	**Function**	**Type**	**Location**	**I.D. No.**	**Means of Verification of Lockout**
Electrical (i.e., 120, 220, 480)					
Pneumatic					
Hydraulic					
Mechanical					
Potential Energy (springs, tension, etc.)					
Gravity					
Chemical					
Other					
Other					
Area:		**Date of Last Review:**			**Authorized Person:**

Exhibit 3 – Equipment Lockout/Tagout Permit to Work

ARCADIS
Infrastructure · Water · Environment · Buildings

Equipment Lockout / Tagout Permit to Work

Equipment:		**On-Site Location:**	
Name of Authorized Person in Control of LO/TO Process:		Name of Authorized Person that Applied Equip Isolation Device:	
Name of Affected Persons receiving notification / copy of this permit:		Name of Authorized Person that verified Hazardous Energy Source is controlled:	
Start Date for LO/TO Procedure:		Estimated Start Time for LO/TO Procedure:	
Estimated Date of Completion for LO/TO		Estimated Completion Time for LO/TO Procedure:	

TRACKing the LO/TO Work Permit

THINK THROUGH THE TASK

Job Task: (Brief summary of what hazardous energy control work is proposed)

WORKFORCE INVOLVED/AFFECTED BY LO/TO WORK		Check all the apply						
Name	Company	LO/TO Authorized Person	Energized Electrical Authorized	Affected Employee	Can Work Alone	Short Service Employee	Additional Training Required	Supervision Required
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
		☐	☑	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐

Comments/Additional Details:

RECOGNIZE THE HAZARDOUS ENERGY SOURCE (check all that apply) and ASSESS THE RISK (Low-Moderate-High)

YES	NO	Type of Hazardous Energy	SELECT↓	YES	NO	Type of Hazardous Energy	SELECT↓
☐	☐	Electrical		☐	☐	Thermal	
☐	☐	Mechanical		☐	☐	Gravitational (Stored)	
☐	☐	Hydraulic		☐	☐	Pressure (Stored)	
☐	☐	Pneumatic		☐	☐	Hazardous Material	
☐	☐	Chemical		☐	☐	Other Hazard	

Rev. 12_13August2014 LO/TO Permit to Work pg. 1 of 2 Retain on site with equip log for a period of 1 year

ARCADIS Infrastructure · Water · Environment · Buildings

CONTROL THE WORKING ENVIRONMENT

	YES	NO		YES	NO
Developed an Equipment LO/TO Procedure	☐	☐	Equipment reduced to zero energy state	☐	☐
Identified all hazardous energy sources	☐	☐	Equipment isolation tested/verified	☐	☐
Notified affected employees	☐	☐	Work Task can be performed without risk to others	☐	☐
Equipment has been removed from service	☐	☐	Project/Task Manager and/or client, as required, notified when equipment is available for use again	☐	☐
Equipment has been isolated	☐	☐	LO/TO devices are returned to proper storage	☐	☐
LO/TO devices applied	☐	☐	Copy of Permit to Work placed into project folder	☐	☐

Notes/Comments (Explain Control Work Environment - No responses; Use Stop Work Authority):

LO/TO POINTS ISOLATED BY AUTHORIZED PERSON(S)

Hazard	Action Required	Lock ID / #	Authorized Person Name	Date LOTO Applied	Date LO/TO Removed

EMERGENCY CONTACT LIST

Emergency Contact:	Phone 1:	Phone 2:	Location:
Local Police:			
Local Ambulance:			
Local Fire Dept.			
Project Manager:			
Site Safety Officer:			
Client Contact:			
H&S Manager:			
Work Care	800-455-6155		

***Include any Task Specific JSA's with this permit to work.**

KEEP H&S FIRST IN ALL THINGS

I understand the nature of the work for this permit, and certify that this permit meets the requirements specified in the ARCADIS LO/TO Standard.

APPROVAL OF LO/TO WORK PERMIT- By ARCADIS LO/TO Authorized Person:

Name: ______________________________ Office Location: ______________________________

Title: ______________________________ Date: ______________________________

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Exhibit 4 – Lockout/Tagout Inspection Checklist

	Is all machinery or equipment capable of movement, required to be de-energized or disengaged and locked-out during cleaning, servicing, adjusting or setting up operations, whenever required?
	Where the power disconnecting means for equipment does not also disconnect the electrical control circuit:
	Are the appropriate electrical enclosures identified?
	Is means provided to assure the control circuit can also be disconnected and locked-out?
	Is the locking-out of control circuits in lieu of locking-out main power disconnects prohibited?
	Are all equipment control valve handles provided with a means for locking-out?
	Does the lock-out procedure require that stored energy (mechanical, hydraulic, air, etc.) be released or blocked before equipment is locked-out for repairs?
	Are appropriate employees provided with individually keyed personal safety locks?
	Are employees required to keep personal control of their key(s) while they have safety locks in use?
	Is it required that only the employee exposed to the hazard, place or remove the safety lock?
	Is it required that employees check the safety of the lock-out by attempting a startup after making sure no one is exposed?
	Are employees instructed to always push the control circuit stop button immediately after checking the safety of the lock-out?
	Is there a means provided to identify any or all employees who are working on locked-out equipment by their locks or accompanying tags?
	Are a sufficient number of accident preventive signs or tags and safety padlocks provided for any reasonably foreseeable repair emergency?
	When machine operations, configuration or size requires the operator to leave his or her control station to install tools or perform other operations, and that part of the machine could move if accidentally activated, is such element required to be separately locked or blocked out?
	In the event that equipment or lines cannot be shut down, locked-out and tagged, is a safe job procedure established and rigidly followed?

Exhibit 5 – Lockout/Tagout Exchange of Information Documentation

The LO/TO standard requires that ARCADIS exchange energy control procedures with outside employers who service and/or maintain equipment/machines owned by ARCADIS that require LO/TO. ARCADIS staff will use this form to notify all parties that they must comply with any identified restrictions and prohibitions, as outlined below. This form should be completed by an ARCADIS Authorized LO/TO staff person in conjunction with the outside employer's LO/TO Authorized representative. This exchange of information must occur before service/maintenance activities begin on ARCADIS-owned equipment. If ARCADIS staff will also be working on this equipment or in surrounding areas, then attach this documentation form to the Equipment Specific LO/TO Procedure and the LO/TO Permit to Work.

1. **Identification of Outside Employer(s):**

   Company:____

   Name:____

   Address:____

____

   Telephone #:____

2. **Identify Location of Equipment:**______________________________

   Identify Equipment/Machine to be serviced:__________________________

   Hazardous energy control procedures for the equipment/machine have been exchanged?____________
   (No response would trigger Stop Work Authority)

3. **After comparing the ARCADIS and Outside Employer LO/TO programs/procedures, identify any specific restrictions/prohibitions or procedural steps below:**

____

____

4. **Affected Persons (listed below) shall review, understand and comply with the above-identified specific restrictions/prohibitions or procedural steps.**

Printed Name	Signature

5. **Acknowledged acceptance of the provisions of this exchange of information form:**

Outside Employer Representative:______________________________ ______________
(LO/TO Qualified) (Signature) (Date)

ARCADIS Authorized LO/TO Staff:______________________________ ______________
(Signature) (Date)

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

1 Identification of the substance/mixture and of the supplier

1.1 Product identifier

Trade Name: Alconox
Synonyms:
Product number: Alconox

1.2 Application of the substance / the mixture : Cleaning material/Detergent

1.3 Details of the supplier of the Safety Data Sheet

Manufacturer	Supplier
Alconox, Inc. 30 Glenn Street White Plains, NY 10603 1-914-948-4040	Not Applicable

Emergency telephone number:
ChemTel Inc
North America: 1-800-255-3924
International: 01-813-248-0585

2 Hazards identification

2.1 Classification of the substance or mixture:

In compliance with EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments.

Hazard-determining components of labeling:
Tetrasodium Pyrophosphate
Sodium tripolyphosphate
Sodium Alkylbenzene Sulfonate

2.2 Label elements:

Skin irritation, category 2.
Eye irritation, category 2A.

Hazard pictograms:

Signal word: Warning

Hazard statements:
H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:
P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

Additional information: None.

Hazard description
Hazards Not Otherwise Classified (HNOC): None

Information concerning particular hazards for humans and environment:
The product has to be labelled due to the calculation procedure of the "General Classification guideline for preparations of the EU" in the latest valid version.

Classification system:
The classification is according to EC regulation No. 1272/2008, 29CFR1910/1200 and GHS Rev. 3 and amendments, and extended by company and literature data. The classification is in accordance with the latest editions of international substances lists, and is supplemented by information from technical literature and by information provided by the company.

3 Composition/information on ingredients

3.1 Chemical characterization : None

3.2 Description : None

3.3 Hazardous components (percentages by weight)

Identification	Chemical Name	Classification	Wt. %
CAS number: 7758-29-4	Sodium tripolyphosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	12-28
CAS number: 68081-81-2	Sodium Alkylbenzene Sulfonate	Acute Tox. 4; H303 Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	8-22
CAS number: 7722-88-5	Tetrasodium Pyrophosphate	Skin Irrit. 2 ; H315 Eye Irrit. 2; H319	2-16

3.4 Additional Information : None.

4 First aid measures

4.1 Description of first aid measures

General information: None.

After inhalation:
Maintain an unobstructed airway.
Loosen clothing as necessary and position individual in a comfortable position.

After skin contact:
Wash affected area with soap and water.
Seek medical attention if symptoms develop or persist.

After eye contact:
Rinse/flush exposed eye(s) gently using water for 15-20 minutes.
Remove contact lens(es) if able to do so during rinsing.
Seek medical attention if irritation persists or if concerned.

After swallowing:
Rinse mouth thoroughly.
Seek medical attention if irritation, discomfort, or vomiting persists.

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

4.2 Most important symptoms and effects, both acute and delayed

None

4.3 Indication of any immediate medical attention and special treatment needed:

No additional information.

5 Firefighting measures

5.1 Extinguishing media

Suitable extinguishing agents:
Use appropriate fire suppression agents for adjacent combustible materials or sources of ignition.

For safety reasons unsuitable extinguishing agents : None

5.2 Special hazards arising from the substance or mixture :
Thermal decomposition can lead to release of irritating gases and vapors.

5.3 Advice for firefighters

Protective equipment:
Wear protective eye wear, gloves and clothing.
Refer to Section 8.

5.4 Additional information :
Avoid inhaling gases, fumes, dust, mist, vapor and aerosols.
Avoid contact with skin, eyes and clothing.

6 Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures :
Ensure adequate ventilation.
Ensure air handling systems are operational.

6.2 Environmental precautions :
Should not be released into the environment.
Prevent from reaching drains, sewer or waterway.

6.3 Methods and material for containment and cleaning up :
Wear protective eye wear, gloves and clothing.

6.4 Reference to other sections : None

7 Handling and storage

7.1 Precautions for safe handling :
Avoid breathing mist or vapor.
Do not eat, drink, smoke or use personal products when handling chemical substances.

7.2 Conditions for safe storage, including any incompatibilities :
Store in a cool, well-ventilated area.

7.3 Specific end use(s):

No additional information.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

8 Exposure controls/personal protection

8.1 Control parameters :

7722-88-5, Tetrasodium Pyrophosphate, OSHA TWA 5 mg/m3.

8.2 Exposure controls

Appropriate engineering controls:

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of use or handling.

Respiratory protection:

Not needed under normal conditions.

Protection of skin:

Select glove material impermeable and resistant to the substance.

Eye protection:

Safety goggles or glasses, or appropriate eye protection.

General hygienic measures:

Wash hands before breaks and at the end of work.
Avoid contact with skin, eyes and clothing.

9 Physical and chemical properties

Appearance (physical state, color):	White and cream colored flakes - powder	**Explosion limit lower**: **Explosion limit upper**:	Not determined or not available. Not determined or not available.
Odor:	Not determined or not available.	**Vapor pressure at 20°C**:	Not determined or not available.
Odor threshold:	Not determined or not available.	**Vapor density**:	Not determined or not available.
pH-value:	9.5 (aqueous solution)	**Relative density**:	Not determined or not available.
Melting/Freezing point:	Not determined or not available.	**Solubilities**:	Not determined or not available.
Boiling point/Boiling range:	Not determined or not available.	**Partition coefficient (n-octanol/water)**:	Not determined or not available.
Flash point (closed cup):	Not determined or not available.	**Auto/Self-ignition temperature**:	Not determined or not available.
Evaporation rate:	Not determined or not available.	**Decomposition temperature**:	Not determined or not available.

Safety Data Sheet

according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

Flammability (solid, gaseous):	Not determined or not available.	**Viscosity**:	a. Kinematic: Not determined or not available. b. Dynamic: Not determined or not available.
Density at 20°C:	Not determined or not available.		

10 Stability and reactivity

10.1 Reactivity : None

10.2 Chemical stability : None

10.3 Possibility hazardous reactions : None

10.4 Conditions to avoid : None

10.5 Incompatible materials : None

10.6 Hazardous decomposition products : None

11 Toxicological information

11.1 Information on toxicological effects :

Acute Toxicity:

Oral:

: LD50 > 5000 mg/kg oral rat - Product .

Chronic Toxicity: No additional information.

Skin corrosion/irritation:

Sodium Alkylbenzene Sulfonate: Causes skin irritation. .

Serious eye damage/irritation:

Sodium Alkylbenzene Sulfonate: Causes serious eye irritation .

Tetrasodium Pyrophosphate: Rabbit - Risk of serious damage to eyes .

Respiratory or skin sensitization: No additional information.

Carcinogenicity: No additional information.

IARC (International Agency for Research on Cancer): None of the ingredients are listed.

NTP (National Toxicology Program): None of the ingredients are listed.

Germ cell mutagenicity: No additional information.

Reproductive toxicity: No additional information.

STOT-single and repeated exposure: No additional information.

Additional toxicological information: No additional information.

12 Ecological information

Safety Data Sheet
according to 1907/2006/EC (REACH), 1272/2008/EC (CLP), 29CFR1910/1200 and GHS Rev. 3

Effective date: 12.08.2015 **Revision** : 12.10.2015

Trade Name: Alconox

12.1 Toxicity:

Sodium Alkylbenzene Sulfonate: Fish, LC50 1.67 mg/l, 96 hours.
Sodium Alkylbenzene Sulfonate: Aquatic invertebrates, EC50 Daphnia 2.4 mg/l, 48 hours.
Sodium Alkylbenzene Sulfonate: Aquatic Plants, EC50 Algae 29 mg/l, 96 hours.
Tetrasodium Pyrophosphate: Fish, LC50 - other fish - 1,380 mg/l - 96 h.
Tetrasodium Pyrophosphate: Aquatic invertebrates, EC50 - Daphnia magna (Water flea) - 391 mg/l - 48 h.

12.2 Persistence and degradability: No additional information.

12.3 Bioaccumulative potential: No additional information.

12.4 Mobility in soil: No additional information.

General notes: No additional information.

12.5 Results of PBT and vPvB assessment:

PBT: No additional information.

vPvB: No additional information.

12.6 Other adverse effects: No additional information.

13 Disposal considerations

13.1 Waste treatment methods (consult local, regional and national authorities for proper disposal)

Relevant Information:

It is the responsibility of the waste generator to properly characterize all waste materials according to applicable regulatory entities. (US 40CFR262.11).

14 Transport information

14.1 UN Number: ADR, ADN, DOT, IMDG, IATA	None
14.2 UN Proper shipping name: ADR, ADN, DOT, IMDG, IATA	None

14.3 Transport hazard classes:
ADR, ADN, DOT, IMDG, IATA

Class:	None
Label:	None
LTD. QTY:	None

US DOT
Limited Quantity Exception: None

Bulk:
RQ (if applicable): None
Proper shipping Name: None
Hazard Class: None
Packing Group: None
Marine Pollutant (if applicable): No additional information.

Non Bulk:
RQ (if applicable): None
Proper shipping Name: None
Hazard Class: None
Packing Group: None
Marine Pollutant (if applicable): No additional information.

	Comments: None	**Comments:** None
14.4	**Packing group:** ADR, ADN, DOT, IMDG, IATA	None
14.5	**Environmental hazards** :	None
14.6	**Special precautions for user:**	None
	Danger code (Kemler):	None
	EMS number:	None
	Segregation groups:	None
14.7	**Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code:** Not applicable.	
14.8	**Transport/Additional information:**	
	Transport category:	None
	Tunnel restriction code:	None
	UN "Model Regulation":	None

15 Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.

North American

SARA

Section 313 (specific toxic chemical listings): None of the ingredients are listed.
Section 302 (extremely hazardous substances): None of the ingredients are listed.

CERCLA (Comprehensive Environmental Response, Clean up and Liability Act) Reportable

Spill Quantity: None of the ingredients are listed.

TSCA (Toxic Substances Control Act):

Inventory: All ingredients are listed.
Rules and Orders: Not applicable.

Proposition 65 (California):

Chemicals known to cause cancer: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for females: None of the ingredients are listed.

Chemicals known to cause reproductive toxicity for males: None of the ingredients are listed.

Chemicals known to cause developmental toxicity: None of the ingredients are listed.

Canadian

Canadian Domestic Substances List (DSL):
All ingredients are listed.

EU

REACH Article 57 (SVHC): None of the ingredients are listed.

Germany MAK: Not classified.

Asia Pacific

Australia

Australian Inventory of Chemical Substances (AICS): All ingredients are listed.

China

Inventory of Existing Chemical Substances in China (IECSC): All ingredients are listed.

Japan

Inventory of Existing and New Chemical Substances (ENCS): All ingredients are listed.

Korea

Existing Chemicals List (ECL): All ingredients are listed.

New Zealand

New Zealand Inventory of Chemicals (NZOIC): All ingredients are listed.

Philippines

Philippine Inventory of Chemicals and Chemical Substances (PICCS): All ingredients are listed.

Taiwan

Taiwan Chemical Substance Inventory (TSCI): All ingredients are listed.

16 Other information

Abbreviations and Acronyms: None

Summary of Phrases

Hazard statements:

H315 Causes skin irritation.
H319 Causes serious eye irritation.

Precautionary statements:

P264 Wash skin thoroughly after handling.
P280 Wear protective gloves/protective clothing/eye protection/face protection.
P302+P352 If on skin: Wash with soap and water.
P305+P351+P338 If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P321 Specific treatment (see supplemental first aid instructions on this label).
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P501 Dispose of contents and container as instructed in Section 13.

Manufacturer Statement:

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

NFPA: 1-0-0

Trade Name: Alconox

HMIS: 1-0-0

HORIBA

SAFETY DATA SHEET

00004US

1. Product and company identification

Product name : 100-4(Phthalate standard solution)

Product code : 3200043638, 9003001600

Relevant identified uses of the substance or mixture and uses advised against

Identified uses
Not available.

Uses advised against
Not available.

Supplier's details : HORIBA, Ltd.
2, Miyanohigashi, Kisshoin, Minami-ku, Kyoto 601-8510 JAPAN
Tel: +81-75-313-8121

Section 2. Hazards identification

OSHA/HCS status : While this material is not considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200), this SDS contains valuable information critical to the safe handling and proper use of the product. This SDS should be retained and available for employees and other users of this product.

Classification of the substance or mixture : Not classified.

Percentage of the mixture consisting of ingredient(s) of unknown toxicity: 1%

GHS label elements

Signal word : No signal word.

Hazard statements : No known significant effects or critical hazards.

Precautionary statements

Prevention : Not applicable.

Response : Not applicable.

Storage : Not applicable.

Disposal : Not applicable.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

CAS number/other identifiers

Product code : 3200043638, 9003001600

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. Get medical attention if symptoms occur.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur.

Ingestion : Wash out mouth with water. Remove victim to fresh air and keep at rest in a position comfortable for breathing. If material has been swallowed and the exposed person is conscious, give small quantities of water to drink. Do not induce vomiting unless directed to do so by medical personnel. Get medical attention if symptoms occur.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : No known significant effects or critical hazards.

Inhalation : No known significant effects or critical hazards.

Skin contact : No known significant effects or critical hazards.

Ingestion : No known significant effects or critical hazards.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : Treat symptomatically. Contact poison treatment specialist immediately if large quantities have been ingested or inhaled.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media : Use an extinguishing agent suitable for the surrounding fire.

Unsuitable extinguishing media : None known.

Specific hazards arising from the chemical : In a fire or if heated, a pressure increase will occur and the container may burst.

Hazardous thermal decomposition products : Decomposition products may include the following materials:
carbon dioxide
carbon monoxide
metal oxide/oxides

Special protective actions for fire-fighters : Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training.

Special protective equipment for fire-fighters : Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Do not touch or walk through spilled material. Put on appropriate personal protective equipment.
For emergency responders	: If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".

Environmental precautions : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill	: Stop leak if without risk. Move containers from spill area. Dilute with water and mop up if water-soluble. Alternatively, or if water-insoluble, absorb with an inert dry material and place in an appropriate waste disposal container. Dispose of via a licensed waste disposal contractor.
Large spill	: Stop leak if without risk. Move containers from spill area. Prevent entry into sewers, water courses, basements or confined areas. Wash spillages into an effluent treatment plant or proceed as follows. Contain and collect spillage with non-combustible, absorbent material e.g. sand, earth, vermiculite or diatomaceous earth and place in container for disposal according to local regulations (see Section 13). Dispose of via a licensed waste disposal contractor. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures	: Put on appropriate personal protective equipment (see Section 8).
Advice on general occupational hygiene	: Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in original container protected from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10) and food and drink. Keep container tightly closed and sealed until ready for use. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Do not store in unlabeled containers. Use appropriate containment to avoid environmental contamination.

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

None.

Appropriate engineering controls	: Good general ventilation should be sufficient to control worker exposure to airborne contaminants.
Environmental exposure controls	: Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Section 8. Exposure controls/personal protection

Hygiene measures	Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.
Eye/face protection	Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.
Skin protection	
Hand protection	Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.
Body protection	Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Other skin protection	Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
Respiratory protection	Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance	
Physical state	Liquid.
Color	Colorless.
Odor	Odorless.
Odor threshold	Not available.
pH	4.01
Melting point	0°C (32°F)
Boiling point	100°C (212°F)
Flash point	[Product does not sustain combustion.]
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Lower and upper explosive (flammable) limits	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	Not available.
Solubility	Not available.
Partition coefficient: n-octanol/water	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

Section 10. Stability and reactivity

Reactivity : No specific test data related to reactivity available for this product or its ingredients.

Chemical stability : The product is stable.

Possibility of hazardous reactions : Hazardous reactions or instability may occur under certain conditions of storage or use.

Conditions to avoid : No specific data.

Incompatible materials : No specific data.

Hazardous decomposition products : Under normal conditions of storage and use, hazardous decomposition products should not be produced.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Not available.

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : No known significant effects or critical hazards.
Inhalation : No known significant effects or critical hazards.
Skin contact : No known significant effects or critical hazards.
Ingestion : No known significant effects or critical hazards.

Symptoms related to the physical, chemical and toxicological characteristics

Section 11. Toxicological information

Eye contact : No specific data.
Inhalation : No specific data.
Skin contact : No specific data.
Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Potential chronic health effects

Not available.

General : No known significant effects or critical hazards.
Carcinogenicity : No known significant effects or critical hazards.
Mutagenicity : No known significant effects or critical hazards.
Teratogenicity : No known significant effects or critical hazards.
Developmental effects : No known significant effects or critical hazards.
Fertility effects : No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Not available.

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 14. Transport information

	DOT Classification	TDG Classification	Mexico Classification	ADR/RID	IMDG	IATA
UN number	No.	No.	No.	No.	No.	No.
UN proper shipping name	No.	No.	No.	No.	No.	No.
Transport hazard class(es)	No.	No.	No.	No.	No.	No.
Packing group	-	-	-	-	-	-
Environmental hazards	No.	No.	No.	No.	No.	No.
Additional information	-	-	-	-	-	-

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): All components are listed or exempted.

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

Section 15. Regulatory information

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Not applicable.

Composition/information on ingredients

No products were found.

State regulations

Massachusetts : None of the components are listed.

New York : None of the components are listed.

New Jersey : None of the components are listed.

Pennsylvania : None of the components are listed.

International regulations

Chemical Weapon Convention List Schedules I, II & III Chemicals

Not listed.

Montreal Protocol (Annexes A, B, C, E)

Not listed.

Stockholm Convention on Persistent Organic Pollutants

Not listed.

Rotterdam Convention on Prior Inform Consent (PIC)

Not listed.

UNECE Aarhus Protocol on POPs and Heavy Metals

Not listed.

Section 16. Other information

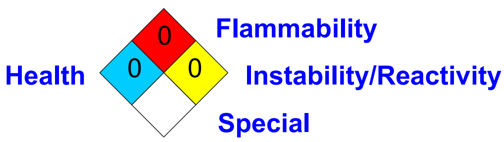
Hazardous Material Information System (U.S.A.)

Health	0
Flammability	0
Physical hazards	0

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



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Section 16. Other information

History

Date of issue/Date of revision : 2015/05/29.

Date of previous issue : No previous validation.

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

HORIBA

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/02/2013 *Reviewed on 10/02/2013*

1 Identification

· ***Product identifier***

· ***Trade name:*** ***pH7 Standard Solution 100-7***

· ***Article Code:*** *3200043637 (9003001700)*
· ***MSDS No:*** *3*
· ***Relevant identified uses of the substance or mixture and uses advised against***
No further relevant information available.
· ***Application of the substance / the preparation*** *Calibration for pH electrode*

· ***Details of the supplier of the safety data sheet***
· ***Manufacturer/Supplier:***
HORIBA, Ltd.
2 Miyanohigashi, Kisshoin,
Minami-ku Kyoto, Japan, KYOTO
601-8510 JAPAN

· ***Information department:*** *Liquid & Water Quality R&D Dept*
· ***Emergency telephone number:***
During normal opening times: +81 75 313-8121
USA Contact : Chemtrec (800) 424-9300

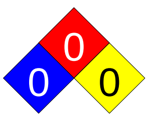
2 Hazard(s) identification

· ***Classification of the substance or mixture***
The product is not classified according to the Globally Harmonized System (GHS).

· ***Classification according to Directive 67/548/EEC or Directive 1999/45/EC*** *Not applicable.*
· ***Information concerning particular hazards for human and environment:***
The product does not have to be labeled due to the calculation procedure of international guidelines.
· ***Classification system:***
The classification was made according to the latest editions of international substances lists, and expanded upon from company and literature data.

· ***Label elements***

· ***Labelling according to EU guidelines:***
Observe the general safety regulations when handling chemicals.
The product is not subject to identification regulations according to directives on hazardous materials.
· ***Classification system:***
· ***NFPA ratings (scale 0 - 4)***



Health = 0
Fire = 0
Reactivity = 0

· ***HMIS-ratings (scale 0 - 4)***

HEALTH	0
FIRE	0
REACTIVITY	0

Health = 0
Fire = 0
Reactivity = 0

· ***Other hazards***
· ***Results of PBT and vPvB assessment***
· ***PBT:*** *Not applicable.*

(Contd. on page 2)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/02/2013 *Reviewed on 10/02/2013*

Trade name: pH7 Standard Solution 100-7

(Contd. of page 1)

· **vPvB:** Not applicable.

3 Composition/information on ingredients

· **Chemical characterization: Mixtures**
· **Description:** Mixture of the substances listed below with nonhazardous additions.

· **Components:**		
7778-77-0	potassium dihydrogenorthophosphate	Nearly 0.34%
7558-79-4	disodium hydrogenorthophosphate	Nearly 0.36%

4 First-aid measures

· **Description of first aid measures**
· **General information:** No special measures required.
· **After inhalation:**
Remove the victim to fresh air, and make him blow his nose and gargle.Refer for medical attenation.
· **After skin contact:** Wash the affect areas under running water.
· **After eye contact:** Rinse opened eye for several minutes under running water. Then consult a doctor.
· **After swallowing:**
Rinse mouth with water. Give the person one or two glasses of water, and let vomit. Refer for medical attenation.
· **Information for doctor:**
· **Most important symptoms and effects, both acute and delayed** No further relevant information available.
· **Indication of any immediate medical attention and special treatment needed**
No further relevant information available.

5 Fire-fighting measures

· **Extinguishing media**
· **Suitable extinguishing agents:** This product is noncombustible.
· **Special hazards arising from the substance or mixture** No further relevant information available.
· **Advice for firefighters**
· **Protective equipment:** No special measures required.

6 Accidental release measures

· **Personal precautions, protective equipment and emergency procedures** Not required.
· **Environmental precautions:** No special measures required.
· **Methods and material for containment and cleaning up:**
Sweep up and place in a vessel. Flush residual area with water.
· **Reference to other sections** No dangerous substances are released.

(Contd. on page 3)

HORIBA

Safety Data Sheet
acc. to OSHA HCS

(Contd. of page 2)

7 Handling and storage

· **Handling:**
· **Precautions for safe handling**
Keep away from heat and direct sunlight.
Keep receptacles tightly sealed.
· **Information about protection against explosions and fires:** No special measures required.

· **Conditions for safe storage, including any incompatibilities**
· **Storage:**
· **Requirements to be met by storerooms and receptacles:** Store in a cool location.
· **Information about storage in one common storage facility:** Not required.
· **Further information about storage conditions:**
Keep receptacle tightly sealed.
Protect from heat and direct sunlight.
· **Specific end use(s)** No further relevant information available.

8 Exposure controls/personal protection

· **Additional information about design of technical systems:**
Provide good ventilation. Make available washbasin and eye wash near the work area.

· **Control parameters**
· **Components with limit values that require monitoring at the workplace:**
The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.
· **Additional information:** The lists that were valid during the creation were used as basis.

· **Exposure controls**
· **Personal protective equipment:**
· **General protective and hygienic measures:**
The usual precautionary measures for handling chemicals should be followed.
· **Breathing equipment:** Suitable respiratory protective device recommended.
· **Protection of hands:**
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation
· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.
· **Eye protection:** Goggles recommended during refilling.

(Contd. on page 4)

Safety Data Sheet
acc. to OSHA HCS

Printing date 10/02/2013 Reviewed on 10/02/2013

Trade name: pH7 Standard Solution 100-7

(Contd. of page 3)

· **Body protection:** Use protective suit.

9 Physical and chemical properties

· **Information on basic physical and chemical properties**
· **General Information**
· **Appearance:**

Form:	Liquid
Color:	Colorless
· **Odor:**	Odorless
· **pH-value at 25 °C (77 °F):**	6.86
· **Change in condition**	
Melting point/Melting range:	0 °C (32 °F)
Boiling point/Boiling range:	100 °C (212 °F)
· **Flash point:**	Not applicable.
· **Auto igniting:**	Product is not selfigniting.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Density at 20 °C (68 °F):**	1 g/cm³ (8.345 lbs/gal)
· **Solubility in / Miscibility with**	
Water:	Fully miscible.
· **Other information**	No further relevant information available.

10 Stability and reactivity

· **Reactivity**
· **Chemical stability**
· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Possibility of hazardous reactions** No dangerous reactions known.
· **Conditions to avoid** No further relevant information available.
· **Incompatible materials:** No further relevant information available.
· **Hazardous decomposition products:** No dangerous decomposition products known.

11 Toxicological information

· **Information on toxicological effects**
· **Acute toxicity:**

· **LD/LC50 values that are relevant for classification:**		
7778-77-0 potassium dihydrogenorthophosphate		
Oral	LD50	2000 mg/kg (mouse)
7558-79-4 disodium hydrogenorthophosphate		
Oral	LD50	17000 mg/kg (rat)

· **Primary irritant effect:**
· **on the skin:** No irritant effect.

(Contd. on page 5)

Safety Data Sheet
acc. to OSHA HCS

(Contd. of page 4)

· **on the eye:** No irritating effect.
· **Sensitization:** No sensitizing effects known.
· **Additional toxicological information:**
The product is not subject to classification according to internally approved calculation methods for preparations:
When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us.

· **Carcinogenic categories**

· **IARC (International Agency for Research on Cancer)**
None of the ingredients is listed.

· **NTP (National Toxicology Program)**
None of the ingredients is listed.

12 Ecological information

· **Toxicity**
· **Aquatic toxicity:** No further relevant information available.
· **Persistence and degradability** No further relevant information available.
· **Behavior in environmental systems:**
· **Bioaccumulative potential** No further relevant information available.
· **Mobility in soil** No further relevant information available.
· **Additional ecological information:**
· **General notes:** Generally not hazardous for water
· **Results of PBT and vPvB assessment**
· **PBT:** Not applicable.
· **vPvB:** Not applicable.
· **Other adverse effects** No further relevant information available.

13 Disposal considerations

· **Waste treatment methods**
· **Recommendation:** Must be specially treated adhering to official regulations.

· **Uncleaned packagings:**
· **Recommendation:** Disposal must be made according to official regulations.

14 Transport information

· **UN-Number**	
· **DOT, ADR, ADN, IMDG, IATA**	Void
· **UN proper shipping name**	
· **DOT, ADR, ADN, IMDG, IATA**	Void
· **Transport hazard class(es)**	
· **DOT, ADR, ADN, IMDG, IATA**	
· **Class**	Void

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Safety Data Sheet
acc. to OSHA HCS

Printing date 10/02/2013 Reviewed on 10/02/2013

Trade name: pH7 Standard Solution 100-7

(Contd. of page 5)

· **Packing group** · **DOT, ADR, IMDG, IATA**	*Void*
· **Environmental hazards:** · **Marine pollutant:**	*No*
· **Special precautions for user**	*Not applicable.*
· **Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code**	*Not applicable.*
· **Transport/Additional information:**	*Cheak the containers are thghthly sealed. Handle carefully so that they will not be damaged by falling or dropping. Keep away from water.*
· **UN "Model Regulation":**	-

15 Regulatory information

· **Safety, health and environmental regulations/legislation specific for the substance or mixture**
· **Sara**

· **Section 355 (extremely hazardous substances):**
None of the ingredients is listed.

· **Section 313 (Specific toxic chemical listings):**
None of the ingredients is listed.

· **TSCA (Toxic Substances Control Act):**
All ingredients are listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for females:**
None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for males:**
None of the ingredients is listed.

· **Chemicals known to cause developmental toxicity:**
None of the ingredients is listed.

· **Carcinogenic categories**

· **EPA (Environmental Protection Agency)**
None of the ingredients is listed.

· **TLV (Threshold Limit Value established by ACGIH)**
None of the ingredients is listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**
None of the ingredients is listed.

(Contd. on page 7)

Safety Data Sheet
acc. to OSHA HCS

(Contd. of page 6)

· **OSHA-Ca (Occupational Safety & Health Administration)**
None of the ingredients is listed.

· **Product related hazard informations:**
Observe the general safety regulations when handling chemicals.
The product is not subject to identification regulations according to directives on hazardous materials.

· **National regulations:**

· **Water hazard class:** Generally not hazardous for water.
· **Chemical safety assessment:** A Chemical Safety Assessment has not been carried out.

16 Other information

HORIBA, Ltd. provides the information contained herein in good faith but makes no representation as to its comprehensives or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose.
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· **Department issuing MSDS:** Water and Temperature Measurement R&D Dept.
· **Abbreviations and acronyms:**
RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)
IATA-DGR: Dangerous Goods Regulations by the "International Air Transport Association" (IATA)
ICAO: International Civil Aviation Organization
ICAO-TI: Technical Instructions by the "International Civil Aviation Organization" (ICAO)
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
ELINCS: European List of Notified Chemical Substances
CAS: Chemical Abstracts Service (division of the American Chemical Society)
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
· **Sources**
HANDBOOK OF ENVIROMENTAL DATA ON ORGANIC CHEMICALS (Karel Verschueren VAN NOSTRAND REINHOLD)
The Sigma-Aldrich Library Regulatory and Safety Data
Safety data sheet guidebook edited by the information center of the Society for Japan Chemical Industry
· *** Data compared to the previous version altered.**
Date May. 11, 1999
Revised Dec. 13, 2009
Revised Oct. 2, 2013

Material Safety Data Sheet
acc. to ISO/DIS 11014

Printing date 02/26/2010 | *Reviewed on 03/26/2009*

1 Identification of substance

· **Product details**

· **Trade name: 100-10 (Sodium Carbonate std. sol.)**

· **Article Code:** 3200043635 (9003001900)
· **MSDS No:** 26
· **Application of the substance / the preparation** pH Standard solution

· **Manufacturer/Supplier:**
HORIBA, Ltd.
2 Miyanohigashi, Kisshoin,
Minami-ku Kyoto, Japan, KYOTO
601-8510 JAPAN

· **Information department:** Water and Temperature Measurement R&D Dept.
· **Emergency information:**
During normal opening times: +81 75 313-8121
USA Contact : Chemtrec (800) 424-9300

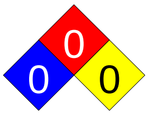
2 Composition/Data on components

· **Chemical characterization**
· **Description:** Mixture of the substances listed below with nonhazardous additions.

· **Components:**			
144-55-8	sodium hydrogencarbonate		0.21%
497-19-8	sodium carbonate	Warning: 3.3/2A	0.27%

3 Hazards identification

· **Hazard description:** Not applicable.
· **Information pertaining to particular dangers for man and environment:**
The product does not have to be labelled due to the calculation procedure of international guidelines.
· **Classification system:**
The classification was made according to the latest editions of international substances lists, and expanded upon from company and literature data.
· **NFPA ratings (scale 0 - 4)**



Health = 0
Fire = 0
Reactivity = 0

· **HMIS-ratings (scale 0 - 4)**

HEALTH	0
FIRE	0
REACTIVITY	0

Health = 0
Fire = 0
Reactivity = 0

· **GHS label elements** Void

4 First aid measures

· **General information:** No special measures required.

(Contd. on page 2)

Material Safety Data Sheet
acc. to ISO/DIS 11014

Printing date 02/26/2010 *Reviewed on 03/26/2009*

Trade name: 100-10 (Sodium Carbonate std. sol.)

(Contd. of page 1)

· ***After inhalation:*** *Supply fresh air; consult doctor in case of complaints.*
· ***After skin contact:*** *Generally the product does not irritate the skin.*
· ***After eye contact:*** *Rinse opened eye for several minutes under running water.*
· ***After swallowing:*** *If symptoms persist consult doctor.*

5 Fire fighting measures

· ***Suitable extinguishing agents:***
CO_2, extinguishing powder or water spray. Fight larger fires with water spray or alcohol resistant foam.
· ***Protective equipment:*** *No special measures required.*

6 Accidental release measures

· ***Person-related safety precautions:*** *Not required.*
· ***Measures for environmental protection:*** *Dilute with plenty of water.*
· ***Measures for cleaning/collecting:***
Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
· ***Additional information:*** *No dangerous substances are released.*

7 Handling and storage

· ***Handling:***
· ***Information for safe handling:*** *No special measures required.*
· ***Information about protection against explosions and fires:*** *No special measures required.*

· ***Storage:***
· ***Requirements to be met by storerooms and receptacles:*** *No special requirements.*
· ***Information about storage in one common storage facility:*** *Not required.*
· ***Further information about storage conditions:*** *None.*
· ***Class according to regulation on flammable liquids:*** *Void*

8 Exposure controls and personal protection

· ***Additional information about design of technical systems:*** *No further data; see item 7.*

· ***Components with limit values that require monitoring at the workplace:***
The product does not contain any relevant quantities of materials with critical values that have to be monitored at the workplace.
· ***Additional information:*** *The lists that were valid during the creation were used as basis.*

· ***Personal protective equipment:***
· ***General protective and hygienic measures:***
The usual precautionary measures for handling chemicals should be followed.
· ***Breathing equipment:*** *Not required.*
· ***Protection of hands:***
The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.

(Contd. on page 3)

Material Safety Data Sheet
acc. to ISO/DIS 11014

Printing date 02/26/2010 Reviewed on 03/26/2009

Trade name: 100-10 (Sodium Carbonate std. sol.)

(Contd. of page 2)

Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

· **Material of gloves**
The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer. As the product is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.

· **Penetration time of glove material**
The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

· **Eye protection:** Goggles recommended during refilling.

9 Physical and chemical properties

· **General Information**	
Form:	Fluid
Color:	According to product specification
Odor:	Characteristic
· **Change in condition**	
Melting point/Melting range:	Undetermined.
Boiling point/Boiling range:	100°C (212°F)
· **Flash point:**	Not applicable.
· **Auto igniting:**	Product is not selfigniting.
· **Danger of explosion:**	Product does not present an explosion hazard.
· **Density at 20°C (68°F):**	1 g/cm³
· **Solubility in / Miscibility with**	
Water:	Fully miscible.

10 Stability and reactivity

· **Thermal decomposition / conditions to be avoided:** No decomposition if used according to specifications.
· **Dangerous reactions** No dangerous reactions known.
· **Dangerous products of decomposition:** No dangerous decomposition products known.

11 Toxicological information

· **Acute toxicity:**

· **LD/LC50 values that are relevant for classification:**		
144-55-8 sodium hydrogencarbonate		
Oral	LD50	4220 mg/kg (rat)
497-19-8 sodium carbonate		
Oral	LD50	4090 mg/kg (rat)

(Contd. on page 4)

Material Safety Data Sheet
acc. to ISO/DIS 11014

Printing date 02/26/2010 *Reviewed on 03/26/2009*

Trade name: ***100-10 (Sodium Carbonate std. sol.)***

(Contd. of page 3)

· ***Primary irritant effect:***
· ***on the skin:*** *No irritant effect.*
· ***on the eye:*** *No irritating effect.*
· ***Sensitization:*** *No sensitizing effects known.*
· ***Additional toxicological information:***
The product is not subject to classification according to internally approved calculation methods for preparations:
When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us.

12 Ecological information

· ***General notes:*** *Generally not hazardous for water*

13 Disposal considerations

· ***Product:***
· ***Recommendation:*** *Must be specially treated adhering to official regulations.*

· ***Uncleaned packagings:***
· ***Recommendation:*** *Disposal must be made according to official regulations.*
· ***Recommended cleansing agent:*** *Water, if necessary with cleansing agents.*

14 Transport information

· ***DOT regulations:***
· ***Hazard class:*** -

· ***Land transport ADR/RID (cross-border):***
· ***ADR/RID class:*** -

· ***Maritime transport IMDG:***
· ***IMDG Class:*** -
· ***Marine pollutant:*** *No*

· ***Air transport ICAO-TI and IATA-DGR:***
· ***ICAO/IATA Class:*** -

· ***UN "Model Regulation":*** -

15 Regulations

· ***Sara***
· ***Section 355 (extremely hazardous substances):***
None of the ingredients is listed.
· ***Section 313 (Specific toxic chemical listings):***
None of the ingredients is listed.

(Contd. on page 5)

(Contd. of page 4)

· **TSCA (Toxic Substances Control Act):**

All ingredients are listed.

· **Proposition 65**

· **Chemicals known to cause cancer:**

None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for females:**

None of the ingredients is listed.

· **Chemicals known to cause reproductive toxicity for males:**

None of the ingredients is listed.

· **Chemicals known to cause developmental toxicity:**

None of the ingredients is listed.

· **Carcinogenicity categories**

· **EPA (Environmental Protection Agency)**

None of the ingredients is listed.

· **IARC (International Agency for Research on Cancer)**

None of the ingredients is listed.

· **NTP (National Toxicology Program)**

None of the ingredients is listed.

· **TLV (Threshold Limit Value established by ACGIH)**

None of the ingredients is listed.

· **NIOSH-Ca (National Institute for Occupational Safety and Health)**

None of the ingredients is listed.

· **OSHA-Ca (Occupational Safety & Health Administration)**

None of the ingredients is listed.

· **Product related hazard informations:**
Observe the general safety regulations when handling chemicals.
The product is not subject to identification regulations according to directives on hazardous materials.

· **National regulations:**

· **Classification according to VbF:** Void

· **Water hazard class:** Generally not hazardous for water.

16 Other information

HORIBA, Ltd. provides the information contained herein in good faith but makes no representation as to its comprehensives or accuracy. This document is intended only as a guide to the appropriate precautionary handling of the material by a properly trained person using this product. Individuals receiving the information must exercise their independent judgment in determining its appropriateness for a particular purpose.
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(Contd. on page 6)

Material Safety Data Sheet
acc. to ISO/DIS 11014

Printing date 02/26/2010 *Reviewed on 03/26/2009*

Trade name: 100-10 (Sodium Carbonate std. sol.)

(Contd. of page 5)

INFORMATION.

· **Department issuing MSDS:** Quality Assurance Center
· **Abbreviations and acronyms:**
ADR: Accord européen sur le transport des marchandises dangereuses par Route (European Agreement concerning the International Carriage of Dangerous Goods by Road)
RID: Règlement international concernant le transport des marchandises dangereuses par chemin de fer (Regulations Concerning the International Transport of Dangerous Goods by Rail)
IMDG: International Maritime Code for Dangerous Goods
DOT: US Department of Transportation
IATA: International Air Transport Association
IATA-DGR: Dangerous Goods Regulations by the "International Air Transport Association" (IATA)
ICAO: International Civil Aviation Organization
ICAO-TI: Technical Instructions by the "International Civil Aviation Organization" (ICAO)
GHS: Globally Harmonized System of Classification and Labelling of Chemicals
ACGIH: American Conference of Governmental Industrial Hygienists
EINECS: European Inventory of Existing Commercial Chemical Substances
NFPA: National Fire Protection Association (USA)
HMIS: Hazardous Materials Identification System (USA)
VbF: Verordnung über brennbare Flüssigkeiten, Österreich (Ordinance on the storage of combustible liquids, Austria)
LC50: Lethal concentration, 50 percent
LD50: Lethal dose, 50 percent
· *** Data compared to the previous version altered.**
Data: May. 11, 1999
Reviced: Dec. 17, 2009

SAFETY DATA SHEET

Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen

Section 1. Identification

GHS product identifier : Nonflammable Gas Mixture: Isobutylene / Nitrogen / Oxygen

Other means of identification : Not available.

Product use : Synthetic/Analytical chemistry.

SDS # : 002103

Supplier's details : Airgas USA, LLC and its affiliates
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253

24-hour telephone : 1-866-734-3438

Section 2. Hazards identification

OSHA/HCS status : This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).

Classification of the substance or mixture : GASES UNDER PRESSURE - Compressed gas

GHS label elements

Hazard pictograms :

Signal word : Warning

Hazard statements : Contains gas under pressure; may explode if heated.

Precautionary statements

General : Read and follow all Safety Data Sheets (SDS'S) before use. Read label before use. Keep out of reach of children. If medical advice is needed, have product container or label at hand. Close valve after each use and when empty. Use equipment rated for cylinder pressure. Do not open valve until connected to equipment prepared for use. Use a back flow preventative device in the piping. Use only equipment of compatible materials of construction.

Prevention : Not applicable.

Response : Not applicable.

Storage : Protect from sunlight when ambient temperature exceeds 52°C/125°F. Store in a well-ventilated place.

Disposal : Not applicable.

Hazards not otherwise classified : None known.

Section 3. Composition/information on ingredients

Substance/mixture : Mixture

Other means of identification : Not available.

CAS number/other identifiers

CAS number : Not applicable.

Product code : 002103

Section 3. Composition/information on ingredients

Ingredient name	%	CAS number
Nitrogen	75 - 80.5	7727-37-9
oxygen	19.5 - 23.5	7782-44-7
Isobutylene	0.0001 - 1.13	115-11-7

Any concentration shown as a range is to protect confidentiality or is due to batch variation.

There are no additional ingredients present which, within the current knowledge of the supplier and in the concentrations applicable, are classified as hazardous to health or the environment and hence require reporting in this section.

Occupational exposure limits, if available, are listed in Section 8.

Section 4. First aid measures

Description of necessary first aid measures

Eye contact : Immediately flush eyes with plenty of water, occasionally lifting the upper and lower eyelids. Check for and remove any contact lenses. Continue to rinse for at least 10 minutes. Get medical attention if irritation occurs.

Inhalation : Remove victim to fresh air and keep at rest in a position comfortable for breathing. If not breathing, if breathing is irregular or if respiratory arrest occurs, provide artificial respiration or oxygen by trained personnel. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation. Get medical attention if adverse health effects persist or are severe. If unconscious, place in recovery position and get medical attention immediately. Maintain an open airway. Loosen tight clothing such as a collar, tie, belt or waistband. In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Skin contact : Flush contaminated skin with plenty of water. Remove contaminated clothing and shoes. Get medical attention if symptoms occur. Wash clothing before reuse. Clean shoes thoroughly before reuse.

Ingestion : As this product is a gas, refer to the inhalation section.

Most important symptoms/effects, acute and delayed

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.

Inhalation : No known significant effects or critical hazards.

Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.

Frostbite : Try to warm up the frozen tissues and seek medical attention.

Ingestion : As this product is a gas, refer to the inhalation section.

Over-exposure signs/symptoms

Eye contact : No specific data.

Inhalation : No specific data.

Skin contact : No specific data.

Ingestion : No specific data.

Indication of immediate medical attention and special treatment needed, if necessary

Notes to physician : In case of inhalation of decomposition products in a fire, symptoms may be delayed. The exposed person may need to be kept under medical surveillance for 48 hours.

Specific treatments : No specific treatment.

Protection of first-aiders : No action shall be taken involving any personal risk or without suitable training. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

See toxicological information (Section 11)

Section 5. Fire-fighting measures

Extinguishing media

Suitable extinguishing media	: Use an extinguishing agent suitable for the surrounding fire.
Unsuitable extinguishing media	: None known.
Specific hazards arising from the chemical	: Contains gas under pressure. In a fire or if heated, a pressure increase will occur and the container may burst or explode.
Hazardous thermal decomposition products	: Decomposition products may include the following materials: carbon dioxide carbon monoxide nitrogen oxides
Special protective actions for fire-fighters	: Promptly isolate the scene by removing all persons from the vicinity of the incident if there is a fire. No action shall be taken involving any personal risk or without suitable training. Contact supplier immediately for specialist advice. Move containers from fire area if this can be done without risk. Use water spray to keep fire-exposed containers cool.
Special protective equipment for fire-fighters	: Fire-fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full face-piece operated in positive pressure mode.

Section 6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

For non-emergency personnel	: No action shall be taken involving any personal risk or without suitable training. Evacuate surrounding areas. Keep unnecessary and unprotected personnel from entering. Avoid breathing gas. Provide adequate ventilation. Wear appropriate respirator when ventilation is inadequate. Put on appropriate personal protective equipment.
For emergency responders	: If specialised clothing is required to deal with the spillage, take note of any information in Section 8 on suitable and unsuitable materials. See also the information in "For non-emergency personnel".
Environmental precautions	: Ensure emergency procedures to deal with accidental gas releases are in place to avoid contamination of the environment. Inform the relevant authorities if the product has caused environmental pollution (sewers, waterways, soil or air).

Methods and materials for containment and cleaning up

Small spill	: Immediately contact emergency personnel. Stop leak if without risk.
Large spill	: Immediately contact emergency personnel. Stop leak if without risk. Note: see Section 1 for emergency contact information and Section 13 for waste disposal.

Section 7. Handling and storage

Precautions for safe handling

Protective measures	: Put on appropriate personal protective equipment (see Section 8). Contains gas under pressure. Avoid contact with eyes, skin and clothing. Avoid breathing gas. Empty containers retain product residue and can be hazardous. Do not puncture or incinerate container. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.
Advice on general occupational hygiene	: Eating, drinking and smoking should be prohibited in areas where this material is handled, stored and processed. Workers should wash hands and face before eating, drinking and smoking. Remove contaminated clothing and protective equipment before entering eating areas. See also Section 8 for additional information on hygiene measures.

Section 7. Handling and storage

Conditions for safe storage, including any incompatibilities : Store in accordance with local regulations. Store in a segregated and approved area. Store away from direct sunlight in a dry, cool and well-ventilated area, away from incompatible materials (see Section 10). Keep container tightly closed and sealed until ready for use. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure controls/personal protection

Control parameters

Occupational exposure limits

Nitrogen	Oxygen Depletion [Asphyxiant]
oxygen	None.
Isobutylene	**ACGIH TLV (United States, 3/2015).** TWA: 250 ppm 8 hours.

Appropriate engineering controls : Good general ventilation should be sufficient to control worker exposure to airborne contaminants.

Environmental exposure controls : Emissions from ventilation or work process equipment should be checked to ensure they comply with the requirements of environmental protection legislation. In some cases, fume scrubbers, filters or engineering modifications to the process equipment will be necessary to reduce emissions to acceptable levels.

Individual protection measures

Hygiene measures : Wash hands, forearms and face thoroughly after handling chemical products, before eating, smoking and using the lavatory and at the end of the working period. Appropriate techniques should be used to remove potentially contaminated clothing. Wash contaminated clothing before reusing. Ensure that eyewash stations and safety showers are close to the workstation location.

Eye/face protection : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists, gases or dusts. If contact is possible, the following protection should be worn, unless the assessment indicates a higher degree of protection: safety glasses with side-shields.

Skin protection

Hand protection : Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary. Considering the parameters specified by the glove manufacturer, check during use that the gloves are still retaining their protective properties. It should be noted that the time to breakthrough for any glove material may be different for different glove manufacturers. In the case of mixtures, consisting of several substances, the protection time of the gloves cannot be accurately estimated.

Body protection : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Other skin protection : Appropriate footwear and any additional skin protection measures should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.

Respiratory protection : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.

Section 9. Physical and chemical properties

Appearance

Physical state	: Gas.
Color	: Not available.
Melting/freezing point	: -140.7°C (-221.3°F) This is based on data for the following ingredient: isobutylene. Weighted average: -211.14°C (-348.1°F)
Critical temperature	: Lowest known value: -146.95°C (-232.5°F) (nitrogen).
Odor	: Not available.
Odor threshold	: Not available.
pH	: Not available.
Flash point	: Not available.
Burning time	: Not applicable.
Burning rate	: Not applicable.
Evaporation rate	: Not available.
Flammability (solid, gas)	: Not available.
Lower and upper explosive (flammable) limits	: Not available.
Vapor pressure	: Not available.
Vapor density	: Highest known value: 1.94 (Air = 1) (isobutylene). Weighted average: 1.01 (Air = 1)
Gas Density (lb/ft^3)	: Weighted average: 0.07
Relative density	: Not applicable.
Solubility	: Not available.
Solubility in water	: Not available.
Partition coefficient: n-octanol/water	: Not available.
Auto-ignition temperature	: Not available.
Decomposition temperature	: Not available.
SADT	: Not available.
Viscosity	: Not applicable.

Section 10. Stability and reactivity

Reactivity	: No specific test data related to reactivity available for this product or its ingredients.
Chemical stability	: The product is stable.
Possibility of hazardous reactions	: Under normal conditions of storage and use, hazardous reactions will not occur.
Conditions to avoid	: No specific data.
Incompatible materials	: No specific data.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Hazardous polymerization	: Under normal conditions of storage and use, hazardous polymerization will not occur.

Section 11. Toxicological information

Information on toxicological effects

Acute toxicity

Product/ingredient name	Result	Species	Dose	Exposure
Isobutylene	LC50 Inhalation Vapor	Rat	550000 mg/m³	4 hours

Irritation/Corrosion

Not available.

Sensitization

Not available.

Mutagenicity

Not available.

Carcinogenicity

Not available.

Reproductive toxicity

Not available.

Teratogenicity

Not available.

Specific target organ toxicity (single exposure)

Not available.

Specific target organ toxicity (repeated exposure)

Not available.

Aspiration hazard

Not available.

Information on the likely routes of exposure : Not available.

Potential acute health effects

Eye contact : Contact with rapidly expanding gas may cause burns or frostbite.
Inhalation : No known significant effects or critical hazards.
Skin contact : Contact with rapidly expanding gas may cause burns or frostbite.
Ingestion : As this product is a gas, refer to the inhalation section.

Symptoms related to the physical, chemical and toxicological characteristics

Eye contact : No specific data.
Inhalation : No specific data.
Skin contact : No specific data.
Ingestion : No specific data.

Delayed and immediate effects and also chronic effects from short and long term exposure

Short term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Long term exposure

Potential immediate effects : Not available.
Potential delayed effects : Not available.

Section 11. Toxicological information

Potential chronic health effects

Not available.

General	:	No known significant effects or critical hazards.
Carcinogenicity	:	No known significant effects or critical hazards.
Mutagenicity	:	No known significant effects or critical hazards.
Teratogenicity	:	No known significant effects or critical hazards.
Developmental effects	:	No known significant effects or critical hazards.
Fertility effects	:	No known significant effects or critical hazards.

Numerical measures of toxicity

Acute toxicity estimates

Not available.

Section 12. Ecological information

Toxicity

Not available.

Persistence and degradability

Not available.

Bioaccumulative potential

Product/ingredient name	$LogP_{ow}$	BCF	Potential
Nitrogen	0.67	-	low
oxygen	0.65	-	low
Isobutylene	2.34	-	low

Mobility in soil

Soil/water partition coefficient (K_{OC}) : Not available.

Other adverse effects : No known significant effects or critical hazards.

Section 13. Disposal considerations

Disposal methods : The generation of waste should be avoided or minimized wherever possible. Disposal of this product, solutions and any by-products should at all times comply with the requirements of environmental protection and waste disposal legislation and any regional local authority requirements. Dispose of surplus and non-recyclable products via a licensed waste disposal contractor. Waste should not be disposed of untreated to the sewer unless fully compliant with the requirements of all authorities with jurisdiction. Empty Airgas-owned pressure vessels should be returned to Airgas. Waste packaging should be recycled. Incineration or landfill should only be considered when recycling is not feasible. This material and its container must be disposed of in a safe way. Empty containers or liners may retain some product residues. Do not puncture or incinerate container.

Section 14. Transport information

	DOT	TDG	Mexico	IMDG	IATA
UN number	UN1956	UN1956	UN1956	UN1956	UN1956
UN proper shipping name	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)	COMPRESSED GAS, N.O.S. (nitrogen, oxygen)
Transport hazard class(es)	2.2 	2.2 	2.2 	2.2 	2.2 
Packing group	-	-	-	-	-
Environment	No.	No.	No.	No.	No.
Additional information	-	Product classified as per the following sections of the Transportation of Dangerous Goods Regulations: 2.13-2.17 (Class 2). **Explosive Limit and Limited Quantity Index** 0.125 **Passenger Carrying Road or Rail Index** 75	-	-	-

"Refer to CFR 49 (or authority having jurisdiction) to determine the information required for shipment of the product."

Special precautions for user : **Transport within user's premises:** always transport in closed containers that are upright and secure. Ensure that persons transporting the product know what to do in the event of an accident or spillage.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code : Not available.

Section 15. Regulatory information

U.S. Federal regulations : **TSCA 8(a) CDR Exempt/Partial exemption**: Not determined

United States inventory (TSCA 8b): All components are listed or exempted.

Clean Air Act (CAA) 112 regulated flammable substances: isobutylene

Clean Air Act Section 112 (b) Hazardous Air Pollutants (HAPs) : Not listed

Clean Air Act Section 602 Class I Substances : Not listed

Clean Air Act Section 602 Class II Substances : Not listed

DEA List I Chemicals (Precursor Chemicals) : Not listed

DEA List II Chemicals (Essential Chemicals) : Not listed

SARA 302/304

Composition/information on ingredients

No products were found.

Section 15. Regulatory information

SARA 304 RQ : Not applicable.

SARA 311/312

Classification : Sudden release of pressure

Composition/information on ingredients

Name	%	Fire hazard	Sudden release of pressure	Reactive	Immediate (acute) health hazard	Delayed (chronic) health hazard
Nitrogen	75 - 80.5	No.	Yes.	No.	No.	No.
oxygen	19.5 - 23.5	No.	Yes.	No.	No.	No.
Isobutylene	0.0001 - 1.13	Yes.	Yes.	No.	No.	No.

State regulations

Massachusetts : The following components are listed: NITROGEN; OXYGEN (LIQUID); 2-METHYLPROPENE

New York : None of the components are listed.

New Jersey : The following components are listed: NITROGEN; OXYGEN; ISOBUTYLENE; 1-PROPENE, 2-METHYL-

Pennsylvania : The following components are listed: NITROGEN; OXYGEN; 1-PROPENE, 2-METHYL-

International regulations

International lists

National inventory

Australia : All components are listed or exempted.

Canada : All components are listed or exempted.

China : All components are listed or exempted.

Europe : All components are listed or exempted.

Japan : Not determined.

Malaysia : Not determined.

New Zealand : All components are listed or exempted.

Philippines : All components are listed or exempted.

Republic of Korea : All components are listed or exempted.

Taiwan : All components are listed or exempted.

Canada

WHMIS (Canada) : Class A: Compressed gas.

CEPA Toxic substances: None of the components are listed.
Canadian ARET: None of the components are listed.
Canadian NPRI: The following components are listed: Butene (all isomers)
Alberta Designated Substances: None of the components are listed.
Ontario Designated Substances: None of the components are listed.
Quebec Designated Substances: None of the components are listed.

Section 16. Other information

Canada Label requirements : Class A: Compressed gas.

Hazardous Material Information System (U.S.A.)

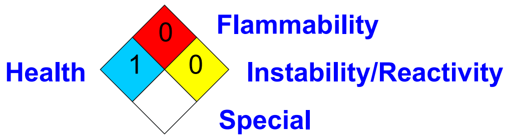
Health	1
Flammability	0
Physical hazards	3

Section 16. Other information

Caution: HMIS® ratings are based on a 0-4 rating scale, with 0 representing minimal hazards or risks, and 4 representing significant hazards or risks Although HMIS® ratings are not required on SDSs under 29 CFR 1910. 1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® is a registered mark of the National Paint & Coatings Association (NPCA). HMIS® materials may be purchased exclusively from J. J. Keller (800) 327-6868.

The customer is responsible for determining the PPE code for this material.

National Fire Protection Association (U.S.A.)



Procedure used to derive the classification

Classification	Justification
Press. Gas Comp. Gas, H280	On basis of test data

History

Date of printing : 1/26/2016

Date of issue/Date of revision : 1/26/2016

Date of previous issue : No previous validation

Version : 0.01

Key to abbreviations : ATE = Acute Toxicity Estimate
BCF = Bioconcentration Factor
GHS = Globally Harmonized System of Classification and Labelling of Chemicals
IATA = International Air Transport Association
IBC = Intermediate Bulk Container
IMDG = International Maritime Dangerous Goods
LogPow = logarithm of the octanol/water partition coefficient
MARPOL 73/78 = International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978. ("Marpol" = marine pollution)
UN = United Nations

References : Not available.

Indicates information that has changed from previously issued version.

Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above-named supplier, nor any of its subsidiaries, assumes any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Safety Data Sheet

1 - Identification

Product Name: WD-40 Multi-Use Product Aerosol ***NOT FOR SALE IN CALIFORNIA*** **Product Use: Lubricant, Penetrant, Drives Out Moisture, Removes and Protects Surfaces From Corrosion** **Restrictions on Use: None identified** **SDS Date Of Preparation: 07/20/2014**	**Manufacturer: WD-40 Company** **Address: 1061 Cudahy Place (92110)** **P.O. Box 80607** **San Diego, California, USA** **92138 –0607** **Telephone:** **Emergency only: 1-888-324-7596 (PROSAR)** **Information: 1-888-324-7596** **Chemical Spills: 1-800-424-9300 (Chemtrec)** **1-703-527-3887 (International Calls)**

2 – Hazards Identification

Hazcom 2012/GHS Classification:
Flammable Aerosol Category 1
Gas Under Pressure: Compressed Gas
Aspiration Toxicity Category 1

Note: This product is a consumer product and is labeled in accordance with the US Consumer Product Safety Commission regulations which take precedence over OSHA Hazard Communication labeling. The actual container label will not include the label elements below. The labeling below applies to industrial/professional products.

Label Elements:

DANGER!
Extremely Flammable Aerosol.
Contains gas under pressure; may explode if heated.
May be fatal if swallowed and enters airways.
Prevention
Keep away from heat, sparks, open flames, hot surfaces – No smoking.
Do not spray on an open flame or other ignition source.
Pressurized container: Do not pierce or burn, even after use.
Response
IF SWALLOWED: Immediately call a POISON CENTER or physician. Do NOT induce vomiting.
Storage
Store locked up.
Protect from sunlight. Do not expose to temperatures exceeding 50°C/122°F. Store in a well-ventilated place.
Disposal
Dispose of contents and container in accordance with local and national regulations.

3 - Composition/Information on Ingredients

Ingredient	CAS #	Weight Percent	US Hazcom 2012/ GHS Classification
Aliphatic Hydrocarbon	64742-47-8	45-50	Flammable Liquid Category 3

			Aspiration Toxicity Category 1
Petroleum Base Oil	64742-56-9 64742-65-0 64742-53-6 64742-54-7 64742-71-8	<25	Not Hazardous
LVP Aliphatic Hydrocarbon	64742-47-8	12-18	Aspiration Toxicity Category 1
Carbon Dioxide	124-38-9	2-3	Simple Asphyxiant Gas Under Pressure, Compressed Gas
Non-Hazardous Ingredients	Mixture	<10	Not Hazardous

Note: The exact percentages are a trade secret.

4 – First Aid Measures

Ingestion (Swallowed): Aspiration Hazard. DO NOT induce vomiting. Call physician, poison control center or the WD-40 Safety Hotline at 1-888-324-7596 immediately.
Eye Contact: Flush thoroughly with water. Remove contact lenses if present after the first 5 minutes and continue flushing for several more minutes. Get medical attention if irritation persists.
Skin Contact: Wash with soap and water. If irritation develops and persists, get medical attention.
Inhalation (Breathing): If irritation is experienced, move to fresh air. Get medical attention if irritation or other symptoms develop and persist.
Signs and Symptoms of Exposure: May cause eye and respiratory irritation. Inhalation may cause coughing, headache and dizziness. Skin contact may cause drying of the skin.
Indication of Immediate Medical Attention/Special Treatment Needed: Immediate medical attention is needed for ingestion.

5 – Fire Fighting Measures

Suitable (and unsuitable) Extinguishing Media: Use water fog, dry chemical, carbon dioxide or foam. Do not use water jet or flooding amounts of water. Burning product will float on the surface and spread fire.
Specific Hazards Arising from the Chemical: Contents under pressure. Keep away from ignition sources and open flames. Exposure of containers to extreme heat and flames can cause them to rupture often with violent force. Vapors are heavier than air and may travel along surfaces to remote ignition sources and flash back. Combustion will produce oxides of carbon and hydrocarbons.
Special Protective Equipment and Precautions for Fire-Fighters: Firefighters should always wear positive pressure self-contained breathing apparatus and full protective clothing. Cool fire-exposed containers with water. Use shielding to protect against bursting containers.

6 – Accidental Release Measures

Personal Precautions, Protective Equipment and Emergency Procedures: Wear appropriate protective clothing (see Section 8). Eliminate all sources of ignition and ventilate area.
Methods and Materials for Containment/Cleanup: Leaking cans should be placed in a plastic bag or open pail until the pressure has dissipated. Contain and collect liquid with an inert absorbent and place in a container for disposal. Clean spill area thoroughly. Report spills to authorities as required.

7 – Handling and Storage

Precautions for Safe Handling: Avoid contact with eyes. Avoid prolonged contact with skin. Avoid breathing vapors or aerosols. Use only with adequate ventilation. Keep away from heat, sparks, pilot lights, hot surfaces and open flames. Unplug electrical tools, motors and appliances before spraying or bringing the can near any source of electricity. Electricity can burn a hole in the can and cause contents to burst into flames. To avoid serious burn injury, do not let the can touch battery terminals, electrical connections on motors or appliances or any other source of electricity. Wash thoroughly with soap and water after handling. Keep containers closed when not in use. Keep out of the reach of children. Do not puncture, crush or incinerate containers, even when empty.

Conditions for Safe Storage: Store in a cool, well-ventilated area, away from incompatible materials Do not store above 120°F or in direct sunlight. U.F.C (NFPA 30B) Level 3 Aerosol. Store away from oxidizers.

8 – Exposure Controls/Personal Protection

Chemical	Occupational Exposure Limits
Aliphatic Hydrocarbon	1200 mg/m3 TWA (manufacturer recommended)
Petroleum Base Oil	5 mg/m3 TWA, 10 mg/m3 STEL ACGIH TLV 5 mg/m3 TWA OSHA PEL
LVP Aliphatic Hydrocarbon	1200 mg/m3 TWA (manufacturer recommended)
Carbon Dioxide	5000 ppm TWA (OSHA/ACGIH), 30,000 ppm STEL (ACGIH)
Non-Hazardous Ingredients	None Established

The Following Controls are Recommended for Normal Consumer Use of this Product
Appropriate Engineering Controls: Use in a well-ventilated area.
Personal Protection:
Eye Protection: Avoid eye contact. Always spray away from your face.
Skin Protection: Avoid prolonged skin contact. Chemical resistant gloves recommended for operations where skin contact is likely.
Respiratory Protection: None needed for normal use with adequate ventilation.

For Bulk Processing or Workplace Use the Following Controls are Recommended
Appropriate Engineering Controls: Use adequate general and local exhaust ventilation to maintain exposure levels below that occupational exposure limits.
Personal Protection:
Eye Protection: Safety goggles recommended where eye contact is possible.
Skin Protection: Wear chemical resistant gloves.
Respiratory Protection: None required if ventilation is adequate. If the occupational exposure limits are exceeded, wear a NIOSH approved respirator. Respirator selection and use should be based on contaminant type, form and concentration. Follow OSHA 1910.134, ANSI Z88.2 and good Industrial Hygiene practice.
Work/Hygiene Practices: Wash with soap and water after handling.

9 – Physical and Chemical Properties

Appearance:	Light amber liquid	Flammable Limits: (Solvent Portion)	LEL: 0.6% UEL: 8%
Odor:	Mild petroleum odor	Vapor Pressure:	95-115 PSI @ 70°F
Odor Threshold:	Not established	Vapor Density:	Greater than 1 (air=1)
pH:	Not Applicable	Relative Density:	0.8 – 0.82 @ 60°F
Melting/Freezing Point	Not established	Solubilities:	Insoluble in water
Boiling Point/Range:	361 - 369°F (183 - 187°C)	Partition Coefficient; n-octanol/water:	Not established
Flash Point:	122°F (49°C) Tag Closed Cup (concentrate)	Autoignition Temperature:	Not established
Evaporation Rate:	Not established	Decomposition Temperature:	Not established
Flammability (solid, gas)	Flammable Aerosol	Viscosity:	2.79-2.96 cSt @ 100°F
VOC:	412 grams/liter (49.5%)	Pour Point:	-63°C (-81.4°F) ASTM D-97

10 – Stability and Reactivity

Reactivity: Not reactive under normal conditions
Chemical Stability: Stable

Possibility of Hazardous Reactions: May react with strong oxidizers generating heat.
Conditions to Avoid: Avoid heat, sparks, flames and other sources of ignition. Do not puncture or incinerate containers.
Incompatible Materials: Strong oxidizing agents.
Hazardous Decomposition Products: Carbon monoxide and carbon dioxide.

11 – Toxicological Information

Symptoms of Overexposure:
Inhalation: High concentrations may cause nasal and respiratory irritation and central nervous system effects such as headache, dizziness and nausea. Intentional abuse may be harmful or fatal.
Skin Contact: Prolonged and/or repeated contact may produce mild irritation and defatting with possible dermatitis.
Eye Contact: Contact may be irritating to eyes. May cause redness and tearing.
Ingestion: This product has low oral toxicity. Swallowing may cause gastrointestinal irritation, nausea, vomiting and diarrhea. This product is an aspiration hazard. If swallowed, can enter the lungs and may cause chemical pneumonitis, severe lung damage and death.
Chronic Effects: None expected.
Carcinogen Status: None of the components are listed as a carcinogen or suspect carcinogen by IARC, NTP, ACGIH or OSHA.
Reproductive Toxicity: None of the components is considered a reproductive hazard.

Numerical Measures of Toxicity:
The oral toxicity of this product is estimated to be greater than 5,000 mg/kg and the dermal toxicity greater than 2,000 mg/kg based on an assessment of the ingredients. This product is not classified as toxic by established criteria. It is an aspiration hazard.

12 – Ecological Information

Ecotoxicity: No specific aquatic toxicity data is currently available, however components of this product are not expected to be harmful to aquatic organisms
Persistence and Degradability: Component are readily biodegradable.
Bioaccumulative Potential: Bioaccumulation is not expected based on an assessment of the ingredients.
Mobility in Soil: No data available
Other Adverse Effects: None known

13 - Disposal Considerations

If this product becomes a waste, it would be expected to meet the criteria of a RCRA ignitable hazardous waste (D001). However, it is the responsibility of the generator to determine at the time of disposal the proper classification and method of disposal. Do not puncture or incinerate containers, even empty. Dispose in accordance with federal, state, and local regulations.

14 – Transportation Information_

DOT Surface Shipping Description:
UN1950, Aerosols, 2.1 Ltd. Qty (Note: Shipping Papers are not required for Limited Quantities unless transported by air or vessel – each package must be marked with the Limited Quantity Mark)
IMDG Shipping Description: Un1950, Aerosols, 2.1, LTD QTY
ICAO Shipping Description: UN1950, Aerosols, flammable, 2.1 NOTE: WD-40 does not test aerosol cans to assure that they meet the pressure and other requirements for transport by air. We do not recommend that our aerosol products be transported by air.

15 – Regulatory Information

U.S. Federal Regulations:
CERCLA 103 Reportable Quantity: This product is not subject to CERCLA reporting requirements, however, oil spills are reportable to the National Response Center under the Clean Water Act and many

states have more stringent release reporting requirements. Report spills required under federal, state and local regulations.
SARA TITLE III:
Hazard Category For Section 311/312: Acute Health, Fire Hazard, Sudden Release of Pressure
Section 313 Toxic Chemicals: This product contains the following chemicals subject to SARA Title III Section 313 Reporting requirements: None
Section 302 Extremely Hazardous Substances (TPQ): None
EPA Toxic Substances Control Act (TSCA) Status: All of the components of this product are listed on the TSCA inventory.
VOC Regulations: This product complies with the consumer product VOC limits of the US EPA and states adopting the OTC VOC rules but does not comply with CARB.
California Safe Drinking Water and Toxic Enforcement Act (Proposition 65): This product does not contain chemicals regulated under California Proposition 65.
Canadian Environmental Protection Act: One of the components is listed on the NDSL. All of the other ingredients are listed on the Canadian Domestic Substances List or exempt from notification.
Canadian WHMIS Classification: Class A (Compressed gas), Class B-5 (Flammable Aerosol)
This MSDS has been prepared according to the criteria of the Controlled Products Regulation (CPR) and the MSDS contains all of the information required by the CPR.

16 – Other Information:

HMIS Hazard Rating:
Health – 1 (slight hazard), Fire Hazard – 4 (severe hazard), Reactivity – 0 (minimal hazard)

Revision Date: July 20, 2014 Supersedes: May 23, 2014

Revision Summary: Convert to Hazcom 2012. Changes in all sections.

Prepared by: Industrial Health & Safety Consultants, Inc. Shelton, CT, USA

APPROVED By: I. Kowalski Regulatory Affairs Dept.

5049000/No.0015205

SAFETY DATA SHEET

1. Identification

Product identifier **PVC Medium Clear Cement**

Other means of identification

SDS number 1101E

Synonyms Part Numbers: Clear - 30350, 31017, 31018, 31019, 31020, 31021, 31550, 31551, 31552, 31553, 31946, 31947, 31948, 31949, 32222, 32223, 32224, 32225

Recommended use Joining PVC Pipes

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Company Name Oatey Co.

Address 4700 West 160th St.
Cleveland, OH 44135

Telephone 216-267-7100

E-mail info@oatey.com

Transport Emergency Chemtrec 1-800-424-9300 (Outside the US 1-703-527-3887)

Emergency First Aid 1-877-740-5015

Contact person MSDS Coordinator

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 2
Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 2A
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
	Specific target organ toxicity, single exposure	Category 3 narcotic effects
	Aspiration hazard	Category 1
OSHA defined hazards	Not classified.	

Label elements

Signal word Danger

Hazard statement Highly flammable liquid and vapor. Harmful if swallowed. May be fatal if swallowed and enters airways. Causes skin irritation. Causes serious eye irritation. May cause respiratory irritation. May cause drowsiness or dizziness.

Precautionary statement

Prevention Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Use only outdoors or in a well-ventilated area. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Avoid breathing mist or vapor. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Wear protective gloves/protective clothing/eye protection/face protection.

Response Rinse mouth. Do NOT induce vomiting. If skin irritation occurs: Get medical advice/attention. If eye irritation persists: Get medical advice/attention. Take off contaminated clothing and wash before reuse. In case of fire: Use appropriate media to extinguish.

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

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC)	Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis. May form explosive peroxides. Contains a chemical classified by the US EPA as a suspected possible carcinogen.

Supplemental information

Not applicable.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Furan, Tetrahydro-	109-99-9	30-50
Acetone	67-64-1	10-25
Methyl ethyl ketone	78-93-3	10-25
Polyvinyl chloride	9002-86-2	12-20
Cyclohexanone	108-94-1	10-20
Fumed Silica	112945-52-5	1-5

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret.

4. First-aid measures

Inhalation	Remove victim to fresh air and keep at rest in a position comfortable for breathing. Call a POISON CENTER or doctor/physician if you feel unwell.
Skin contact	Take off immediately all contaminated clothing. Wash with plenty of soap and water. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash before reuse.
Eye contact	Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.
Ingestion	Call a physician or poison control center immediately. Do not induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Aspiration may cause pulmonary edema and pneumonitis.
Most important symptoms/effects, acute and delayed	Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Skin irritation. Vapors have a narcotic effect and may cause headache, fatigue, dizziness and nausea. May cause redness and pain.
Indication of immediate medical attention and special treatment needed	Provide general supportive measures and treat symptomatically. Thermal burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital. In case of shortness of breath, give oxygen. Keep victim warm. Keep victim under observation. Symptoms may be delayed.
General information	Take off all contaminated clothing immediately. IF exposed or concerned: Get medical advice/attention. Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Wash contaminated clothing before reuse.

5. Fire-fighting measures

Suitable extinguishing media	Alcohol resistant foam. Water fog. Dry chemical powder. Carbon dioxide (CO_2).
Unsuitable extinguishing media	Do not use water jet as an extinguisher, as this will spread the fire.
Specific hazards arising from the chemical	Vapors may form explosive mixtures with air. Vapors may travel considerable distance to a source of ignition and flash back. During fire, gases hazardous to health may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Fire fighting equipment/instructions	In case of fire and/or explosion do not breathe fumes. Move containers from fire area if you can do so without risk.
Specific methods	Use standard firefighting procedures and consider the hazards of other involved materials.
General fire hazards	Highly flammable liquid and vapor. This product contains tetrahydrofuran that may form explosive organic peroxide when exposed to air or light or with age.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Keep out of low areas. Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Wear appropriate protective equipment and clothing during clean-up. Avoid inhalation of vapors or mists. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ventilate closed spaces before entering them. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.
Methods and materials for containment and cleaning up	Eliminate all ignition sources (no smoking, flares, sparks, or flames in immediate area). Take precautionary measures against static discharge. Use only non-sparking tools. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Use water spray to reduce vapors or divert vapor cloud drift. Prevent entry into waterways, sewer, basements or confined areas. Following product recovery, flush area with water. Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination. Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground.

7. Handling and storage

Precautions for safe handling	Vapors may form explosive mixtures with air. Do not handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Take precautionary measures against static discharges. All equipment used when handling the product must be grounded. Use non-sparking tools and explosion-proof equipment. Do not taste or swallow. Avoid breathing mist or vapor. Avoid contact with skin. Avoid contact with eyes. Avoid prolonged exposure. Avoid contact with clothing. Provide adequate ventilation. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. When using, do not eat, drink or smoke. Wash hands thoroughly after handling.
Conditions for safe storage, including any incompatibilities	Store locked up. Keep away from heat, sparks and open flame. Prevent electrostatic charge build-up by using common bonding and grounding techniques. Store in original tightly closed container. Store in a cool, dry place out of direct sunlight. Store in a well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS). Keep in an area equipped with sprinklers.

8. Exposure controls/personal protection

Occupational exposure limits

U.S. - OSHA

Components	Type	Value	Form
Fumed Silica (CAS 112945-52-5)	TWA	0.8 mg/m3	Unspecified.
		20 mppcf	Unspecified.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Components	Type	Value
Polyvinyl chloride (CAS 9002-86-2)	STEL	5 ppm
	TWA	1 ppm

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Acetone (CAS 67-64-1)	PEL	2400 mg/m3	
		1000 ppm	
Cyclohexanone (CAS 108-94-1)	PEL	200 mg/m3	
		50 ppm	
Furan, Tetrahydro- (CAS 109-99-9)	PEL	590 mg/m3	
		200 ppm	

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Methyl ethyl ketone (CAS 78-93-3)	PEL	590 mg/m3	
		200 ppm	
Polyvinyl chloride (CAS 9002-86-2)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value
Fumed Silica (CAS 112945-52-5)	TWA	0.8 mg/m3
		20 mppcf

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Acetone (CAS 67-64-1)	STEL	750 ppm	
	TWA	500 ppm	
Cyclohexanone (CAS 108-94-1)	STEL	50 ppm	
	TWA	20 ppm	
Furan, Tetrahydro- (CAS 109-99-9)	STEL	100 ppm	
	TWA	50 ppm	
Methyl ethyl ketone (CAS 78-93-3)	STEL	300 ppm	
	TWA	200 ppm	
Polyvinyl chloride (CAS 9002-86-2)	TWA	1 mg/m3	Respirable fraction.

U.S. - NIOSH

Components	Type	Value	Form
Fumed Silica (CAS 112945-52-5)	REL	6 mg/m3	Unspecified.

US. NIOSH: Pocket Guide to Chemical Hazards

Components	Type	Value
Acetone (CAS 67-64-1)	TWA	590 mg/m3
		250 ppm
Cyclohexanone (CAS 108-94-1)	TWA	100 mg/m3
		25 ppm
Fumed Silica (CAS 112945-52-5)	TWA	6 mg/m3
Furan, Tetrahydro- (CAS 109-99-9)	STEL	735 mg/m3
		250 ppm
	TWA	590 mg/m3
		200 ppm
Methyl ethyl ketone (CAS 78-93-3)	STEL	885 mg/m3
		300 ppm
	TWA	590 mg/m3
		200 ppm

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
Acetone (CAS 67-64-1)	50 mg/l	Acetone	Urine	*
Cyclohexanone (CAS 108-94-1)	80 mg/l	1,2-Cyclohexanediol, with hydrolysis	Urine	*
	8 mg/l	Cyclohexanol, with hydrolysis	Urine	*
Furan, Tetrahydro- (CAS 109-99-9)	2 mg/l	Tetrahydrofuran	Urine	*
Methyl ethyl ketone (CAS 78-93-3)	2 mg/l	MEK	Urine	*

* - For sampling details, please see the source document.

Exposure guidelines

US - California OELs: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

US - Minnesota Haz Subs: Skin designation applies

Cyclohexanone (CAS 108-94-1) Skin designation applies.

US - Tennessee OELs: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

US ACGIH Threshold Limit Values: Skin designation

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.
Furan, Tetrahydro- (CAS 109-99-9) Can be absorbed through the skin.

US. NIOSH: Pocket Guide to Chemical Hazards

Cyclohexanone (CAS 108-94-1) Can be absorbed through the skin.

Appropriate engineering controls Explosion-proof general and local exhaust ventilation. Good general ventilation (typically 10 air changes per hour) should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Eye wash facilities and emergency shower must be available when handling this product.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles).

Skin protection

Hand protection Wear appropriate chemical resistant gloves.

Other Wear appropriate chemical resistant clothing.

Respiratory protection If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations When using, do not eat, drink or smoke. Wash hands after handling and before eating.

9. Physical and chemical properties

Appearance

Physical state Liquid.

Form Translucent liquid.

Color Clear.

Odor Solvent.

Odor threshold Not available.

pH Not available.

Melting point/freezing point Not available.

Initial boiling point and boiling range 151 °F (66.11 °C)

Flash point 14.0 - 23.0 °F (-10.0 - -5.0 °C)

Evaporation rate 5.5 - 8

Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	1.8
Flammability limit - upper (%)	11.8
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	145 mm Hg @ 20 C
Vapor density	2.5
Relative density	0.93 +/- 0.02
Solubility(ies)	
Solubility (water)	Negligible
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	1200 - 2500 cP
Viscosity temperature	77 °F (25 °C)
Other information	
Bulk density	7.7 lbs/gal
VOC (Weight %)	484 g/l SCAQMD 1168/M316A

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Material is stable under normal conditions.
Possibility of hazardous reactions	No dangerous reaction known under conditions of normal use.
Conditions to avoid	Avoid heat, sparks, open flames and other ignition sources. Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Acids. Strong oxidizing agents. Ammonia. Amines. Isocyanates. Caustics.
Hazardous decomposition products	No hazardous decomposition products are known.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May be fatal if swallowed and enters airways. Vapors have a narcotic effect and may cause headache, fatigue, dizziness and nausea. Prolonged inhalation may be harmful. May cause irritation to the respiratory system.
Skin contact	Causes skin irritation.
Eye contact	Causes serious eye irritation.
Ingestion	May be fatal if swallowed and enters airways. Harmful if swallowed.
Symptoms related to the physical, chemical and toxicological characteristics	Symptoms may include stinging, tearing, redness, swelling, and blurred vision. Skin irritation. May cause redness and pain. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.

Information on toxicological effects

Acute toxicity May be fatal if swallowed and enters airways. Narcotic effects. May cause respiratory irritation.

Components	Species	Test Results
Cyclohexanone (CAS 108-94-1)		
Acute		
Dermal		
LD50	Rabbit	948 mg/kg

Components	Species	Test Results
Inhalation		
LC50	Rat	8000 ppm, 4 hours
Oral		
LD50	Rat	1540 mg/kg

* Estimates for product may be based on additional component data not shown.

Skin corrosion/irritation Causes skin irritation.

Serious eye damage/eye irritation Causes serious eye irritation.

Respiratory or skin sensitization

Respiratory sensitization Not available.

Skin sensitization This product is not expected to cause skin sensitization.

Germ cell mutagenicity No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Carcinogenicity Suspected of causing cancer. In 2012 USEPA Integrated Risk Information System (IRIS) reviewed a two species inhalation lifetime study on THF conducted by NTP (1998). Male rats developed renal tumors and female mice developed liver tumors while neither the female rats nor the male mice showed similar results. Because the carcinogenic mechanisms could not be identified clearly in either species for either tumor, the EPA determined that the male rat and female mouse findings are relevant to the assessment of carcinogenic potential in humans. Therefore, the IRIS review concludes that these data in aggregate indicate that there is "suggestive evidence of carcinogenic potential" following exposure to THF by all routes of exposure. This product contains polyvinyl chloride (PVC) that is not a fabricated product, and is therefore, defined and regulated as a toxic and hazardous substance under 29 C.F.R. § 1910.1017 due to the presumed presence of residual vinyl chloride monomer. The concentrations of residual vinyl chloride calculated to be contained in this product are well below the threshold for classification in accordance with 29 C.F.R. § 1910.1200.

IARC Monographs. Overall Evaluation of Carcinogenicity

Cyclohexanone (CAS 108-94-1)	3 Not classifiable as to carcinogenicity to humans.
Fumed Silica (CAS 112945-52-5)	3 Not classifiable as to carcinogenicity to humans.
Polyvinyl chloride (CAS 9002-86-2)	3 Not classifiable as to carcinogenicity to humans.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Polyvinyl chloride (CAS 9002-86-2)	Cancer

Reproductive toxicity This product is not expected to cause reproductive or developmental effects.

Specific target organ toxicity - single exposure Respiratory tract irritation. Narcotic effects.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard May be fatal if swallowed and enters airways.

Chronic effects Prolonged inhalation may be harmful.

12. Ecological information

Ecotoxicity The product is not classified as environmentally hazardous. However, this does not exclude the possibility that large or frequent spills can have a harmful or damaging effect on the environment.

Components		Species	Test Results
Cyclohexanone (CAS 108-94-1)			
Aquatic			
Fish	LC50	Fathead minnow (Pimephales promelas)	481 - 578 mg/l, 96 hours

* Estimates for product may be based on additional component data not shown.

Persistence and degradability No data is available on the degradability of this product.

Bioaccumulative potential No data available.

Partition coefficient n-octanol / water (log Kow)

Acetone (CAS 67-64-1)	-0.24
Cyclohexanone (CAS 108-94-1)	0.81
Furan, Tetrahydro- (CAS 109-99-9)	0.46
Methyl ethyl ketone (CAS 78-93-3)	0.29

Mobility in soil No data available.

Other adverse effects No other adverse environmental effects (e.g. ozone depletion, photochemical ozone creation potential, endocrine disruption, global warming potential) are expected from this component.

13. Disposal considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. This material and its container must be disposed of as hazardous waste. Do not allow this material to drain into sewers/water supplies. Do not contaminate ponds, waterways or ditches with chemical or used container. Dispose of contents/container in accordance with local/regional/national/international regulations.

Local disposal regulations Dispose in accordance with all applicable regulations.

Hazardous waste code The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions).

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN number	UN1133
UN proper shipping name	Adhesives
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Label(s)	3
Packing group	II
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	T11, TP1, TP8, TP27
Packaging exceptions	150
Packaging non bulk	201
Packaging bulk	243

IATA

UN number	UN1133
UN proper shipping name	Adhesives
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	II
Environmental hazards	No.
ERG Code	3L
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN1133
UN proper shipping name	ADHESIVES
Transport hazard class(es)	
Class	3
Subsidiary risk	-
Packing group	II
Environmental hazards	
Marine pollutant	No.
EmS	F-E, S-D
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not available.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Polyvinyl chloride (CAS 9002-86-2)	Cancer Central nervous system Liver Blood Flammability

CERCLA Hazardous Substance List (40 CFR 302.4)

Acetone (CAS 67-64-1)	LISTED
Cyclohexanone (CAS 108-94-1)	LISTED
Furan, Tetrahydro- (CAS 109-99-9)	LISTED
Methyl ethyl ketone (CAS 78-93-3)	LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - Yes
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Drug Enforcement Administration (DEA). List 2, Essential Chemicals (21 CFR 1310.02(b) and 1310.04(f)(2) and Chemical Code Number

Acetone (CAS 67-64-1)	6532
Methyl ethyl ketone (CAS 78-93-3)	6714

Drug Enforcement Administration (DEA). List 1 & 2 Exempt Chemical Mixtures (21 CFR 1310.12(c))

Acetone (CAS 67-64-1)	35 %WV
Methyl ethyl ketone (CAS 78-93-3)	35 %WV

DEA Exempt Chemical Mixtures Code Number

Acetone (CAS 67-64-1)	6532
Methyl ethyl ketone (CAS 78-93-3)	6714

US state regulations

US. Massachusetts RTK - Substance List

Acetone (CAS 67-64-1)
Cyclohexanone (CAS 108-94-1)
Fumed Silica (CAS 112945-52-5)
Furan, Tetrahydro- (CAS 109-99-9)
Methyl ethyl ketone (CAS 78-93-3)

US. New Jersey Worker and Community Right-to-Know Act

Acetone (CAS 67-64-1)
Cyclohexanone (CAS 108-94-1)
Furan, Tetrahydro- (CAS 109-99-9)
Methyl ethyl ketone (CAS 78-93-3)

Polyvinyl chloride (CAS 9002-86-2)

US. Pennsylvania Worker and Community Right-to-Know Law

Acetone (CAS 67-64-1)
Cyclohexanone (CAS 108-94-1)
Fumed Silica (CAS 112945-52-5)
Furan, Tetrahydro- (CAS 109-99-9)
Methyl ethyl ketone (CAS 78-93-3)

US. Rhode Island RTK

Acetone (CAS 67-64-1)
Cyclohexanone (CAS 108-94-1)
Furan, Tetrahydro- (CAS 109-99-9)
Methyl ethyl ketone (CAS 78-93-3)

US. California Proposition 65

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): This material is not known to contain any chemicals currently listed as carcinogens or reproductive toxins. This product contains trace amounts of chemicals known to the state of California to cause cancer. Under normal use conditions, exposure to these chemicals at levels above the State of California “No significant Risk Level” (NSRL) are unlikely. The use of proper personal protective equipment (PPE) and ventilation guidelines noted in Section 8 will minimize exposure levels to these chemicals.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Chemical Substances (AICS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	No
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

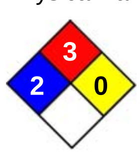
Issue date 27-May-2015

Revision date -

Version # 01

HMIS® ratings Health: 2
Flammability: 3
Physical hazard: 0

NFPA ratings



Disclaimer The information in the sheet was written based on the best knowledge and experience currently available.

Site Traffic Awareness and Response (STAR) Plan

Revision 3, 9/18/2013

1.0 General

Project Name:	Watervliet Arsenal
Project Number:	6261060
STAR Plan Developer Name:	Kathryn Farris
Reviewed By:	
Duration of Work (hours or days):	7:30-5:30 (approximate)
Time Restrictions (describe below):	Arsenal imposed restrictions apply

Comments:

2.0 Work Description

Provide a brief description of expected site traffic conditions:

Site is active military manufacturing facility. Large trucks, forklifts, and regular traffic pass through site. Speed limits are posted (15 mph) and strictly enforced by on-site police force

☐ Work is planned on off site properties but not in the public right-of-way.

To facilitate identification of traffic controls to use, check all that apply to this project:

Notes: Time at a specific location on the project site ("> 8 hours at MW-1" etc). Exclude activities such as monitor well pad setting times where equipment is not at location. Indicate controls to protect monitor well pads in comments below.

Short Duration Work (<1 hour)

- ☑ Water-level gauging and well sounding
- ☐ Surface soil sampling using manual methods
- ☐ Intermediate depth soil sampling using DPT
- ☑ Shallow monitor well purging and sampling
- ☐ Product recovery using manual methods
- ☐ Surveying
- ☐ Other (specify):

Intermediate Duration Work (1-8 hours)

- ☑ Intermediate/deep or > 2 in. diameter well sampling
- ☐ Slug testing and similar tests
- ☐ Deep handauger sampling (>20 ft depth)
- ☐ Manual soil sampling through concrete/asphalt
- ☐ Deep soil sampling using DPT (>40 ft depth)
- ☐ Soil sampling using other automated drilling method
- ☐ Other (specify):

Long Duration Work (>8 hours)

- ☐ Deep monitor well installation (>50 ft depth)
- ☐ Monitor wells with surface casing installation
- ☐ Intermediate depth monitor wells ≥ 4 in. diam.
- ☐ Long term product recovery using equipment
- ☐ Long term pump testing
- ☐ Other (specify):

Comments:

Traffic Type:

Check all that apply:

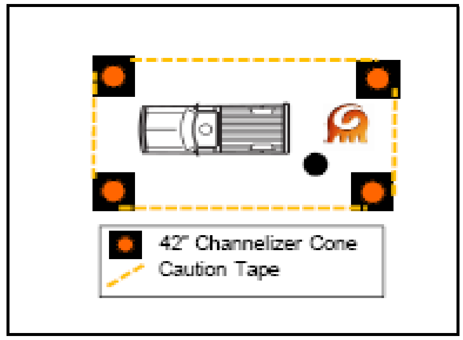
- ☑ Automobiles
- ☑ Straight truck
- ☑ Semi truck
- ☐ Other:
- ☑ Forklifts
- ☑ Bicycles
- ☑ Pedestrian
- ☐ Construction equipment

3.0 Traffic Control Layout

The following DOT Fact Sheets and/or diagrams are applicable to this project:
Notes: DOT Fact Sheets have numbered scenarios, select the appropriate scenario(s) for the project and indicate duration [Short (S), Intermediate (I), Long (L)]. Manually revise diagrams, if needed, to convey requirements.

			1	2	3	4	5	6	7	8	9	S	I	L
☑	DOT Facts-302a	Retail Gas Station/Small Business Parking Lot (<1 Hour)												
	☑ With Truck	☐ Without Truck	☐	☐	☐	☐	☐							
☑	DOT Facts-302b	Retail Gas Station/Small Business Parking Lot (1-8 Hours)	☐	☐	☐	☐								
☐	DOT Facts-302c	Retail Gas Station/Small Business (>8 Hours)	☐	☐	☐									
☐	DOT Facts-302e	Multi-business Parking Lot	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☑	DOT Facts-302e	Facility Parking Area	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☐

☐ Parking Garage (develop drawing for controls)
☐ Other (specify): ____________________
☐ STAR Select controls to the right will be used



How will the above documents be communicated to field staff?
(excludes STAR Select)

☐ The above documents are attached to this STAR Plan
☑ The above documents are appropriate without significant modification and are available to field staff in the

Field Guide for Roadway Work Zone Safety.

4.0 Required Traffic Control Devices and Phasing

Tasks on this project may be implemented both individually or concurrently. Selection and number of traffic control devices required will be dependent on the scope of work.

Traffic control device help: DOT Facts-302d

Check all that apply:	Number:	*Phasing:*
☐ Channelizer cone (42 inch height, 10 lb base)		1) Position truck as shield, if practical
☐ Channelizer cone (42 inch height, 30 lb base)		2) Deploy traffic control devices
☑ Traffic cones (≥ 18 inches tall)		3) Affix flags, caution tape or fencing as prescribed in fact sheet
☐ Barricade ☐ Type I ☐ Type II		4) Unload project equipment
☑ Flags for cones		5) Commence work
☐ Lights (for night work)		6) SSO to maintain controls
☐ Plastic fencing (rolls)		7) Remove controls in opposite order
☑ Caution tape (rolls)		
☐ Other (specify): ____________________		

☐ Additional client requirements are attached

If vehicle equipped with high intensity strobe or rotating lights, the lights should be utilized during work. If the vehicle is not equipped with supplemental lighting devices, use vehicle flashers (be aware of battery drain when using any of the lighting devices) should be considered.
Personal protective equipment required for this work is listed in the applicable project Job Safety Analysis (JSA) or project specific HASP. A Class II (minimum) high visibility vest is required.

5.0 Approvals

	Printed Name	Date	Signature
Plan Developer:	Kathryn Farris	10/24/2014	
Plan Reviewer:			

Attachment 3

Resumes and Certifications

Education

MS, Environmental Health Science, City University of New York, Hunter College

BS, Health Science, City University of New York, Brooklyn College

Years of Experience

Total - 25
With ARCADIS –0

Professional Registrations

Certified Industrial Hygienist # 5279
Certified Safety Professional # 11120
OSHA 500 Course Authorized Trainer 2015

Professional Qualifications

American Industrial Hygiene Association
American Academy of Industrial Hygiene
American Conference of Governmental Industrial Hygienists
NJ Chapter of the AIHA- Director of Member Services

Grey P. Coppi, CIH, CSP

Health and Safety Lead, Federal Programs

Mr. Coppi is based out of our Edison, New Jersey office. He is a Certified Industrial Hygienist and a Certified Safety Professional with more than 25 years of environmental, occupational health and safety experience providing practical, cost effective loss control solutions.

His work experience includes USDOL/OSHA/private sector giving him a unique perspective using proven loss control techniques to achieve best-in-class performance and interact with all levels of personnel with the goal of improving margin.

Notable skills include -

- EHS program devt
- ISO 9001/14001/VPP
- RCRA/EPCRA
- staff mentoring
- training courses
- hazard recognition
- practical solutions
- site auditing
- workers comp
- time management

Mr. Coppi acted as the VP Environmental, Safety and Quality Department head for 18 months at Tetratech where he provided administrative support and annual budgetary control ($4 million) for Tetra Tech EC, Inc. leading a staff of 45 full time employees.

Project Experience

CH2M-Construction Management, Environmental Health and Safety Manager, April 2012- October 2015;

Various NYCDEP waste water treatment facilities; New York, NY. Supported CH2M Construction Manager overseeing conformance with contract specifications, applicable environmental, health and safety regulations and DEP Environmental, Health and Safety Policies and Procedures.

Also supported CH2M Construction Managers similarly for two NYCDDC infrastructure projects that involved reconstruction of Fordham Plaza in the Bronx and the replacement of gas and water mains and catch basins as part of the bus bulb build out along 34th Street, Manhattan.

Stuyvesant Environmental Contracting Inc. 9/2011-4/2012, CIH Consultant

Provided ehs consulting service for startup and operation during excavation of 40,000 cubic yards of PCB contaminated sediment from the Passaic River, located in Newark, NJ.

Developed hasp, SWPP and SPCC plans, provided employee training and site ehs support services.

TetraTech/Foster Wheeler 1995-2011

Acting VP of Environmental, Safety and Quality, Morris Plains, NJ

Led a diversified team of 45 full time employees within the ESQ department that included quality, H&S, health physics and environmental specialists located throughout the US while reporting directly to CEO.

Coordinated company recertification in 2010 under ISO 9001 and 14001 and OSHAVPP, NRC licensing and USDOT hazardous material permit.

Part of team that supported, managed and completed government and commercial projects that totaled >3/4 billion dollars.

Maintained ESQ department employee certifications and licenses; improved billability. Oversaw EH&S program implementation at environmental remediation, restoration projects and for all east coast office based personnel.

Major Projects (TetraTech/Foster Wheeler)

East Coast EHS Services Manager/Program Health and Safety Manager, 09/1995 - 06/2011, U.S. Navy, NORTHDIV RAC throughout New England, Mid-Atlantic States

Provided successful health and safety management of ehs program at shipyards, landfills, reserve centers, naval air stations. Remedial methods included soil stabilization and disposal, drum removal, and lead, mercury, mold and asbestos abatement. Managed all worker compensation claims including medical management and follow-up with insurance carrier, risk management and corporate medical consultant. Conducted and issued site audits, tracked responses to closure.

Program received the 1999 and 2004 TtEC, Inc. President's Award for Health and Safety Performance. In addition, worker compensation loss from 1999-2011 amounted to only $8,500. The last lost time injury occurred in August 1998 representing over 1.3 million hours worked. Personally received the TtEC, Inc. CSQ Star for the first quarter of 2001 and March 2008 for outstanding leadership and teamwork on the RAC and ACOE New England TERC, respectively.

Program Health and Safety Manager, 04/1998 - 12/2008, USEPA RAC Region II; PADEP, GTAC-2/3

Successfully implemented the H&S program for all task orders, developed and peer-reviewed all health and safety plans, provided advice and counsel to project managers. Project activities included soil gas surveys, collecting groundwater and soil samples, installing wells, managing air sparging technology and test pit excavations. Potential occupational contaminants included VOCs, metals, PCBs and PNAs.

The EPARAC program worked 500,000 hours from 1998 – 2009 with only a single recordable injury.

Program Health and Safety Manager, 01/2005 - 12/2009, New England TERC/Army Corps of Engineers

Successfully implemented the H&S program for all task orders, developed and peer-reviewed all health and safety plans, provided advice and counsel to project managers. Project activities included structural demolition, sorting debris and backfilling, grinding of vegetative cover, rock crushing and transportation and disposal of wastes.

Received the Army Corps of Engineer NY District Commander's Certificate of Appreciation in December 2008 for "Outstanding dedication and lasting contribution to safety and occupational health".

This program worked 140,000 hours with only a single recordable injury.

Program Health and Safety Manager, 03/2006 - 03/2009, New York City Housing Authority (NYCHA)

Oversaw ehs implementation for this 36 month, $90M renovation of 600 tenant apartments and 61 elevators. Scope of work included modernizing apartments and the associated electrical/mechanical/plumbing systems in each apartment. Elevator renovation included demolition and replacement of existing elevator penthouses with 18 feet of new steel, concrete block and bricks and new electrical and mechanical systems.

Hazard control included physical/health hazards such as the fall prevention from 8 story buildings, scaffold assembly and use, use of cranes to hoist and place steel, welding, painting, cement mixing and silica exposure prevention. Reviewed health and safety plans, performed weekly/monthly site visits to assess subcontractor compliance with plans, regulations and initiatives; report inspection findings and develop corrective actions; developed and offered training to subcontractor workers. Project worked 275,000 hours with only two recordable injuries.

Program Health and Safety Manager, 06/2008 - 06/2011, Fox River Restoration, Green Bay, WI

EHS implementation for this 10 year $700M remediation of river sediments contaminated with PCB's. Activities include construction of a 250,000 square foot treatment and processing building, parking lots, and the hydraulic dredging of river sediments, physical treatment and disposal of waste materials. This project worked 550,000 hours without a lost time case and only a single recordable injury.

Other Work Experience

Dames & Moore (D&M) Consulting Certified Industrial Hygienist, Cranford, NJ

NJ Turnpike Widening Program

Provided technical, managerial and leadership oversight to the New Jersey Turnpike Authority (NJTA) during their $500M roadway-widening program that involved the excavation, segregation and replacement of soil contaminated with lead and VOCs. Approved all on-site health and safety personnel (25) employed by the construction contractors, performed site audits and assessments, developed an audit checklist and communicated results and recommendations to contractors and the NJTA; acted as a liaison to NJTA, environmental firms, contractor and section engineers, evaluated air monitoring data, maintained training records.

D&M- Wards Island WPC Plant Upgrade, Wards Island, New York, NY

Provided project health, safety and environmental support to Slattery Construction, Inc. for a $10M plus addition to an existing NYC wastewater pollution control plant located on Wards Island, New York City. Contaminants of concern were volatile organics and fuel oils. Developed the site-specific HASP, supervised on-site health and safety officers and performed bi-weekly site audits to assess compliance with the contract specifications/HASP.

ENSR/R&C, Pompton Lakes, NJ, Health and Safety Officer

Responsible for daily onsite E/H/S compliance for a $15M residential remediation located in northern New Jersey. Project involved excavation, transportation and disposal of 100,000 tons of soil contaminated with lead and mercury from a nearby explosives manufacturing plant, backfilling and restoring lawns, walkways, garages, and decks. Duties involved ensuring adherence with the HASP, maintaining training, air, medical and biological monitoring records; provided training to all personnel; supervised and implemented perimeter and personal air monitoring strategies for dust, lead and mercury. Collaborated with client, NJDEP and oversight engineer.

Chemical Waste Management, Princeton, NJ, Industrial Hygienist and Eastern Division Manager

Responsible for health and safety oversight and staff supervision for a hazardous waste remediation firm. Projects included the remediation of PCB contaminated soils for three New Jersey compressor stations; remediation of soil containing mercury and lead at a New Jersey explosives facility; remediation of ponds and lagoons containing VOCs at a fragrance manufacturer located in New Jersey.

U.S. Department of Labor/OSHA, Parsippany, NJ
Senior Industrial Hygienist

Enforced the Occupational Safety and Health Act throughout manufacturing, construction and maritime. Evaluated worker exposure through the use of a variety of sampling instruments. Supervised up to four compliance officers.

The

American Board of Industrial Hygiene®

ABIH®

organized to improve the practice of Industrial Hygiene
proclaims that

Grey Peter Coppi

having met all requirements through
education, experience, and examination,
is hereby certified in the

COMPREHENSIVE PRACTICE
of
INDUSTRIAL HYGIENE

and has the right to use the designations

CERTIFIED INDUSTRIAL HYGIENIST

CIH

December 9, 1991
date

Kenneth M. Wallingford
Chair ABIH

5279
certificate number

C. Monty Herr
Secretary ABIH

BOARD OF CERTIFIED SAFETY PROFESSIONALS

AFFIRMS THAT

Grey P. Coppi

HAVING MADE APPLICATION FOR AND GIVEN SATISFACTORY EVIDENCE OF QUALIFICATION AS REQUIRED IN THE BY-LAWS; IS QUALIFIED TO RECEIVE AND IS HEREBY AUTHORIZED TO USE THE DESIGNATION

CERTIFIED SAFETY PROFESSIONAL

IN

MANAGEMENT ASPECTS

SO LONG AS THIS CERTIFICATE OF QUALIFICATION IS RENEWED ANNUALLY AND NOT REVOKED

BOARD OF EXAMINERS IN WITNESS WHEREOF WE HAVE HEREUNTO SET OUR HANDS AND AFFIXED THE SEAL OF THE BOARD THIS 1st DAY OF AUGUST, 1992

R E McClay

PRESIDENT

John Alden

SECRETARY

SERIAL NO. 11120

BOARD OF CERTIFIED SAFETY PROFESSIONALS

Sarosh Manekshaw, CIH*			Certified Industrial Hygienist
Firm / Location:	PIKA-MP JV / Houston, TX	Years of Experience:	42
Education:	MS, Chemical Engineering, 1975; BS, Chemical Engineering, 1972		
Licenses / Certifications:		Specialized Training:	
Certified Industrial Hygienist, No. 1491, 1978 Individual Asbestos Management Planner, Texas Department of Health, License No. 205543		Initial 40-Hour, 8-Hour Refresher, 8-Hour Supervisory Hazardous Waste Operations Safety Training; USACE Construction Quality Management for Contractors	

Relevant Projects

- Phase I Time Critical Removal Action (TCRA) and Phase II TCRA and Field Work at the Rocket Ridge Area (RRA) of Open Demolition Area #2 (ODA2), Ravenna Army Ammunition Plant (RVAAP), Ravenna, OH
- Corporate Director - Environmental, Safety & Health - Pennzoil Company, New York Site
- Army Field Support Command: Time Critical Cleanup, Transportation and Disposal of Hazardous Wastes/Burn Rubble from Fire at 41-010 at Pine Bluff Arsenal/Pine Bluff, AR

Professional Highlights

- Certified Industrial Hygienist
- Experience working NAVFAC, TACOM, and several USACE Districts, to include Louisville, Baltimore, and Omaha
- Spearheaded a $34-million UST remediation program, which came in 27% under budget
- Developed and implemented S&H training programs for 16 major operating locations
- Developed emergency response action plans and provided technical support during emergencies

Corporate Senior CIH for PIKA International, Inc. Responsible for developing and implementing PIKA's S&H Program at HTRW, low-level radiological waste (LLRW), and MMRP projects involving Levels A, B, C, and D. Works in concert with Corporate S&H Manager, provides CIH direction on the development and maintenance of the corporate environmental, S&H program (CESHP). Provides IH direction from corporate level down to project level. Interprets regulations, implements PIKA and ensure compliance with federal, state, and local policies and procedures; trains support personnel; tracks S&H Program performance; develops and approves S&H plans; oversees personnel monitoring and personal protective equipment (PPE) programs; conducts inspections and accident investigations; audits field projects for PIKA and subcontract, or performance; documents issues, accidents, and violations; and ensures corrective actions are implemented. Provides exposure assessment, asbestos and lead-based paint assessment and management, current air monitoring techniques, Hazard Communication, industrial ventilation, and job hazard assessments to identify health hazards, design control measures for hazards, and perform related training, as needed and in concert with CESHM. Clients include NAVFAC, TACOM, and several USACE Districts, to include Louisville, Baltimore, and Omaha.

- USACE Omaha District: Removal of MEC at the Demolition and Burning Grounds (DBG), Cornhusker AAP, Grand Island, NE. Served as the Corporate Environmental, Safety, and Health Manager (CESHM) responsible for development and maintenance of CEHS Program and provide S&H direction from Corporate level down to project level. When a PIKA employee was injured by a piece of MEC/UXO processing equipment, he worked with the CSP to evaluate the circumstances, review PIKA's S&H policies/procedures, and aided in the determination as to what happened and how this incident could have been prevented. As a result and though OSHA determined there was no PIKA error or violation, PIKA's safety procedures were revised and protective shields were added to the equipment to inhibit any recurrence of such an incident. Though the incident was defined by OSHA as operator error, an internal review was provided to be certain PIKA was mitigating this risk to the greatest extent possible. *Relevant Project Element: Site Safety and Health Plans, Environmental Monitoring, Reports/Plans.*

- USACE Louisville District: Phase I Time Critical Removal Action (TCRA) and Phase II TCRA and Field Work at the Rocket Ridge Area (RRA) of Open Demolition Area #2 (ODA2), Ravenna Army Ammunition Plant (RVAAP), Ravenna, OH. CESHM/CIH responsible for CESHP implementation, employee training, development and approval of SSHPs, and field audits for the process clearing the area which had been used as a bombing area and a dump site containing both MEC and MEC containing WP. This project includes thermal decontamination using PIKA's thermal convection system (TCS) and responsibilities include development of appropriate safety guidance related to the TCS process. In addition, due to the discovery of previously unknown uranium, thorium, radium, and cesium-137 at the site, provided guidance for the hazardous, toxic, and radiological waste (HTRW) services performed by PIKA personnel and oversaw the updates to the site safety and health plan. *Relevant Project Element: Site Safety and Health Plans, Environmental Monitoring, Reports/Plans*
- USACE Fort Worth District: Disassembly and Decontamination/Demolition of Buildings Containing Asbestos and Mercury, Fort Wingate Activity Depot, Gallup, NM. CESHM, responsible for employee training, development and approval of SSHPs, and field audits to verify that safety plans are properly implemented in the field. Worked very closely with CSP and SSHOs to enforce project safety. Provided oversight and guidance as related to the handling of the HTRW. *Relevant Project Element: Site Safety and Health Plans, Environmental Monitoring, Reports/Plans.*
- Army Field Support Command: Time Critical Cleanup, Transportation and Disposal of Hazardous Wastes/Burn Rubble from Fire at 41-010 at Pine Bluff Arsenal/Pine Bluff, AR. CIH for time-critical cleanup, packaging, and T&D of M825 white phosphorous (WP) canisters, WP contaminated waste, and asbestos contaminated rubble which remained on and around the building pad after a fire. This time-critical emergency response project required mobilization within 3-5 days after notice to proceed, requiring rapid development and approval of the work plan, accident prevention plan, site safety and health plan, and asbestos abatement plan. Responsible for overall health and safety of all PIKA and subcontractor personnel, and ensured integration of appropriate procedures for this highly complex HTW project. Responsible for evaluating the health and well-being of workers in various site environments including the lab, the field, and the office. *Relevant Project Element: Site Safety and Health Plans, Environmental Monitoring, Reports/Plans.*
- TACOM: Explosives Equipment Relocation, Equipment Excessing, Explosives Visual Inspection, and Foundation Testing, Indiana AAP, Charlestown, IN. CIH and has overall responsibility for the health and safety of all PIKA and subcontractor personnel on this project. Responsible for integration of appropriate procedures for this highly complex HTW and explosives decontamination and demolition. Responsible for evaluating the health and well-being of workers in various site environments. Objectives of this project were to perform various equipment disconnects, relocation, inspection and testing, explosives-free equipment disposal, and equipment decontamination prior to land transfers. Specific tasks included: tank disassembly, relocation, and tank replacement; inspection and disposal of cradles, conveyors, and spent acid transfer tank; explosives-free personal property disposal; foundation testing; explosives testing of change house drains; explosives decontamination of ship houses; inspection and disposal of Kentucky trailers; visual inspection of load, assemble, and pack (LAP) area magazines; and explosives testing and decontamination of building 228-1.
Relevant Project Element: Site Safety and Health Plans, Environmental Monitoring, Reports/Plans.
- Corporate Director - Environmental, Safety & Health - Pennzoil Company (1989-1998): Managed the cleanup and site remediation for a Superfund site in New York. Responsible for the removal of hundreds of petroleum, underground storage tanks, and for the remediation of sites contaminated with petroleum hydrocarbons. Directed the cleanup of hydrocarbon-contaminated soils (under RCRA) at several refineries and oil production sites.

ABIH

american board of industrial hygiene®

organized to improve the practice of industrial hygiene
proclaims that

Sarosh J.H. Manekshaw

having met all requirements of
education, experience and examination, and
ongoing maintenance,
is hereby certified in the

COMPREHENSIVE PRACTICE
of
INDUSTRIAL HYGIENE

and has the right to use the designations

CERTIFIED INDUSTRIAL HYGIENIST

CIH

Certificate Number	1491 CP
Awarded:	October 31, 1978
Expiration Date:	June 1, 2020

Nicole Greeson
Chair, ABIH

Chief Executive Officer, ABIH

Attachment 4

PIKA-MP JV Drug and Alcohol Policy

DRUG AND ALCOHOL POLICY

Policy Number: HR.4.06 Date Written: 1/1/98 Date Revised: 6/1/2013

Applicability

All candidates for employment and all employees other than those employed in the state of Maine. For those employed in Maine, a separate policy has been adopted that is in accordance with the requirements set by the state of Maine.

Policy

The purpose of this policy is to promote a safe, healthy, and productive work environment for all employees free from the effects of substance abuse. All employees have been issued upon initiation of this policy or upon hire, a copy of the Drug and Alcohol Policy, describing in detail what substances will be tested for and under what conditions employees will be tested.

Abuse of alcohol, drugs, and controlled substances impairs employee judgment, resulting in increased safety risks, injuries, and faulty decision-making.

To ensure a safe and productive work environment, the company prohibits the use, sale, dispensation, manufacture, distribution or possession of alcohol, drugs, controlled substances, or drug paraphernalia on any company premises, worksites including company owned, leased or rented vehicles, or personal vehicles being used for company business or parked on company or client property. The only exception is for alcohol at company sponsored events, approved in advance by management.

No employee will report to work or be at work with alcohol or with any detectable amount of prohibited drugs in the employee's system. (A detectable amount refers to the standards generally used in workplace drug and alcohol testing).

Employee will, when drugs are prescribed by a medical professional, inquire of the prescribing professional whether the drug prescribed has any side effects that may impair the employee's ability to safely perform the employee's job duties. If the answer from the medical professional is yes, the employee will obtain a statement from the medical professional indicating any work restrictions and their duration. The employee will present that statement to his or her supervisor prior to going on duty.

Illegal use of drugs off duty and off company premises or worksites is not acceptable. It can affect on-the-job performance, the confidence of the public and our customers in the company's ability to meet its responsibilities.

Any violation of this policy will result in termination.

Employee Drug and Alcohol Testing

To promote a safe and productive workplace, ARCADIS will conduct the following types of drug and alcohol testing for all employees:

- Pre-employment;
- Reasonable Suspicion;
- As Clients Require;
- Post-accident (ARCADIS may require post-accident testing as described below).

Categories of Employee Substance Testing

Pre-Employment Testing

Pre-employment – means that applicants offered employment will be required to take a pre-employment drug test. Applicants whose test results are positive will not be hired.

Reasonable Suspicion Testing

An employee will be required to submit to tests for alcohol and/or illegal drugs when the employee is reasonably suspected of being impaired in the performance of his or her job.

1. Reasonable suspicion testing may result from one of the following examples, but is not limited to the following:

    a. Specific, personal, and articulable observations concerning the appearance, behavior, speech or performance of the employee; or

    b. Violation of a safety rule or other unsafe work incident that, after further investigation of the employee's behavior, leads the supervisor(s)/manager(s) to believe that the employee's functioning is impaired; or

    c. Other physical, circumstantial, or contemporaneous indicators of impairment.

2. When a supervisor/manager has reasonable suspicion to request testing, the supervisor/manager will first contact Corporate Human Resources, and then the supervisor/manager will arrange to transport the employee to the alcohol/drug testing facility and will arrange for the employee's transport home.

3. The employee will be paid for the time required to take the alcohol/drug test. Time waiting for results of the alcohol or drug test will be paid if the results of such test are negative. Time waiting for results of the alcohol or drug test will not be paid if the results of such test are positive.

Client-Required Testing

An increasing number of ARCADIS clients are requiring drug and/or alcohol testing for all contractors working on their sites. Employees who do not consent to drug testing or who test positive will not be permitted to enter a worksite for which testing is required. Employees are advised that if they refuse to submit to alcohol/drug testing required by a client or test positive for an alcohol/drug testing, the company will terminate their employment. Testing will be conducted before commencing work on the site. In addition, client-required testing might be conducted 1) randomly, 2) for cause, upon reasonable suspicion of intoxication, or 3) after the occurrence of an accident. Please be aware that some clients require that substances in addition to those listed below be included in the drug screening. Therefore, a copy of each client's substance abuse policy is provided to the test administrator/laboratory to ensure that screens are analyzed for the appropriate substances pursuant to that client's requirements.

Post-Accident Testing

Post-accident testing may be required in the following circumstances:

1. Employee is involved in an on-the-job driving accident that results in injury or death, or
2. Employee is involved in an on-the-job driving accident that results in a citation to the employee under state or local law for a moving traffic violation arising from the accident and when any vehicle requires towing from the accident scene or any involved person requires treatment away from the accident scene. An employee in such an accident is required to report it as soon as possible to the supervisor.
3. Post-accident testing may also be required in any other on-the-job accident.

The kinds of substances tested for will include (but are not limited to) the following substances or their metabolites, plus alcohol:

1. Amphetamines ("speed")
2. Cannabinoids ("marijuana")
3. Cocaine
4. Phencyclidine ("PCP")
5. Opiates ("morphine," "heroin")
6. Ocycodone/Oxycontin (synthetic opiates)
7. Barbiturates ("Amytal," "Seconal")
8. Benzodiazepines ("Valium," "Xanax")
9. Methadone
10. Propoxyphene ("Darvocet")
11. Alcohol

Inspection and Searches

The company may conduct unannounced inspections for violations of this policy in the workplace, worksites, or company premises. Employees are expected to cooperate in any inspection.

Voluntary Treatment

The company supports sound treatment efforts. Whenever practical, the company will assist employees in overcoming drug, alcohol, and other problems that may affect employee job performance, as long as this policy has not already been violated.

Any employee with a problem relating to either drug or alcohol abuse is encouraged to seek professional counseling. Our employee assistance program (EAP) and medical benefits program offer information and professional services. All requests for assistance through the HR Department or the EAP will be kept confidential. Contact information for the EAP is 888-371-1125.

Safeguards/Confidentiality

The drug screen analysis is accomplished through urinalysis testing. Alcohol testing may be through breath testing. Samples will be collected in a sanitary environment designed to maximize employee's privacy while minimizing the possibility of sample tampering. If there is a positive drug and/or alcohol result on the initial screening test, the laboratory or blood alcohol technician will automatically do a second test to confirm the results. The second drug test will be performed using gas chromatography/mass spectrometry or other scientifically accepted method. A positive breath alcohol test will be confirmed by a second breath test.

The employee undergoing reasonable suspicion testing is prohibited from performing any job duties until the results of the test are known.

Disciplinary Action

Testing Positive

Employees who test positive for drugs or alcohol are in violation of this policy and will terminated immediately

Please note that three (3) successive negative dilutes will be treated the same as a positive test result.

Refusal to comply

Employees who refuse required testing are in violation of this policy and will be terminated.

Interference with testing

Employees who adulterate, tamper with or otherwise interfere with accurate testing are in violation of this policy and will be terminated.

Any employee who has been observed using or possessing illegal drugs or alcohol during work time, including lunch breaks, or on ARCADIS or client premises is in violation of this policy and will terminated.

Procedure

Drug Testing

All drug tests will be performed by a government-certified outside laboratory. All government-certified outside laboratories strictly follow chain-of-custody guidelines to ensure the integrity of the testing process. The company will use a Medical Review Officer (MRO), who will receive the laboratory results of the testing procedure. The MRO should be a licensed physician, have knowledge of substance abuse disorders, and have the appropriate medical training to evaluate positive results, medical histories, and any other relevant biomedical information. The MRO will review all medical records made available by the tested individual when a confirmed positive drug test could have resulted from legally prescribed medication.

If the results of the initial test are negative, the testing laboratory will report the results to the MRO. The MRO or the testing laboratory will report the negative results to the ARCADIS Human Resources Department. In this instance, no additional tests on the specimen will be done.

If the results of the initial drug test are positive, a second confirmatory test will be performed. Only specimens that are confirmed positive on the second (confirmatory) test are reported positive to the MRO for review and analysis. The MRO will attempt to contact the employee/candidate personally once per day for three days, after which the MRO will report to the ARCADIS Human Resources Department whether the test results are positive or negative.

An employee who does not pass a drug test may request that the original sample be analyzed again at the individual's expense by a government-certified laboratory. All requests for an independent analysis must be made in writing to the testing laboratory within 72 hours of notification of a confirmed positive test result.

Each employee will have an opportunity to discuss the drug test with a MRO in a confidential setting. Each applicant or employee may request in writing a copy of the positive test result. Upon written request within seven days of taking the test, an employee may access records relating to his or her drug and/or alcohol test.

Because state and local laws regarding drug and alcohol testing vary greatly, it is imperative that the supervisor contact Human Resources to discuss the issue prior to sending the employee for testing.

Alcohol Testing

A positive breath alcohol test will be reported to ARCADIS by the clinic that performed the test. It is not medically necessary for the MRO to review the results of the two breath tests. Therefore, the MRO will not attempt to contact the employee.

It is imperative that the supervisor contact Human Resources to discuss the issue, prior to sending the employee for testing, since state and local laws regarding drug and alcohol testing vary greatly.

For further information regarding this policy, please contact the Human Resources Department.

Attachment 5

Control of Hazardous Energy Procedure

EXECUTIVE SUMMARY

This Health and Safety Standard (HSS) sets forth minimum requirements for ARCADIS personnel to conduct work that involves stored energy sources, and to prevent employees from injuries by controlling the associated hazardous energy and unexpected start-up of equipment by means of Lockout/Tagout (LO/TO) procedures.

This Standard applies:

- To hazardous energy including but not limited to kinetic, electrical, chemical, thermal, hydraulic, gravitational, and pneumatic.
- When servicing or performing maintenance on equipment.
- When required to remove or bypass a guard or other safety device.
- When required to place any part of their body in an area where a danger zone exists during a machine or equipment operating cycle.

Through this standard, ARCADIS requires:

- Development of a LO/TO plan prior to initiating the energy isolation process.
- ARCADIS staff to use the Permit to Work process, as outlined in Exhibit 3.
- Use of a lockout device and an attached tag on all isolating devices capable of being locked out or accepting lockout devices.
- At a minimum, the use of a tagout system designed to provide full employee protection against equipment start-up, if an energy isolating device is not capable of being locked out.
- Only Authorized personnel are to initiate Lockout/tagout isolation procedures.
- Notification of all affected personnel prior to equipment deactivation and isolation, and also prior to equipment reactivation after isolation measures have been removed.
- Those authorized to perform energy isolation will use their own locking device.
- Authorized Person(s) are to conduct a periodic inspection of their energy control procedure(s) **at least annually** to ensure that the requirements of the established energy control procedure and the LO/TO standard are being followed. The periodic inspection (LO/TO Task Improvement Process – TIP) shall be performed by an authorized employee other than the ones(s) utilizing the energy control procedure being inspected.
- Awareness level training of all affected employees who work in areas or with equipment where Lockout/Tagout will be performed, in order to recognize the hazards of energized and locked or tagged out equipment, and to understand the basic requirements of Lockout/Tagout.

1. POLICY

It is ARCADIS policy to be proactive in the identification, assessment and control of health and safety hazards and associated risks. To those means, any equipment that utilizes or stores hazardous energy will be controlled following this standard at any time ARCADIS staff or its subcontractors must perform maintenance on this equipment. Whenever possible, ARCADIS will de-energize equipment before performing maintenance, troubleshooting, or other activities where hazardous energy is present. When controlling hazardous energy, this standard, at a minimum will be strictly followed.

When fulfilling the Authorized Employee role, ARCADIS will provide the necessary equipment to isolate, secure or block unexpected energization of equipment. This equipment includes but is not limited to locks, tags, chains, wedges, key blocks, plug lockouts, adapter pins, self locking fasteners or other hardware for isolating, securing or blocking of machines or equipment to prevent incidents involving hazardous energy.

2. PURPOSE AND SCOPE

2.1 Purpose

This Health & Safety standard (HSS) details the administration and necessary provisions for protecting employees from injuries associated with hazardous energy release, and unexpected start-up of equipment.

2.2 Scope

This standard applies to all ARCADIS employees and on all projects where equipment that utilizes hazardous energy is present and maintained by ARCADIS staff. ARCADIS subcontractors must have LO/TO programs that meet the minimum requirements of this standard.

Only trained and authorized personnel are permitted to use procedures outlined here for locking or tagging out equipment to ensure it does not unexpectedly energize and/or start while an Authorized person is performing maintenance or service activities. This standard applies specifically to employees that operate, service or maintain equipment requiring the removal or by-passing of a machine guard or protective enclosure. In addition, it applies to personnel who must place any part of their body in a place where the accidental energization of equipment, release of stored energy, or release of stored hazardous materials may cause injury.

ARCADIS US staff who design and develop equipment and processes that require energization, must do so to allow for LO/TO and include information as to how to LO/TO such equipment or processes.

If any device must be worked on in an electrically energized capacity, the work will be done following the ARCADIS Electrical Safety Standard (ARC HSFS006). If other energized equipment must be worked on in an energized state, contact Corporate H&S or the client H&S resource for guidance.

3. DEFINITIONS

Definitions relating to LO/TO can be found in **Exhibit 1**.

4. RESPONSIBILITIES

4.1 Corporate H&S with Division and Practice Experts

On an annual basis, review and update, as necessary, this standard. In addition, corporate health & safety along with division and practice expert staff shall:

- Review LO/TO procedures in the field periodically using the Task Improvement Process (TIP) to ensure conformance to this standard;
- Provide and/or coordinate the initial LO/TO training and retraining, and/or recommend qualified training provider, to staff based on needs;
- Provide technical assistance regarding LO/TO processes; and
- As requested, assess project-specific LO/TO programs for compliance with this HSS.

4.2 Principal in Charge (PIC), Project Manager (PM), and Task Manager (TM)

Are responsible to:

- Verify that LO/TO protocols are properly identified and addressed within the project work plan, project health & safety plan, and/or other project-related documents.
- Verify that their project team employees have received the proper LO/TO training provided by Corporate Health & Safety or qualified training source prior to conducting LO/TO activities.
- Verify that the proper LO/TO equipment, including PPE, electrical testing equipment and safety equipment, is available for use by their project employees.

4.3 Health and Safety Plan Writers and Reviewers

Reference this standard as guidance and regulatory requirements to ensure the appropriate identification, assessment and control of equipment with hazardous energy for documentation in project HASPs.

4.4 Authorized Employees

Authorized employees must have training and instruction in their duties and responsibilities regarding LO/TO. Authorized employees must:

- Recognize the hazards which may be faced during LO/TO activities.
- Develop an equipment specific LO/TO procedure for the specific LO/TO work to be done.
- Conduct a periodic inspection of energy control procedure **at least annually** to ensure that the requirements of the established energy control procedure and the LO/TO standard are being followed:

- The periodic inspection shall be performed by an authorized employee other than the ones(s) utilizing the energy control procedure being inspected;

- The periodic inspection shall be conducted to correct any deviations or inadequacies identified;

- Where lockout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized employee, of that employee's responsibilities under the energy control procedure being inspected; and

- Where tagout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized and affected employee, of that employee's responsibilities under the energy control procedure being inspected, and the elements set forth in the standard.

Note: The Authorized Person conducting the inspection must document that the periodic inspections have been performed. This certification shall identify the machine or equipment on which the energy control procedure was being utilized, the date of the inspection, the employees included in the inspection, and the authorized person performing the inspection. The periodic inspection documentation can be achieved by using the TIP (task observation) process, Project H&S Conformance Assessement form or similar.

- Follow the requirements of this HSS, the project HASP, JSAs and any other specific LO/TO procedures applicable to the work being done.

- Use the appropriate and applicable PPE and testing equipment that has been provided.

- Conducting periodic inspections using the TIP process.

Information about ARCADIS Authorized LO/TO staff can be obtained from the ARCADIS Training Team.

4.5 Affected Employees

Affected Employees are responsible to:

- Understand the hazards of energized and de-energized equipment.

- Follow the instructions provided by supervisors and authorized employees who are conducting LO/TO work.

- Acknowledge LO/TO hazardous energy control work by reviewing and signing the Permit to Work.

- Not tamper with or remove LO/TO devices.

- Not perform servicing or maintenance on a machine or piece of equipment which is locked or tagged out. Servicing or maintenance work on a piece of equipment that is locked out/tagged out can only be conducted by an Authorized Employee.

4.6 All ARCADIS Employees

Use the TRACK process regularly and frequently. In addition, read and understand all hazard identification and risk assessments conducted using the HARC process as documented in HASPs, JSAs, and other written plans that are associated with their work. ARCADIS employees will:

- Participate in entry operations only if trained and authorized to do so;
- Never tamper with equipment that is under LO/TO control; and
- Never attempt to work on energized or de-energized equipment without appropriate training and authorization

5. PROCEDURE

LO/TO procedures are used to control energy hazards associated with service and maintenance of equipment which uses hazardous energy to operate. This Standard applies to all types of energy including kinetic, potential, electrical, chemical, thermal, hydraulic, gravitational, and pneumatic. The HSS applies when servicing or performing maintenance on equipment and during normal production operations if personnel are:

- Required to remove or bypass a guard or other safety device, or
- Required to place any part of their body in an area where a danger zone exists during a machine or equipment operating cycle.

Note: Requirements of this standard do not apply when Work on cord and plug connected electric equipment for which exposure to the hazards of unexpected energization or start up of the equipment is controlled by the unplugging of the equipment from the energy source and by the plug being under the exclusive control of the employee performing the servicing or maintenance.

5.1 General Requirements

An Energy Control Program is developed to ensure that before service or maintenance of equipment is performed, the equipment is isolated from its energy source and made inoperable so that unexpected energizing, startup or release of stored energy during equipment service and maintenance is prevented. This program can be developed as part of the project HASP, a JSA, or specific LO/TO procedure to include the requirements of this Standard and our clients.

Prior to initiating the LO/TO process, ARCADIS employees will complete and use the Permit to Work (refer to Exhibit 3).

5.2 Equipment List

5.2.1 Hardware

ARCADIS will provide, as necessary to execute project work, locks, tags, chains, wedges, key blocks, plug lockouts, adapter pins, self locking fasteners or other hardware for isolating, securing or blocking of machines or equipment to control energy sources.

5.2.2 Lockout/Tagout Devices

Lockout devices and tags are color coded and issued by ARCADIS, and are the only device(s) used for controlling energy. LO/TO Locks and tags must not be used for other purposes. All locks and tags provided by ARCADIS are capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected. Locks and tags are of substantial construction in order to prevent inadvertent or accidental removal. All tags are required to be marked to identify the employee applying the lock(s)/tag(s).

5.2.3 Lockout/Tagout Tags

Only standard “Danger – Do Not Operate” (black, red and white) tags will be used. Tags are constructed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible. Tags will warn against hazardous conditions if the machine or equipment is energized, and will include a legend such as the following: “Do Not Start,” “Do Not Open,” “Do Not Close,” “Do Not Energize,” or “Do Not Operate,” depending on application. Used tags are to be destroyed and the tags will not be re-used unless designated for re-use.

5.2.4 Energy Isolating Devices

When replacement or major repair, renovation, or modification of a machine or equipment is performed, and when new machines or equipment are installed, energy-isolating devices designed to accept a lockout device for such machines or equipment will be installed. If equipment for de-energizing is in a confined space, the confined space will be cleared of all employees prior to testing the energy source for de-activation.

5.3 Safety Procedures for Lockout/Tagout and Isolation

ARCADIS requires the use of a lockout device and an attached tag on all isolating devices capable of being locked out or accepting lockout devices. If an energy isolating device is not capable of being locked out, ARCADIS requires the use of a tagout system designed to provide full employee protection against equipment start-up. When a tagout device is used on an energy-isolating device, the tag shall be attached at the same location that the lockout device would have been attached. Additional precautions will be implemented to provide a level of safety equivalent to that obtained by using a lockout device. Additional safety measures may include such steps as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or removal of a valve handle to reduce the likelihood of inadvertent energization.

Lockout/tagout isolation procedures will be initiated only by authorized personnel. Personnel not trained in lockout/tagout procedures are not authorized to install, inspect, repair, adjust, remove, maintain or service equipment where the potential for injury due to accidental start-up, energization, or release of stored energy exists.

All affected personnel must be notified prior to equipment deactivation and isolation and must be notified prior to equipment reactivation after isolation measures have been removed. Personnel involved with lockout/tagout isolation of equipment shall receive information concerning the specific type and magnitude of energy or hazardous material involved, the hazards involved, and the method of control to be utilized.

Authorized personnel shall de-energize equipment by following a procedure developed specifically for the equipment involved and consistent with this Standard and OSHA 29 CFR 1910.147 or other applicable laws and client requirements.

Prior to performing any work on equipment, all isolation devices shall be in place. Locks and tags shall be affixed to each energy-isolating device by authorized personnel. These must secure the isolated equipment in the “off” position. Each person involved with servicing the isolated equipment shall attach a lock to the isolating device. In situations involving two or more persons, multiple lock hasps shall be utilized. **Tags shall be attached with all locks and must identify the authorized individual responsible for each lock, must be signed, dated and must have the name of the contractor with which the employee is employed.**

All potentially stored or residual energy must be released, relieved or disconnected. If there is a potential of accumulation, verification of isolation shall be conducted and documented throughout the project (see the next section).

Prior to work, authorized personnel shall verify and document that the equipment has been disengaged, de-energized, and isolated. Release of lockout/tagout isolation includes (see Template for Equipment Specific LO/TO Procedure in **Exhibit 2**) :

- The work area and equipment shall be inspected to ensure that non-essential items (i.e., tools) are not left in the work area and that the equipment is intact
- The work area shall be checked to ensure that all personnel are clear. Before lockout/tagout devices are removed, affected personnel shall be notified
- Removal of lockout/tagout devices shall be performed by the authorized personnel who attached the devices

If a machine must be re-energized after initial isolation (i.e., for testing or repositioning), then lockout/tagout procedures must be followed as outlined to re-isolate the equipment.

During shift or personnel changes, transfer of control will occur between authorized personnel only. If an authorized person must leave the site, then he/she must remove his/her locks and tags. The new authorized person will then immediately place his/her locks and tags on the equipment and complete the entire lockout/tagout procedure as outlined above.

Use of tagout procedures without the use of locks can only be utilized if the equipment to be de-energized will not accept a lock and the following conditions are met:

- Tagout procedures will provide protection to personnel equivalent to the use of locks
- Additional measures, sufficient to ensure protection of employees, are taken to prevent accidental start-up or energization
- If equipment for de-energizing is in a confined space, the confined space will be cleared of all employees prior to testing the energy source for deactivation

5.4 General Lockout Tagout

Specific LO/TO procedures will be developed for each piece of energized equipment requiring maintenance or service. These specific procedures can be developed on the form found in Exhibit 2 of this Standard. If a client has specific written lockout/tagout procedures for its facility equipment with which employees of ARCADIS are working, the procedure will be reviewed and used or revised by ARCADIS, as appropriate.

The following information provides general LO/TO procedures to be used for the development of equipment specific procedures.

5.4.1 Lockout/Tagout Sequence

- The authorized employee(s) shall notify all affected employees prior to the shutdown and isolation of the equipment/machine. Affected employees should be informed of the reason for shutdown and approximate length of time required for servicing or maintenance.
- The authorized employee(s) shall review the type(s) and magnitude(s) of energy present and the hazards present.
- If the machine/equipment is operating, the authorized employee(s) shall have the machine/ equipment operator explain the standard shutdown procedure and then shut it down according to the procedure.
- The energy isolating devices shall be deactivated so the machine/equipment is isolated from the energy source(s).
- Each isolating device shall be locked out and tagged out. If lockout is not feasible, only tagout of the isolating device will be conducted, and additional precautions will be required to provide employee protection equivalent to the protection provided when lockout procedures are utilized. Each authorized person conducting activities on the equipment/machine shall attach a(n) [individually assigned] safety lock to each isolating device. A standard tag shall also be attached to each individual's lock that identifies, by name, the authorized employee responsible for each lock. Stored or residual energy must be released or dissipated from each system to reach a zero energy state. Visual inspection shall be made to confirm that all moving parts have stopped. Any stored or residual energy shall be drained, blocked, repositioned, restrained, or bled. Electrical circuits shall be grounded to discharge electricity stored in capacitors.
- To ensure that the equipment is completely isolated from the energy source(s), it is necessary to test the equipment to make certain that it will not operate. The following methods shall be used to test the equipment.
- Check the area and equipment to assure that no personnel are exposed to the start-up of equipment
- Activate all start-up devices and operating controls
- Use tic-tracers or voltage indicators to test electrical circuits
- Return all operating control(s) to the neutral or off position after verifying the isolation of the equipment

5.4.2 Release of Lockout/Tagout and Return of Equipment to Service

When the equipment/machine is ready to be returned to service at the conclusion of work activities, the following steps shall be taken to safely return equipment to service:

- Check the machine/equipment and immediate area to ensure that non-essential items and tools have been removed
- Check to ensure that all guards and covers have been replaced
- Check to ensure that all employees are safely positioned or have left the area
- Check to ensure that all operating controls are in the neutral or off position
- All authorized employees shall personally remove their individual locks and tags from the isolation devices and destroy used danger tags unless tags are designed for reuse
- All affected employees must be notified that the work activities are completed and the equipment/machine is ready for use

If work activities are not completed prior to a shift ending (or other personnel change), then the procedures in “Transfer of Lockout/Tagout During Shift and Personnel Changes” (below) must be followed.

5.4.3 Transfer of Lockout/Tagout During Shift and Personnel Changes

The supervisor shall designate an authorized employee who shall control the lockout/tagout devices at the end of a shift and shall be responsible for transferring lockout/tagout authority to the next shift.

The designated authorized employee shall not remove his/her lock from any of the isolation devices until at least one of the arriving authorized employees has locked out and tagged out all of the isolation devices.

If the arriving authorized employees assuming responsibility for lockout/tagout do not attach locks prior to the previous shift employees removing all of their locks, then the employees assuming lockout/tagout authority shall repeat the entire lockout/tagout sequence.

5.5 Group Lockout/Tagout

Authorized employees shall obtain specific site lockout instructions from the project manager or designee and shall coordinate extended lockout requirements with the project manager or designee. When more than two employees are involved in work activities on the machine or equipment covered by this Standard, each authorized employee will attach a lock to a multi-lock hasp on each isolation device.

When group lockout/tagout is used, the last authorized employee with a lock attached to isolation devices will be responsible for removing the isolation devices and restoring equipment to use conditions according to the equipment-specific or general HSS.

When more than one crew, trade, or contractor, etc, is used on a project that requires equipment lockout/tagout, one specific employee shall be designated to coordinate affected work forces and to ensure continuity of protection.

5.6 Employee Unavailable to Unlock

If the employee who installed a locking device is not available, the following procedure shall be used to unlock the device(s).

- The individual requesting device removal will attempt to contact the authorized employee via cell phone, hotel phone or home phone and request the employee return to remove the device. If the authorized employee is contacted but can not come in, the status of the locked equipment will be documented and the requesting entity notified of the equipment status. All of the above to include unanswered attempts at contact will be documented. If contact is not made, a message will be left to indicate that the locking device will be removed. Upon removal a red warning tag will be left where the device was placed indicating to the authorized employee that the device was removed and the equipment is now energized.

- The Project Manager or designee will verify that the authorized employee is not at the facility and is not potentially in harms way relative to the affected equipment.

- The Project Manager or designee will notify the Division Director of H&S or the client H&S resource of the reason for device removal and the status of the affected employee.

- The device shall be removed after verifying that no employees are in harms way.

- The entire sequence of events will be documented in the form of a memorandum addressed to the Division Director of H&S.

5.7 Additional Precautions

- All energy sources must be isolated and locked out. Be aware that there can be more than one energy source.

- Additional safety precautions must be taken in situations where only a tag can be used.

- Stored energy must be released or isolated after applying lockout/tagout devices.

- Make sure that all tools and equipment are removed from the work area prior to removing lockout/tagout devices and restoring energy.

6. TRAINING

All affected employees who work in areas or with equipment where or on which LO/TO will be performed will be trained in awareness level training as provided by ARCADIS in order to recognize the hazards of energized and locked or tagged out equipment and to understand the basic requirements of LO/TO.

Training provided to Authorized Employees will be offered as approved by the Corporate H&S Training Department. In addition, staff who wish to be considered as an Authorized Employee must obtain equipment specific hands-on instruction from an Authorized person for the equipment he or she will work on, and participate in a lockout/tagout TIP as the Observee to verify that they understand the concepts and requirements of lockout/tagout.

Documentation of training certification received by attendance at any training course including externally provided training courses will be kept by the employee with copies provided to the Training Department.

Retraining is required when there is a change in job assignments, machines, or the energy control procedures, or a new hazard is introduced. Documentation of this retraining is accomplished by working with the vendor or supplier to complete or revise Exhibit 2 for the relevant piece of equipment. This revised form is then attached to the Lockout/Tagout Permit to Work and both are reviewed with applicable staff prior to LOTO activity.

7. REFERENCES

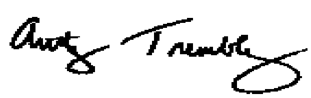
- ARCADIS Health and Safety Standard ARC HSFS010– Health and Safety Planning
- ARCADIS Health and Safety Standard ARC HSFS003 – Confined Space Entry
- ARCADIS Health and Safety Standard ARC HSFS006 – Electrical Safety
- OSHA 29 CFR 1910.147, The Control of Hazardous Energy

8. RECORDS

- Training records will be kept by the individual employee with copies of such certificates kept by the ARCADIS Training Team.
- Specific LO/TO procedures and JSAs will be kept with project files or in the 4 Sight database.
- Copies of all HASPs that document LO/TO procedures will be kept in the project files.
- Completed Permit(s) to Work detailing hazardous energy control shall be kept readily available for examination at the project location and thereafter shall be kept on file for a period of 1 year.
- Lockout/Tagout Inspection Checklists will be kept in the project files.

9. APPROVALS AND HISTORY OF CHANGE

Approved By: Tony Tremblay, CSP - Infrastructure Division Director of Health & Safety



History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
1 October 2008	01	Mike Thomas / Michael Ramer	Original document
26 February 2009	02		Corrected title and document number in the Exhibit
6 October 2010	03		Addition to section 6.0
28 February 2011	04		Reviewed and Updated to new Standards Format. Added Executive Summary Section.
1 August 2011	05		Updated training section to reflect live offering
14 March 2012	06	Brent Oakeson/ Tony Tremblay	Standard Reviewed; Section 5.6, bullet 3 reference changed to Authorized Employee; Definitions moved to Exhibit 1
13 April 2012	07	Tony Tremblay	Replaced terminology JLA to JSA
16 October 2012	08	Pat Vollertsen/Tony Tremblay	Section 5 - clarified that plug connected electric equipment may be exempt from this LO/TO HSS; Revision of section 6.0; LO/TO Permit to Work (refer to Exhibit 3) process instituted; Permit to Work record keeping detailed in Section 8; Exhibit 5 Exchange of Information form added
15 February 2013	09	Tremblay/Vollertsen	Inserted statement that Authorized Person(s) to conduct a periodic inspection of their energy control procedure(s) at least annually into Executive Summary, Section 4.4 and Exhibit 2 – Equipment Specific LO/TO Procedure; Added reference to locating information about Authorized LO/TO staff from the Training Team into Section 4.4
20 February 2013	10	Pat Vollertsent/Tony Tremblay	Section 6 Retraining clarified

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
25 November 2013	11	Tony Tremblay	Section 1 Policy, Clarified that when fulfilling the Authorized Employee role, ARCADIS will provide the necessary equipment to isolate, secure or block unexpected energization of equipment; Section 4.5 Affected Employee, now includes anote that Affected Employees CAN NOT service or maintain a piece of equipment that has been locked out/tagged out; Section 5.2 bullets renumbered; Section 7 OSHA Control of Hazardous Energy reference - hyperlink added; Exhibit 1: Clarified Affected Employee definition, so staff understand that they CAN NOT service or maintain a piece of equipment that has been locked out/tagged out; Authorized Employee definition includes more detail; Servicing or Maintenance definition added
13 August 2014	12	Tony Tremblay	Removed references to Qualified Employee and replaced with Authorized Employee to match terminology with OSHA standard. Exhbit 3 and 5 references to Qualified Employee changed to Authorized Employee; Authorized Employee definition had training requirments added

Exhibit 1 – Definitions

Affected Employee operates or uses equipment that is subject to lockout/tagout procedures or works around or in the vicinity of equipment subject to lockout/tagout processes.

Note: An affected employee becomes an authorized employee when the affected employee's duties are enlarged to include performing servicing or maintenance on a machine or piece of equipment which must be locked or tagged out. See the definition of an *Authorized employee* below. Before performing service or maintenance on a piece of equipment that is locked or tagged, that employee must receive the training detailed in Section 6 of this standard.

Authorized Employee is someone who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. Each authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control. ARCADIS Training Team maintains a list of LO/TO Authorized Employees.

Energy Isolation Device is a mechanical device that physically prevents the transmission or release of energy. It does not include control circuit type devices, but rather physical devices that control circuit operation designed to accept a lockout device. They are installed when replacement or major repair, renovation, or modification of a machine or equipment is performed, and when new machines or equipment are installed.

Hazardous Energy covered by this standard includes, but is not limited to:

- Electrical
- Mechanical
- Hydraulic
- Pneumatic
- Chemical
- Thermal
- Gravitational (stored)
- Pressure (stored)
- Hazardous materials

Lockout Device is a device that utilizes a positive means, such as a lock, chain, block, etc. to hold an energy-isolating device in a safe position ensuring that the energy isolating device and equipment cannot be operated.

Servicing and/or maintenance are workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the *unexpected* energization or startup of the equipment or release of hazardous energy.

Tagout Device is a prominent warning device, such as a tag, to indicate that the isolating energy device and equipment may not be operated.

Exhibit 2 – Template for Equipment Specific LO/TO Procedure

LOCKOUT/TAGOUT PROCEDURE

ARCADIS Office: ______________________________

Written By (Name/Job Title): _____________________ Date Written:__________________

Revised By (Name/Job Title): _____________________ Date Revised:_________________

INTRODUCTION

This procedure is specific to machines/equipment with an energy source and covers the safety rules and procedures to follow while installing, servicing or performing maintenance on any equipment or machines in which unexpected energization or start up, or release of stored energy could cause injury to employees. This procedure includes the following machine(s)/equipment(s):

- **[machine/equipment name or description]**
- **[machine/equipment name or description]**
- **[machine/equipment name or description]**

The circuits that energize the equipment or machines will be locked with a personally assigned lock and a disposable tag per the ARCADIS Control of Hazardous Energy (Lockout/Tagout) Standard-ARC HSFS004.

PURPOSE

This procedure establishes the minimum requirements for the lockout of energy isolating devices whenever maintenance or servicing is performed on machines or equipment. It shall insure that the machine or equipment is stopped, isolated from all potentially hazardous energy sources and locked out before any servicing or maintenance where the unexpected energization or start-up of the machine or equipment or releases of stored energy could cause injury.

Prior to initiating the LO/TO process, ARCADIS employees will complete and use the Permit to Work.

COMPLIANCE

All employees are required to comply with the limitations and restrictions imposed on them during the use of this lockout/tagout procedure. The authorized employees are required to perform the lockout/tagout in accordance with this standard. All employees, upon observing a machine or piece of equipment which is locked/tagged out to perform servicing or maintenance shall not attempt to use that machine or equipment. This standard is written in accordance with the Occupational Safety and Health Administration (OSHA) Standard 1910.147.

Any person who willfully violates this standard is subject to disciplinary action including termination.

An Authorized Person shall conduct a periodic inspection of this energy control procedure **at least annually** to ensure that the requirements of this energy control procedure and the LO/TO standard are being followed.

SEQUENCE OF LOCKOUT/TAGOUT

Prior to removing a **machine/equipment** from service for servicing or maintenance the following steps shall be taken.

1. Notify all affected employees that servicing or maintenance is required on a machine or piece of equipment and that the machine or equipment must be shut down and locked/tagged out to perform the servicing or maintenance. In addition, all other employees, whose work operations are or may be in an area where energy control procedures may be utilized, shall be instructed about the procedure and about attempts to restart or energize machines or equipment which are locked out or tagged out.
2. The authorized employees (e.g.__________________) shall refer to the manufacturer's manual to identify the type and magnitude of the energy source that the machine or equipment utilizes, shall understand the hazards of the energy source, and shall know how to control the energy.
3. If the machine or equipment is operating, shut it down through the normal procedures as specified in the manufacturer's manual.
4. Deactivate the electrical energy isolating device so that the machine or equipment is isolated from the energy source. Most equipment and machines that require this procedure have a separate circuit box that can be locked/tagged out for that specific piece of equipment or machine.
5. Lock/tag out the energy isolating device with an assigned individual lock and disposable red tag. The (e.g.__________________) will place the first lock followed by the mechanical assembly supervisor or designee.
6. Any stored or residual electrical energy must be dissipated or restrained by the (e.g.__________________) first and then the (e.g.__________________).
7. Ensure that the equipment is disconnected from its energy source. Make sure no personnel are or will be exposed; then verify the isolation of the equipment by attempting to operate through the normal controls. CAUTION: The operating controls must be returned to the neutral or "off' position after verification of isolation.
8. The machine/equipment is now locked/tagged out and servicing or maintenance can proceed.

RESTORING EQUIPMENT TO SERVICE

1. After servicing or maintenance is completed and the **machine/equipment** is ready to be returned to normal operation, the following steps shall be taken.
2. Check the **machine/equipment** and the area immediately around the **machine/equipment** to ensure that non-essential items have been removed and the **machine/equipment** and/or components are operationally intact.
3. Check the area to ensure that all non-essential personnel are in a safe place or are well clear of the area.
4. Verify that all operating controls are in the "off" position or are in neutral.
5. Remove the lock/tag out devices. The (e.g.__________________) will remove his lock first

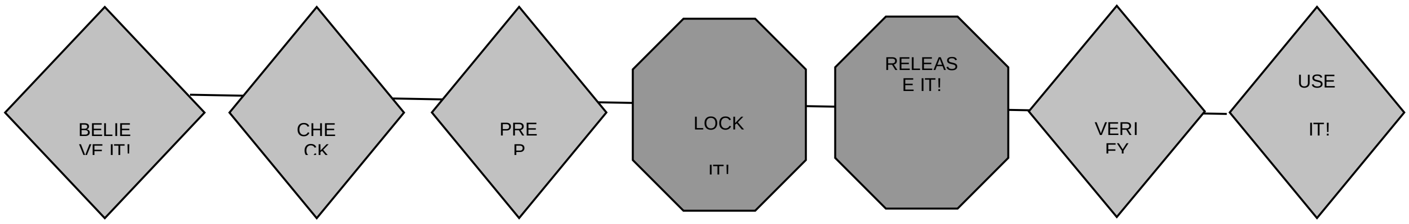
followed by the (e.g.__________________).

6. Notify affected employees that the servicing or maintenance has been completed and that the **machine/equipment** is ready for use.

7. Re-energize the **machine/equipment.**

ARCADIS Infrastructure, environment, facilities

Lockout / Tagout Equipment-Specific Energy Control Procedure



Equipment Identification:

____

____

Hazardous Energy Source		Isolation Device			Verifying Lockout
Type and Magnitude	**Function**	**Type**	**Location**	**I.D. No.**	**Means of Verification of Lockout**
Electrical (i.e., 120, 220, 480)					
Pneumatic					
Hydraulic					
Mechanical					
Potential Energy (springs, tension, etc.)					
Gravity					
Chemical					
Other					
Other					

Area:	**Date of Last Review:**	**Authorized Person:**

Exhibit 3 – Equipment Lockout/Tagout Permit to Work

ARCADIS
Infrastructure · Water · Environment · Buildings

Equipment Lockout / Tagout Permit to Work

Equipment:		**On-Site Location:**	
Name of Authorized Person in Control of LO/TO Process:		Name of Authorized Person that Applied Equip Isolation Device:	
Name of Affected Persons receiving notification / copy of this permit:		Name of Authorized Person that verified Hazardous Energy Source is controlled:	
Start Date for LO/TO Procedure:		Estimated Start Time for LO/TO Procedure:	
Estimated Date of Completion for LO/TO		Estimated Completion Time for LO/TO Procedure:	

TRACKing the LO/TO Work Permit

THINK THROUGH THE TASK

Job Task: (Brief summary of what hazardous energy control work is proposed)

WORKFORCE INVOLVED/AFFECTED BY LO/TO WORK		Check all the apply						
Name	Company	LO/TO Authorized Person	Energized Electrical Authorized	Affected Employee	Can Work Alone	Short Service Employee	Additional Training Required	Supervision Required
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐	☐	☐
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Comments/Additional Details:

RECOGNIZE THE HAZARDOUS ENERGY SOURCE (check all that apply) and ASSESS THE RISK (Low-Moderate-High)

YES	NO	Type of Hazardous Energy	SELECT↓	YES	NO	Type of Hazardous Energy	SELECT↓
☐	☐	Electrical		☐	☐	Thermal	
☐	☐	Mechanical		☐	☐	Gravitational (Stored)	
☐	☐	Hydraulic		☐	☐	Pressure (Stored)	
☐	☐	Pneumatic		☐	☐	Hazardous Material	
☐	☐	Chemical		☐	☐	Other Hazard	

Rev. 12_13August2014 LO/TO Permit to Work pg. 1 of 2 Retain on site with equip log for a period of 1 year

ARCADIS
Infrastructure · Water · Environment · Buildings

CONTROL THE WORKING ENVIRONMENT

	YES	NO		YES	NO
Developed an Equipment LO/TO Procedure	☐	☐	Equipment reduced to zero energy state	☐	☐
Identified all hazardous energy sources	☐	☐	Equipment isolation tested/verified	☐	☐
Notified affected employees	☐	☐	Work Task can be performed without risk to others	☐	☐
Equipment has been removed from service	☐	☐	Project/Task Manager and/or client, as required, notified when equipment is available for use again	☐	☐
Equipment has been isolated	☐	☐	LO/TO devices are returned to proper storage	☐	☐
LO/TO devices applied	☐	☐	Copy of Permit to Work placed into project folder	☐	☐

Notes/Comments (Explain Control Work Environment - No responses; Use Stop Work Authority):

LO/TO POINTS ISOLATED BY AUTHORIZED PERSON(S)

Hazard	Action Required	Lock ID / #	Authorized Person Name	Date LOTO Applied	Date LO/TO Removed

EMERGENCY CONTACT LIST

Emergency Contact:	Phone 1:	Phone 2:	Location:
Local Police:			
Local Ambulance:			
Local Fire Dept.			
Project Manager:			
Site Safety Officer:			
Client Contact:			
H&S Manager:			
Work Care	800-455-6155		

***Include any Task Specific JSA's with this permit to work.**

KEEP H&S FIRST IN ALL THINGS

I understand the nature of the work for this permit, and certify that this permit meets the requirements specified in the ARCADIS LO/TO Standard.

APPROVAL OF LO/TO WORK PERMIT- By ARCADIS LO/TO Authorized Person:

Name: ______________________________ Office Location: ______________________________

Title: ______________________________ Date: ______________________________

Exhibit 4 – Lockout/Tagout Inspection Checklist

	Is all machinery or equipment capable of movement, required to be de-energized or disengaged and locked-out during cleaning, servicing, adjusting or setting up operations, whenever required?
	Where the power disconnecting means for equipment does not also disconnect the electrical control circuit:
	Are the appropriate electrical enclosures identified?
	Is means provided to assure the control circuit can also be disconnected and locked-out?
	Is the locking-out of control circuits in lieu of locking-out main power disconnects prohibited?
	Are all equipment control valve handles provided with a means for locking-out?
	Does the lock-out procedure require that stored energy (mechanical, hydraulic, air, etc.) be released or blocked before equipment is locked-out for repairs?
	Are appropriate employees provided with individually keyed personal safety locks?
	Are employees required to keep personal control of their key(s) while they have safety locks in use?
	Is it required that only the employee exposed to the hazard, place or remove the safety lock?
	Is it required that employees check the safety of the lock-out by attempting a startup after making sure no one is exposed?
	Are employees instructed to always push the control circuit stop button immediately after checking the safety of the lock-out?
	Is there a means provided to identify any or all employees who are working on locked-out equipment by their locks or accompanying tags?
	Are a sufficient number of accident preventive signs or tags and safety padlocks provided for any reasonably foreseeable repair emergency?
	When machine operations, configuration or size requires the operator to leave his or her control station to install tools or perform other operations, and that part of the machine could move if accidentally activated, is such element required to be separately locked or blocked out?
	In the event that equipment or lines cannot be shut down, locked-out and tagged, is a safe job procedure established and rigidly followed?

Exhibit 5 – Lockout/Tagout Exchange of Information Documentation

The LO/TO standard requires that ARCADIS exchange energy control procedures with outside employers who service and/or maintain equipment/machines owned by ARCADIS that require LO/TO. ARCADIS staff will use this form to notify all parties that they must comply with any identified restrictions and prohibitions, as outlined below. This form should be completed by an ARCADIS Authorized LO/TO staff person in conjunction with the outside employer's LO/TO Authorized representative. This exchange of information must occur before service/maintenance activities begin on ARCADIS-owned equipment. If ARCADIS staff will also be working on this equipment or in surrounding areas, then attach this documentation form to the Equipment Specific LO/TO Procedure and the LO/TO Permit to Work.

1. **Identification of Outside Employer(s):**

   Company:____

   Name:____

   Address:____

____

   Telephone #:______________________________________

2. **Identify Location of Equipment:**______________________________

   Identify Equipment/Machine to be serviced:____________________________

   Hazardous energy control procedures for the equipment/machine have been exchanged?______________
   (No response would trigger Stop Work Authority)

3. **After comparing the ARCADIS and Outside Employer LO/TO programs/procedures, identify any specific restrictions/prohibitions or procedural steps below:**

____

____

4. **Affected Persons (listed below) shall review, understand and comply with the above-identified specific restrictions/prohibitions or procedural steps.**

Printed Name	Signature

5. **Acknowledged acceptance of the provisions of this exchange of information form:**

Outside Employer Representative:______________________________ ______________
(LO/TO Qualified) (Signature) (Date)

ARCADIS Authorized LO/TO Staff:______________________________ ______________
(Signature) (Date)

Appendix D

Long-Term Monitoring Plan
Update

Long-Term Monitoring Plan Update

Main Manufacturing Area (WVAA-32)
Siberia Area (WVAA-25)

Watervliet Arsenal
Watervliet, New York

April 2016

Contract No.: W912DR-12-D-0007
Delivery Order No.: 0007

Prepared For:

U.S. ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT
10 South Howard Street
Baltimore, Maryland 21201-2536

Prepared By:

PIKA-MP JV LLC
12723 Capricorn Drive, Suite 500
Stafford, Texas 77477

LTM Plan Update

Installation Restoration Program
Watervliet Arsenal
Watervliet, New York

Andy Vitolins, PG
JV Project Manager

Stefan Bagnato, PG
Task Manager

Prepared for:
US Army Corps of Engineers
Contract No. W912DR-12-D-0007
Delivery Order 0003

Prepared by:
PIKA - MP JV LLC
12723 Capricorn Drive, Suite 500
Stafford, Texas 77477

Our Ref.:
06261067.0000

Date:
April 21, 2016

FOR OFFICIAL USE ONLY

Figures

Tables

Acronyms and Abbreviations

ASP	Analytical Services Protocol
bgs	Below Ground Surface
cDCE	Cis-1,2-dichloroethene
CMMP	Corrective Measures Monitoring Plan
CMS	Corrective Measures Study
COC	Contaminant of Concern
DER-10	DER Technical Guidance for Site Investigation and Remediation
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DOT	Department of Transportation
ELAP	Environmental Laboratory Approval Program
ICM	Interim Corrective Measures
IDW	Investigation Derived Waste
IRP	Installation Restoration Program
LNAPL	Light Non-Aqueous Phase Liquid
LTM	Long-Term Monitoring
MAES	Multiple Award Environmental Services
mL	Milliliters
MMA	Main Manufacturing Area
NAP	Natural Attenuation Parameters
NAPL	Non-Aqueous Phase Liquid
NYCRR	New York Codes Rules and Regulations

NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	Operation and Maintenance
ORP	Oxidation-Reduction Potential
PCE	Tetrachloroethene
PID	Photoionization Detector
PDB	Passive Diffusion Bag
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
PVC	Poly-vinyl Chloride
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SA	Siberia Area
SOP	Standard Operating Procedure
TAGM	Technical and Administrative Guidance Memorandum
TAL	Target Analyte List
TCE	Trichloroethene
TCL	Target Compound List
µg/L	Micrograms per liter
US	United States
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

VOCs	Volatile Organic Compounds
VC	Vinyl chloride
WVA	Watervliet Arsenal

1. Introduction

1.1 Purpose

The PIKA - MP JV, LLC[1] (hereinafter referred to as the JV) has been retained by the Baltimore District of the US Army Corps of Engineers (USACE) to implement the Long-Term Monitoring Plan (LTM Plan) for the Watervliet Arsenal (WVA) in Watervliet, New York. Long-term monitoring is being conducted at the WVA in support of investigations and corrective measures that have been conducted at the WVA under a United States Environmental Protection Agency (USEPA) Administrative Order on Consent (Docket No. II RCRA-3008(h)-93-0210). The purpose of the LTM Plan is to act as an interim/long-term monitoring program for the Main Manufacturing and Siberia Areas of the WVA. This LTM Plan Update was prepared to consolidate the New York State Department of Environmental Conservation (NYSDEC)-approved changes that have been made to the program since the last plan update in 2010 and to accompany the Work Plan for Installation Restoration Program (IRP) activities at WVA under the Multiple Award Environmental Services (MAES) contract, Award No. W912DR-12-D-0007, Delivery Order 0007.

1.2 Facility Description

The WVA encompasses approximately 140 acres in and around the City of Watervliet, New York, approximately 3.5 miles northeast of the City of Albany (Figure 1-1). To the east of the WVA, Broadway Street and a six-lane interstate highway (I-787) separate the WVA from the Hudson River. To the west, the WVA extends beyond the limits of the City of Watervliet into the Town of Colonie. Residential areas border the WVA to the north and south.

The WVA consists of two primary areas: (1) The "Main Manufacturing Area" (MMA), where manufacturing and administrative operations occur, comprises about 125 acres, and, (2) The "Siberia Area" (SA), which is chiefly used for the storage of raw and hazardous materials, comprises about 15 acres. These areas are shown on Figure 1-2.

[1] The PIKA-MP JV LLC Joint Venture is comprised of PIKA International, Inc. and its mentor ARCADIS-U.S. Inc.

1.3 Previous and Ongoing Studies

1.3.1 Main Manufacturing Area

Several environmental studies have been conducted at the MMA of the WVA. The most comprehensive investigation, an RFI, was conducted by MPI and Louis Berger & Associates, Inc. from 1995 to 1998. Previous investigations are summarized in the RFI. Two ICM studies involving in-situ groundwater remedial techniques were conducted at the MMA in the area of Buildings 25 and 40 between 2001 and 2003. Final corrective measures, in the form of in-situ chemical oxidation, were conducted at Building 40 in accordance with the Corrective Measures Work Plan – Building 40 Groundwater, dated July 2004 (Malcolm Pirnie, 2004) from 2004 through 2007. Monitoring of the wells in the Building 40 area was conducted separately under the Corrective Measures Monitoring Plan, Building 40 Groundwater, dated August 2004 (Malcolm Pirnie, 2004a) (CMMP) during that time. Based on an evaluation of the performance of the Building 40 groundwater corrective measures (Malcolm Pirnie, 2009 & 2010), which concluded that additional corrective measures were not feasible, wells in the Building 40 area were added to the LTM Plan in May 2010.

1.3.2 Siberia Area

A RFI was conducted by Malcolm Pirnie at the Siberia Area from 1994 to 1995. Additional investigations and ICMs were completed by Malcolm Pirnie from 1996 to 2002. The CMS Report for Siberia was approved in August 2003. The CMS Certification Report was approved by the NYSDEC and USEPA in 2007. The ICMs are summarized in the CMS report.

1.4 Generalized Site Geology and Hydrogeology

1.4.1 Main Manufacturing Area

The major overburden unit identified in the MMA is fill, consisting of brown or dark gray silty sand with angular gravel. The fill material is the only unit consistently found throughout the site, with the thickest amount of fill being in the eastern portion of the MMA. Underlying the fill are the following native overburden units: a fine-grained alluvium, a coarser alluvium, and glacial till. These units are not present in all areas of the site.

The bedrock underlying the site is a black, medium-hard laminated shale, showing some characteristics of minor metamorphism. This shale is part of the Snake Hill Formation. The bedrock can be described in three ways based on the degree of weathering observed. The first is an extremely weathered zone approximately four feet thick. This extremely weathered bedrock unit was encountered at depths ranging from near ground surface to approximately 20 feet below ground surface (bgs). Beneath this extremely weathered bedrock is a zone of less weathered shale showing minimal competency. Competent bedrock is generally encountered at depths ranging from approximately 1.5 feet bgs to 18 feet bgs.

The majority of the MMA is relatively impervious to rainfall except at the residential and recreational areas of the northeastern portion of the WVA. Due to the shallow depth of bedrock and the limited amount of overburden in several areas of the WVA, groundwater is encountered within different geologic units (overburden, weathered bedrock, or bedrock) depending on the location. For instance, groundwater is encountered in the bedrock at the western end of WVA (topographic high and local recharge area); progressing eastward toward the Hudson River, groundwater is encountered in the weathered bedrock and then in the overburden deposits.

Groundwater flow in bedrock in the MMA is primarily controlled by the degree of fracturing within the bedrock itself and in the local recharge area, which is coincident with a topographic high along a bedrock ridge in the central portion of the facility. The most prominent feature on the potentiometric surface is a groundwater divide trending approximately north to south through Buildings 135 and 125. This feature appears to mirror the bedrock ridge. The primary discharge area for groundwater from the Main Manufacturing Area is the Hudson River, which is located to the east of WVA. For the area surrounding Building 25, groundwater in each of the hydrostratigraphic units flows from west to east towards the Hudson River, with a component of flow to the northeast. In the Building 40 area, groundwater in the bedrock unit flows to the east-southeast. West of the groundwater divide, shallow groundwater flow discharges toward the Kromma Kill.

1.4.2 Siberia Area

According to the "Surficial Geologic Map of New York - Hudson-Mohawk Sheet, 1987", a majority of the SA is underlain by recent alluvial deposits. These are defined as fine sand and gravel deposits overlain by silt. The SA, which is at a lower elevation than the MMA of the WVA located to the east, is generally underlain by a layer of fill (sand, shale fragments, slag, cinders, brick, wire, wood and concrete). Alluvium, lenses of peat, and lacustrine clay deposits were encountered beneath the layer of fill material. Bedrock beneath the SA is also the Snake Hill shale. During the SA investigation, highly weathered shale was encountered from approximately 3.5 feet bgs to 31 feet bgs. In general, competent bedrock was encountered at approximately 12 feet bgs. The upper portion of the competent bedrock was found to be fissile and highly fractured with 45 to 60 degree bedding planes.

Groundwater flows generally to the north-northwest in the NE Quadrant of the SA, and generally to the west across the remainder of the SA. The water table responds quickly to recharge events, and during times of low precipitation the water table may be present in the shale bedrock over portions of the SA. However, on the average, the water table is encountered in the overburden. Surface water in the SA that does not infiltrate is generally directed into the existing storm sewers.

2. Field Sampling Plan

The Field Sampling Plan presents the current groundwater sampling locations, sample analyses, sampling frequency, and sampling methodology for the groundwater monitoring program at the WVA.

2.1 Main Manufacturing Area

There are a total of 58 groundwater monitoring wells in the MMA that are sampled under this LTM Plan. Of these, 14 wells monitor the saturated overburden; six wells monitor either the overburden and weathered bedrock saturated zones (hybrid wells) or the weathered bedrock; and 38 wells monitor the bedrock at varying depths. Monitoring wells currently sampled in the MMA as part of the LTM are listed in Table 2-1, with selection rationale, analytes, and sampling frequency, and are also shown on Figure 2-1. Wells sampled annually are sampled during the spring/summer (typically in May or June). Seven of the MMA wells are sampled every five years during the spring/summer sampling event. These wells were last sampled in 2011, and will be sampled again in 2016. Wells sampled for natural attenuation parameters are sampled every three years; were last sampled in 2014, and will be sampled again in 2017.

2.2 Siberia Area

There are a total of 24 monitoring wells in the Siberia Area that are sampled under this LTM Plan. Of these, six wells monitor the saturated overburden, eight monitor either weathered bedrock or the overburden and weathered bedrock (hybrid wells), and 10 monitor the bedrock at varying depths. In addition to the monitoring wells, three storm sewer locations and one sanitary sewer bedding monitoring point are sampled as part of the long-term monitoring program. Monitoring wells currently sampled in the SA as part of the LTM are listed in Table 2-2, with selection rationale, and are shown on Figure 2-2. All SA wells are sampled annually during the spring/summer. Wells sampled for natural attenuation parameters are sampled every three years; were last sampled in 2014, and will be sampled again in 2017.

2.3 Water Level Measurements

Water levels are measured during purging in those wells which will be sampled for chemical analysis in both the MMA and the Siberia Area prior to groundwater sampling using a decontaminated water level probe. If any significant changes in water levels relative to past measurements are noted, the water level in the anomalous well will be re-measured after adequate time to return to static level, and the NYSDEC notified if the anomalous condition remains. In consultation with the NYSDEC, a site-wide potentiometric map may be required for that year's monitoring report. Water level measurement procedures are described in more detail in Section 3.0.

2.4 Sample Collection

All wells are sampled either according to the USEPA protocol for Low Stress (Low Flow) Purging and Sampling (USEPA, 1998) or using Passive Diffusion Bag (PDB) samplers. Dedicated, permanently installed bladder pumps are installed in each of the wells included in the long-term sampling program. The permanent installation of the bladder pumps has eliminated the need for decontamination of pumps and allows for more efficient sampling. A flow-through cell is used to measure field parameters during well purging and after sample collection. All non-dedicated equipment and instrumentation is decontaminated before and after use. In accordance with the USEPA letter dated September 20, 2002 (USEPA, 2002), the reactive wall monitoring wells are sampled using PDB samplers. Further, all wells that are sampled for only VOCs in any given year are sampled using PDB samplers. Water levels are measured in all sampled wells and compared to historic measurements to evaluate potential changes in groundwater flow conditions. Sample collection methods and equipment decontamination procedures are described in more detail in Section 3.0.

2.5 Sample Analyses

Groundwater samples are analyzed by a NYSDEC Analytical Services Protocol (ASP)-certified laboratory, for Target Compound List (TCL) volatile organic compounds (VOCs), dissolved sulfide, dissolved organic carbon (DOC), and dissolved gases, as listed in Tables 2-1 and 2-2. Samples collected from reactive wall wells are analyzed for VOCs only. Additional laboratory analyses, including Resource Conservation and Recovery Act (RCRA)-listed metals, are also performed at select locations listed in Tables 2-1 and 2-2.

Groundwater samples collected as part of the long-term monitoring program are analyzed for VOCs by SW-846 Method 8260, and RCRA-metals by SW-846 Methods 6010 and 7470, by the analytical laboratory under a standard turnaround time with NYSDEC ASP Category A deliverables. Quality Assurance (QA) and Quality Control (QC) samples in the form of blind duplicates are collected at a rate of one per 20 environmental samples.

Field parameters, consisting of temperature, pH, specific conductivity, dissolved oxygen, oxidation-reduction potential, and turbidity are measured during purging using a Horiba U-22 (or equivalent) water quality meter equipped with a flow-through cell. Natural attenuation parameters (NAP) consisting of dissolved sulfide, dissolved organic carbon, and dissolved gases (methane, ethane, ethene, and carbon dioxide) are also analyzed. Sample analysis methods are described in more detail in Section 3.0.

2.6 Investigation Derived Waste

Groundwater that is purged from monitoring wells will be discharged to the ground surface within 50 feet of each monitoring well location in accordance with the NYSDEC Proposed Technical and Administrative Guidance Memorandum (TAGM) - Disposal of contaminated groundwater generated during Site Investigations, if the following criteria are met:

1. There is a defined site which is the source of the groundwater contamination;

2. There is no free product observed such as DNAPLs or LNAPLs;

3. The infiltrating groundwater is being returned to the same water bearing zone from which it is being purged.

If there is no recharge surface (i.e., grass, uncovered soil, etc.) located within 50 feet of a well, then the purge water will be containerized, brought to the Siberia Area, and discharged to the ground in a designated area up-gradient of the reactive wall area.

For the Building 40 monitoring wells and other wells that do not meet the above criteria, the materials will be containerized onsite in a polyethylene storage tank and disposed off-site in accordance with federal, state, and local regulations. Some disposable personal protective equipment (PPE) and decontamination fluids will be generated. Attempts will be made to wash surface contamination off so that PPE (i.e., gloves and other disposable items) may be disposed of as ordinary solid waste. If contamination is suspected, these materials will be collected and containerized in DOT-approved, 55-gallon steel drums (separately from contaminated groundwater and disposed of off-site). IDW control procedures are discussed in more detail in Section 3.0.

2.7 Monitoring Well Maintenance

All monitoring wells at the MMA and the Siberia Area are inspected as part of the monitoring well maintenance program during the sampling event. Monitoring well inspection takes place during groundwater sampling activities. The monitoring well maintenance program consists of the following:

- Each monitoring well pad is inspected for cracks, heaving/subsidence, and deterioration of the concrete. Well pads requiring repair will be repaired before the next sampling event.
- Monitoring well surface casings or flush-mount casings/covers are inspected for physical damage, rust, and paint condition. If a casing or flush mount casing/cover is damaged or rusted to the point where well integrity is in question, the casing or flush-mount casing/cover will be replaced prior to the next sampling event. Wells which require repainting will be painted prior to the next sampling event.
- The total depth of each well is measured and compared to the constructed total depth to assess whether the screened or open portion of the well has become filled with silt/sediment. If a significant portion (i.e., more than 25 percent) of the screened or open section of the well has been filled in, then the well will be redeveloped to remove the sediment before the next sampling event.
- Damaged wells and/or pumps will be replaced at the original specifications.

3. Sampling Methods

One of the objectives of the LTM Plan is to ensure that all data collected during the long-term groundwater monitoring program are of acceptable quality. To meet this objective, the following topics are presented and discussed in this document:

- Sample collection procedures;
- Sample integrity;
- Other field data collection procedures; and
- Field instrument calibration and maintenance.

3.1 Sample Collection Procedures

The sampling procedures described in this plan are designed to ensure collection of representative samples for analysis, and are based on the following sources:

1. USEPA Region II GROUNDWATER SAMPLING PROCEDURE, LOW STRESS (LOW FLOW) PURGING AND SAMPLING, March, 1998.
2. USEPA Region II CERCLA QUALITY ASSURANCE MANUAL, October, 1989.
3. NYS Department of Environmental Conservation Analytical Services Protocol 9/89, Revisions 12/91, and any subsequent modifications.
4. RCRA Quality Assurance Project Plan Guidance, NYS Department of Environmental Conservation, Division of Hazardous Substances Regulation, 3/29/91.
5. USEPA RCRA Ground Water Monitoring Technical Enforcement Guidance Document, September 1986.

The objectives for each field team member are to:

1. Collect a sample that is representative of the matrix being sampled; and
2. Maintain sample integrity from the time of sample collection to receipt by the laboratory.

3.1.1 Decontamination of Field Equipment

Cross-contamination of samples from any source is to be avoided. All sampling equipment must be clean and free from the residue of any previous samples. To accomplish this, the following procedures will be followed:

- All non-dedicated sampling equipment must be cleaned initially and prior to being reused. The following is the procedure for decontamination.
- Wash and scrub with low phosphate detergent;
- Rinse with tap water;
- Rinse thoroughly with deionized water;
- Air dry; and
- Wrap in aluminum foil for transport.

Field filtration equipment will be decontaminated prior to use using a deionized water rinse. Field instrumentation should be cleaned per manufacturer's instructions. Probes, such as those used in pH and conductivity meters, and thermometers must be rinsed prior to and after each use with deionized water.

3.1.2 Water Level Measurements

Water levels in the groundwater monitoring wells will be measured and used in conjunction with horizontal and vertical ground survey data to determine horizontal components of groundwater flow. Water level measurements will also be used to determine the volume of standing water in the wells for purging activities.

3.1.2.1 Measurement Equipment

The following equipment will be used for the measurement of water levels:

- Electronic water level indicator
- Oil/Water interface probe
- Field logbook and pen
- Photoionization Detector (PID)
- Deionized Water
- Low Phosphate Detergent

3.1.2.2 Measurement Procedure

At each monitoring well, the PVC cap will be removed and the head space and breathing zone's air quality will be monitored with a PID. The battery of the electric water level indicator will be checked by pushing the battery check button, and waiting for the audible signal to sound or the instrument light to come on. The water level indicator will be decontaminated before collecting a measurement in each well point by using an Alconox wash and deionized water rinse. The instrument will then be turned on and the probe will be slowly lowered into the monitoring well until the audible signal is heard or the instrument light goes on, indicating that the sensor in the probe has made contact with the water surface. The total depth of each well will be measured once the depth to water has been determined. The depth to water will be recorded to the nearest one-hundredth of a foot, from the top of the measuring mark on the monitoring well or well point riser. The date, time, well number, and depth to water will be recorded in the field book. Selected wells will also be gauged for the presence of LNAPL or DNAPL using an oil/water interface probe. The procedure for using the oil/water interface probe is identical to that of the electronic water level meter.

3.1.3 Groundwater Sampling

Groundwater samples will be collected for chemical quality analysis. Groundwater samples which will be collected at the WVA during each groundwater sampling event are summarized in Tables 2-1 and 2-2. A summary of the Contract Required Quantitation Limits for the groundwater samples is provided in Table 3-2.

3.1.3.1 Sampling Equipment

The following equipment will be needed to collect groundwater samples for analysis:

- Electric water level indicator
- Passive Diffusion Bags
- Stainless steel weights
- Rope/wire/cord
- Bladder pump
- Air compressor/control box
- Polyethylene discharge tubing
- Temperature, pH, dissolved oxygen, redox, specific conductivity and turbidity meters
- Photoionization Detector (PID)
- Field logbook and field logs
- Preservatives
- Laboratory prepared sample containers
- Roll of polyethylene sheeting
- Decontamination equipment

3.1.3.2 Sampling Procedures

For wells sampled by PDBs, attach a stainless steel weight to the end of the line to overcome the buoyancy of the PDB sampler. Calculate the distance from the bottom of the well, to the depth where the PDB sampler is to be placed (generally the center point of the saturated well screen length). At the designated point, secure the PDB sampler and weighted line at target depth. Secure the assembly in place. Attach the weighted line with a hook to the well riser or well cap. The well should be covered to prevent surface water infiltration. Allow the system to remain undisturbed while the PDB samplers equilibrate (minimum 14 days recommended). After deployment period, remove the PDB sampler from the well. If a discharge device is provided by the PDB sampler supplier, it can be inserted either in place of the fill plug or directly into the bag. If no discharge device is provided, the PDB sampler can be cut at one end using scissors or a sharp probe. The water should then be poured gently from the PDB sampler to the 40 ml VOA vials.

For wells sampled by low-flow sampling protocol (USEPA 1998), the wells will be purged using the permanent, dedicated bladder pump installed in each well at a steady rate of approximately 200 to 500 milliliters per minute (ml/min) while maintaining a drawdown of no more than 0.3 feet in the well. Measurements of field parameters consisting of pH, specific conductance, temperature, dissolved oxygen, reduction potential, turbidity, and water level will be made in each monitoring well prior to, during, and after purging (just before sampling) through the use of a flow-through cell. Both the pH and the specific conductivity meters will be calibrated for water temperature before each sampling event.

The volume of water removed from each monitoring well will be dependent upon the amount of time required for stabilization of the field parameters. In general, the well will be considered stabilized for sample collection when field parameters have stabilized for three consecutive readings as follows:

- pH: +/- 0.1 standard units
- Specific Conductance: +/- 3%
- Reduction Potential: +/- 10 millivolts
- Dissolved Oxygen +/- 10%
- Turbidity +/- 10%

When the field parameters have stabilized, the volume of water will be recorded, and groundwater in the monitoring well will be sampled through the bladder pump at a flow rate between 100 and 250 ml/min. The purge water will be discharged in accordance with Section 3.4.

The two 40 ml vials for volatile organic analysis will be filled first, without leaving any head space. All other sample bottles will be filled such that some headspace remains in the bottle (with the exception of dissolved gases). The analytical parameters and order of sample collection for groundwater samples will be:

1. In-situ measurements: temperature, pH, specific conductance, turbidity, dissolved oxygen, reduction potential, and PID
2. Volatile organics
3. Metals (if required)
4. Natural attenuation parameters (if required)

Aqueous samples to be analyzed for dissolved organic carbon and dissolved sulfide will be filtered by the analytical laboratory. All paperwork accompanying samples to the analytical laboratory should clearly state that the samples should be filtered by the laboratory. The sample bottles will be pre-preserved by the laboratory according to the analytical protocols. The sample bottles will be immediately placed in a cooler held at 4°C.

Disposable gloves will be worn by the sampling personnel and changed between sampling points. While performing any equipment decontamination, phthalate-free gloves (neoprene or natural rubber) will be worn in order to prevent phthalate contamination of the sampling equipment by interaction between the gloves and the organic solvent(s).

Data to be recorded in the field logbook will include the purging and sampling methods, depth to water, volume of water removed during purging, pH, temperature and specific conductivity values, and PID readings.

3.1.4 Containers, Preservatives, and Holding Times

Sample integrity is preserved through the use of proper sample containers, addition of the correct preservatives to the samples, and meeting designated holding times (the time from sample collection to sample analysis). The field team leader is responsible for proper sample collection, labeling, preservation, and shipment to the laboratory to meet required holding times. Table 3-3 identifies the proper containers, preservation techniques, and maximum holding times.

The analytical laboratory will supply the JV with commercially-cleaned sample containers. The containers will meet or exceed cleaning and quality control requirements of USEPA OSWER Directive 9240.0 05, Specifications for Obtaining Contaminant Free Sample Containers. Sample containers will be stored in clean, dust free areas that are segregated from the analytical laboratory and solvent/reagent storage areas.

3.1.5 Quality Control Samples

Sample blanks and field duplicate samples will be collected to ensure proper QA/QC, and will be prepared and submitted for analysis along with the actual samples. The collection procedures and frequency of collection of these samples are presented below.

- ***Trip Blanks*** - When collecting environmental aqueous samples for volatile organic compound analysis, a trip blank is taken into the field as part of the sampling kit (the set of appropriate containers used to collect the samples). Trip blanks consist of demonstrated analyte free water sealed in 40 ml Teflon®-lined septum vials. A clean pair of latex gloves must be worn when preparing a trip blank. These blanks are used to determine whether collected samples have been contaminated by outside sources during shipment or storage. One trip blank sample will be prepared and carried with every shipment of aqueous samples that are to be analyzed for volatiles.
- ***Field duplicates*** - are collected in such a manner that they are equally representative of parameters of interest at a given point in space and time. They are separate from laboratory duplicates, which demonstrate analytical precision. Field duplicates will be collected at a rate of one per 20 environmental samples. The field duplicate samples will be "blind" duplicates, meaning that the laboratory must not know that the sample is a duplicate; therefore, the duplicates will be numbered in the same manner as the other samples, and may be numbered randomly. The duplicate samples will be identified in the field notes, but not on the chain of custody recorded by the field team at the time of collection.

3.2 Sample Custody

An essential part of any program that requires sampling and analysis is ensuring sample integrity from collection to data reporting. This includes the ability to trace the possession and handling of samples from collection through analysis and final disposition. The documentation of the history of the sample is referred to as chain-of-custody. This section addresses the following sample custody procedures:

- Sample Identification and Labeling
- Sample Custody in the Field
- Sample Shipping
- Sample Custody in the Laboratory
- Document Control

3.2.1 Sample Identification and Labeling

All samples collected will be identified by affixing a unique sample label to each sample container. Indelible ink will be used to complete sample labels. After they are affixed to the containers, the labels will be covered with clear plastic waterproof tape. Each sample will have a unique designation, using the well IDs on Tables 2-1 and 2-2, plus the sample date. The labels will not indicate that a sample is a duplicate or a blank.

Each label will contain the following information:

1. Site Name
2. Project Number
3. Sample Number
4. Sample Matrix
5. Company Name
6. Parameters to be Analyzed
7. Date of Collection
8. Time of Collection
9. Preservation Technique Employed
10. Sampler's Name

3.2.2 Sample Custody in the Field

Sample custody in the field consists of documenting all field activities related to sampling and establishing an accurate written record that traces the possession and handling of each sample from the moment of its collection, through shipment to the laboratory, and ultimately through analysis. The custody procedures described herein conform with US Army Corps of Engineers Guidance ER 1100-1-263, Chemical Data Quality Management for Hazardous Waste Remedial Activities, and are modeled after standard USEPA procedures.

Field activities will be documented in a field notebook. All field notes will be recorded in indelible ink on standard forms or in bound notebooks. All standard forms used during the field investigation will be bound in a notebook and centrally located on-site at the end of each day. The notebook will be signed and dated at the end of each day. Similarly, significant events occurring during the day will be reported to the project manager at the end of each day. All field notes will be reviewed by the project manager.

At a minimum, the notebook will contain the following:

- Sample number
- Date and time of sample collection
- Sample location
- Name of collector
- Analytical work to be done
- Type of sample, and whether the sample is a duplicate, quality assurance, or quality control sample
- Volume of sample taken
- Type of container, number of containers/samples
- Any field observations or measurements (e.g. pH, temperature, specific conductance)
- Type of concentration: low, medium, high
- Preservatives used
- Sampling methodology/special features
- Sampler's signature
- Method of shipment to the laboratory

After samples are collected, chain-of-custody records will be used to trace the possession and handling of the samples. A chain-of-custody record is a printed form that accompanies a sample or group of samples as custody is transferred from person to person. Figure 3-1 provides the typical chain-of-custody document.

As soon as practical after sample collection, the following information must be entered, in indelible ink, on the chain-of-custody record:

1. Project number.
2. Project name.
3. Sampler(s) signature(s).

4. Sample identification code for each sample contained in the shipment. This code appears on the sample label.
5. The date-of-collection of each sample, entered as six-digit number indicating the year, month, and day.
6. The time-of-collection of each sample, entered as a four-digit number indicating the military time of collection; for example, the time entered for a sample collected at 1:54 p.m. would be 13:54 hrs.
7. The matrix of each sample (e.g. soil, aqueous, sludge).
8. The analysis and analytical method to be performed for each sample.
9. The number of containers for each sample identification code (when analyzing for several chemical parameters, a number of containers are filled at each sampling location).
10. Remarks. Enter any appropriate remarks.

A person is in custody of a sample if the sample is:

- In that person's physical possession;
- In view after being in that person's physical possession;
- Placed in a locked repository by that person, or;
- Placed in a secure, restricted area by that person.

Custody of the samples may be transferred several times prior to their arrival at the laboratory. For example, a field team shipper may be designated to receive all samples from field team members. When transferring custody to another responsible individual, perform the following:

1. Enter the date and time of sample transfer on the chain-of-custody form, and sign the form, under the "Relinquished by:" entry.
2. Make certain that the individual receiving custody signs the "Received by:" entry.

When transferring custody to a common carrier (e.g. Federal Express), perform the following:

1. Enter the date and time of sample transfer on the chain-of-custody form, and sign the form, under the "Relinquished by:" entry.
2. Enter the name of the carrier under the "Received by:" entry.
3. Enter the bill-of-lading or Federal Express airbill number under the "Remarks:" entry.

4. Follow the packaging procedures presented in Section 3.2.3

3.2.3 Sample Shipping

The following procedures shall be followed for packaging and shipping of samples:

1. Coolers shall be used to ship samples.
2. All labels shall be written with indelible ink.
3. Approximately 3 inches of inert cushioning material such as vermiculite shall be placed in the bottom of the cooler.
4. Each sample container shall be enclosed in a clear plastic bag through which the labels are visible, and the bag sealed. The containers shall be placed upright in the cooler in such a way that they do not touch, and will not touch during shipping.
5. Additional vermiculite packing material shall be placed in the cooler to partially cover the sample containers (more than halfway). Bags of ice shall then be placed around, among, and on top of the sample containers.
6. The cooler shall then be filled with cushioning material.
7. The original chain of custody form shall be placed in a waterproof plastic bag and placed inside the cooler. Retain a copy of the form with the field records.
8. The drain of the cooler shall be taped shut.
9. The cooler lid shall be secured by taping. The cooler shall be wrapped completely with strapping tape at a minimum of two locations in such a way that no labels are covered.
10. The shipping label shall be attached to top of cooler.
11. "This Side Up" labels with arrows and "Fragile" labels shall be placed on at least two sides of the cooler.
12. Numbered and signed custody seals shall be affixed on the front right and back left sides of the cooler, across the lid and body of the cooler. These seals shall be covered with wide, clear tape.

3.2.4 Sample Custody in the Laboratory

Once the samples arrive at the laboratory, custody of the samples will be maintained by laboratory personnel. Each sample will be identified upon receipt by the laboratory and cross-referenced to the chain-of-custody record. Any inconsistencies will be noted on the custody record. Laboratory personnel will immediately notify the Malcolm Pirnie Quality Control Officer, field manager, or project manager if inconsistencies are identified.

The analytical laboratory will have written SOPs for maintaining security of samples and tracking the work performed on samples through the entire analytical process. The SOP requires that sample receipt, sample extraction/preparation, sample analysis, data reduction and data reporting be documented by the laboratory.

3.2.5 Document Control

Document control consists of maintaining a project file, an analytical laboratory batch file, a project field file, and a QA project file. The project file will be maintained by the Malcolm Pirnie Project Manager and will contain all original documents. Project personnel may keep their own files; however, all original documents will be kept in the project file. All laboratory records, including batch forms, log sheets, and computerized worksheets, will be kept by the analytical laboratory in a batch file in the sample control center. Field logs will be maintained by the project manager in a project field file. The project QA supervisor will independently maintain a QA project file. At the end of the project, the QA project file will be turned over to the project manager. The following documents will be placed in the QA project file:

1. QA records maintained throughout the investigation;
2. Documentation of QA system and performance audits;
3. Documentation of all unusual findings or observations;
4. Documentation of all QA corrective actions;
5. All official QA correspondence received or issued relating to the investigation, including records of telephone calls;
6. One copy of all QA deliverable review sheets; and
7. Any other QA documents related to the project or follow-up activities related to the investigation.

3.3 Equipment Calibration and Maintenance Procedures

Instruments must be properly calibrated to produce technically valid data. Documented calibration and calibration check results verify that the instruments used for measurement are in proper working order and the data produced are reliable. The calibration requirements described or referenced in this section are necessary to support the data quality objectives for this project. When calibration requirements are met, the data will support the focused investigation decisions dealing with the nature and extent of contamination and safety concerns. In the event that the data are used in court, documented calibrations are necessary to ensure that the data are legally defensible.

3.3.1 Field Equipment Calibration

The following table provides a list of the tasks that will require field equipment, and the specific field instruments that will be used for each task and which require calibration.

TASK	FIELD INSTRUMENT
Groundwater Sampling	MiniRae Photoionization Detector
	pH Meter
	Temperature Probe
	Specific Conductivity Meter
	Turbidimeter
	Reduction Potential Meter
	Dissolved Oxygen Probe

3.3.2 General Procedures

Field equipment to be used during groundwater sampling will be operated and maintained per the manufacturer's instructions. General calibration procedures and requirements are described below:

- All instruments will be calibrated at least once a month.
- All instruments will have the calibrations checked at a minimum at the start of each day before measurements are made.
- The calibration and calibration checks will indicate that the sensitivity of the instrument (practical detection limit) is adequate to meet project needs and that the instrument is accurate over the working range.
- All calibration information will be recorded in the field log book. This includes date and time, technician signature, calibration procedure, calibration results, calibration problems, recalibration and maintenance, and instrument serial numbers.
- All calibration standards will be of National Bureau of Standards (NBS) quality and their sources listed and documented so that standards are traceable. In addition, only technicians trained in the use of the field instruments will operate them. If the instrument readings are incorrect at the time of the initial calibration, the instrument will either be calibrated by the technician or returned to the manufacturer for calibration. If the instrument readings are incorrect after a continuing calibration check, the preceding sample results will be reviewed for validity, and reanalyzed if necessary.

3.4 Investigation Derived Waste

Groundwater that is purged from monitoring wells will be discharged to the ground surface within 50 feet of each monitoring well location in accordance with the NYSDEC Proposed Technical and Administrative Guidance Memorandum (TAGM) - Disposal of contaminated groundwater generated during Site Investigations, if the following criteria are met:

- There is a defined site which is the source of the groundwater contamination;
- There is no free product observed such as DNAPLs or LNAPLs;
- The infiltrating groundwater is being returned to the same water bearing zone from which it is being purged.

If there is no recharge surface (i.e., grass, uncovered soil, etc.) located within 50 feet of a well, then the purge water will be containerized, brought to the Siberia Area, and discharged to the ground in a designated area up-gradient of the reactive wall area.

For the Building 40 monitoring wells and other wells that do not meet the above criteria, the materials will be containerized onsite in a polyethylene storage tank and disposed off-site in accordance with federal, state, and local regulations. Some disposable PPE and decontamination fluids will be generated. Attempts will be made to wash surface contamination off so that PPE (i.e., gloves and other disposable items) may be disposed of as ordinary solid waste. If contamination is suspected, these materials will be collected and containerized in DOT-approved, 55-gallon steel drums (separately from contaminated groundwater and disposed of off-site). IDW control procedures are discussed in more detail in Section 3.0.

4. Contingency Evaluation Protocol

Due to the presence of chlorinated VOCs (CVOCs) in the compliance boundary monitoring wells in the Building 40 area, and monitoring wells in the Building 25 and Building 114 areas, a contingency monitoring plan has been developed. The contaminants of concern (COCs) in the wells are as follows:

- Trichloroethene (TCE)
- Tetrachloroethene (PCE)
- Cis-1,2-dichloroethene (cDCE)
- Vinyl chloride (VC)

4.1 Statistical Trigger

The proposed contingency evaluation protocol utilizes a well- and contaminant-specific statistical “trigger” concentration that initiates a contingency evaluation in the event groundwater monitoring data indicates a potential changes in site conditions. This method is currently utilized by the NYSDEC for solid waste landfill monitoring programs to evaluate if a statistically significant release from a landfill has occurred [6 NYCRR Part 360-2.11(c)(5)(i)]. The statistical trigger will be calculated as follows:

1. The results for the COCs in each of the wells from the period of the spring of 2004 through the spring of 2009 were averaged to determine the mean “background concentration”. The standard deviation of the “background” data set was also established. The “background” mean and standard deviation will be the basis for all future comparisons.
2. Trigger values were established for each COC in each well as the sum of the background mean plus three times the background standard deviation. This test is commonly used to identify outlying data that fall outside the expected range of values based on a given baseline data set.
3. Monitoring events during which permanganate was present in the Building 40 compliance boundary wells (i.e, assumed zero concentrations) were not included in the calculations.
4. Monitoring events during which the compound was not detected were included as one half of the laboratory reporting limit for that compound.

Table 4-1 presents a summary of the minimum, maximum, average, and standard deviation for each compound in each well, and lists the statistical trigger concentrations calculated from the data.

4.1 Contingency Monitoring

Upon receipt of analytical data, the result for each of the COCs in the wells in Table 4-1 will be compared against the statistical trigger concentration. If the data for the COCs in a given well exceed the statistical trigger concentrations, the NYSDEC will be notified of the condition within 15 days and potential follow up actions will be determined in consultation with the NYSDEC. If samples from three or more of the Building 40 compliance boundary wells contain COCs at concentrations greater than the corresponding statistical trigger concentrations, verification sampling consisting of quarterly sampling for one year will be conducted, with sampling results provided to the NYSDEC each quarter. The objective of the verification sampling will be to evaluate the potential causes of the increase in COC concentrations; to assess whether changes to the monitoring program are required; and, if necessary, to perform a risk evaluation and technology screening to evaluate potential corrective measures technologies that may be applicable to the site. Based on the results of the verification sampling, potential follow-up actions will be determined in consultation with the NYSDEC. For wells in the Building 25 and Building 114 areas, the need for reinstatement of more frequent monitoring conditions will be determined in consultation with the NYSDEC. Significant increases in the levels of COCs will be discussed in the annual monitoring report and recommendations made for further actions, if necessary.

5. Reporting

The JV will prepare an annual Data Summary Report and submit the report for review to the USACE - Baltimore District, Watervliet Arsenal, and the NYSDEC. The purpose of this report will be to present the field observations from that year's sampling event and summary figures and tables of the analytical data. The report will also present the recommendations for site activities to be completed prior to the next sampling event, and/or recommendations for adjustments to the LTM Plan.

6. References

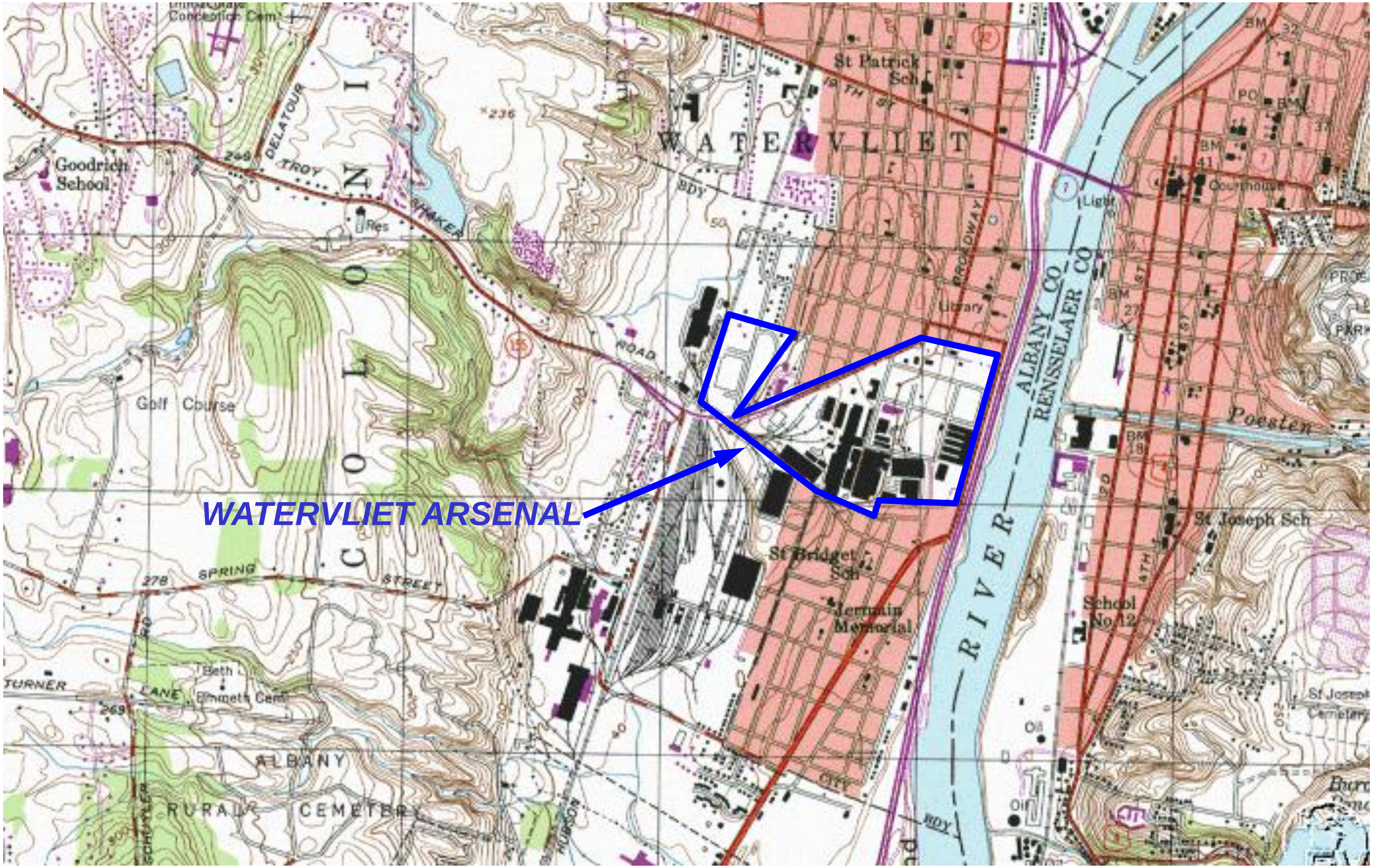
Malcolm Pirnie, 2004, Corrective Measures Work Plan – Building 40 Groundwater, Watervliet Arsenal, Watervliet, New York.

Malcolm Pirnie, 2004a, Corrective Measures Monitoring Plan, Building 40 Groundwater, Watervliet Arsenal, Watervliet, New York.

Malcolm Pirnie, 2009, Corrective Measures Performance Evaluation Report, Building 40 Bedrock Groundwater Corrective Measures, Main Manufacturing Area, Watervliet Arsenal, Watervliet, New York.

Malcolm Pirnie, 2010, VOC Mass Discharge Evaluation and Long-Term Monitoring Work Plan, Building 40 Bedrock Groundwater, Watervliet Arsenal, Watervliet, New York – Attachment B to the Response to Comments on Malcolm Pirnie, 2009.

Figures



SOURCE: U.S.G.S 7.5 MIN. TROY SOUTH QUADRANGLE

SCALE IN FEET

0 1000 2000 4000

US Army Corps of Engineers
Baltimore District

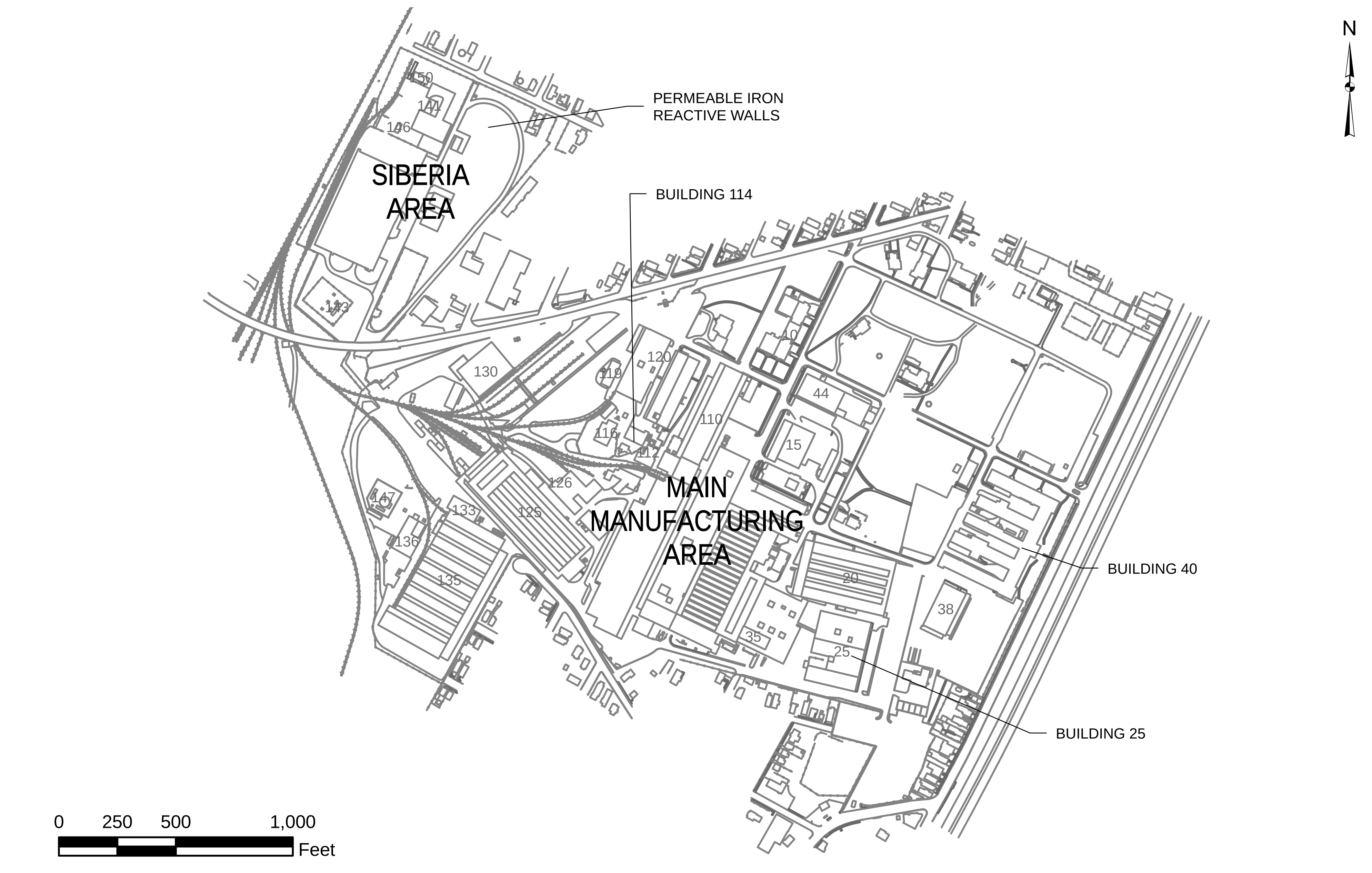
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

LONG-TERM MONITORING PLAN UPDATE

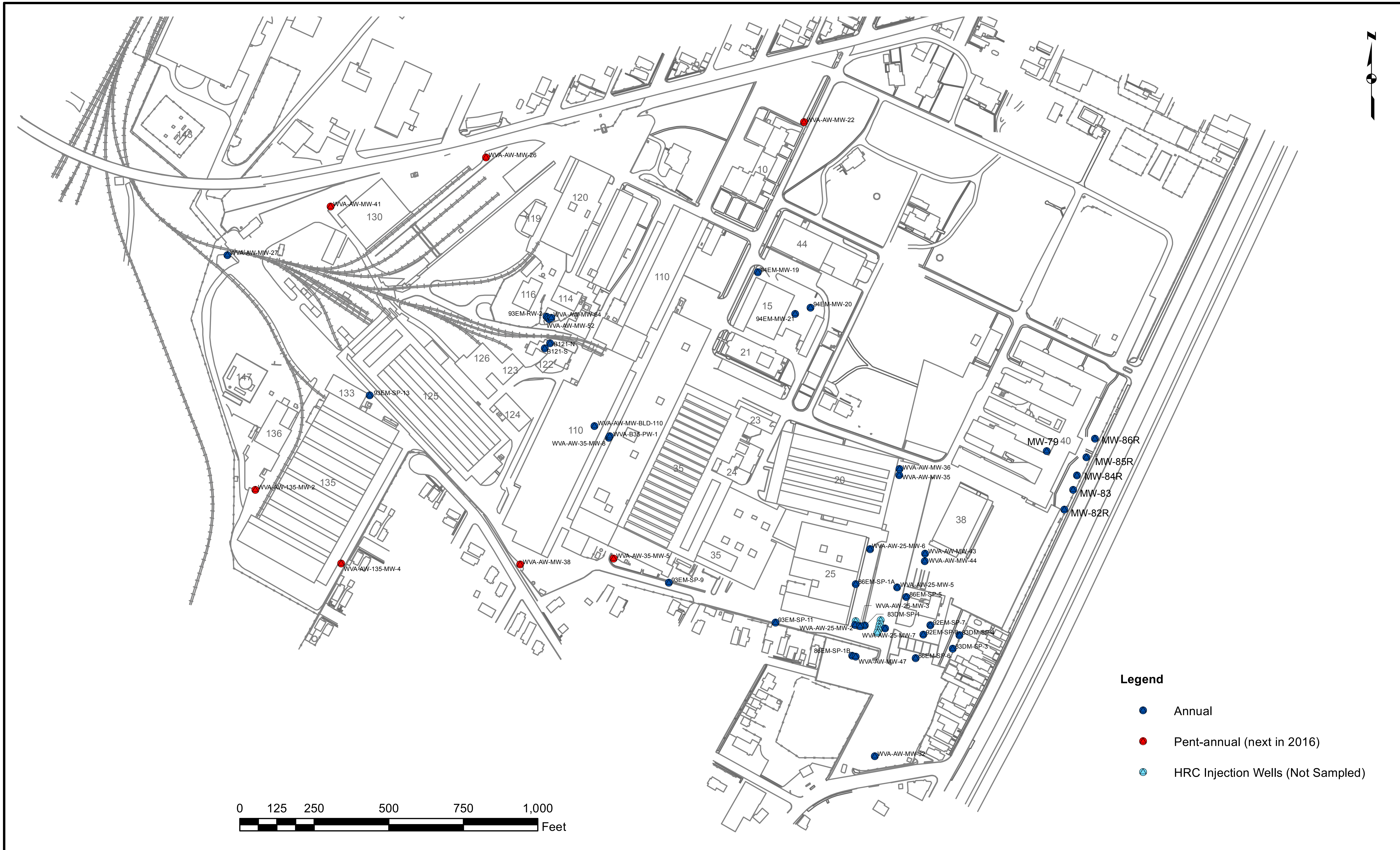
SITE LOCATION

FIGURE 1-1

\\ny05fp01\GISMOD\WatervlietArsenal\LTM\Figures\LTM Plan Update 2010\WVA Site Plan.mxd



US Army Corps of Engineers	LONG-TERM MONITORING PLAN UPDATE WATERVLIET ARSENAL WATERVLIET, NEW YORK	**SITE MAP**	MALCOLM PIRNIE, INC. AUGUST 2010 **FIGURE 1-2**



US Army Corps of Engineers

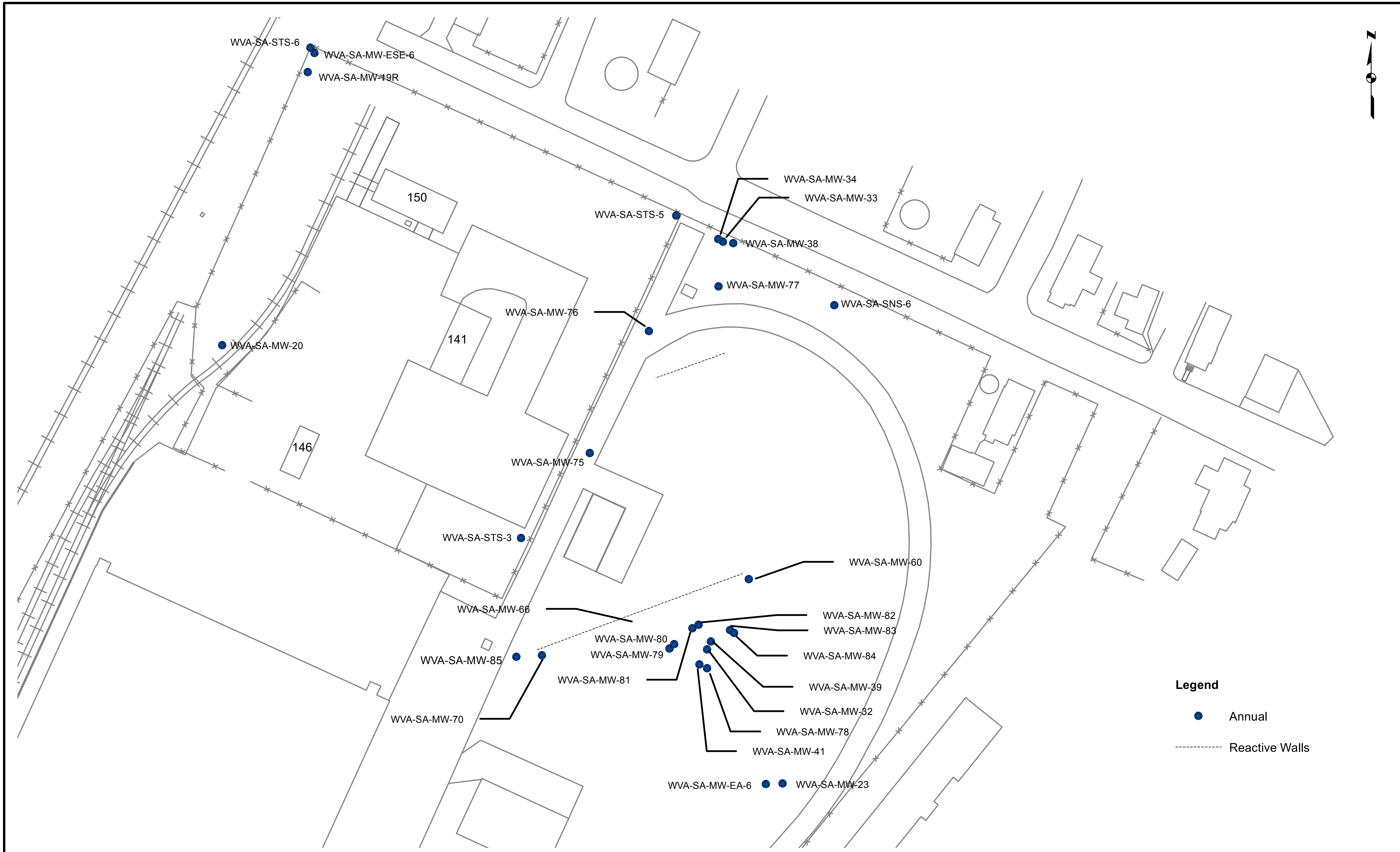
LONG-TERM MONITORING PLAN UPDATE
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

MAIN MANUFACTURING AREA
GROUNDWATER MONITORING LOCATIONS

PIKA-MP JV, LLC

APRIL 2016

FIGURE 2-1



US Army Corps of Engineers

LONG-TERM MONITORING PLAN UPDATE
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

SIBERIA AREA
GROUNDWATER MONITORING LOCATIONS

PIKA-MP JV, LLC

APRIL 2016

FIGURE 2-2

CHAIN OF CUSTODY RECORD

518-250-7300
FAX: 518-250-7301

PIKA-MP JV
855 ROUTE 146, SUITE 210
CLIFTON PARK, NEW YORK 12065

CLIENT: ____________________

PROJECT: ____________________

PROJECT NUMBER: ____________________

LABORATORY: ____________________

LABORATORY CONTACT: ____________________

SPECIAL INSTRUCTIONS:

LAB ID	SAMPLE ID/ DESCRIPTION	DATE	TIME	MATRIX	GRAB/ COMPOSITE	No. of Cont.	ANALYSIS REQUIRED	NOTES / PRESERVATIVE

Matrix Identification:

S - SOIL	**SL - SLUDGE**	**SW - SURFACE WATER**	**DS - DRUM SOLID**
SE- SEDIMENT	**DW - DRINKING WATER**	**L - LEACHATE**	**DL - DRUM LIQUIDS**
SO - SOLID	**GW - GROUND WATER**	**A - AIR**	**X - OTHER**
	O - OIL	**WI - WIPE**	**WW - WASTE WATER**

LAB USE ONLY

SAMPLED BY (SINGATURE):	DATE/TIME	RECEIVED BY (SIGNATURE):	DATE/TIME:
RELINQUISHED BY (SIGNATURE):	DATE/TIME	RECEIVED BY (SIGNATURE):	DATE/TIME:
RELINQUISHED BY (SIGNATURE):	DATE/TIME	RECEIVED BY (SIGNATURE):	DATE/TIME:
METHOD OF SHIPMENT:	DATE/TIME	LAB USE ONLY:	
RECEIVED AT LABORATORY:	DATE/TIME		

US Army Corps
of Engineers
Baltimore District

WATERVLIET ARSENAL
WATERVLIET, NEW YORK

LONG-TERM MONITORING PLAN UPDATE

TYPICAL CHAIN-OF-CUSTODY

FIGURE 3-1

Tables

Table 2-1
Long Term Monitoring Wells (Updated April 2016)
Main Manufacturing Area
Watervliet Arsenal, Watervliet, New York

Well	Area Monitored	Geologic Unit	VOCs (b)	Metals	NAP	Frequency
83DM-SP-1	Building 25	Hybrid (a)	X		X	NAP every 3 yrs. - Next in 2017
83DM-SP-3	WWTP	Bedrock	X	X (c)	X	NAP every 3 yrs. - Next in 2017
83DM-SP-4	WWTP	Bedrock	X			
86EM-SP-1A	Building 25	Overburden	X			
86EM-SP-1B	Building 25	Overburden	X			
86EM-SP-5	Building 25	Overburden	X		X	NAP every 3 yrs. - Next in 2017
86EM-SP-6	WWTP	Overburden	X	X	X	NAP every 3 yrs. - Next in 2017
92EM-SP-7	WWTP	Overburden	X		X	NAP every 3 yrs. - Next in 2017
92EM-SP-8	WWTP	Overburden	X		X	NAP every 3 yrs. - Next in 2017
93EM-SP-9	WVA boundary	Overburden	X			
93EM-SP-11	Building 25	Overburden	X			
93EM-SP-13	Building 135	Bedrock	X			
94EM-MW-19	Building 15	Bedrock	X	X		
94EM-MW-20	Building 15	Bedrock	X	X		
94EM-MW-21	Building 15	Bedrock	X	X		
93EM-RW-2	Building 114	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-AW-25-MW-2	Building 25	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-AW-25-MW-3	Building 25	Overburden	X		X	NAP every 3 yrs. - Next in 2017
WVA-AW-25-MW-5	Building 25	Hybrid (a)	X			
WVA-AW-25-MW-6	Building 25	Overburden	X			
WVA-AW-25-MW-7	Building 25	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-AW-35-MW-5	Building 35	Bedrock				VOCs every 5 yrs. - Next in 2016
WVA-AW-35-MW-8	Building 35	Bedrock	X			
WVA-AW-135-MW-2	Building 135	Bedrock				VOCs every 5 yrs. - Next in 2016
WVA-AW-135-MW-4	Building 135	Bedrock				VOCs & NAP every 5 yrs. - Next in 2016
WVA-AW-MW-22	WVA boundary	Bedrock				VOCs every 5 yrs. - Next in 2016
WVA-AW-MW-26	WVA boundary	Bedrock				VOCs every 5 yrs. - Next in 2016
WVA-AW-MW-27	WVA boundary	Overburden	X			
WVA-AW-MW-32	WVA boundary	Weathered	X			
WVA-AW-MW-35	Building 20	Bedrock	X			
WVA-AW-MW-36	Building 20	Overburden	X			
WVA-AW-MW-38	WVA boundary	Bedrock				VOCs every 5 yrs. - Next in 2016
WVA-AW-MW-41	WVA boundary	Bedrock				VOCs every 5 yrs. - Next in 2016
WVA-AW-MW-43	Building 25	Overburden	X			
WVA-AW-MW-44	Building 25	Overburden	X			
WVA-AW-MW-47	WVA boundary	Weathered	X		X	NAP every 3 yrs. - Next in 2017
WVA-AW-MW-52	Building 114	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-AW-MW-64	Building 114	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
B121-N	Building 121	Hybrid (a)	X		X	NAP every 3 yrs. - Next in 2017
B121-S	Building 121	Hybrid (a)	X		X	NAP every 3 yrs. - Next in 2017
WVA-AW-MW-BLD-110	Building 110	Bedrock	X			
WVA-B35-PW-1	Building 110	Bedrock	X			
WVA-MW-79	Building 40	Bedrock	X			
WVA-MW-82R-1	Building 40	Bedrock	X			
WVA-MW-82R-2	Building 40	Bedrock	X			
WVA-MW-82R-3	Building 40	Bedrock	X			
WVA-MW-83-1	Building 40	Bedrock	X			

Notes:
WWTP - Wastewater treatment plant.
(a) Overburden and weathered bedrock.
(b) If sampled for VOCs only in a given year,
well sampled using passive diffusion bags.
(c) Chromium only.

Table 2-1
Long Term Monitoring Wells (Updated April 2016)
Main Manufacturing Area
Watervliet Arsenal, Watervliet, New York

Well	Area Monitored	Geologic Unit	VOCs (b)	Metals	NAP	Frequency
WVA-MW-83-2	Building 40	Bedrock	X			
WVA-MW-83-3	Building 40	Bedrock	X			
WVA-MW-84R-1	Building 40	Bedrock	X			
WVA-MW-84R-2	Building 40	Bedrock	X			
WVA-MW-84R-3	Building 40	Bedrock	X			
WVA-MW-85R-1	Building 40	Bedrock	X			
WVA-MW-85R-2	Building 40	Bedrock	X			
WVA-MW-85R-3	Building 40	Bedrock	X			
WVA-MW-86R-1	Building 40	Bedrock	X			
WVA-MW-86R-2	Building 40	Bedrock	X			
WVA-MW-86R-3	Building 40	Bedrock	X			

Notes:
WWTP - Wastewater treatment plant.
(a) Overburden and weathered bedrock.
(b) If sampled for VOCs only in a given year,
well sampled using passive diffusion bags.
(c) Chromium only.

Table 2-2
Long Term Monitoring Wells (updated April 2016)
Siberia Area
Watervliet Arsenal, Watervliet, New York

Well	Area Monitored	Geologic Unit	VOCs (b)	Metals	NAP	Frequency
WVA-SA-MW-19R	WVA boundary	Overburden	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-20	WVA boundary	Overburden	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-23	WVA boundary	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-32	Burn Pit	Overburden	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-33	WVA boundary	Overburden	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-34	WVA boundary	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-38	WVA boundary	Weathered	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-39	Burn Pit	Weathered	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-41	Burn Pit	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-60	Reactive Wall	Weathered	X			
WVA-SA-MW-70	Reactive Wall	Overburden	X			
WVA-SA-MW-75	Reactive Wall	Weathered	X			
WVA-SA-MW-76	Reactive Wall	Weathered	X			
WVA-SA-MW-77	Reactive Wall	Weathered	X			
WVA-SA-MW-78	Burn Pit	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-79	Burn Pit	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-80	Burn Pit	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-81	Burn Pit	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-82	Burn Pit	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-83	Burn Pit	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-84	Burn Pit	Bedrock	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-85	Reactive Wall	Hybrid (a)	X			
WVA-SA-MW-EA-6	WVA boundary	Weathered	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-MW-ESE-6	WVA boundary	Overburden	X		X	NAP every 3 yrs. - Next in 2017
WVA-SA-STS-3	Sewer	Storm Sewer	X			
WVA-SA-STS-5	Sewer	Storm Sewer	X			
WVA-SA-STS-6	Sewer	Storm Sewer	X			
WVA-SA-SNS-6	Sewer	Sanitary Sewer	X		X	NAP every 3 yrs. - Next in 2017

Notes:
(a) Overburden and weathered bedrock.
(b) If sampled for VOCs only in a given year, well sampled using passive diffusion bags.

Table 3-1
Methods for Sample Analysis
Long-Term Groundwater Monitoring Program
Watervliet Arsenal, Watervliet, New York

ANALYTE	METHOD
Volatile Organics	SW-846 8260B
Metals	SW-846 6010C & 7470A
Dissolved Sulfide	EPA 376.1
Dissolved Organic Carbon	SW-846 9060
Dissolved Gases (a)	AM15.01

(a) Dissolved gases are methane, ethane, ethene, and carbon dioxide.

TABLE 3-2
Summary of Contract Required Quantitation Limits
Long-Term Monitoring Program
Watervliet Arsenal
Watervliet, New York

NY TCL EPA 8260B Liquid	
Analytes	RL ug/L
1,1,1-Trichloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
1,1,2-Trichloroethane	0.75
1,1-Dichloroethane	0.75
1,1-Dichloroethene	0.5
1,2-Dichloroethane	0.5
1,2-Dichloropropane	1.8
2-Butanone	5.0
Benzene	0.5
Bromodichloromethane	0.5
Bromoform	2.0
Bromomethane	1.0
Carbon disulfide	5.0
Carbon tetrachloride	0.5
Chlorobenzene	0.5
Chloroethane	1.0
Chloroform	0.75
Chloromethane	2.5
cis-1,3-Dichloropropene	0.5
Dibromochloromethane	0.5
Ethylbenzene	0.5
Methylene chloride	5
o-Xylene	1.0
p/m-Xylene	1.0
Tetrachloroethene	0.5
Toluene	0.75
trans-1,2-Dichloroethene	0.75
trans-1,3-Dichloropropene	0.5
Trichloroethene	0.5
Trichlorofluoromethane	2.5
Vinyl chloride	1.0

NY TCL EPA 8270C Liquid	
Analytes	RL ug/L
1,2,4-Trichlorobenzene	5
1,2-Dichlorobenzene	5
1,3-Dichlorobenzene	5
1,4-Dichlorobenzene	5
2,4,6-Trichlorophenol	5
2,4-Dichlorophenol	10
2,4-Dimethylphenol	10
2,4-Dinitrophenol	30
2,4-Dinitrotoluene	6
2,6-Dinitrotoluene	5

TABLE 3-2
Summary of Contract Required Quantitation Limits
Long-Term Monitoring Program
Watervliet Arsenal
Watervliet, New York

NY TCL EPA 8270C Liquid	
Analytes	RL ug/L
2-Chloronaphthalene	6
2-Chlorophenol	6
2-Methylnaphthalene	5
2-Nitrophenol	20
3,3'-Dichlorobenzidine	50
4-Bromophenyl phenyl ether	5
4-Chlorophenyl phenyl ether	5
4-Nitrophenol	10
Acenaphthene	5
Acenaphthylene	5
Anthracene	5
Benzidine	50
Benzo(a)anthracene	5
Benzo(a)pyrene	5
Benzo(b)fluoranthene	5
Benzo(ghi)perylene	5
Benzo(k)fluoranthene	5
Bis(2-chloroethoxy)methane	5
Bis(2-chloroethyl)ether	5
Bis(2-chloroisopropyl)ether	5
Bis(2-Ethylhexyl)phthalate	5
Butyl benzyl phthalate	5
Chrysene	5
Dibenzo(a,h)anthracene	5
Diethyl phthalate	5
Dimethyl phthalate	5
Di-n-butylphthalate	5
Di-n-octylphthalate	5
Fluoranthene	5
Fluorene	5
Hexachlorobenzene	5
Hexachlorobutadiene	10
Hexachlorocyclopentadiene	30
Hexachloroethane	5
Indeno(1,2,3-cd)Pyrene	7
Isophorone	5
Naphthalene	5
Nitrobenzene	5
NitrosoDiPhenylAmine(NDPA)/DPA	15
n-Nitrosodimethylamine	50
n-Nitrosodi-n-propylamine	5
Pentachlorophenol	10
Phenanthrene	5
Phenol	7
Pyrene	5

TABLE 3-2
Summary of Contract Required Quantitation Limits
Long-Term Monitoring Program
Watervliet Arsenal
Watervliet, New York

NY TCL EPA 8270CSIM Liquid	
Analytes	RL ug/L
2-Chloronaphthalene	0.2
2-Methylnaphthalene	0.2
Acenaphthene	0.2
Acenaphthylene	0.2
Anthracene	0.2
Benzo(a)anthracene	0.2
Benzo(a)pyrene	0.2
Benzo(b)fluoranthene	0.2
Benzo(ghi)perylene	0.2
Benzo(k)fluoranthene	0.2
Chrysene	0.2
Dibenzo(a,h)anthracene	0.2
Fluoranthene	0.2
Fluorene	0.2
Hexachlorobenzene	0.8
Hexachlorobutadiene	0.5
Hexachloroethane	0.8
Indeno(1,2,3-cd)Pyrene	0.2
Naphthalene	0.2
Pentachlorophenol	0.8
Phenanthrene	0.2
Pyrene	0.2

TAL Metals - 6010B/7471A	
Element	RL mg/L
Arsenic	0.005
Barium	0.010
Cadmium	0.005
Chromium	0.010
Lead	0.010
Mercury	0.0002
Selenium	0.010
Silver	0.007

Table 3-3
Sample Containers, Preservation, and Holding Time Requirements
Long-Term Monitoring Program
Watervliet Arsenal, Watervliet, New York

MATRIX	ANALYSIS	CONTAINER	PRESERVATION	HOLDING TIME
Groundwater	Volatiles - 8260	2 - 40 mL glass	HCl Cool to 4°C	7 days
Groundwater	Metals – 6010 & 7470	500 mL - plastic	HNO_3 Cool to 4°C	180 days
Groundwater	Dissolved Sulfide - EPA 376.1	500 mL - plastic	NaOH Cool to 4°C	5 days
Groundwater	Dissolved Organic Carbon - 9060	100 mL - plastic	H_2SO_4 Cool to 4°C	26 days
Groundwater	Dissolved Gases - AM15.01 (a)	4 - 40 mL glass	Cool to 4°C	14 days

(a) Methane, ethane, ethene, carbon dioxide.

Table 4-1
Summary of Baseline Groundwater Data and Trigger Values
Long-Term Monitoring Plan Update
Watervliet Arsenal, Watervliet, New York

Monitoring Well	Area Monitored	Contaminant	Baseline Data (a)				Trigger Concentration (b)
			Minimum Concentration (ug/l)	Maximum Concentration (ug/l)	Average Concentration (ug/)	Standard Deviation (ug/l)	(ug/l)
MW-82R-1	Building 40	Vinyl chloride	45	250	88	73	307
		cis-1,2 DCE	170	940	526	261	1,310
		TCE	20	480	177	141	599
		PCE	41	2,200	746	650	2,696
MW-82R-2	Building 40	Vinyl chloride	48	160	89	42	214
		cis-1,2 DCE	110	350	224	77	454
		TCE	1	10	4.7	4	17
		PCE	1	10	4.6	3.7	16
MW-82R-3	Building 40	Vinyl chloride	4.2	76	22	25	97
		cis-1,2 DCE	1.1	65	35	46	174
		TCE	2.5	2.5	2.3	0.4	4
		PCE	0.6	2.5	2.2	0.8	4
MW-83-1	Building 40	Vinyl chloride	120	1,000	396	307	1,318
		cis-1,2 DCE	4,300	6,000	5,278	626	7,156
		TCE	2,400	10,000	4,022	2,313	10,963
		PCE	6,100	29,000	10,078	7,320	32,039
MW-83-2	Building 40	Vinyl chloride	320	980	550	197	1,141
		cis-1,2 DCE	5,900	11,000	8,344	1,671	13,358
		TCE	960	5,300	3,473	1,530	8,064
		PCE	250	12,000	7,283	4,369	20,391
MW-83-3	Building 40	Vinyl chloride	49	670	320	203	928
		cis-1,2 DCE	1,300	6,350	2,979	1,659	7,955
		TCE	190	915	361	260	1,141
		PCE	410	2,600	943	776	3,272

Table 4-1
Summary of Baseline Groundwater Data and Trigger Values
Long-Term Monitoring Plan Update
Watervliet Arsenal, Watervliet, New York

Monitoring Well	Area Monitored	Contaminant	Baseline Data (a)				Trigger Concentration (b)
			Minimum Concentration (ug/l)	Maximum Concentration (ug/l)	Average Concentration (ug/)	Standard Deviation (ug/l)	(ug/l)
MW-84R-1	Building 40	Vinyl chloride	125	1,200	436	365	1,530
		cis-1,2 DCE	3,300	9,200	6,810	1,962	12,696
		TCE	1,300	5,100	2,085	1,125	5,461
		PCE	940	6,900	2,834	1,974	8,756
MW-84R-2	Building 40	Vinyl chloride	440	5,000	1,560	1,527	6,141
		cis-1,2 DCE	5,100	11,000	8,550	2,217	15,202
		TCE	8,150	20,000	13,675	3,583	24,423
		PCE	47,000	75,000	59,000	9,006	86,019
MW-84R-3	Building 40	Vinyl chloride	380	1,900	872	480	2,311
		cis-1,2 DCE	6,600	21,000	10,717	4,240	23,438
		TCE	3,400	14,000	7,333	3,319	17,290
		PCE	3,800	20,500	12,967	5,334	28,968
MW-85R-1	Building 40	Vinyl chloride	4	130	53	41	175
		cis-1,2 DCE	2	1,400	346	466	1,743
		TCE	0.5	235	30	77	261
		PCE	0.5	950	109	315	1,055
MW-85R-2	Building 40	Vinyl chloride	3	230	125	92	399
		cis-1,2 DCE	88	3,500	2,261	1,025	5,335
		TCE	16	730	436	275	1,261
		PCE	43	2,600	1,451	979	4,388

Table 4-1
Summary of Baseline Groundwater Data and Trigger Values
Long-Term Monitoring Plan Update
Watervliet Arsenal, Watervliet, New York

Monitoring Well	Area Monitored	Contaminant	Baseline Data (a)				Trigger Concentration (b)
			Minimum Concentration (ug/l)	Maximum Concentration (ug/l)	Average Concentration (ug/)	Standard Deviation (ug/l)	(ug/l)
MW-85R-3	Building 40	Vinyl chloride	510	1,900	834	439	2,150
		cis-1,2 DCE	120	4,100	2,719	1,136	6,126
		TCE	255	3,400	1,346	928	4,130
		PCE	100	32,000	23,200	11,366	57,299
MW-86R-1	Building 40	Vinyl chloride	11	89	36	27	118
		cis-1,2 DCE	26	850	321	275	1,146
		TCE	1	305	45	99	342
		PCE	1.1	1,200	142	397	1,333
MW-86R-2	Building 40	Vinyl chloride	19	91	39	21	102
		cis-1,2 DCE	390	1,400	1,054	322	2,021
		TCE	92	440	240	128	625
		PCE	290	5,350	1,684	1,660	6,665
MW-86R-3	Building 40	Vinyl chloride	28	1,200	575	357	1,647
		cis-1,2 DCE	2,150	8,400	5,594	2,113	11,934
		TCE	240	1,800	753	564	2,445
		PCE	330	6,900	2,036	2,161	8,520

Table 4-1
Summary of Baseline Groundwater Data and Trigger Values
Long-Term Monitoring Plan Update
Watervliet Arsenal, Watervliet, New York

Monitoring Well	Area Monitored	Contaminant	Baseline Data (a)				Trigger Concentration (b)
			Minimum Concentration (ug/l)	Maximum Concentration (ug/l)	Average Concentration (ug/)	Standard Deviation (ug/l)	(ug/l)
83DM-SP-1	Building 25	Vinyl chloride	0.4	25	4.1	7.4	26
		cis-1,2 DCE	1.2	89	14.5	27.0	95
		TCE	3.6	76	16	21.7	81
		PCE	0.25	2.5	1.6	1.1	5
86EM-SP-1A	Building 25	Vinyl chloride	0.4	2.5	1.7	1.0	5
		cis-1,2 DCE	1.5	3.2	2.3	0.6	4
		TCE	8.2	15	11.5	2.2	18
		PCE	0.25	2.5	1.4	1.1	5
WVA-AW-25-MW-2	Building 25	Vinyl chloride	2.8	15	7.8	3.8	19
		cis-1,2 DCE	9.4	64	22.7	15.8	70
		TCE	6	75	21.8	20.7	84
		PCE	0.3	2.5	1.6	1.1	5
WVA-AW-25-MW-3	Building 25	Vinyl chloride	13	27	20.7	5	36
		cis-1,2 DCE	100	190	143	33	242
		TCE	16	170	81.9	52.4	239
		PCE	0.25	5	2.3	1.7	7
WVA-AW-25-MW-6	Building 25	Vinyl chloride	0.8	12.5	4.9	3.8	16
		cis-1,2 DCE	0.6	12.5	4.7	4.1	17
		TCE	250	360	287	37.4	399
		PCE	0.5	12.5	3.8	3.8	15
WVA-AW-25-MW-7	Building 25	Vinyl chloride	0.5	2.5	1.5	0.9	4
		cis-1,2 DCE	0.25	16	3	4.8	17
		TCE	0.25	4	1.8	1.3	6
		PCE	0.25	14	2.8	4.1	15

Table 4-1
Summary of Baseline Groundwater Data and Trigger Values
Long-Term Monitoring Plan Update
Watervliet Arsenal, Watervliet, New York

Monitoring Well	Area Monitored	Contaminant	Baseline Data (a)				Trigger Concentration (b)
			Minimum Concentration (ug/l)	Maximum Concentration (ug/l)	Average Concentration (ug/)	Standard Deviation (ug/l)	(ug/l)
WVA-AW-MW-52	Building 114	Vinyl chloride	0.4	2.5	1.7	1	5
		cis-1,2 DCE	0.5	2	1.2	0.5	3
		TCE	2	3.1	2.4	0.4	4
		PCE	2.5	7.4	5.4	1.4	10
WVA-AW-MW-64	Building 114	Vinyl chloride	58	780	503.8	214.8	1,148
		cis-1,2 DCE	380	2,500	1,648	569.1	3,355
		TCE	300	2,200	1,350	464.9	2,745
		PCE	990	5,300	3,619	1,218.8	7,275

Notes:
(a) Building 40 Baseline data calculated from 10 monitoring events (August 2004 through May 2009).
Building 25 and 114 baseline data calculated from 10 monitoring events (May 2004 through June 2009).
(b) Proposed trigger set at the 99% confidence interval (average plus 3 times standard deviation).
ug/l - micrograms per liter
DCE - Dichloroethene
TCE - Trichloroethene
PCE - Tetrachloroethene

Appendix E

Vapor Intrusion Interim
Corrective Measures Work
Plan

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Remedial Bureau B
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January 28, 2015

Ms. JoAnn Kellogg
Department of the Army
Watervliet Arsenal
1 Buffington Street
Watervliet, NY 12189-4000

Re: Watervliet Arsenal, ID #401034A - LTM 2015 Data Summary Report

Dear Ms. Kellogg:

I have reviewed the Long-Term Monitoring 2015 Data Summary Report for the Watervliet Arsenal.

I have the following responses to the recommendations in the report:

Recommendation 1 - With the reduced frequency (every three years) of NAP sampling approved by the NYSDEC in 2015, the majority of WVA wells are now sampled for only VOCs during non-NAP years. Given that continuous groundwater monitoring has been conducted at the site since the late 1990s and typical concentrations and trends are well established, it is recommended that all wells that are sampled for only VOCs in any given year be sampled using PDBs. PDB efficacy has been well documented and demonstrated at WVA.

Response 1 - This is acceptable.

Recommendation 2 - Based on 2015 Type A and B SSDS operating data, continued O&M in accordance with the ICM Work Plan will provide effective monitoring of the SSDSs.

Response 2 - This is acceptable.

Recommendation 3 - Based on the results of the DAR-1 model analysis, none of the CVOCs of concern for the Building 20/25, 21, and 114 systems exceeded the guideline concentrations, indicating that treatment of system effluent using GAC is no longer necessary. It is therefore recommended that beginning in 2016 the GAC vessels at these systems be taken offline. System effluent sampling would still be conducted as currently scheduled to evaluate effluent concentrations and the need to bring GAC treatment back online if needed.

Response 3 - This is acceptable.

The report is hereby approved. If you have any questions or comments, please feel free to contact me at (518) 402-9767.

Sincerely,

Lawrence Alden

Lawrence J. Alden, P.E.
Project Manager
Remedial Bureau B
Division of Environmental Remediation

Ec: M. Sergott - NYSDOH

Watervliet Arsenal

Watervliet, New York

Vapor Intrusion Interim Corrective Measures Work Plan

Main Manufacturing Area Watervliet Arsenal Watervliet New York

July 2009

Report Prepared By:

Malcolm Pirnie, Inc.

43 British American Blvd.
Latham, New York 12110

Report Prepared For:

U.S. Army Corps of Engineers

Baltimore District, Baltimore, Maryland
Contract No. W912DR-05-D-0004

2118047

US Army Corps of Engineers

MALCOLM PIRNIE

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1. Introduction

The Watervliet Arsenal (WVA) is a 140-acre government-owned installation under the command of the U.S. Army Tank-automotive and Armaments Command (TACOM) located in the City of Watervliet, New York. The WVA is located on the western shore of the Hudson River and approximately five miles north of the City of Albany (Figure 1-1). The WVA currently manufactures large caliber cannons and mortars.

The WVA consists of two primary areas: the Main Manufacturing Area (MMA), encompassing approximately 125 acres, where manufacturing and administrative operations occur, and the Siberia Area (SA), primarily used for the storage of raw and hazardous materials, finished goods, and supplies brought from the MMA (Figure 1-2). Broadway Street (New York State Route 32) and a six-lane interstate highway (Interstate 787) are located between the WVA and the Hudson River.

In accordance with the results and recommendations of the *Vapor Intrusion Investigation Report, Watervliet Arsenal, Watervliet, New York* (Malcolm Pirnie 2008), and subsequent discussions and agreements between the WVA, the New York State Department of Environmental Conservation (NYSDEC), and the New York State Department of Health (NYSDOH), the WVA is implementing Interim Corrective Measures (ICMs) to mitigate vapor intrusion impacts at eight buildings within the Main Manufacturing Area of the WVA. The ICMs, which are being conducted in accordance with the Administrative Order on Consent between the WVA, the NYSDEC, and the United States Environmental Protection Agency (USEPA), will consist of the construction and operation of sub-slab depressurization systems (SSDSs) in each building to prevent the intrusion of soil vapors containing chlorinated volatile organic compounds (VOCs). This ICM Work Plan presents the design of the SSDS for each of the eight buildings; the operation, maintenance, and monitoring requirements for the SSDSs; project reporting requirements; and the anticipated schedule for construction and operation of the SSDSs.

2. Background and Objective

2.1. Background

The WVA performed a vapor intrusion investigation within, and adjacent to, the Main Manufacturing Area (MMA) and adjacent to the Siberia Area of the WVA. This work was performed in two phases: November 2007 and February 2008. The purpose of the investigation was to assess whether chlorinated volatile organic compounds (CVOCs) were present in the sub-slab soil vapor beneath, and the indoor air within, buildings located in the MMA, including those that once contained degreasing operations, as well as three off-site private residences along the southeastern WVA property boundary. The evaluation also assessed whether soil vapor at the WVA southern property boundary and northern property boundary adjacent to the Siberia Area contained CVOCs.

A total of 25 buildings in the MMA were sampled during at least one of the two investigation phases. Based on the results of the investigations, no further action is required at the off-site residences, the WVA property boundary, and at Buildings 9, 18, 19, 23, 24, 35, 38, 44, 108, 110, 112, 115, 124, and 126. Sub-slab VOC concentrations at Building 15 will require monitoring of the indoor air, but not corrective measures. VOCs detected in the sub-slab at Buildings 116 and 123 were also in the range where indoor air monitoring would be required. However, since Building 116 is not occupied and Building 123 is only periodically used for painting operations, no monitoring will be conducted at these buildings. However, indoor air monitoring will be conducted at Buildings 116 and 123 if the use of either building changes in the future. The buildings requiring interim corrective measures are summarized in Table 2-1 below.

Table 2-1 – Buildings Requiring Soil Vapor Interim Corrective Measures

Building	Impacted Media	Target Chlorinated VOCs
20	Sub-Slab Soil Vapor	PCE, TCE, TCA
21	Sub-Slab Soil Vapor	TCE
22	Sub-Slab Soil Vapor	TCE
25	Indoor Air, Sub-Slab Soil Vapor	TCE, TCA
114	Indoor Air, Sub-Slab Soil Vapor	PCE, TCE
120	Sub-Slab Soil Vapor	PCE, Carbon Tetrachloride
121	Sub-Slab Soil Vapor	TCE
130	Sub-Slab Soil Vapor	TCE

Notes:
PCE – Tetrachloroethene
TCE – Trichloroethene
TCA – 1,1,1-Trichloroethane

2.2. ICM Objective

The objective of the ICM is to prevent exposure to chlorinated VOCs present in the soil vapor beneath the affected buildings in accordance with the *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (NYSDOH 2006). This will be accomplished through the installation and operation of SSDSs in the eight buildings listed in Table 2-1.

3. ICM Summary

The ICM will consist of the installation and operation of SSDSs at each of the eight buildings identified in Table 2-1. Due to the large differences in the size, layout, and use of the buildings, the type of, and operational parameters for, the SSDSs varies from building to building. The design of each SSDS was based on the results of pilot testing conducted in 2008. A summary of the pilot testing results, as well as a brief description of the SSDS design, for each building is presented below. Details for the SSDS system designs are presented in Section 4.

3.1. Building 20

Building 20 is primarily utilized for small-parts manufacturing; however, a mezzanine located on the west side of the building is used for office space. Concentrations of TCE (maximum 1,100 µg/m^3), TCA (maximum 930 µg/m^3), and PCE (maximum 150 µg/m^3) were detected in the sub-slab soil vapor in the southeastern portion of Building 20. These concentrations fall within the Monitor/Mitigate categories of the guidance matrices utilized by the NYSDEC and NYSDOH. Indoor air guidance values were not exceeded in the indoor air samples collected in Building 20.

3.1.1. Pilot Testing Results

A pilot test well was installed in the southeast corner of Building 20. The well was constructed and tested in the same manner as previously described in Section 3.1.1. Field pilot test results for Building 20 are summarized in the field test sheets located in Appendix A. The results of the pilot testing indicated that the pilot test well had a radius of influence (ROI) of approximately 57 feet at a flow rate of approximately 120 cfm, with an applied vacuum pressure of (-)36 in H_2O at the well head. TCE, TCA, and PCE concentrations in the effluent air sample collected during the pilot test were 900 µg/m^3, 32 µg/m^3, and 280 µg/m^3, respectively.

3.1.2. SSDS System

The Building 20 SSDS will consist of three extraction points located in the southeastern portion of the building, one of which will be the pilot test well. These wells will be connected to an external treatment building containing blowers and control systems through overhead piping. This building will also serve as the treatment system for the adjacent Building 25 SSDS (see Section 3.4). Effluent air treatment will be accomplished through the use of granular activated carbon (GAC).

3.2. Building 21

Building 21 has multiple uses. The eastern portion of the first floor was once used as the WVA cafeteria, but is now primarily unoccupied space that is used periodically for banquets. The western portion of the first floor is utilized as quarters for military personnel. The basement level, which is only present beneath the western half of the building, is used for storage. Concentrations of TCE (maximum 2,500 µg/m^3) and trans-1,2-Dichloroethene (tDCE) (maximum 5,700 µg/m^3) were detected in the sub-slab soil vapor beneath the eastern portion of the first floor and beneath the basement in Building 21. The highest concentrations were detected beneath the basement. The detected TCE concentrations fall within the Mitigate category of the guidance matrices utilized by the NYSDEC and NYSDOH. Indoor air guidance values were not exceeded in the indoor air samples collected in Building 21.

3.2.1. Pilot Testing Results

A pilot test well was installed in the basement of Building 21. The well was constructed and tested in the same manner as previously described in Section 3.1.1. Field pilot test results for Building 21 are summarized in the field test sheets located in Appendix A. The results of the pilot testing indicated that the pilot test well had a radius of influence (ROI) of approximately 30 feet at a flow rate of approximately 27 cfm, with an applied vacuum pressure of (-)5 in H_2O at the well head. TCE, cis-1,2-Dichloroethene (cDCE), and PCE concentrations in the effluent air sample collected during the pilot test were 480 µg/m^3, 150 µg/m^3, and 78 µg/m^3, respectively.

3.2.2. SSDS System

Two SSDSs will be installed in Building 21, one in the eastern portion of the first floor and one in the basement. The first floor system will be located in the former cafeteria seating area and will consist of one extraction point equipped with an in-line fan that will be vented to the atmosphere above the roof line. The basement system will be located in the basement portion of the building and will utilize the pilot test well. This well will be connected to an external treatment shed containing a blower and control systems through overhead piping in the basement ceiling. Effluent air treatment for the basement system will be accomplished through the use of GAC.

3.3. Building 22

Building 22 contains the equipment and living quarters for the WVA Fire Department. The eastern portion of the building is used as a garage for emergency vehicles. The western portion of the building is utilized as offices and sleeping quarters for fire department personnel. Similar to the adjacent Building 21, the eastern portion of the building has a basement that is used for storage. Concentrations of TCE (140 µg/m^3) and PCE (470 µg/m^3) were detected in the sub-slab soil vapor beneath the eastern portion of the building. These concentrations fall within the Monitor/Mitigate category of the guidance matrices utilized by the NYSDEC and NYSDOH. Indoor air guidance values were not exceeded in the indoor air samples collected in Building 22.

3.3.1. Pilot Testing Results

A pilot test well was installed in the basement of Building 22. The well was constructed and tested in the same manner as previously described in Section 3.1.1. Field pilot test results for Building 22 are summarized in the field test sheets located in Appendix A. The results of the pilot testing indicated that the pilot test well had a radius of influence (ROI) of approximately 44 feet at a flow rate of approximately 120 cfm, with an applied vacuum pressure of (-)6 in H_2O at the well head. TCE and PCE concentrations in the effluent air sample collected during the pilot test were 67 µg/m^3 and 220 µg/m^3, respectively.

3.3.2. SSDS System

Two SSDSs will be installed in Building 22. Both systems will consist of one extraction point equipped with an in-line fan and which will be vented to the atmosphere above the roof line. The first system will be located in the basement portion of the building and will utilize the pilot test well. The second system will be located in the eastern portion of the building in the rear of the vehicle garage area.

3.4. Building 25

Building 25 is a three-story building where the first two floors are used for small-parts manufacturing and the third floor is used for office space. Concentrations of TCE (maximum 94,000 µg/m^3), TCA (maximum 12,000 µg/m^3), and PCE (maximum 900 µg/m^3) were detected in the sub-slab soil vapor at several locations beneath the central and eastern portions of the building. These concentrations fall within the Mitigate category of the guidance matrices utilized by the NYSDEC and NYSDOH. The indoor air guidance value for TCE of 5 µg/m^3 was exceeded in two of the 13 indoor air samples collected on the third floor of Building 25.

3.4.1. Pilot Testing Results

A pilot test well was installed in the southeastern corner of the first floor of Building 25. The well was constructed and tested in the same manner as previously described in Section 3.1.1. Field pilot test results for Building 25 are summarized in the field test sheets located in Appendix A. The results of the pilot testing indicated that the pilot test well had a radius of influence (ROI) of approximately 37 feet at a flow rate of approximately 130 cfm, with an applied vacuum pressure of (-)7 in H_2O at the well head. TCE, TCA, and cDCE concentrations in the effluent air sample collected during the pilot test were 78,000 µg/m^3, 7,800 µg/m^3, 510 µg/m^3,and respectively.

3.4.2. SSDS System

The Building 25 SSDS will consist of four extraction points located in the eastern and central portions of the building, one of which will be the pilot test well. These wells will be connected to an external treatment building containing blowers and control systems through overhead piping. The manifold piping will be constructed with a capped connection located in the northern portion of the building to allow for the installation of a fifth extraction point in this area, if warranted based on performance monitoring. The blowers will be sized to accommodate additional extraction points, if necessary. This building will also serve as the treatment system for the adjacent Building 20 SSDS (see Section 3.1). Effluent air treatment will be accomplished through the use of GAC.

3.5. Building 114

Building 114 is a single-story building used for laboratory space by Benet Laboratories. The building is currently only used occasionally. Concentrations of TCE (1,400 $\mu g/m^3$) and PCE (8,300 $\mu g/m^3$) were detected in the sub-slab soil vapor beneath the building. These concentrations fall within the Mitigate category of the guidance matrices utilized by the NYSDEC and NYSDOH. The indoor air guidance value for TCE of 5 $\mu g/m^3$ was exceeded in the indoor air sample collected from Building 114.

3.5.1. Pilot Testing Results

A pilot test well was installed in the eastern portion of Building 114. The well was constructed and tested in the same manner as previously described in Section 3.1.1. Field pilot test results for Building 114 are summarized in the field test sheets located in Appendix A. The results of the pilot testing indicated that the pilot test well had a radius of influence (ROI) of approximately 23 feet at a flow rate of approximately 120 cfm, with an applied vacuum pressure of (-)34 in H_2O at the well head. TCE, PCE, and cDCE concentrations in the effluent air sample collected during the pilot test were 4,200 $\mu g/m^3$, 17,000 $\mu g/m^3$, 230 $\mu g/m^3$,and respectively.

3.5.2. SSDS System

The Building 114 SSDS will consist of two extraction points located in the eastern and western portions of the building, one of which will be the pilot test well. These wells will be connected to an external treatment building containing a blower and control systems through overhead piping. Effluent air treatment will be accomplished through the use of GAC.

3.6. Building 120

Building 120 is a three-story building utilized for Department of Public Works (DPW) shops, office space for the New York Army National Guard, and laboratory/office space for Benet Laboratories. The western portion of the first floor of the building contains the DPW carpentry and plumbing shops. The eastern portion of the first floor contains a high-bay testing laboratory. The second and third floors are use for office/laboratory space. Concentrations of TCE (150 µg/m^3) and PCE (430 µg/m^3) were detected in the sub-slab soil vapor beneath the southwestern portion of the building in the carpentry shop. These concentrations fall within the Monitor/Mitigate category of the guidance matrices utilized by the NYSDEC and NYSDOH. Indoor air guidance values were not exceeded in the indoor air samples collected in Building 120.

3.6.1. Pilot Testing Results

A pilot test well was installed in the carpentry shop of Building 120. The well was constructed and tested in the same manner as previously described in Section 3.1.1. Field pilot test results for Building 120 are summarized in the field test sheets located in Appendix A. The results of the pilot testing indicated that the pilot test well had a radius of influence (ROI) of approximately 27 feet at a flow rate of approximately 140 cfm, with an applied vacuum pressure of (-)18 in H_2O at the well head. TCE and PCE concentrations in the effluent air sample collected during the pilot test were 6 µg/m^3 and 140 µg/m^3, respectively.

3.6.2. SSDS System

The Building 120 SSDS will consist of two extraction points manifolded to a single in-line fan which will be vented to the atmosphere above the roof line. The pilot test well will be used as one of the extraction points.

3.7. Building 121

Building 121 is a single-story building utilized as a high-bay testing laboratory by Benet Laboratories. TCE (65 µg/m^3) was detected in the sub-slab soil vapor beneath the southeastern portion of the building. This concentration falls within the Monitor/Mitigate category of the guidance matrices utilized by the NYSDEC and NYSDOH. Indoor air guidance values were not exceeded in the indoor air samples collected in Building 121.

3.7.1. Pilot Testing Results

A pilot test well was installed in the southeast corner of Building 121. The well was constructed and tested in the same manner as previously described in Section 3.1.1. Field pilot test results for Building 121 are summarized in the field test sheets located in Appendix A. The results of the pilot testing indicated that the pilot test well had a radius of influence (ROI) of approximately 45 feet at a flow rate of approximately 120 cfm, with an applied vacuum pressure of (-)7 in H_2O at the well head. TCE and PCE concentrations in the effluent air sample collected during the pilot test were 96 µg/m^3 and 29 µg/m^3, respectively.

3.7.2. SSDS System

The Building 121 SSDS will consist of a single extraction point (the pilot test well) equipped with an in-line fan which will be vented to the atmosphere above the roof line.

3.8. Building 130

Building 130 is a single-story building utilized for storage of manufactured small parts. TCE (960 µg/m^3) and PCE (120 µg/m^3) were detected in the sub-slab soil vapor beneath the northern portion of the building. This TCE concentration falls within the Mitigate category of the guidance matrices utilized by the NYSDEC and NYSDOH. Indoor air guidance values were not exceeded in the indoor air sample collected in Building 130.

3.8.1. Pilot Testing Results

A pilot test well was installed in the northern portion of Building 130. The well was constructed and tested in the same manner as previously described in Section 3.1.1. Field pilot test results for Building 130 are summarized in the field test sheets located in Appendix A. The results of the pilot testing indicated that the pilot test well had a radius of influence (ROI) of approximately 25 feet at a flow rate of approximately 160 cfm, with an applied vacuum pressure of (-)9 in H_2O at the well head. TCE and PCE concentrations in the effluent air sample collected during the pilot test were 1,200 µg/m^3 and 300 µg/m^3, respectively.

3.8.2. SSDS System

The Building 130 SSDS will consist of a single extraction point (the pilot test well) equipped with an in-line fan which will be vented to the atmosphere above the roof line.

4. ICM Design

The ICM will utilize three general SSDS designs, designated Type A, Type B, and Type C. The type of SSDS installed in each building will be based on the size of building, the magnitude of the soil vapor impacts, and the flow rates and vacuum pressures required to create a negative pressure environment beneath the targeted area(s) of the building. A description of each system, as well as a list of the buildings for which they will be used, is presented below. Detailed mechanical designs for each system, as well as details for specific connections and equipment, are provided in the half-size design drawings contained in Appendix B.

4.1. SSDS Type A

The Type A SSDS will be used for buildings that require greater flow rates and vacuum pressures than can be supplied with traditional in-line fan systems. These systems will also be used where off-gas treatment through GAC is required before discharge to the atmosphere, based on the sub-slab soil vapor concentrations measured during the investigation and effluent concentrations measures during the pilot studies. The Type A SSDSs will be housed within an insulated seven foot by four foot enclosure that is approximately eight feet high. The enclosure will be situated immediately adjacent to the building and will be connected to the extraction wells via a wall penetration. The Type A SSDS will include the following components:

- Regenerative or positive-displacement blower equipped with a variable-speed drive (size dependent on building requirements);
- Control panel with alarms and automatic shutdown capability;
- Electrical panel;
- Programmable Logic Controller (PLC) capable of remote operation and telemetry transmission;
- Vapor Knockout Tank;
- Critical Silencer;
- Air intake hood and dilution controls;
- In-series 200-pound or 400-pound GAC vessels (where required);
- Vacuum/pressure gauges and sampling ports; and
- Environmental controls, including thermostat, exhaust fan, and lighting.

The enclosure will be heated by radiant heat generated from the blower exhaust piping, which will be allowed to radiate before leaving the enclosure. The Type A SSDS will be used at the following buildings:

1. Building 21 (basement) (200-pound GAC vessels)
2. Building 114 (400-pound GAC vessels)

4.2. SSDS Type B

The Type B SSDS will be used for Buildings 20 and 25, which will require the largest flow rates and vacuum pressures due to the size of the buildings and treatment areas. The system will service both buildings from a single location and will be equipped with large capacity GAC vessels to treat off-gas before discharge to the atmosphere. The Type B SSDS will be housed within an insulated 20 foot by eight foot enclosure that is approximately nine feet high (i.e., shipping container). The enclosure will be situated adjacent to Building 20 in the alleyway between the north side of Building 25 and the south side of Building 20 and will be connected to the extraction wells via wall penetrations. The piping from Building 25 will cross the alleyway via an overhead insulated pipe that will be supported from the ground. The Type B SSDS will include the following components:

- Two regenerative or positive-displacement blowers equipped with a variable-speed drive (size dependent on building requirements);
- Control panel with alarms and automatic shutdown capability;
- Electrical room with panels;
- Programmable Logic Controller (PLC) capable of remote operation and telemetry transmission;
- Vapor Knockout Tanks;
- Critical Silencers;
- Air intake louver and dilution controls;
- Heat exchanger;
- Two 2,000-pound GAC vessels, in-series;
- Vacuum/pressure gauges and sampling ports; and
- Environmental controls, including thermostat, heating, exhaust fan, and lighting.

4.3. SSDS Type C

The Type C SSDS will be used for smaller buildings and/or smaller treatment areas where off-gas treatment is not required. The system will consist of an in-line fan connected directly to the extraction well through piping and will be similar to a traditional radon mitigation system. The fan will be located outside of the structure and will be connected to the extraction well through a wall penetration.

The Type C SSDS will include the following components:

- In-line Fantech radon mitigation fan; and
- Pitot tube (for pressure readings) and sampling ports.

The Type C SSDS will be used at the following buildings:

1. Building 21 (eastern end)
2. Building 22 (two systems)
3. Building 120
4. Building 121
5. Building 130

5. ICM Performance Monitoring

Performance monitoring will be conducted to evaluate the effectiveness of the SSDSs and to optimize SSDS operation. In addition, since the SSDSs will not depressurize the entire footprint of the buildings being mitigated, annual monitoring of the indoor air will be required to evaluate if the corrective action objectives are being met. The performance monitoring will include the following elements:

- Operational monitoring and maintenance, including measurement of vacuum pressures, optimization of flow rates and number of extraction points, system balancing, and required maintenance.
- Effluent sampling for SSDSs equipped with off-gas treatment to evaluate treatment efficacy and GAC change-out schedule.
- Indoor air sampling to assess mitigation system performance at meeting the corrective action objectives.

Effluent testing will be conducted quarterly. Indoor air sampling will be performed once during the heating season, which is defined as November 1 through March 30. The anticipated sample requirements are listed in Table 5-1, below.

Table 5-1: ICM Performance Monitoring Sampling Requirements

Building	No. Effluent Samples	Number IA Samples
Building 15		2
Building 20	4	1
Building 21	4	2
Building 22		2
Building 25	4	5
Building 114	4	1
Building 120		2
Building 121		1
Building 130		1

5.1. Indoor Air Sampling Procedures

Indoor air samples will be collected using a Summa canister sampling train, which consists of a Summa canister, flow controller, particulate filter, pressure gage, and associated fittings. All canisters will be batch-certified as analyte-free by the analytical laboratory prior to use. Flow regulators calibrated and supplied by the analytical laboratory will be used to allow for continuous sampling over the eight-hour sampling period. Each flow regulator will be equipped with a filter to prevent particulate matter from entering the canister.

The following procedure will be used for the collection of indoor air samples:

- Place Summa canister at sampling location so the sample is collected at a height of approximately two to three feet above the floor.
- Note the environmental conditions in the sample area on the sample collection sheet.
- Remove the brass fitting covering the 6-liter Summa canister sampling port using a wrench.
- Assemble the sampling train, connecting the flow controller with integral pressure gage to the Summa canister sampling port. Each fitting should be hand tightened and then tightened with a wrench approximately ¼ turn.
- Confirm that the sampling train is air tight by conducting a vacuum test. Place the brass cap at the end of the sampling train (particulate filter), quickly open and close the sampling valve and monitor the vacuum on the pressure gage. If the vacuum decreases, there is a leak in the system and the fitting should be rechecked and the vacuum test redone.
- Initiate sampling by opening the Summa canister valve. Record starting time and the vacuum within the canister on the sample collection sheet and canister identification tag.
- Check the sampling train pressure gage after one hour of sampling to confirm that the air sampling is proceeding as planned.
- When approximately eight hours have elapsed since initiation of sampling, close the canister valve. Check the vacuum within the canister using the pressure gauge and record the measurement on the sample collection sheet and canister identification tag.
- Since the flow rate into the canister can fluctuate due to variations in atmospheric conditions, the measured final vacuum may range from 2 to 12 inches of mercury (Hg). If the measured vacuum is greater the 12 inches of Hg or less than 1.0 inches of Hg, the sample may be flagged and re-sampling may be required.
- Disassemble the sampling train and place the brass cap on the sampling port of the canister and tighten. The air sampling is complete.
- Place the canister in the travel box and complete the chain-of-custody forms and identification tag on the canister.
- Send the canister to the laboratory via next day airmail service for analysis. As a general rule the final measured vacuum in the field and the vacuum measured at the laboratory prior to analysis should be within 1.5 inches of Hg.

All samples will be analyzed by a laboratory accredited by the National Environmental Laboratory Accreditation Conference (NELAC) and certified by the NYSDOH for analysis of air samples. EPA Method Low Level TO-15 (GC/MS) in Selective Ion Mode (SIM), or equivalent, will be used to analyze the samples.

The samples will be analyzed for the following compounds:

- Trichloroethene (TCE)
- Tetrachloroethene (PCE)
- 1,1,2,2-Tetrachloroethane
- 1,1,1-Trichloroethane (TCA)
- 1,1,2-Trichloroethane
- Chloromethane
- Vinyl chloride
- 1,1-Dichloroethene
- cis- & trans-1,2-Dichloroethene (DCE)
- 1,2-Dichloroethane
- Chlorobenzene
- Carbon tetrachloride
- Chloroethane
- 1,1-Dichloroethane

The field sampling team will maintain a sample log sheet for each sample collected. The sample log sheets will include:

- Sample identification;
- Date and time of sample collection;
- Sampling height;
- Identity of samplers;
- Sampling methods and devices;
- Volume of air sampled;
- Vacuum of canister before and after samples are collected; and
- Chain of custody protocols and records used to track samples from sampling point to analysis.

5.2. SSDS Monitoring

Daily operational monitoring, monthly system checks, and quarterly monitoring events will be conducted during the operation of the SSDSs. Daily operational system monitoring will be conducted remotely through the PLC telemetry for the Type A and Type B SSDSs. Type C systems will be checked on a minimum bi-weekly basis to confirm that they are operating. The monthly system checks will monitor system performance and confirm that equipment is functioning properly. The quarterly monitoring events will evaluate overall performance of the SSDSs and provide information to support any changes to the systems to optimize their operation.

Monthly system checks will consist of the following activities:

- Recording of system performance parameters (i.e., flows, pressures, and temperatures).
- Any required maintenance.

- Monitoring of volatile vapor concentrations in the air effluent using a photoionization detector (PID).
- Flow measurements.
- Balancing of flows.

Quarterly monitoring will consist of the same activities as the monthly system checks, plus the following activities:

- Sampling of air effluent for systems with off-gas treatment.

Records of bi-weekly (Type C SSDSs), monthly, and quarterly system checks will be maintained throughout the operation of the SSDSs. Performance monitoring operations are summarized in Table 5-2.

5.3. Contingency Plan

The following general steps will be taken in the event monitoring shows that an SSDS is not performing as designed. Specific actions will be discussed with the regulators prior to implementation.

5.3.1. Indoor Air Sampling Contingency

1. If, during operational monitoring, indoor air sampling results for VOCs are greater than NYSDOH/NYSDEC indoor air guidance values, then additional sampling will be conducted to confirm the original result.
2. If the additional sampling confirms the original result, then SSDS operations will be modified. This may include increasing blower flows and pressures (through adjustment of the variable frequency drive) or re-balancing to adjust flows and/or pressures in specific areas. Additional sampling will then be conducted to evaluate concentrations of VOCs in the indoor air.
3. If indoor air concentrations remain at levels greater than guidance values, then additional actions, including the installation of additional extraction points, will be discussed with the regulators. It should be noted that the blowers for the Type A and Type B systems have been sized to accommodate additional extraction points, if necessary.

5.3.2. SSDS Operational Performance Contingency

1. In the event that an SSDS is not operating as designed in terms of radius of influence, air flow, or vacuum pressure, then SSDS operations will be modified. This may include increasing blower flows and pressures (through adjustment of the variable frequency drive) or re-balancing to adjust flows and/or pressures in specific areas.
2. If, after such adjustments, the SSDS is still not operating as designed, additional actions, including the installation of additional extraction points, will be discussed with the regulators. These discussions will take into account the results of indoor air samples for the building in which the SSDS is located.

6. ICM Installation Schedule

The anticipated schedule for the installation of the vapor intrusion ICM is presented in Figure 6-1. SSDS operation will be conducted in accordance with Section 5 upon the completion of installation and startup testing.

7. Reporting

An annual report will be submitted after receipt of the indoor air samples collected during each heating season. The report will summarize the sampling results, operations and maintenance activities, and recommendations for any changes to the operation of SSDSs. The report will include the following:

- Overall performance of the SSDSs;
- Summary of SSDS operational parameters (i.e., flows, pressures, etc.);
- Discussion of sampling activities and methodologies;
- Analytical results for indoor air and air effluent samples;
- Maps showing the locations of the indoor air sampling locations;
- Recommendations for modifications to the SSDSs and/or performance monitoring program based on system performance; and
- Supporting data, including analytical data packages and field log forms.

The draft summary report will be submitted to the agencies upon review by the WVA. A final report and/or response to comments will be prepared and submitted to the regulators upon the receipts of any comments on the draft report.

8. References

Malcolm Pirnie 2007. *Vapor Intrusion Evaluation Work Plan, Main Manufacturing Area, Watervliet Arsenal, Watervliet, New York*, June 2007 (amended August 1, 2007 and approved September 20, 2007).

Malcolm Pirnie 2008a. *Vapor Intrusion Evaluation Work Plan Addendum, Main Manufacturing Area, Watervliet Arsenal, Watervliet, New York*, January 2008 (supplemented February 8, 2008).

Malcolm Pirnie 2008b. *Vapor Intrusion Investigation Report, Main Manufacturing Area, Watervliet Arsenal, Watervliet New York*, August 2008.

NYSDOH 2006. *New York State Department of Health Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, October 2006.

NYSDOH 2007. Letter to NYSDEC regarding "Soil Vapor/Indoor Air Matrices", June 25, 2007.

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WATERVLIET ARSENAL MAIN MANUFACTURING AREA
WATERVLIET, NEW YORK
VAPOR INTRUSION INTERIM CORRECTIVE MEASURES SITE MAP

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FIGURE 1-2

Figure 6-1
Anticipated Vapor Intrusion ICM Installation Schedule
Watervliet Aresenal
Watervliet, New York

ID	Task Name
1	**ICM Contracting**
2	**Vapor Intrusion Work Plan Review**
3	**Vapor Intrusion Work Plan Approval**
4	**Installation of SSDSs**
5	**SSDS Startup Testing**
6	**SSDSs Operational**
7	**ICM Installation and Startup Report**
8	**ICM Installation and Startup Report Submission**
9	**Indoor Air Sampling**
10	**Air Sample Analysis**
11	**Annual Report Preparation**
12	**Annual Report Submission**

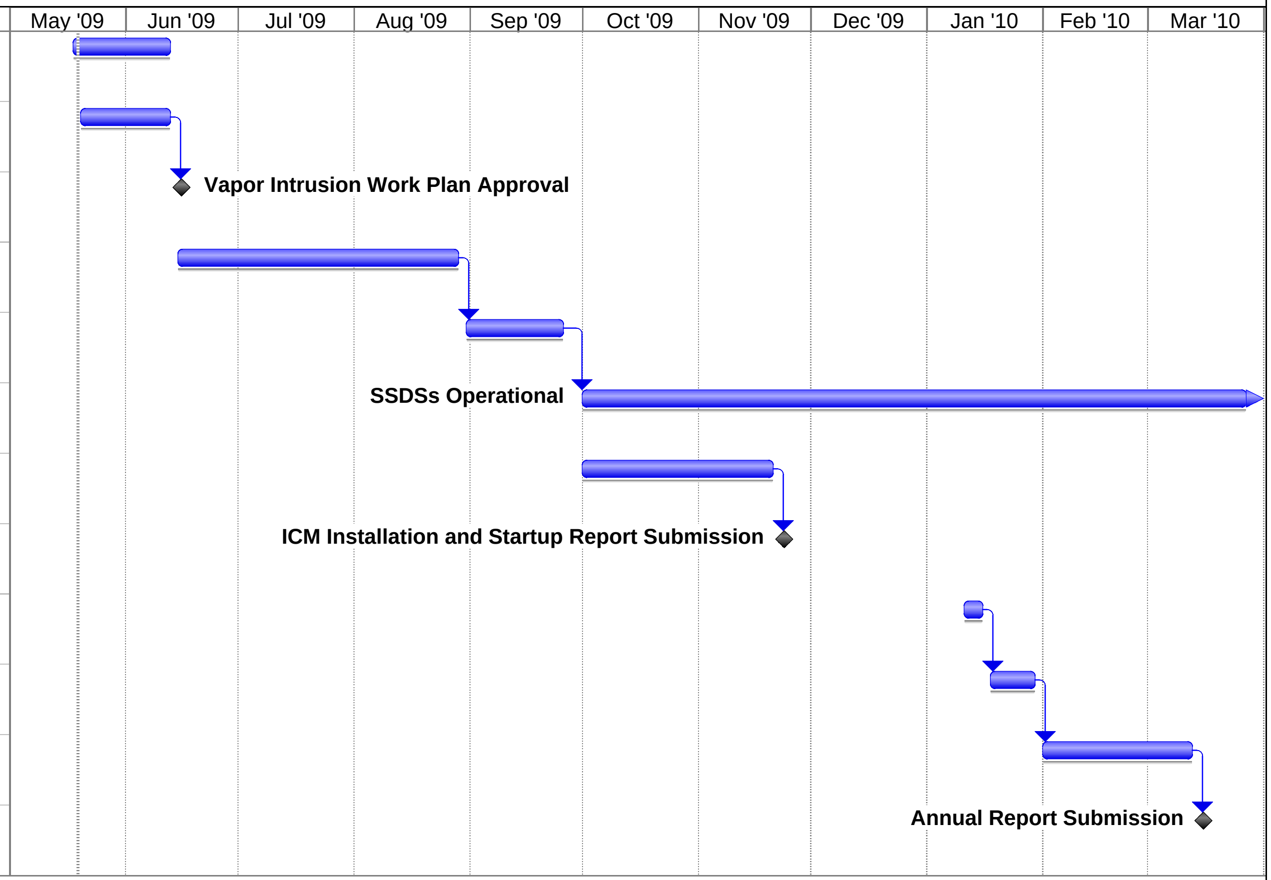

Table 5-2
Summary of SSDS Performance Monitoring
Main Manufacturing Area
Watervliet Arsenal, Watervliet, New York

Monitoring Frequency	**Daily***			**Bi-Weekly**			**Monthly**			**Quarterly**		
SSDS Type	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Status (On/Off)	✓	✓				✓	✓	✓	✓	✓	✓	✓
Total System Vacuum Pressure	✓	✓				✓	✓	✓	✓	✓	✓	✓
Total System Flow	✓	✓					✓	✓	✓	✓	✓	✓
Influent Temperature		✓						✓			✓	
VFD Status	✓	✓					✓	✓		✓	✓	
Alarms**	✓	✓					✓	✓		✓	✓	
Extraction Point Flow							✓	✓		✓	✓	✓
Extraction Point Pressure							✓	✓		✓	✓	
Flow Balancing							✓	✓		✓	✓	
Influent Volatile Vapor Concentrations (PID)							✓	✓		✓	✓	
Effluent Volatile Vapor Concentrations (PID)							✓	✓	✓	✓	✓	✓
Extraction Point Volatile Vapor Concentrations (PID)							✓	✓		✓	✓	
System Maintenance							✓	✓	✓	✓	✓	✓
Influent/Effluent Sampling										✓	✓	

Building	**SSDS Type**	**Monitoring Frequency**			
		Daily*	**Bi-Weekly**	**Monthly**	**Quarterly**
20	B	✓		✓	✓
21	A	✓		✓	✓
	C		✓	✓	✓
22	C (2)		✓	✓	✓
25	B	✓		✓	✓
114	A	✓		✓	✓
120	C		✓	✓	✓
121	C		✓	✓	✓
130	C		✓	✓	✓

Notes:
* Daily monitoring performed via remote telemetry.
** Alarms are provided for system pressure, flow rate, suction, and temperature (Type B only).
VFD - Variable Frequency Drive
PID - Photoionization Detector

Watervliet Arsenal, Watervliet, New York
Vapor Intrusion Interim Corrective Measures Work Plan

Appendix A – Field Pilot Testing Results

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Sub-Slab Depressurization Field Test
Building 20, EW - 1

Pressure Table		Pressures (inH2O)								
Pressure Monitoring Points		Blower/Fan	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8
Distance from Pilot SSDS Well (ft)		Inlet	11.7	18.9	25	30	44	57	60	
Flow Rate (ft^3/min)	Time									
121.3	910	-36	0.003	-2.66	0.018	-0.647	-0.39	-0.182	-0.07	
110.0	935	-28	0.02	-2.08	0.017	-0.488	-0.184	-0.146	-0.056	
83.8	950	-19	0.012	-0.573	0.022	-0.369	0.013	-0.087	-0.024	
44.7	1015	-8	0.008	-0.688	0.021	-0.16	0.018	-0.015	0.007	
32.5	1030	-5	-	-0.41	0.022	-0.099	0.059	0.009	0.015	

Summa Canister ID 2605 Pressure Regulator ID

Summa Sample ID B20 Effluent

Notes:

At least four pressure monitoring points should be used over three flow ranges to determine ROI and optimize blower/fan

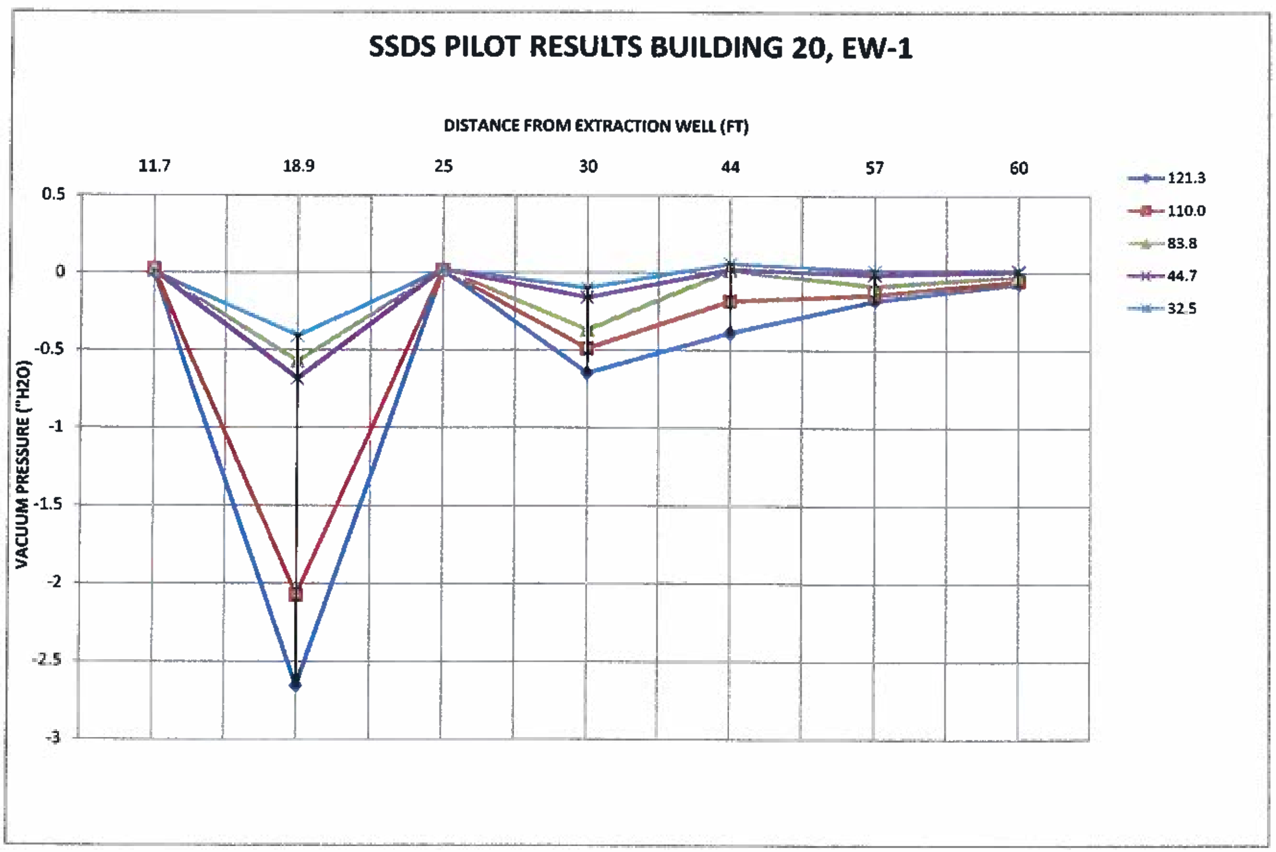
One summa canister should be collected after the range of testing and flow rates occurred to determine concentrations of chemicals of concern.

Comments:

Max. Velocity = 5560 ft/min or max flow = 121.3 cfm

@0910 - 0ppm, @0930 - 0ppm, @0955-0ppm, @1030-0ppm

Collected effluent sample @ 1116 (121.3, -36"H20)



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Sub-Slab Depressurization Field Test
Building 21, EW - 1

Pressure Table		Pressures (inH2O)								
Pressure Monitoring Points		Blower/Fan	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8
Distance from Pilot SSDS Well (ft)		Inlet	1.5	16.4	26	32				
Flow Rate (ft^3/min)	Time									
117	1422	-44	0	-0.288	0	0				
42	1504	-10	-2.88	-0.138	-0.089	-0.146				
27.5	1510	-5	-1.841	-0.091	-0.654	-0.098				

Summa Canister ID 35171 Pressure Regulator ID

Summa Sample ID B21 Effluent

Notes:

At least four pressure monitoring points should be used over three flow ranges to determine ROI and optimize blower/fan

One summa canister should be collected after the range of testing and flow rates occurred to determine concentrations of chemicals of concern.

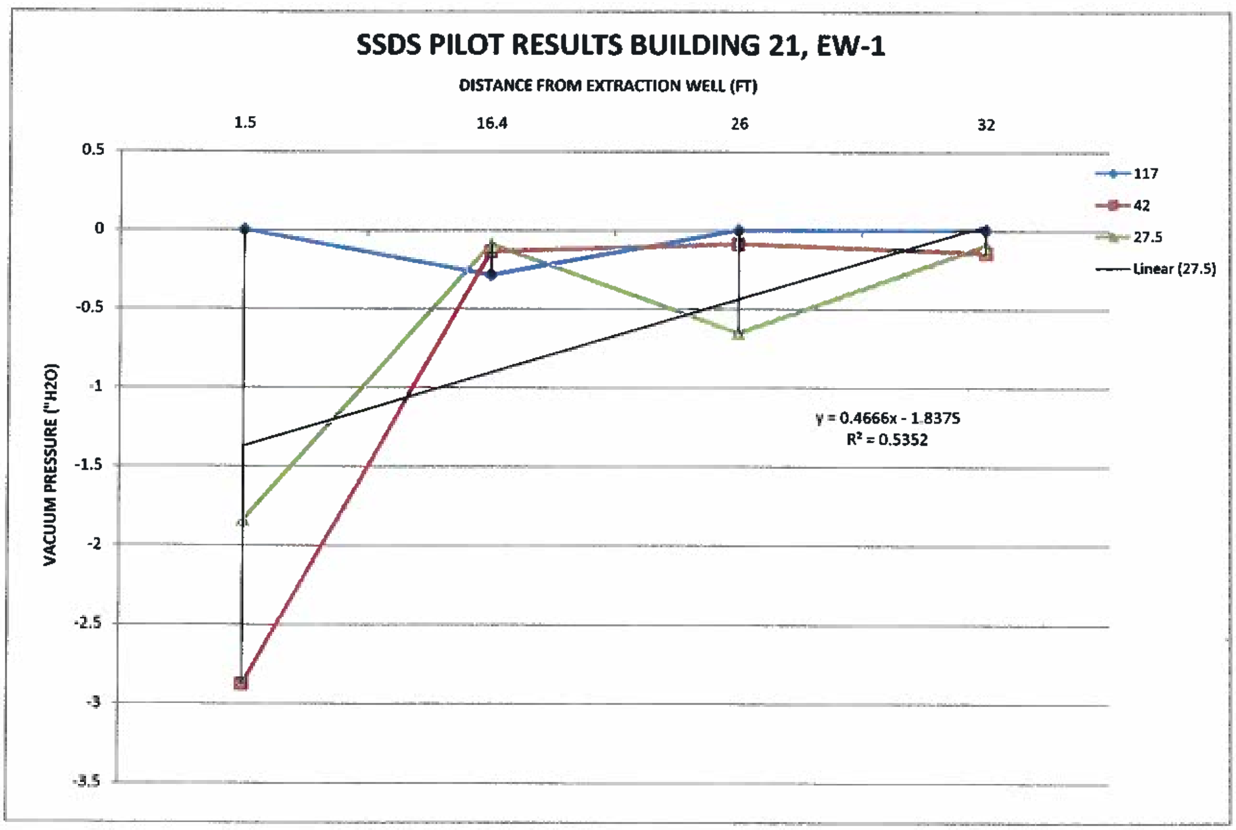
Comments:

Max flow = 117 cfm (due to the pressence of water - 42 cfm was used) This basement area experiences occational flooding and going at to high of a pressure and flow rate mound the ground water in the SSDS pipe and seals off the flow.

@1422 - 2.66 ppm, 1505 - 0.55 ppm, 1510 - 0.2ppm, @1430 stopped pilot test due to drawing water up

@ -20"H2O and @-15"H2O drawing water up, run system @ -10"H2O to reduce water intake between 1440 and 1500

Collected effluent sample @ 1555 (27.5cfm, -5"H20)



MALCOLM PIRNIE

Sub-Slab Depressurization Field Test
Building 22, EW - 1

Pressure Table		Pressures (inH2O)								
Pressure Monitoring Points		Blower/Fan	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8
Distance from Pilot SSDS Well (ft)		Inlet	20.7	51	70.6	97				
Flow Rate (ft^3/min)	Time									
202	1455	-10.8	-0.527	-0.089	-0.003	-0.014				
174	1500	-6.4	-0.342	-0.06	-0.001	-0.014				
112	1505	-3.7	-0.225	-0.038	-0.001	-0.011				

Summa Canister ID 9557 Pressure Regulator ID FC00992

Summa Sample ID Bldg. 22 Effluent

Notes:

At least four pressure monitoring points should be used over three flow ranges to determine ROI and optimize blower/fan

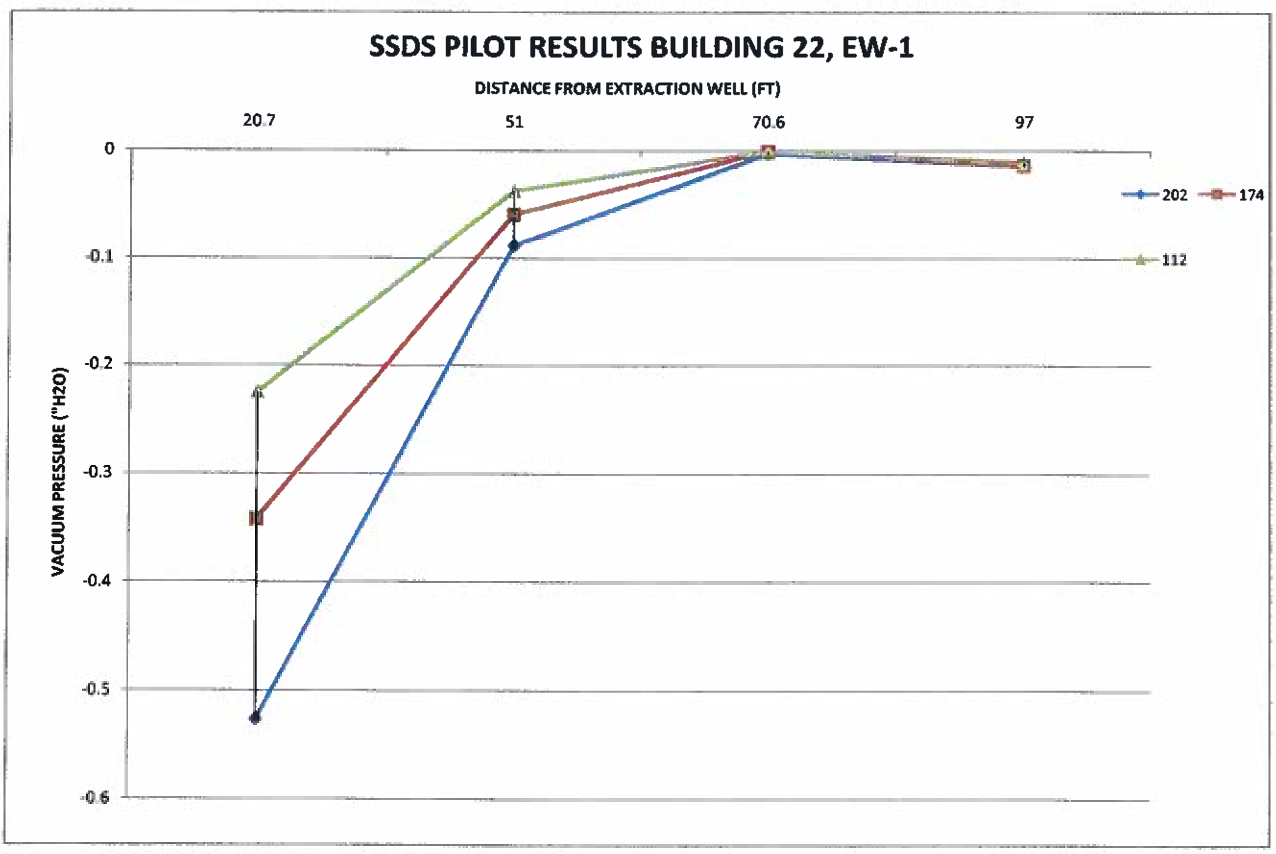
One summa canister should be collected after the range of testing and flow rates occurred to determine concentrations of chemicals of concern.

Comments:

Sample Started @ 1231 -30"HG, Collect @ 7070 ft/min, -10.8"H2O

Sample Stopped at 1259 - 3.5"HG

@1422 - 0.499ppm, @1500 - .519ppm, @1505-0.338ppm



MALCOLM PIRNIE

Sub-Slab Depressurization Field Test
Building 25, EW - 1

Pressure Table		Pressures (inH2O)								
Pressure Monitoring Points		Blower/Fan	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8
Distance from Pilot SSDS Well (ft)		Inlet	6.4	11.3	21.2	31.5	37.3	52	62.2	73
Flow Rate (ft^3/min)	Time									
127.0	1330	-7	-2.67	-0.18	-0.108	-0.006	-0.1	-0.041	-0.022	-0.011
85.0	1340	-4	-1.65	-0.11	-0.068	-0.004	-0.063	-0.005	-0.015	-0.007
55.0	1345	-1.8	-0.098	-0.067	-0.041	-0.003	-0.038	-0.007	-0.01	-0.006

Summa Canister ID 120741 Pressure Regulator ID

Summa Sample ID B25 Effluent

Notes:

At least four pressure monitoring points should be used over three flow ranges to determine ROI and optimize blower/fan

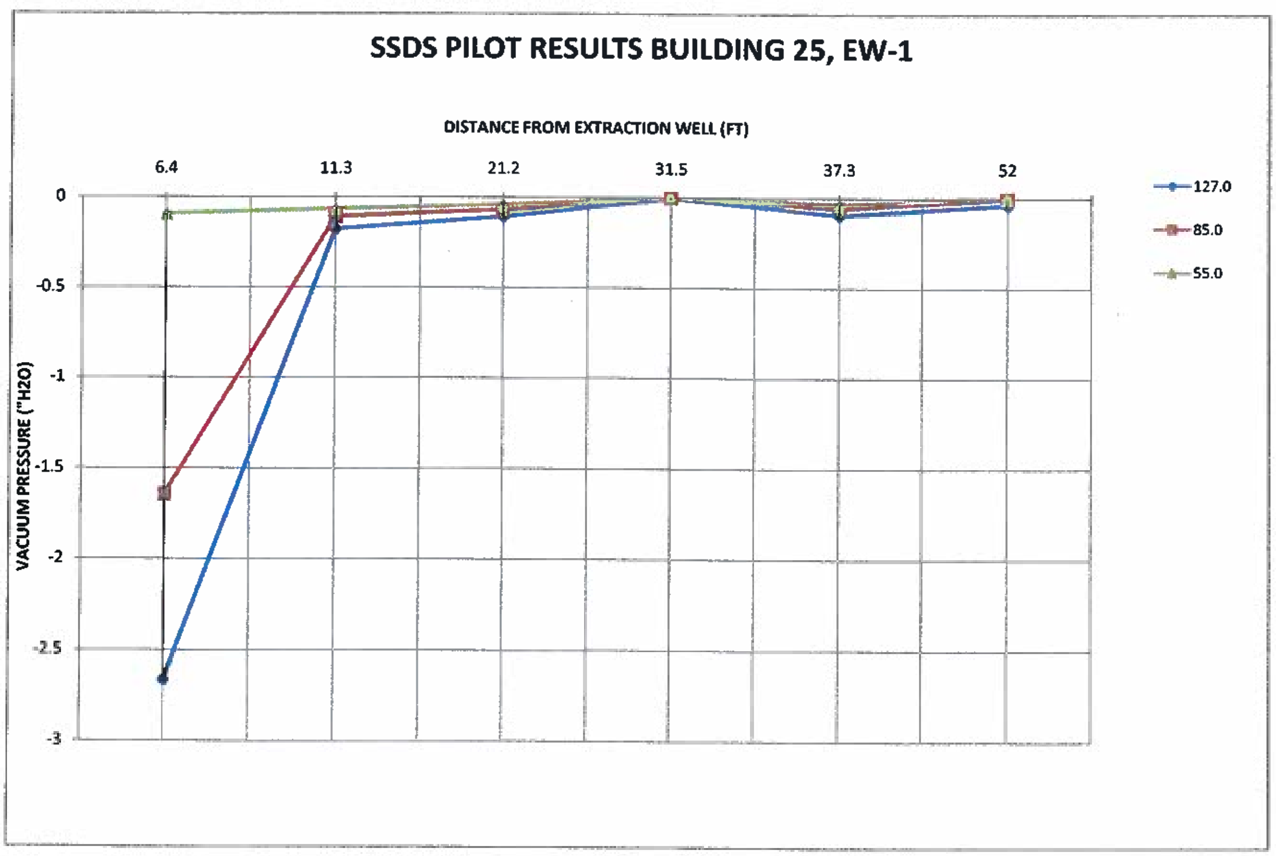
One summa canister should be collected after the range of testing and flow rates occurred to determine concentrations of chemicals of concern.

Comments:

Max. Flow = 127 cfm

@1355 - 35.5ppm,

Collected effluent sample @ 1445 (127 CFM cfm, -7"H20)



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Sub-Slab Depressurization Field Test
Building 114, EW - 1

Pressure Table		Pressures (inH2O)								
Pressure Monitoring Points		Blower/Fan	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8
Distance from Pilot SSDS Well (ft)		Inlet	14.8	15.4	28	31.9	52.6			
Flow Rate (ft^3/min)	Time									
122.0	1255	-34	-0.458	-0.172	-0.045	-0.076	-0.03			
101.0	1300	-25	-0.274	-0.136	-0.033	-0.061	-0.021			
74.5	1305	-12	-0.26	-0.089	-0.02	-0.037	-0.012			
51	1310	-9	-0.179	-0.058	-0.011	-0.023	-0.005			

Summa Canister ID ____________ Pressure Regulator ID ____________

Summa Sample ID B114 Effluent

Notes:

At least four pressure monitoring points should be used over three flow ranges to determine ROI and optimize blower/fan

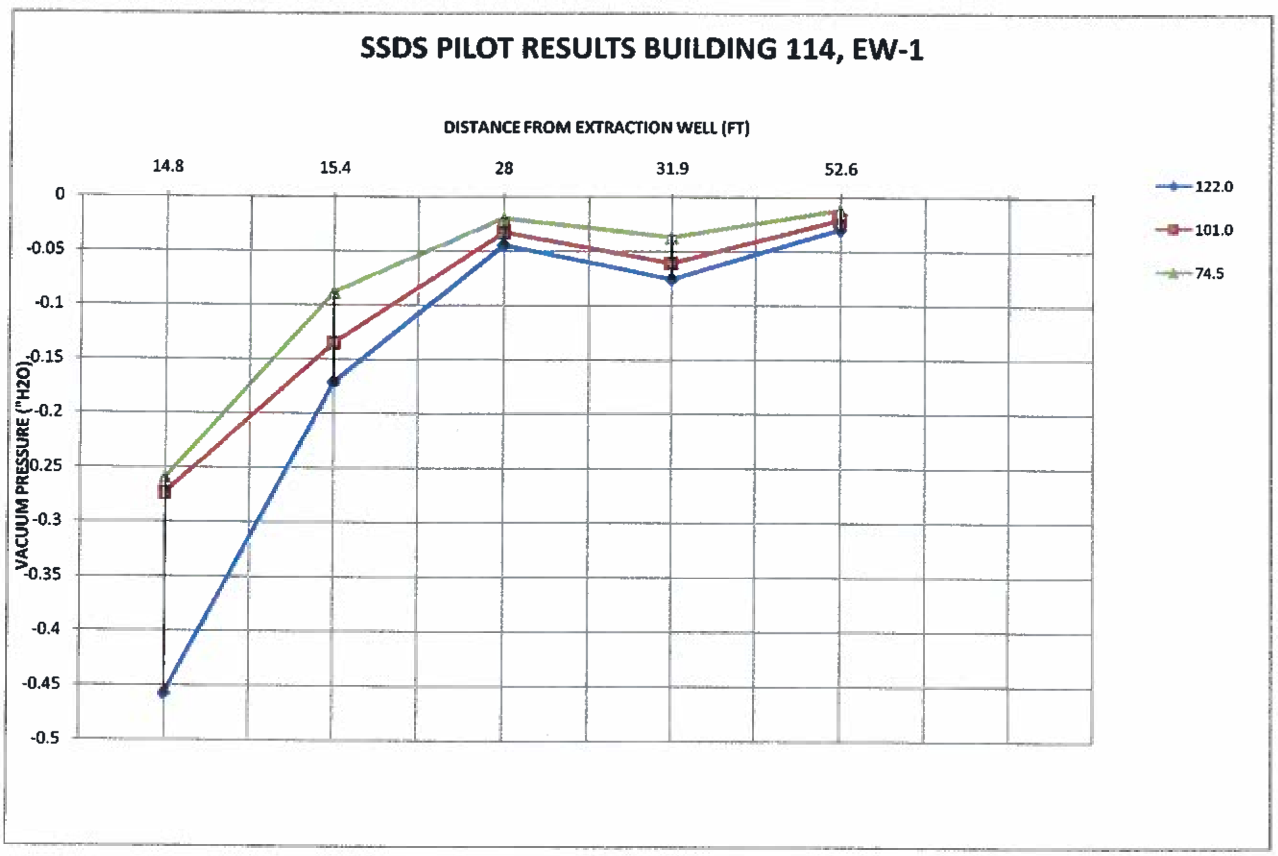
One summa canister should be collected after the range of testing and flow rates occurred to determine concentrations of chemicals of concern.

Comments:

Max. Flow = 122 cfm @ -34

@ 1255 - 6.5ppm, @1300-6.93ppm, @1305-6.74ppm, @1345-5.2ppm

Collected effluent sample @ 1345 (122 cfm, -34"H20)



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Sub-Slab Depressurization Field Test
Building 120, EW - 1

Pressure Table		Pressures (inH2O)								
Pressure Monitoring Points		Blower/Fan	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8
Distance from Pilot SSDS Well (ft)		Inlet	5.5	20.75	57	53	39	53.25		
Flow Rate (ft^3/min)	Time									
137.9	1717	-18	-1.537	-0.125	-0.036	-0.035	-0.058	-0.015		
109.3	1725	-12	-1.17	-0.089	-0.021	-0.023	-0.023	-0.005		
87.8	1732	-9	-0.906	-0.072	-0.012	-0.016	-0.02	-0.002		

Summa Canister ID ______ Pressure Regulator ID ______

Summa Sample ID B120 Effluent

Notes:

At least four pressure monitoring points should be used over three flow ranges to determine ROI and optimize blower/fan

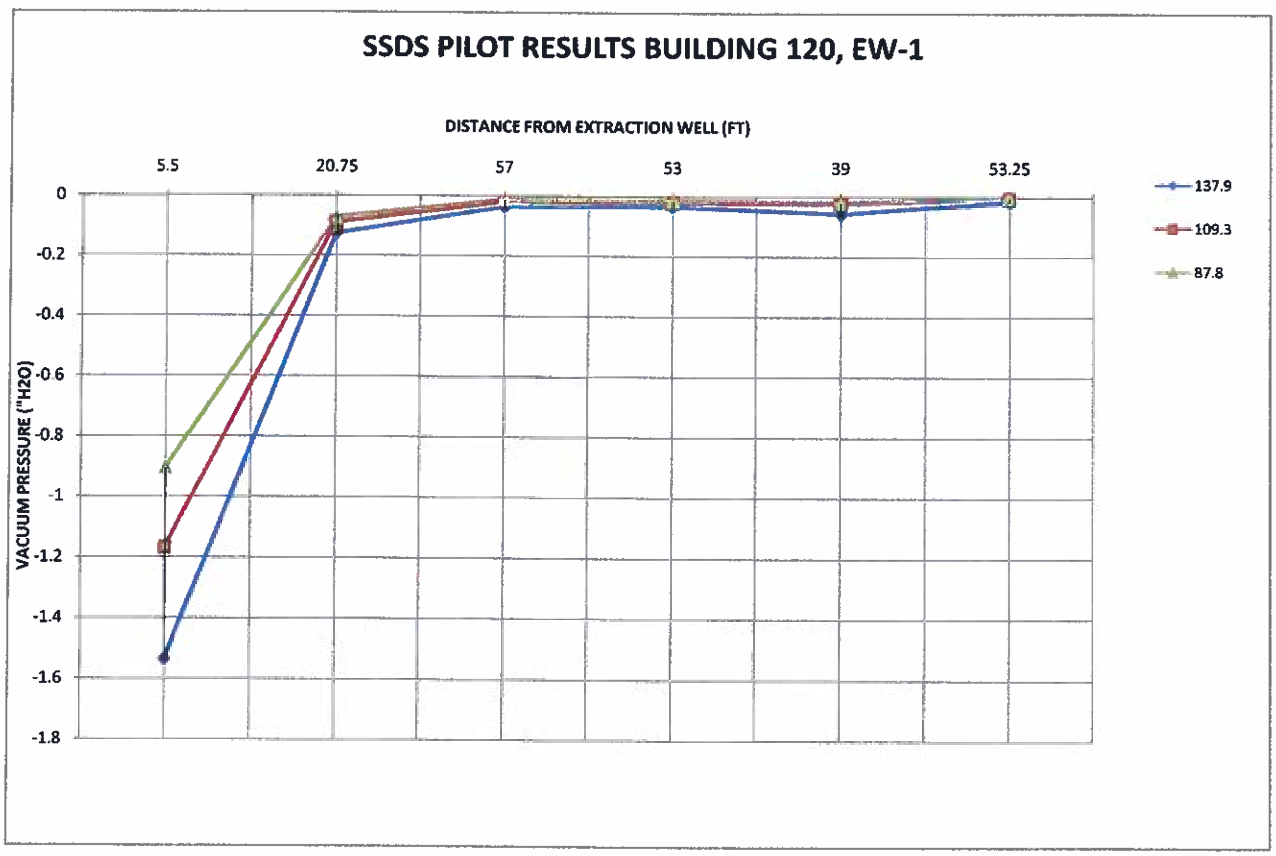
One summa canister should be collected after the range of testing and flow rates occurred to determine concentrations of chemicals of concern.

Comments:

Max. Velocity = 6320 ft/min or max flow = 137.9 cfm

@1713 - 0ppm, @1725 - 0 ppm, @1732 - 0 ppm

Collected effluent sample @ 1805 (137.9 cfm, -18"H20)



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Sub-Slab Depressurization Field Test
Building 121, EW - 1

Pressure Table		Pressures (inH2O)								
Pressure Monitoring Points		Blower/Fan	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8
Distance from Pilot SSDS Well (ft)		Inlet	20.7	51	70.6	97				
Flow Rate (ft^3/min)	Time									
154	1455	-10.8	-0.527	-0.089	-0.003	-0.014				
120	1500	-6.4	-0.342	-0.06	-0.001	-0.014				
89	1505	-3.7	-0.225	-0.038	-0.001	-0.011				

Summa Canister ID 9557 Pressure Regulator ID FC00992

Summa Sample ID Bldg. 121 Effluent

Notes:

At least four pressure monitoring points should be used over three flow ranges to determine ROI and optimize blower/fan

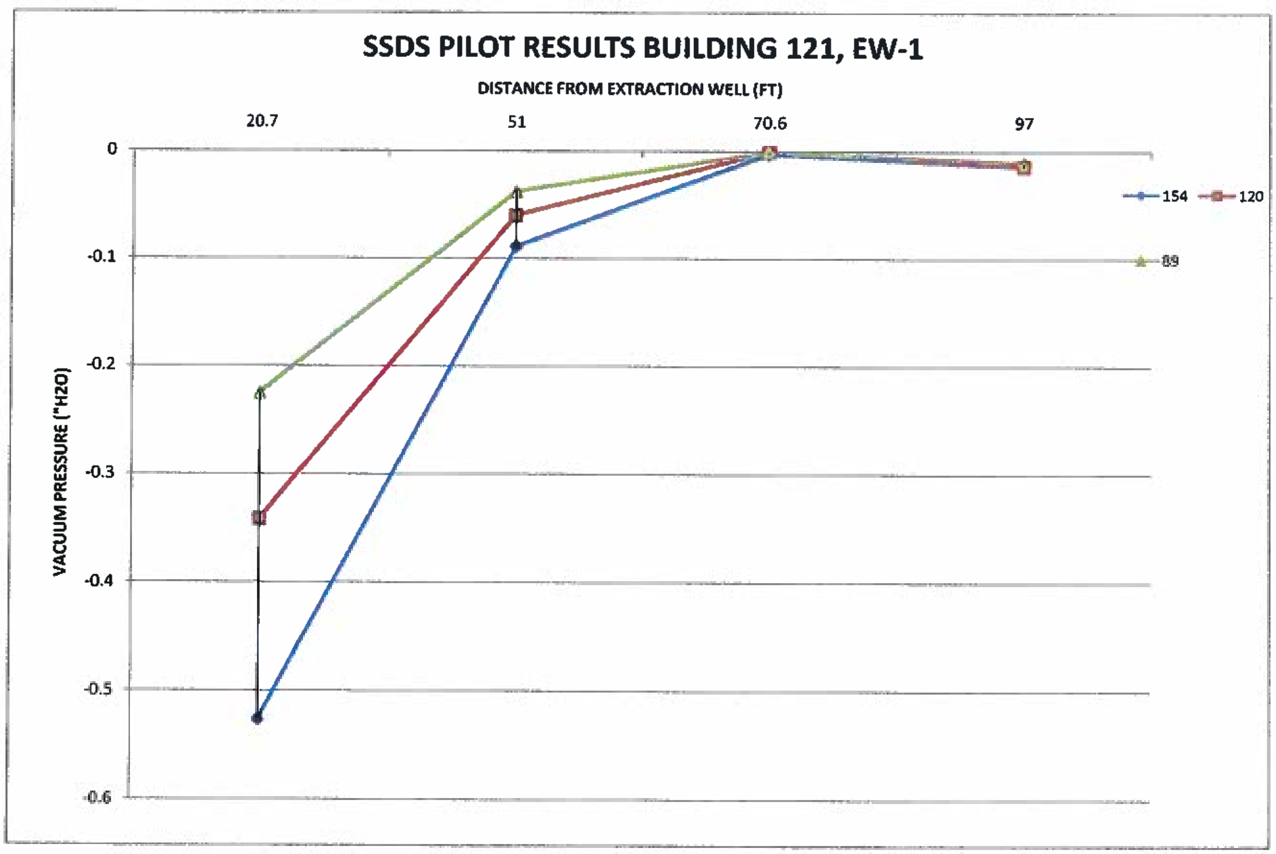
One summa canister should be collected after the range of testing and flow rates occurred to determine concentrations of chemicals of concern.

Comments:

Sample Started @ 1231 -30"HG, Collect @ 7070 ft/min, -10.8"H2O

Sample Stopped at 1259 - 3.5"HG

@1422 - 0.499ppm, @1500 - .519ppm, @1505-0.338ppm



Sub-Slab Depressurization Field Test
Building 130, EW - 1

Pressure Table		Pressures (inH2O)								
Pressure Monitoring Points		Blower/Fan	PM-1	PM-2	PM-3	PM-4	PM-5	PM-6	PM-7	PM-8
Distance from Pilot SSDS Well (ft)		Inlet	10.2	19.6	27.5	46	65	85		
Flow Rate (ft^3/min)	Time									
184.4	1545	-12	-0.333	-0.148	-0.11	-0.048	-0.03	-0.016		
157.3	1550	-9	-0.278	-0.123	-0.092	-0.048	-0.025	-0.012		
111.2	1555	-5	-0.18	-0.079	-0.058	-0.03	-0.015	-0.008		

Summa Canister ID 34023 Pressure Regulator ID

Summa Sample ID B130 Effluent

Notes:

At least four pressure monitoring points should be used over three flow ranges to determine ROI and optimize blower/fan

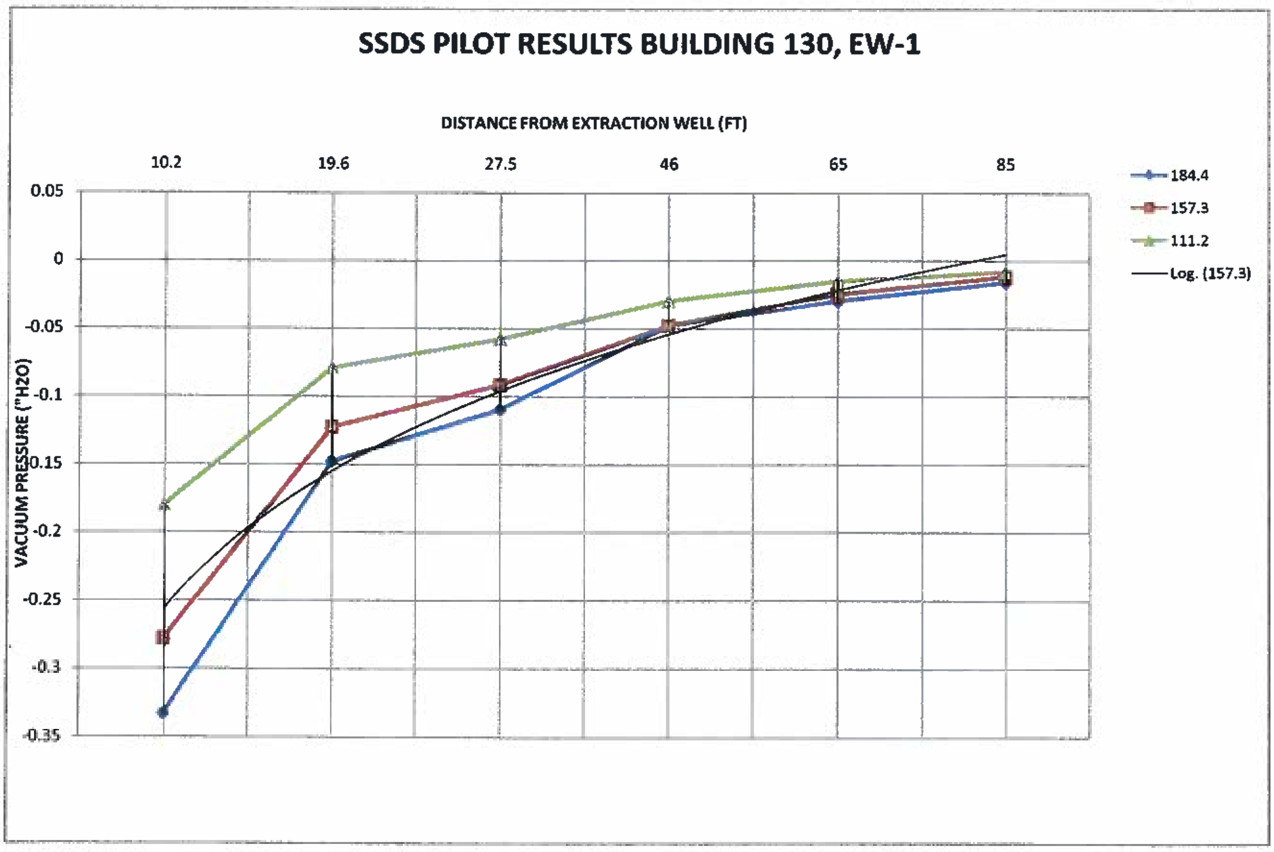
One summa canister should be collected after the range of testing and flow rates occurred to determine concentrations of chemicals of concern.

Comments:

Max. Velocity = 8450 ft/min or max flow = 184.4 cfm

@1435 - 0ppm, @1440 - 0 ppm, @1445 - 0 ppm

Collected effluent sample @ 1518 (184.4 cfm, -12"H20)



Watervliet Arsenal, Watervliet, New York

Vapor Intrusion Interim Corrective Measures Work Plan

Appenix B – SSDS Design Drawings and Details

2118047

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VAPOR INTRUSION MITIGATION

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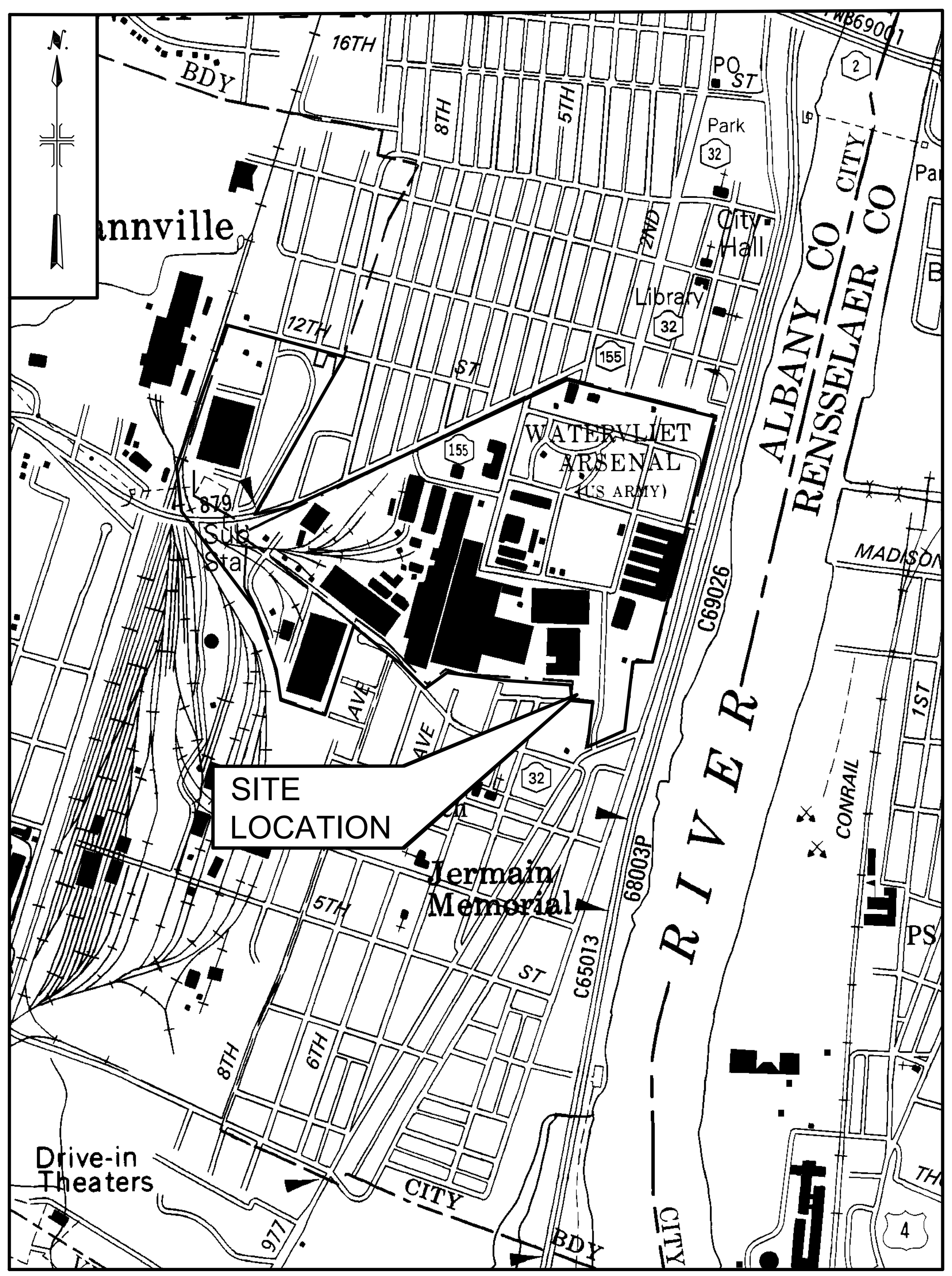
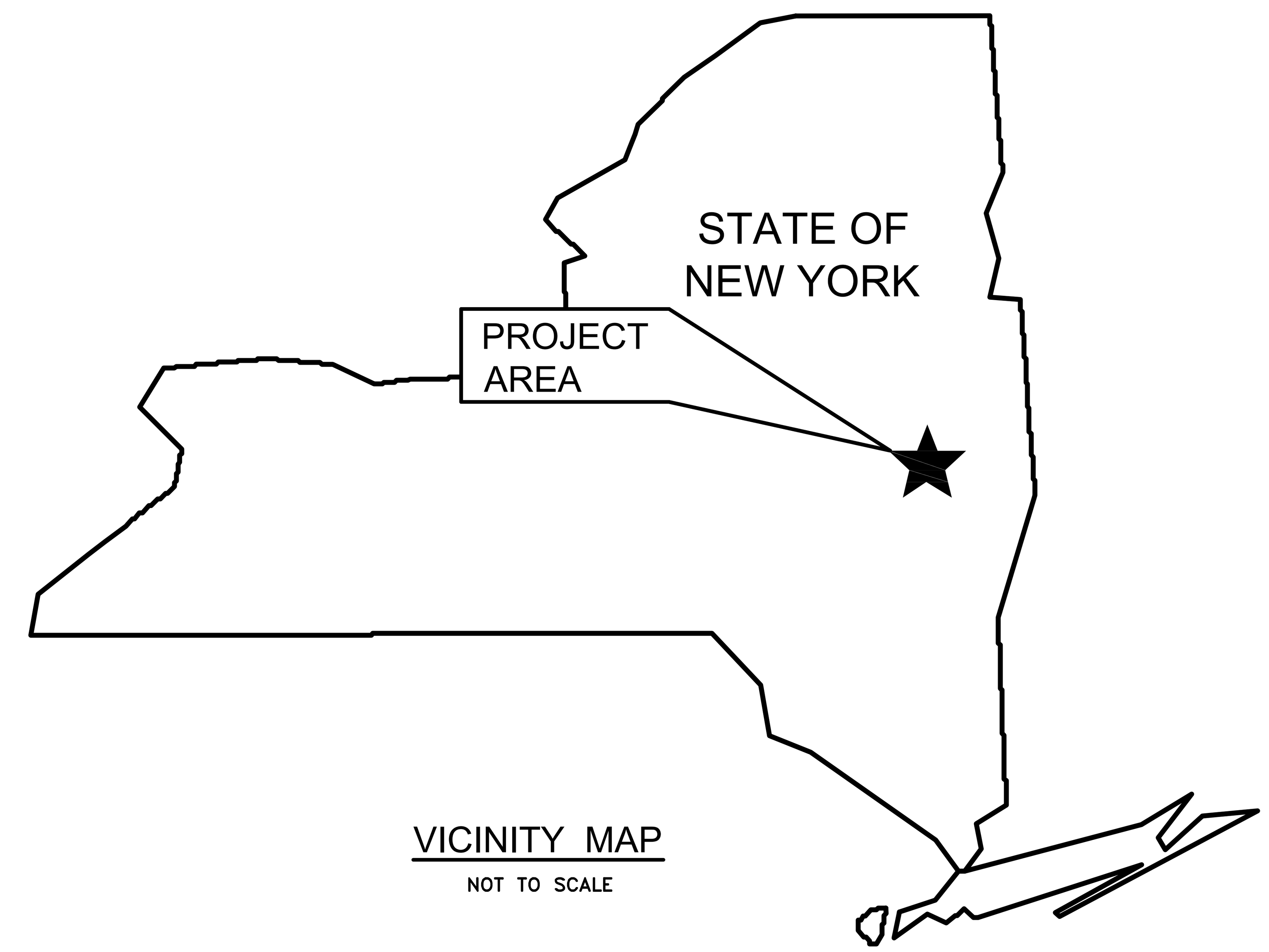


SITE LOCATION MAP
APPROXIMATE SCALE: 1" = 1000'

US Army Corps
of Engineers

60% SUBMISSION
APRIL 2009



VICINITY MAP
NOT TO SCALE

US Army Corps of Engineers
BALTIMORE DISTRICT

MARK	DESCRIPTION	DATE	APPR

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DRAWN BY: MRJ DATE: APRIL 2009
REVIEWED BY: DATE:
APPROVED BY: DATE:
FILE NAME: 2118136G001

U.S. ARMY ENGINEER DIVISION
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BALTIMORE DISTRICT
BALTIMORE, MARYLAND

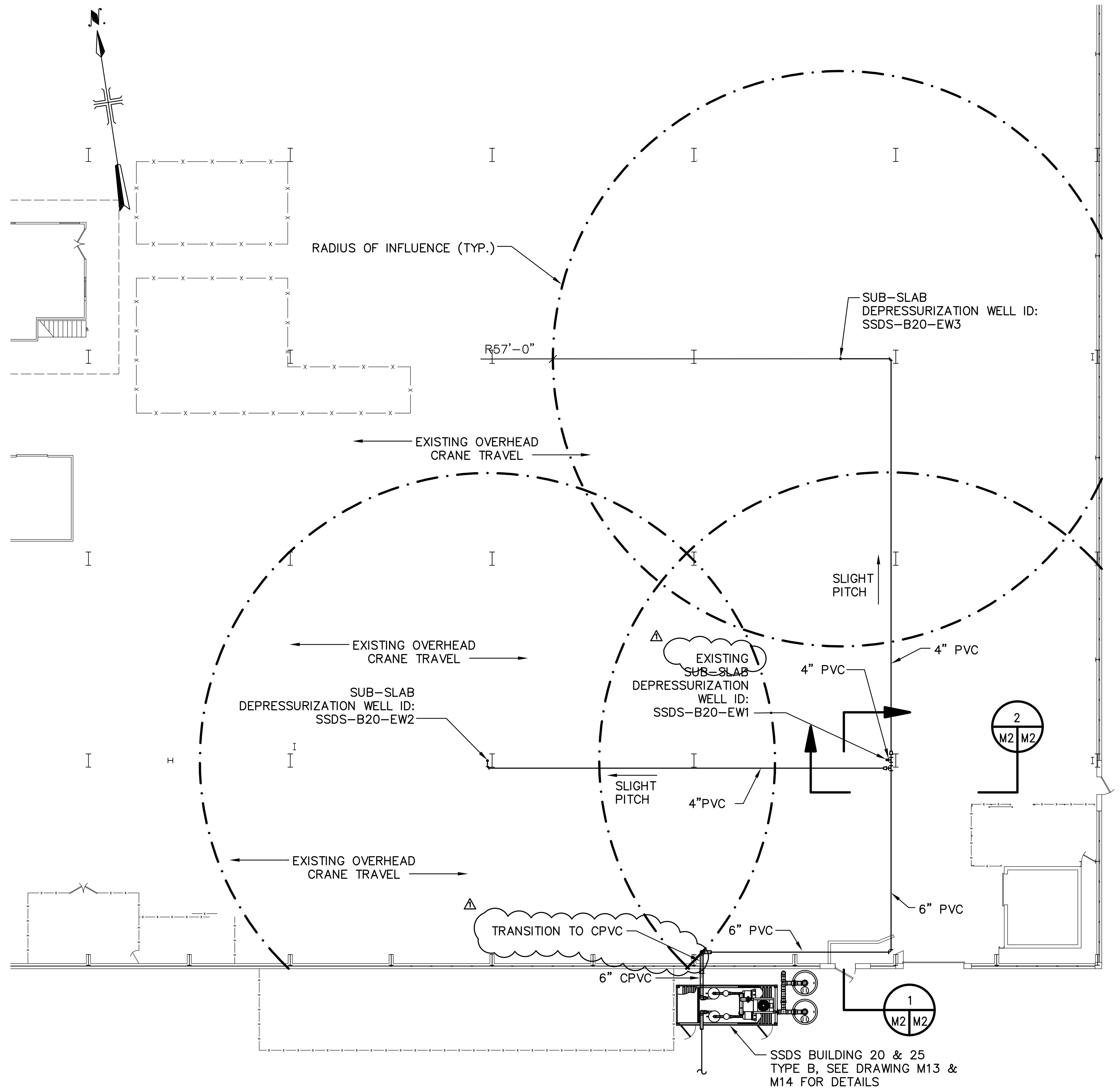
MALCOLM PIRNIE, INC.
43 BRITISH AMERICAN BOULEVARD
LATHAM, NEW YORK 12110

WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

COVER SHEET

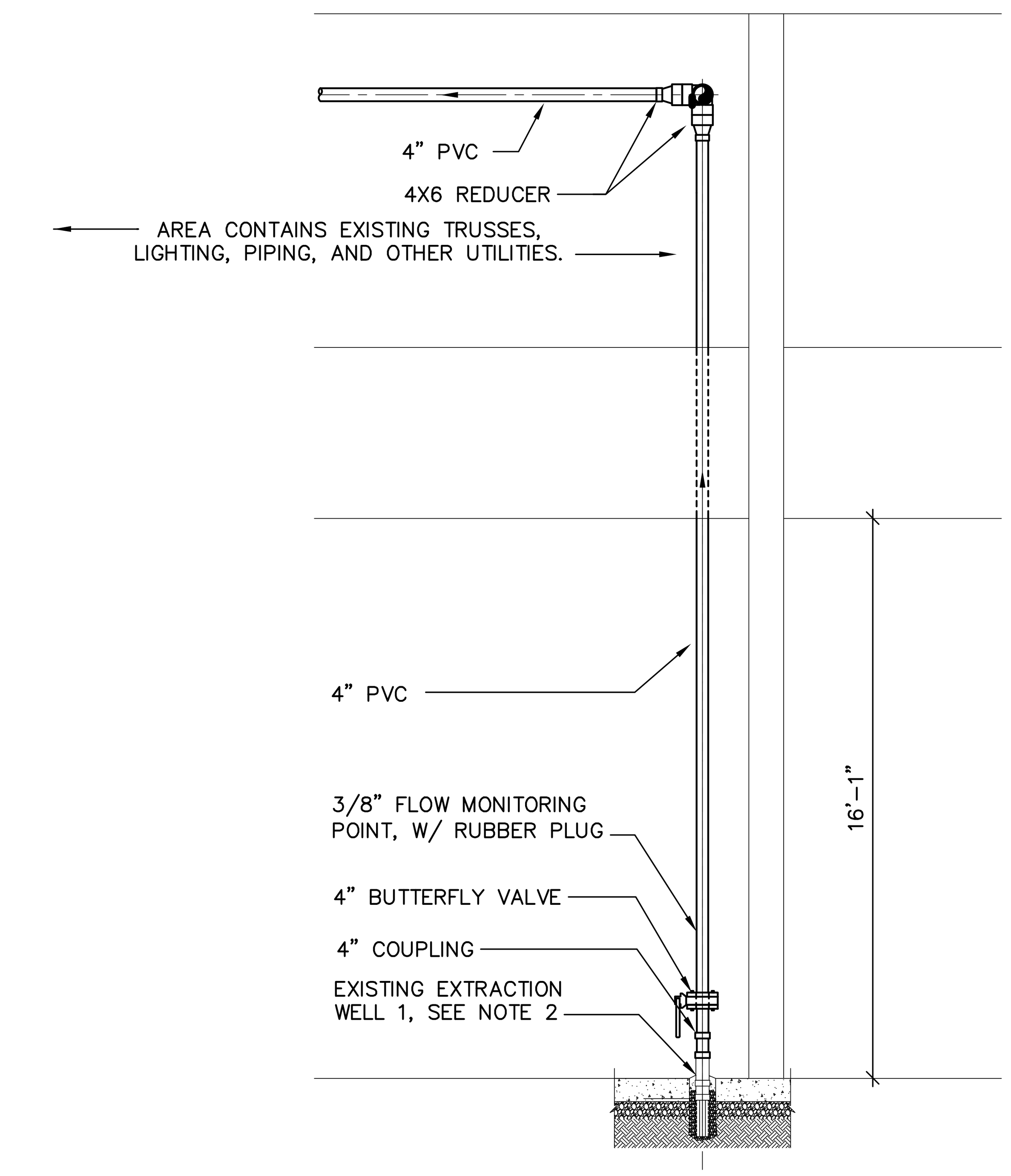
G-1
SHEET 1 OF 3

XREFS: I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\2118136-TB.dwg IMAGES: I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\s49plan.tif I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\WVA logo.TIF
User: Hausmann Spec: PIRNIE STANDARD File: I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\GEN\2118136G001.DWG Scale: 1:1 Date: 04/18/2009 Time: 10:02 Layout: G01



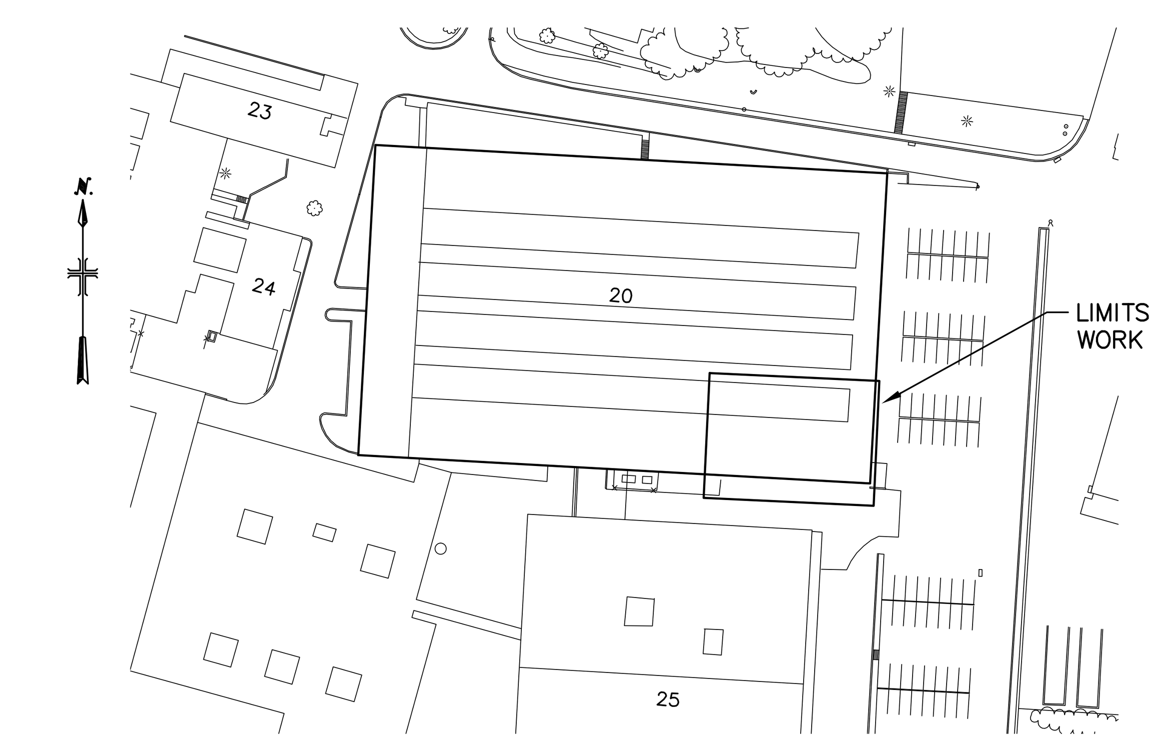
BUILDING 20
PLAN VIEW

8 0 8 16
SCALE: 1/16" = 1'-0"



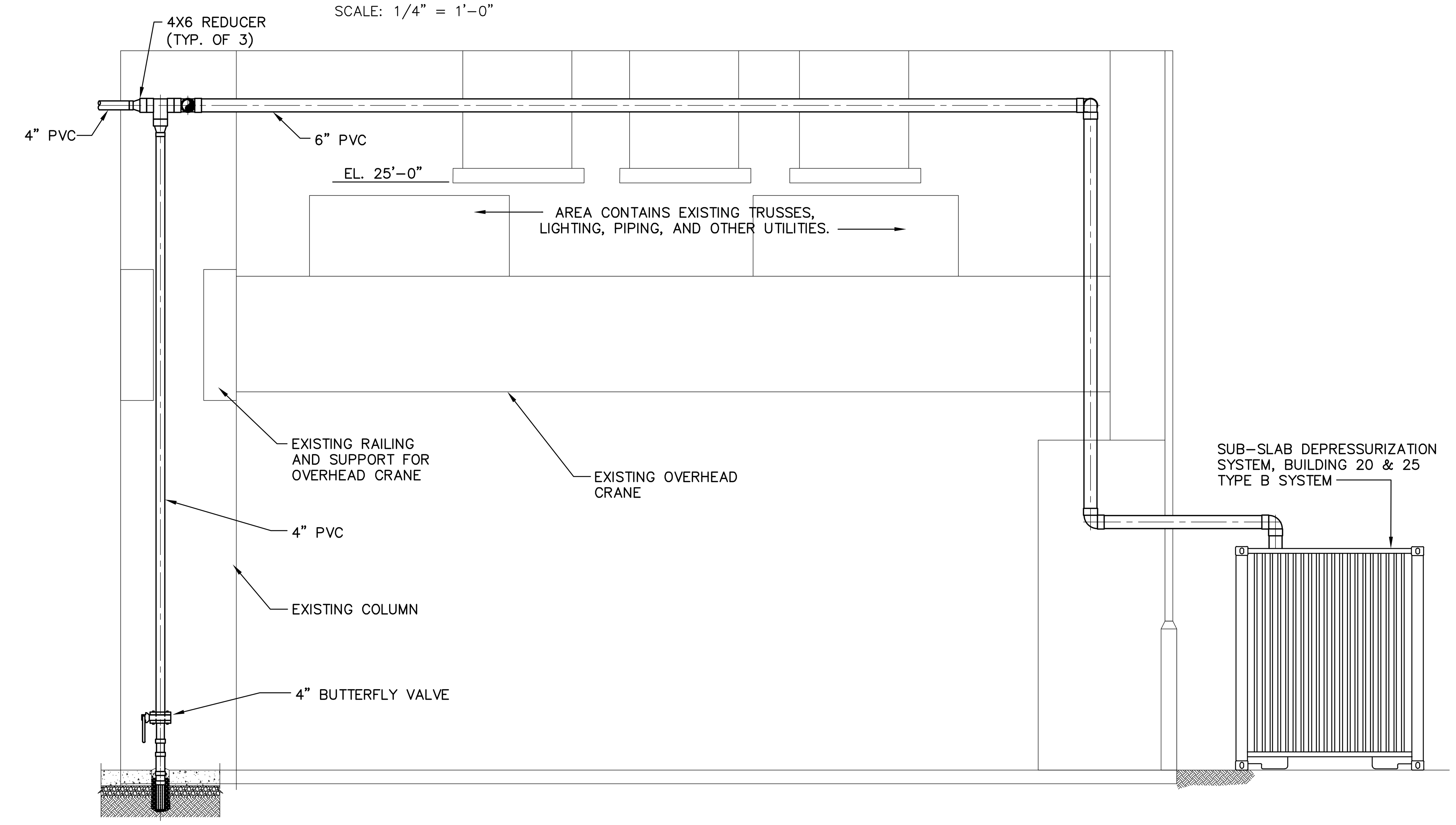
SECTION 2 M2 M2

2 0 6
SCALE: 1/4" = 1'-0"



BUILDING 20
PLAN VIEW

NOT TO SCALE



SECTION 1 M2 M2

2 0 6
SCALE: 1/4" = 1'-0"

NOTES:

1. EXISTING WALL CONTAINS ASBESTOS. CONTRACTOR SHALL PREPARE WALL AND AREA TO PREVENT THE CREATION OF DUST DURING CORE DRILLING OF PENETRATION THOUGH THE WALL.
2. EXTRACTION WELL SSDS-B20-EW1 WAS PREVIOUSLY INSTALLED DURING SYSTEM PILOT TEST AND IS FINISHED APPROXIMATELY 1-FOOT ABOVE FINISHED FLOOR. CONTRACTOR SHALL PROVIDE CONNECTION TO EXTRACTION WELL SSDS-B20-EW1 AND INSTALL EXTRACTION WELL SSDS-B20-EW2 & SSDS-B20-EW3 INCLUDING SUB-SLAB PIPING.
3. CONTRACTOR SHALL PLACE A 3/8" DIAMETER HOLE FOR FLOW MONITORING. THE HOLE SHALL BE A MINIMUM OF THREE PIPE DIAMETER UPSTREAM AND DOWNSTREAM OF ANY FLOW RESTRICTIONS. CONTRACTOR SHALL PROVIDE A RUBBER PLUG FOR SEALING HOLE DURING NORMAL OPERATION.
4. CONTRACTOR SHALL ROUTE HORIZONTAL AND VERTICAL PIPING TO PREVENT OBSTRUCTION AND DAMAGE TO OVERHEAD CRANE AND PIPING DURING OVERHEAD CRANE OPERATION.
5. PIPING SHALL BE HUNG ABOVE LIGHTING AND OVERHEAD CRANE. CONTRACTOR SHALL FIELD DETERMINE BEST ROUTE FOR HORIZONTAL AND VERTICAL EXTRACTION PIPING DUE TO EXISTING OBSTRUCTIONS.

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FILE NAME: 2118198002

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BALTIMORE DISTRICT
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MALCOLM PIRNIE
MALCOLM PIRNIE, INC.
43 BRITISH AMERICAN BOULEVARD
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24GA2797I200

WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

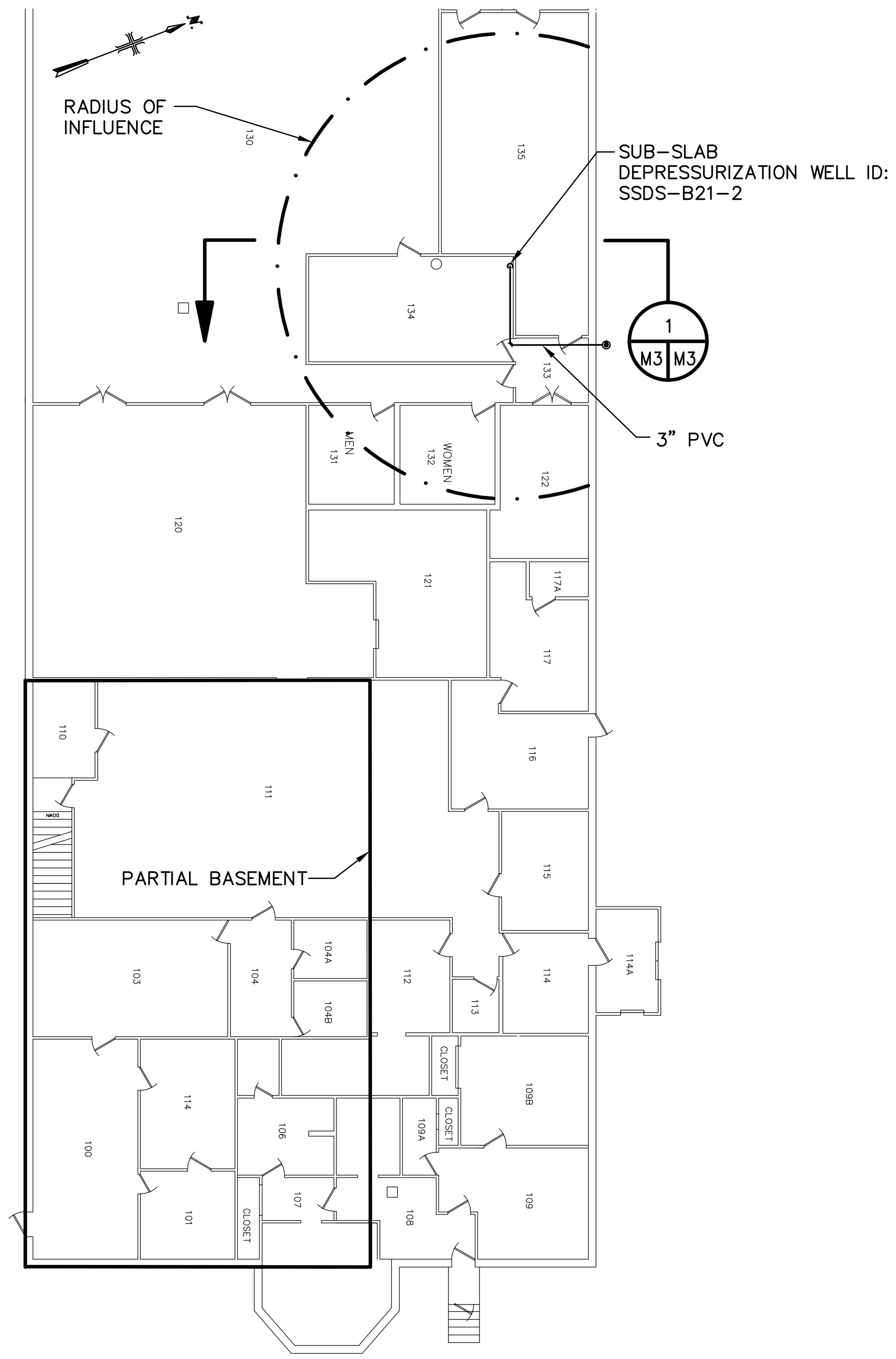
MECHANICAL
BUILDING 20
PLAN AND SECTION VIEW

M-2

SHEET 2 OF 15

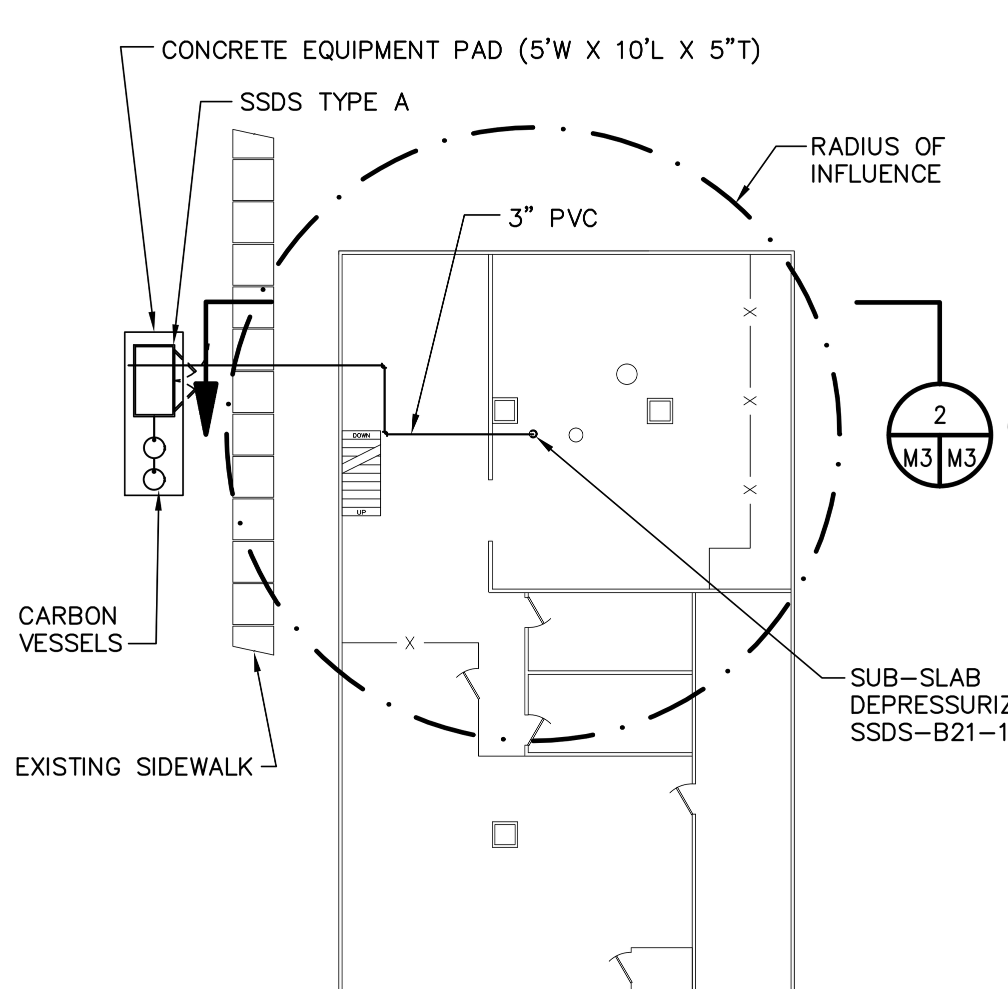
NOTES:

1. CONTRACTOR SHALL PROVIDE TWO SSD SYSTEMS FOR BUILDING 25:
   SSDS-B21-1 SHALL BE A TYPE A SYSTEM AS FOUND ON SHEET M11 AND M12,
   SSDS-B21-2 SHALL BE A TYPE C SYSTEM AS FOUND ON SHEET M15.
2. THE CONTRACTOR SHALL PROVIDE SSDS-B21-1 TO DEPRESSURIZE THE PARTIAL BASEMENT OF BUILDING 21.
3. THE CONTRACTOR SHALL PROVIDE SSDS-B21-2 TO DEPRSSURIZE THE 1ST FLOOR PARTIAL FLOOR PLAN.
4. THE CONTRACTOR SHALL IDENTIFY AND PROVIDE SNOW SLIDE GUARDS TO MATCH THE EXISTING SLATE ROOFS, TO PREVENT SNOW FROM SLIDING AND DAMAGING THE SSDS PIPING AND EQUIPMENT ON BOTH SYSTEMS.
5. THE CONTRACTOR SHALL PROVIDE A 5" WIRE MESH REINFORCED CONCRETE EQUIPMENT PAD FOR SSDS-B21-1. THE PAD SHALL BE INSTALLED TO PREMOTE DRAINAGE AWAY FORM THE SSDS SYSTEM.



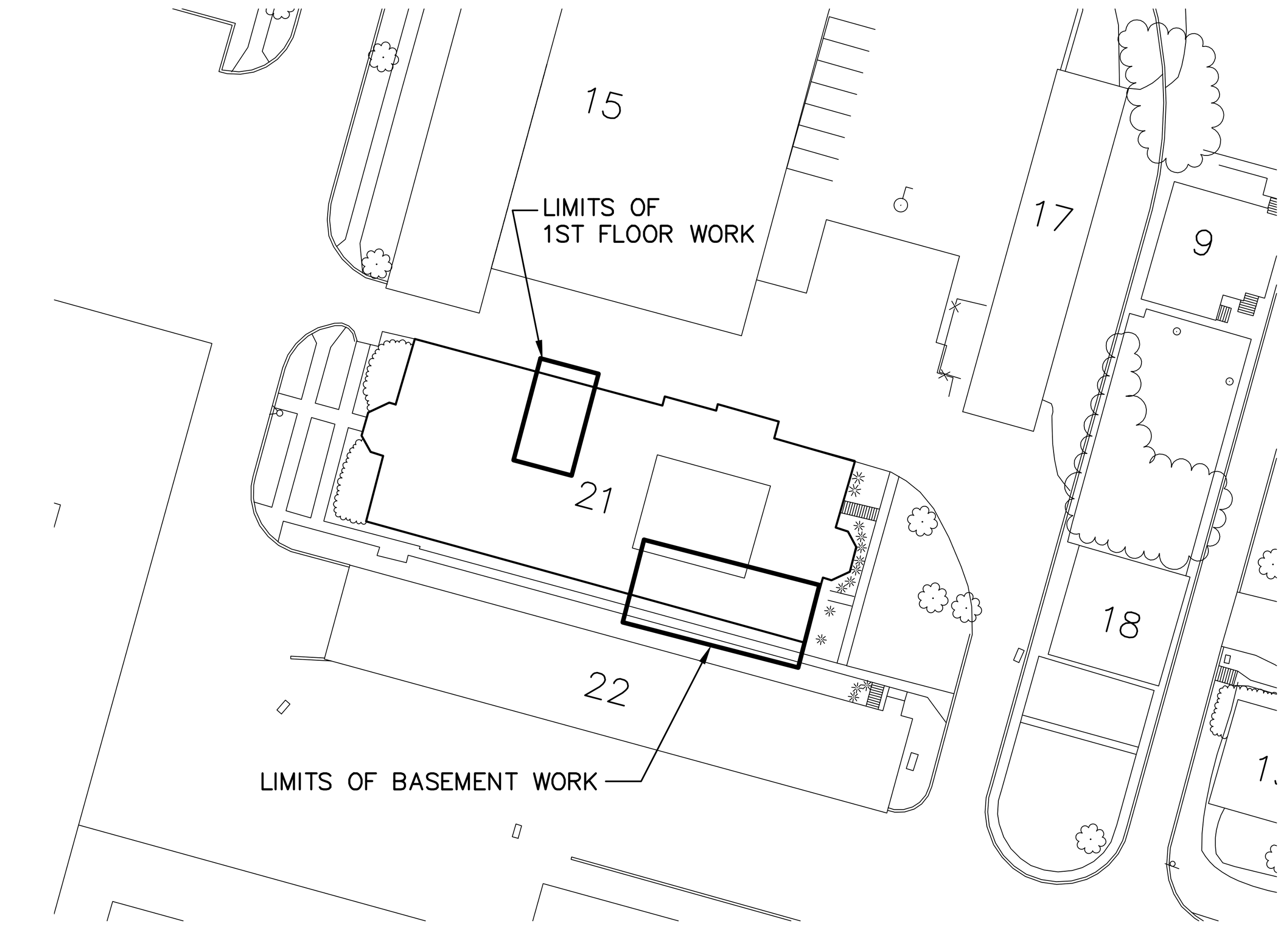
BUILDING 21 – 1ST FLOOR PLAN VIEW

SCALE: 1/16" = 1'-0"



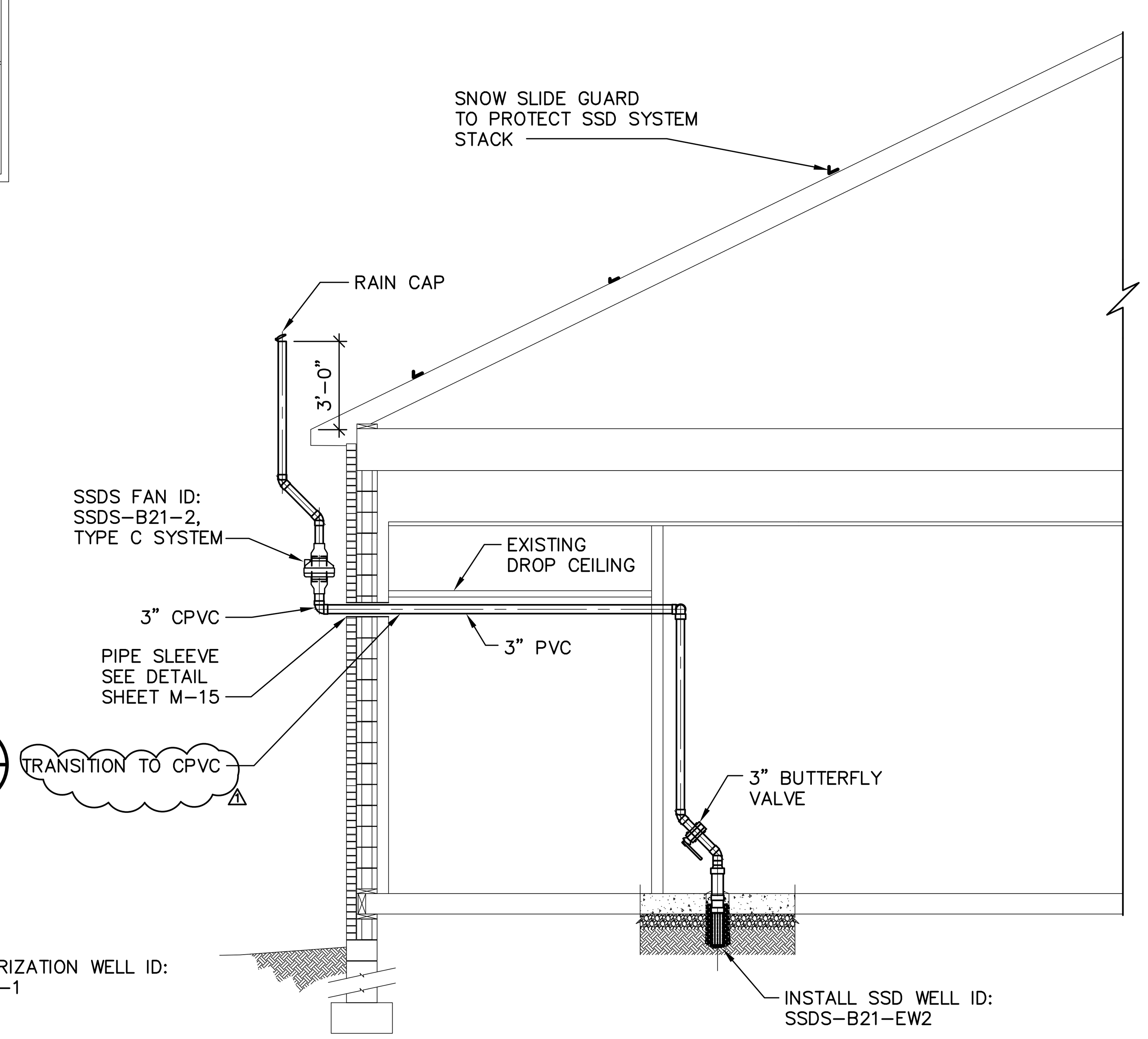
BUILDING 21 – BASEMENT PLAN VIEW

SCALE: 1/16" = 1'-0"



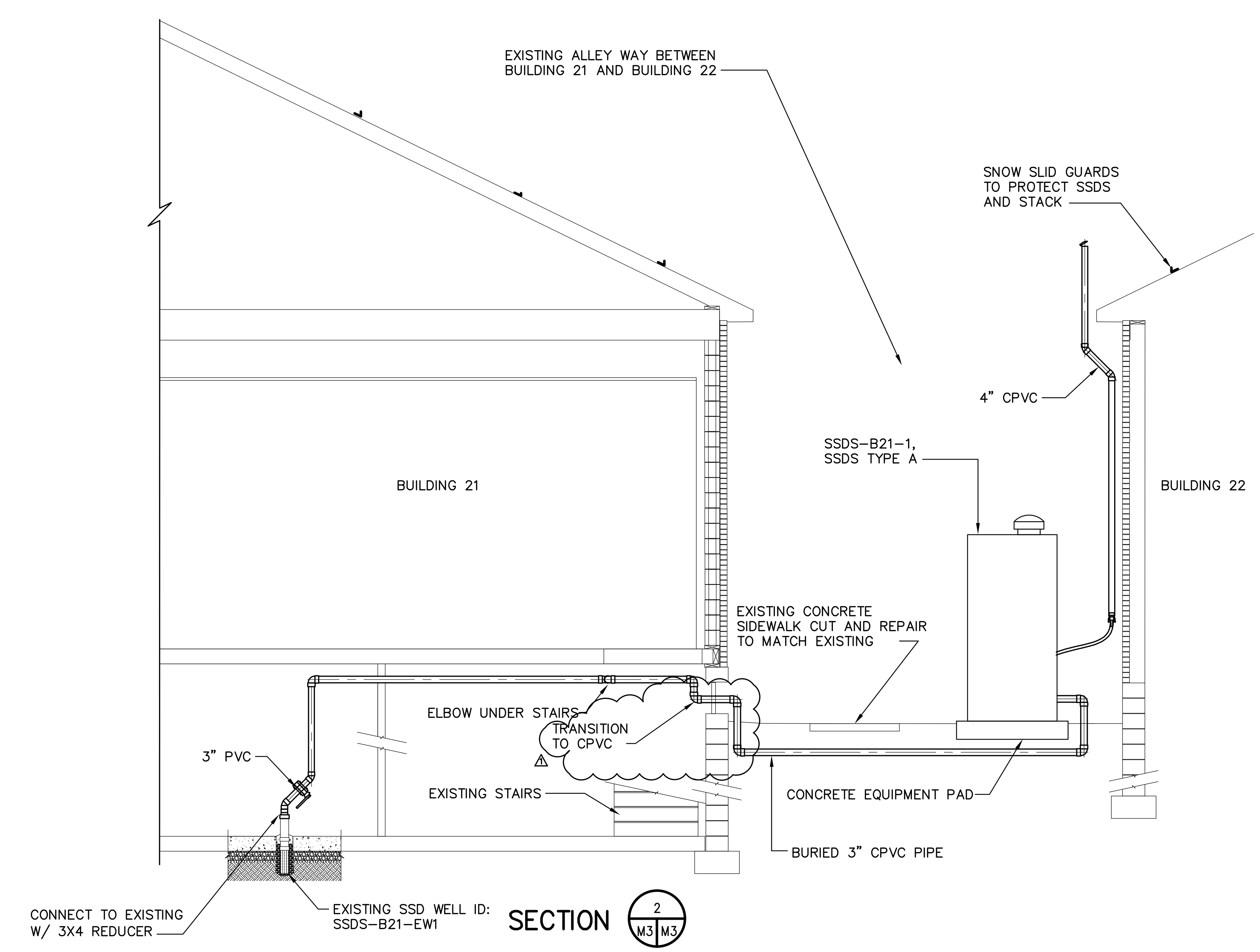
BUILDING 21 PLAN VIEW

NOT TO SCALE



SECTION 1 M3 M3

SCALE: 1/4" = 1'-0"



SECTION 2 M3 M3

SCALE: 1/4" = 1'-0"

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BALTIMORE, MARYLAND

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MALCOLM PIRNIE, INC.
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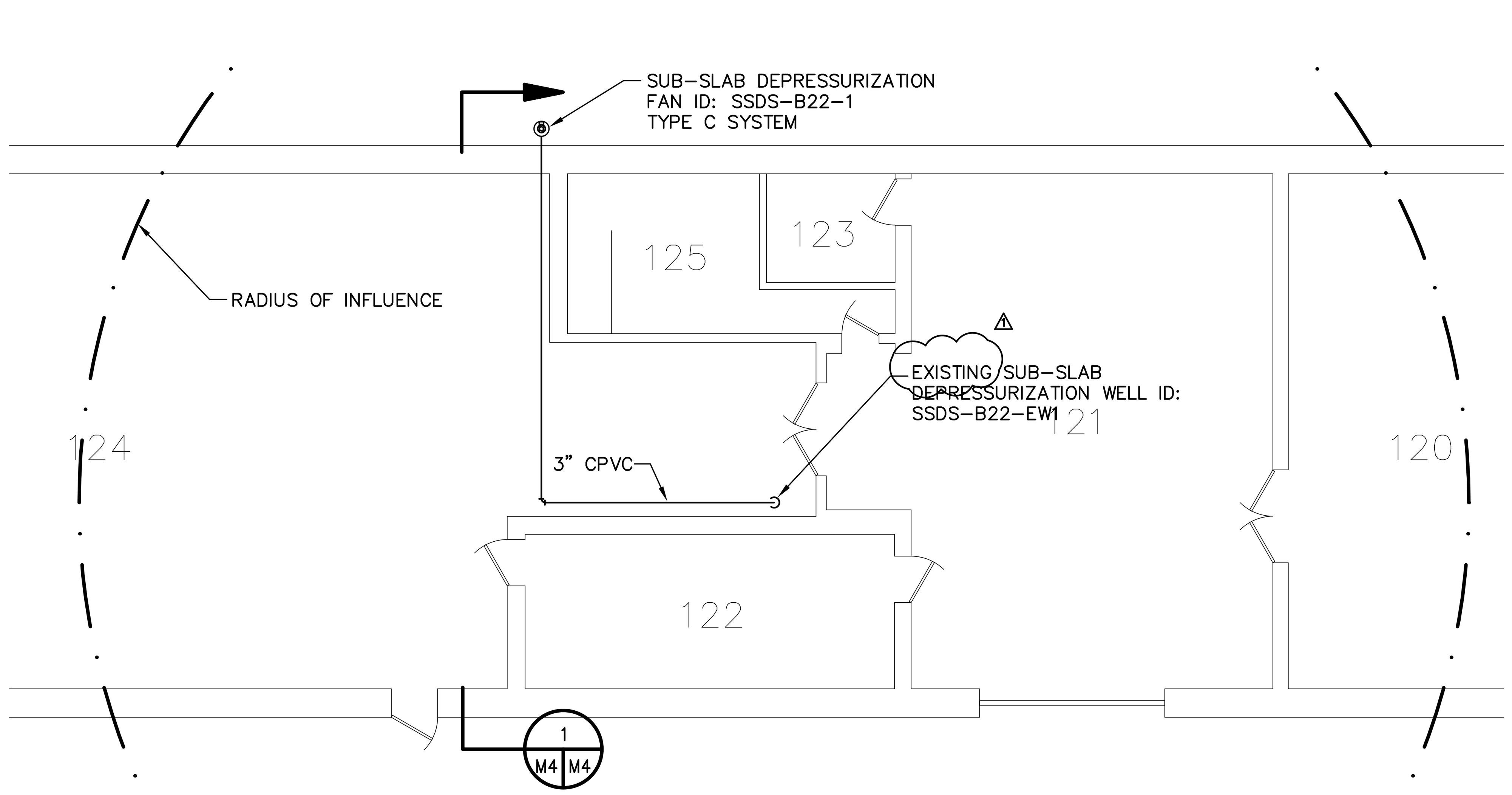
WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

MECHANICAL
BUILDING 21
PLAN AND SECTION VIEW

M-3

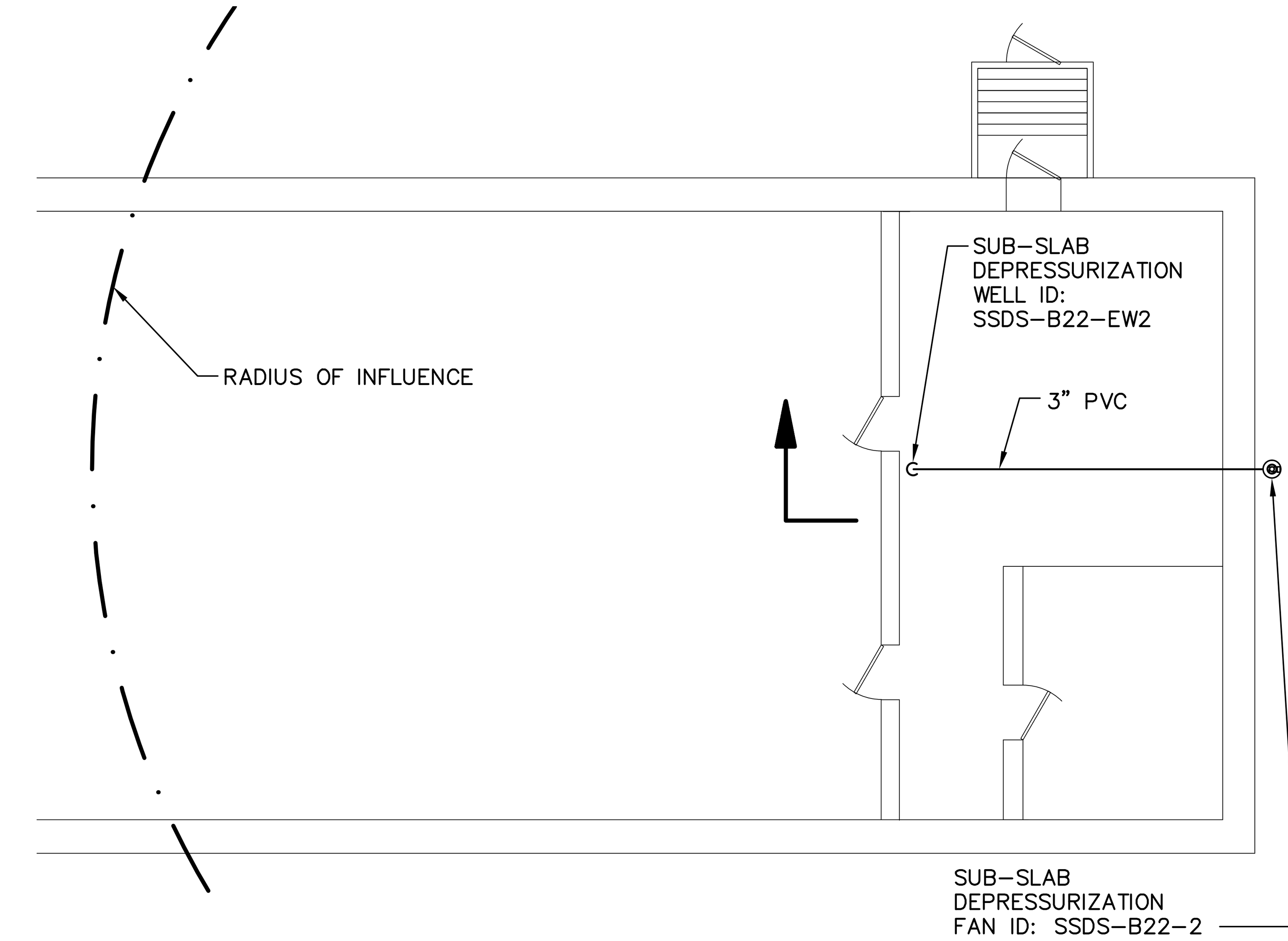
SHEET 3 OF 15



BUILDING 22 – 1ST FLOOR PLAN VIEW

4 0 4 8

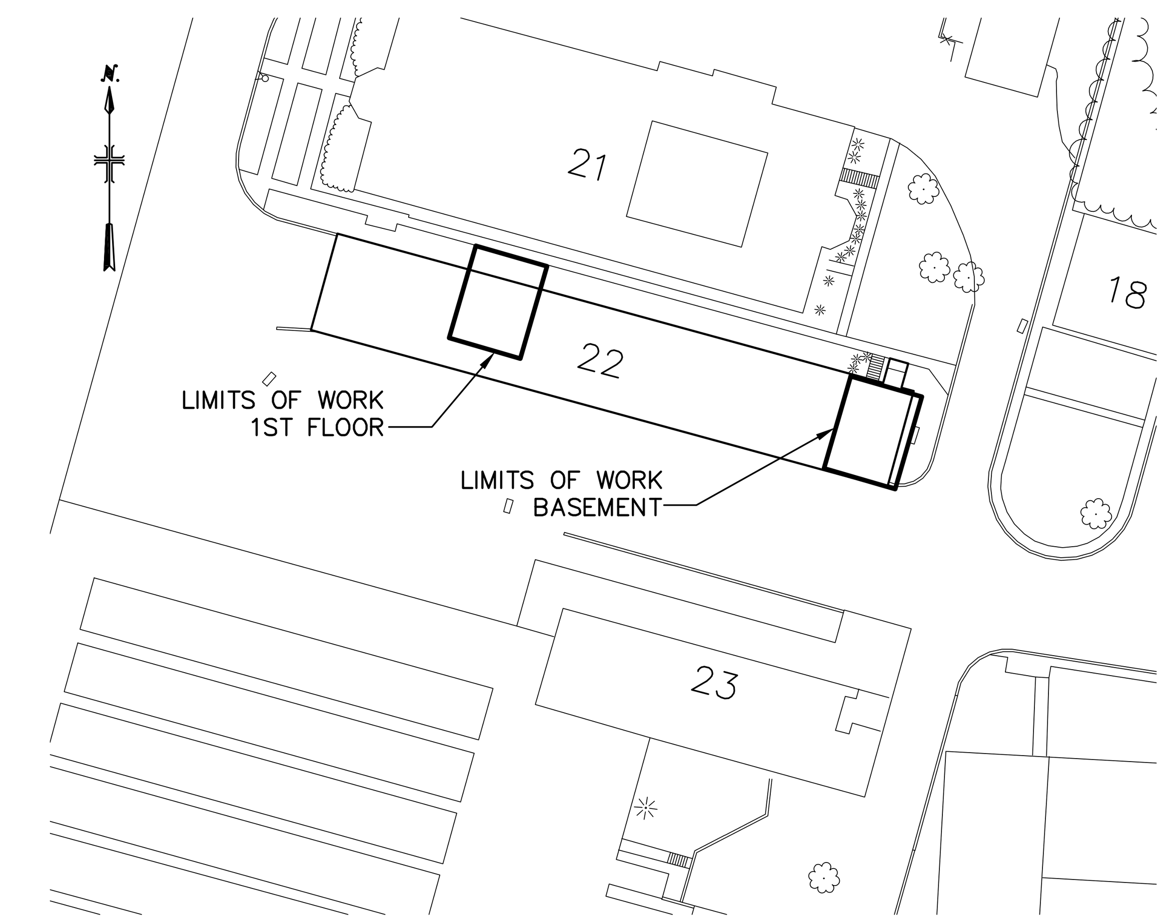
SCALE: 1/8" = 1'-0"



BUILDING 22 –BASEMENT PLAN VIEW

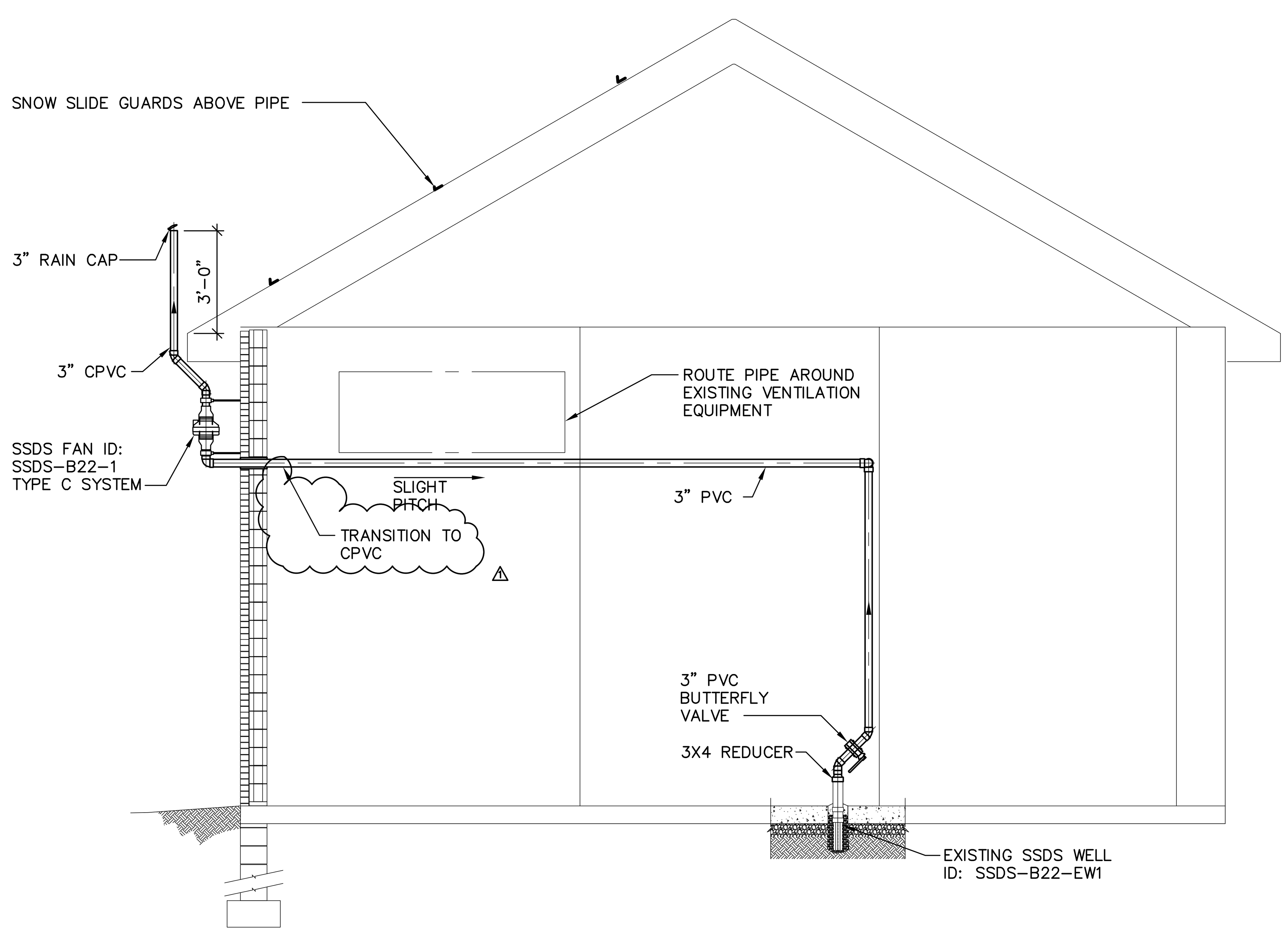
4 0 4 8

SCALE: 1/8" = 1'-0"



BUILDING 22 PLAN VIEW

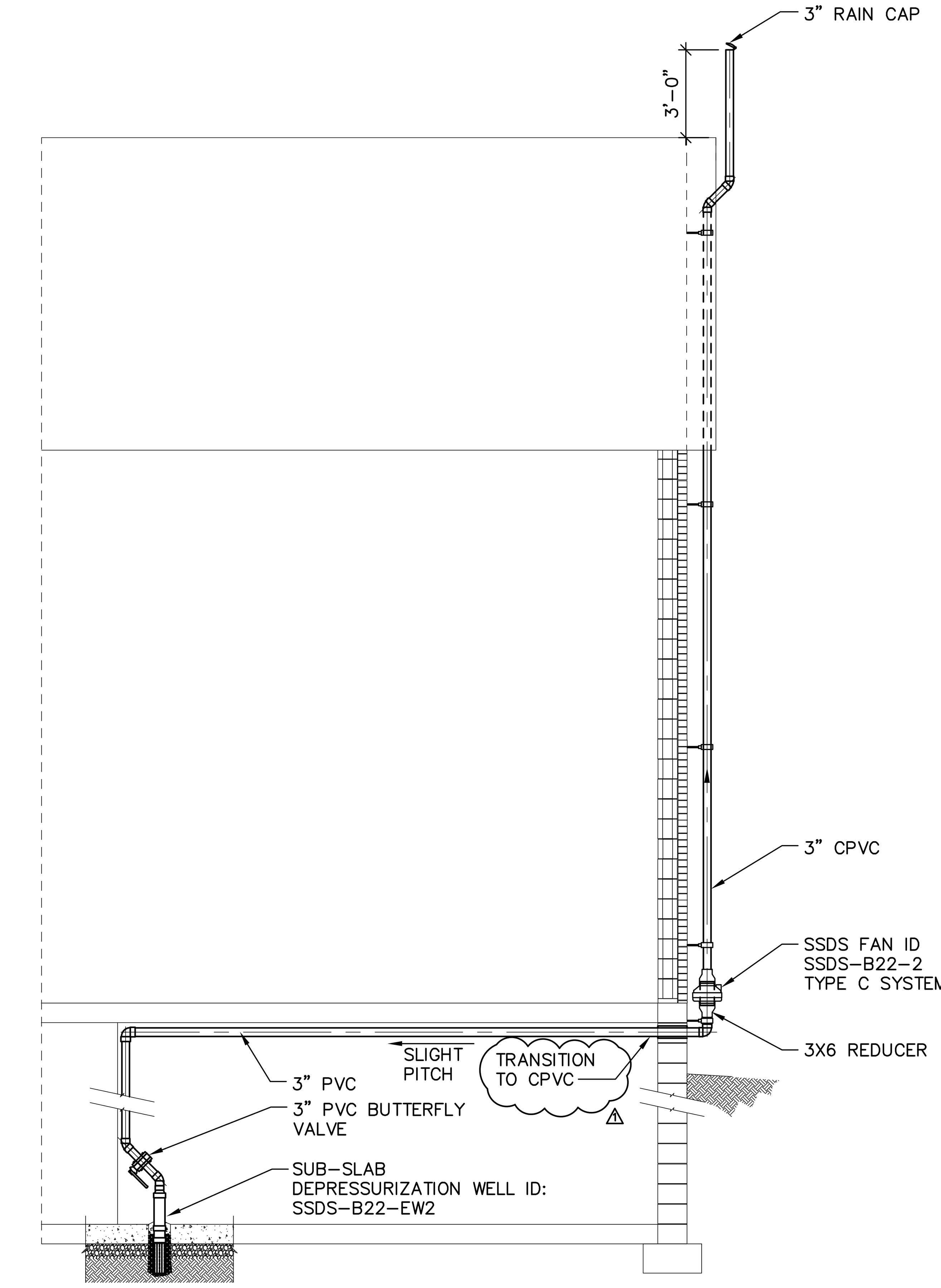
NOT TO SCALE



SECTION 1 (M4 M4)

2 0 6

SCALE: 1/4" = 1'-0"



SECTION 2 (M4 M4)

2 0 6

SCALE: 1/4" = 1'-0"

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DRAWN BY: TAL	DATE: APRIL 2009	FILE NAME: 2118136M004	
REVIEWED BY: -	DATE: -		

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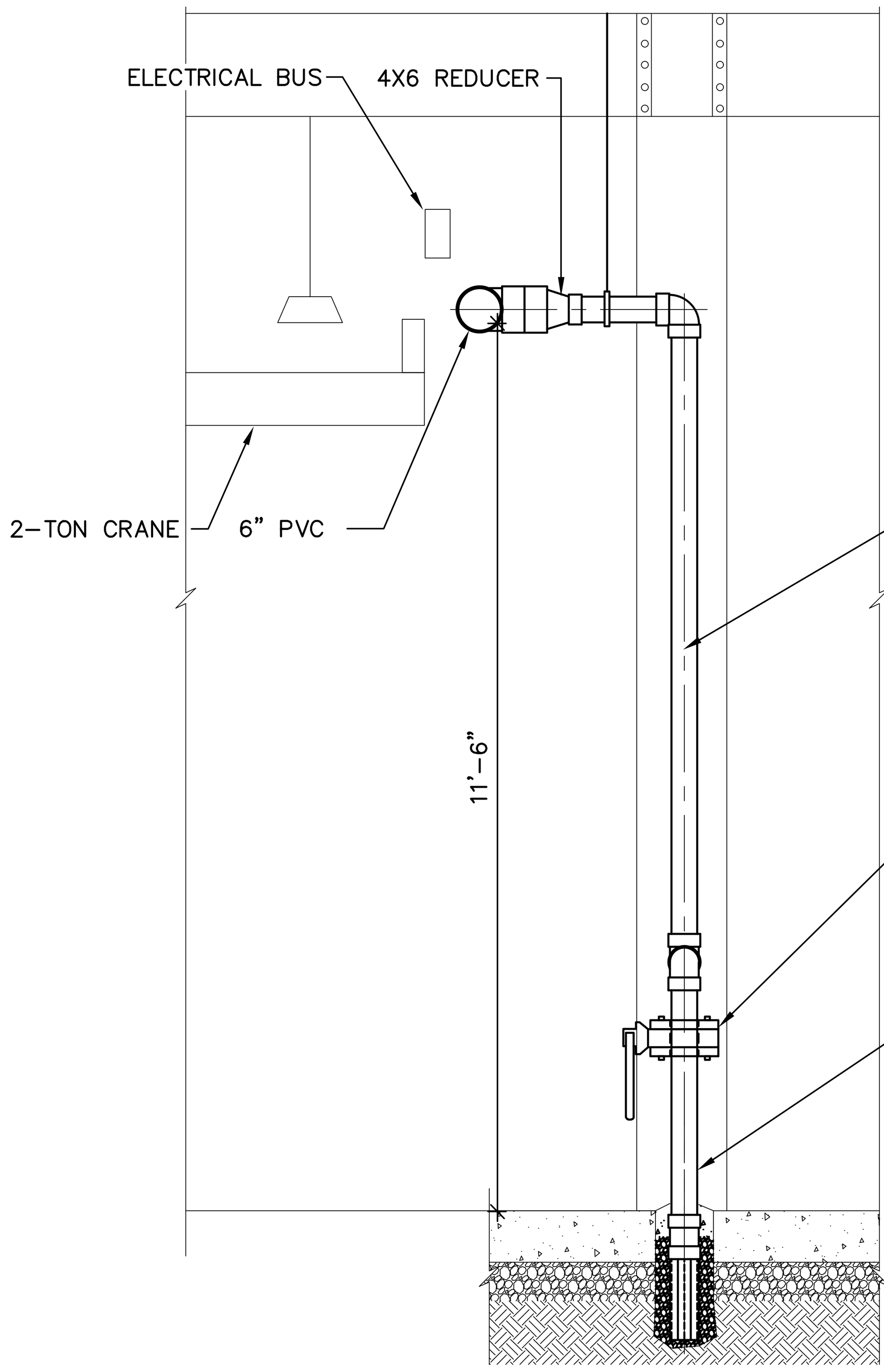
WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

MECHANICAL
BUILDING 22
PLAN AND SECTION VIEW

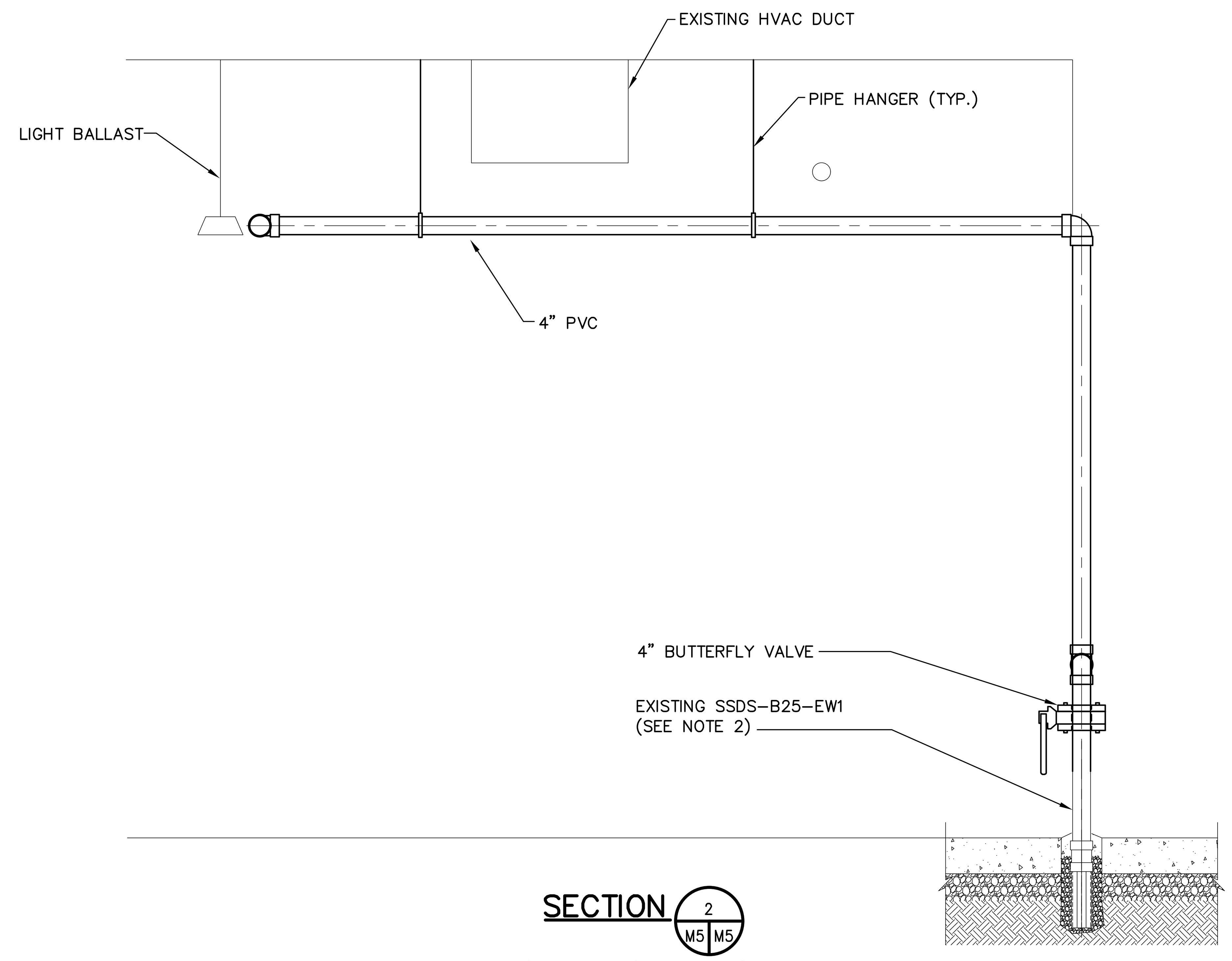
M-4

SHEET 4 OF 15



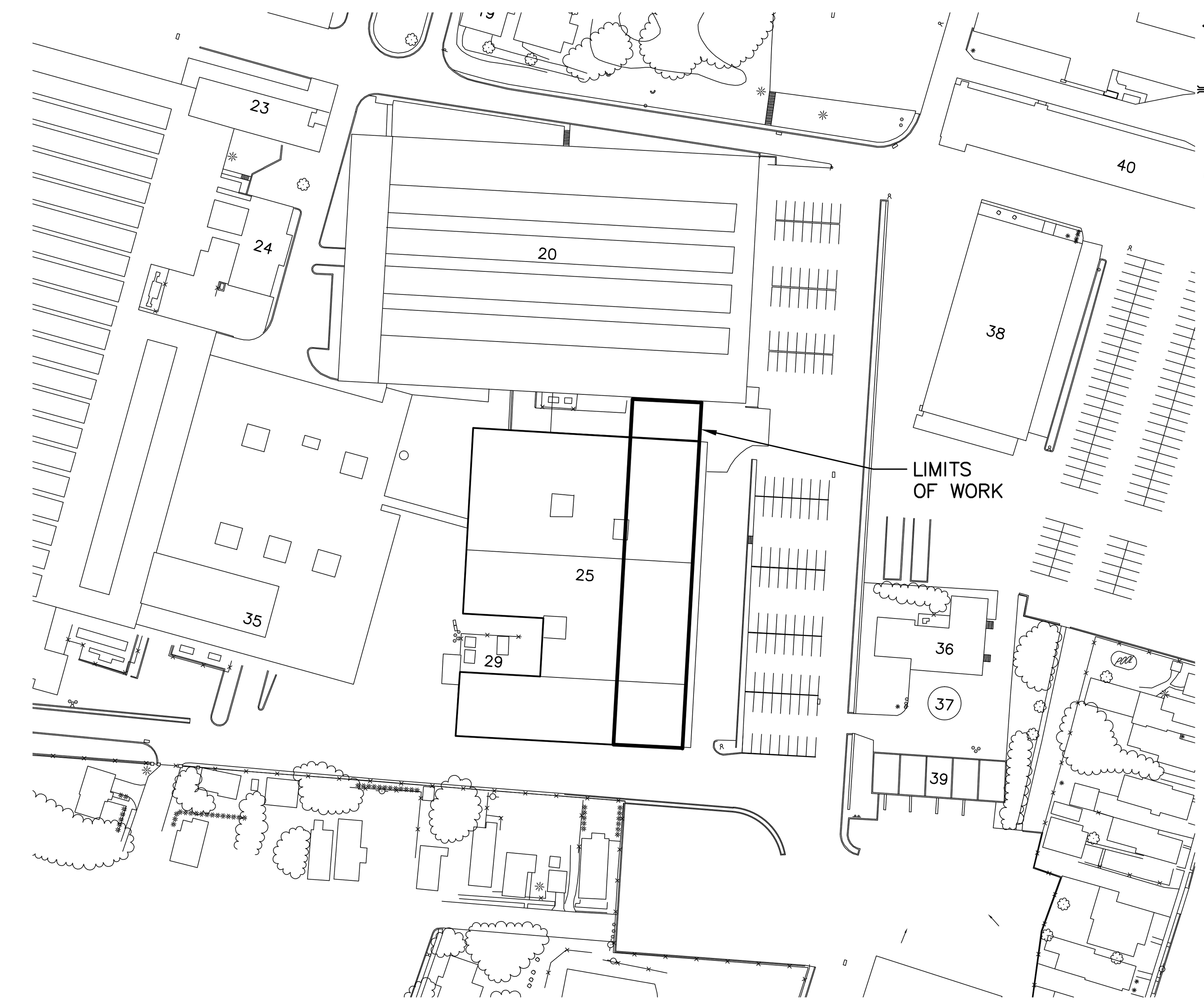
SECTION 1 M5 M5

SCALE: 1/2" = 1'-0"



SECTION 2 M5 M5

SCALE: 1/2" = 1'-0"

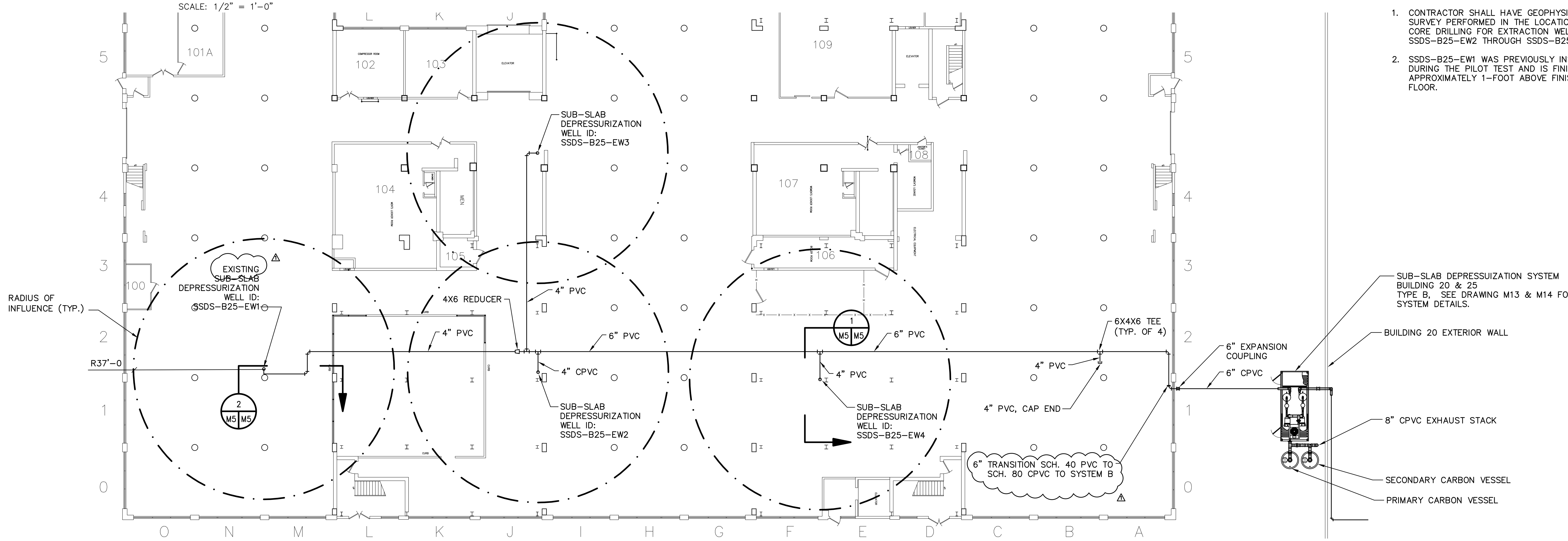


BUILDING 25
PLAN VIEW

NOT TO SCALE

NOTES:

1. CONTRACTOR SHALL HAVE GEOPHYSICAL SURVEY PERFORMED IN THE LOCATIONS OF CORE DRILLING FOR EXTRACTION WELL SSDS-B25-EW2 THROUGH SSDS-B25-EW4.
2. SSDS-B25-EW1 WAS PREVIOUSLY INSTALLED DURING THE PILOT TEST AND IS FINISHED AT APPROXIMATELY 1-FOOT ABOVE FINISHED FLOOR.



PLAN VIEW - BUILDING 25 - 1ST FLOOR

SCALE: 1/16" = 1'-0"

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1	ADDENDUM 1	4/27/2009	MRJ

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DRAWN BY: FAL	DATE: APRIL 2009	FILE NAME: 21181368005	
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MALCOLM PIRNIE, INC.
43 BRITISH AMERICAN BOULEVARD
LATHAM, NEW YORK 12110
24GA2797 1200

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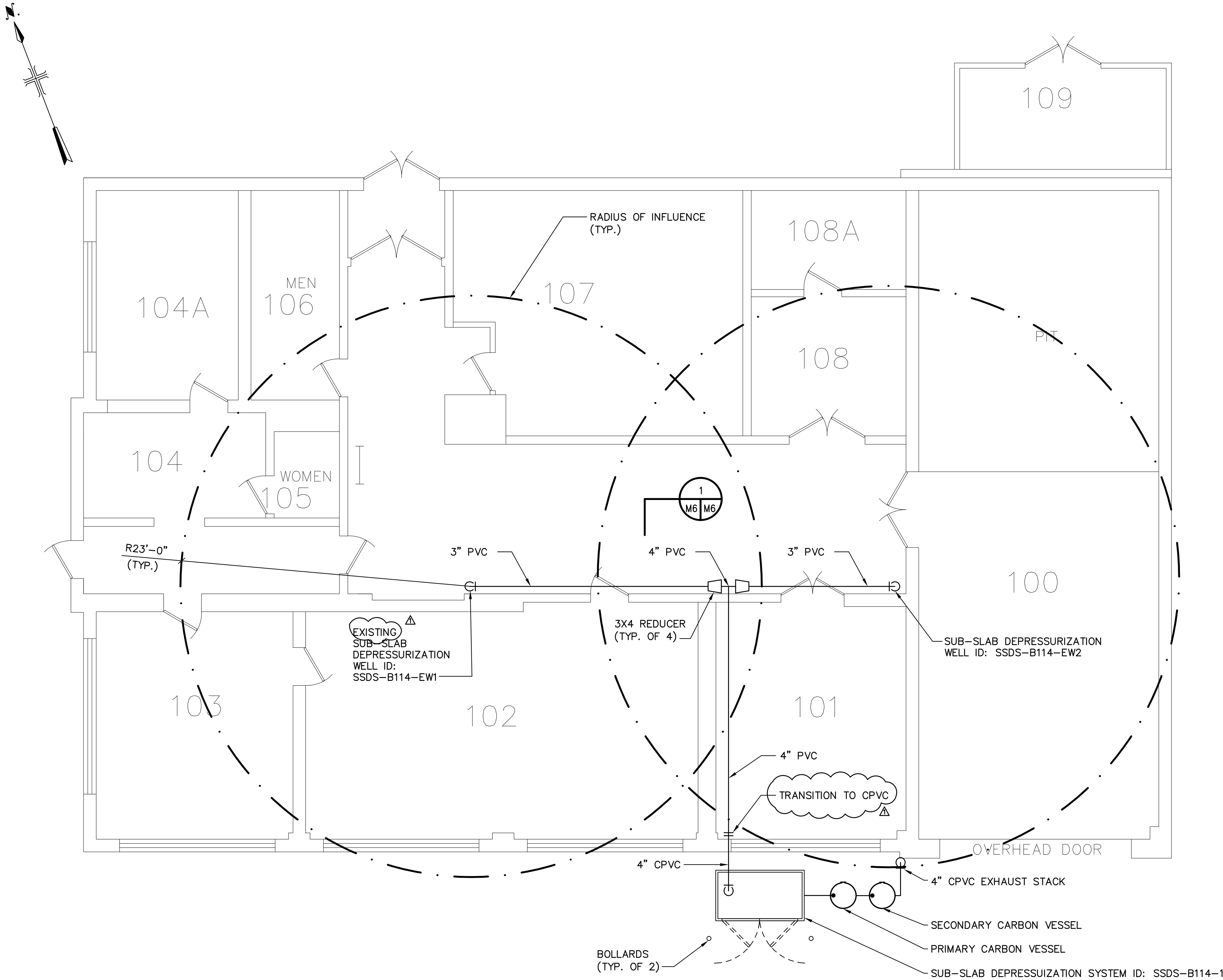
VAPOR INTRUSION MITIGATION

MECHANICAL
BUILDING 25
PLAN AND SECTION VIEW

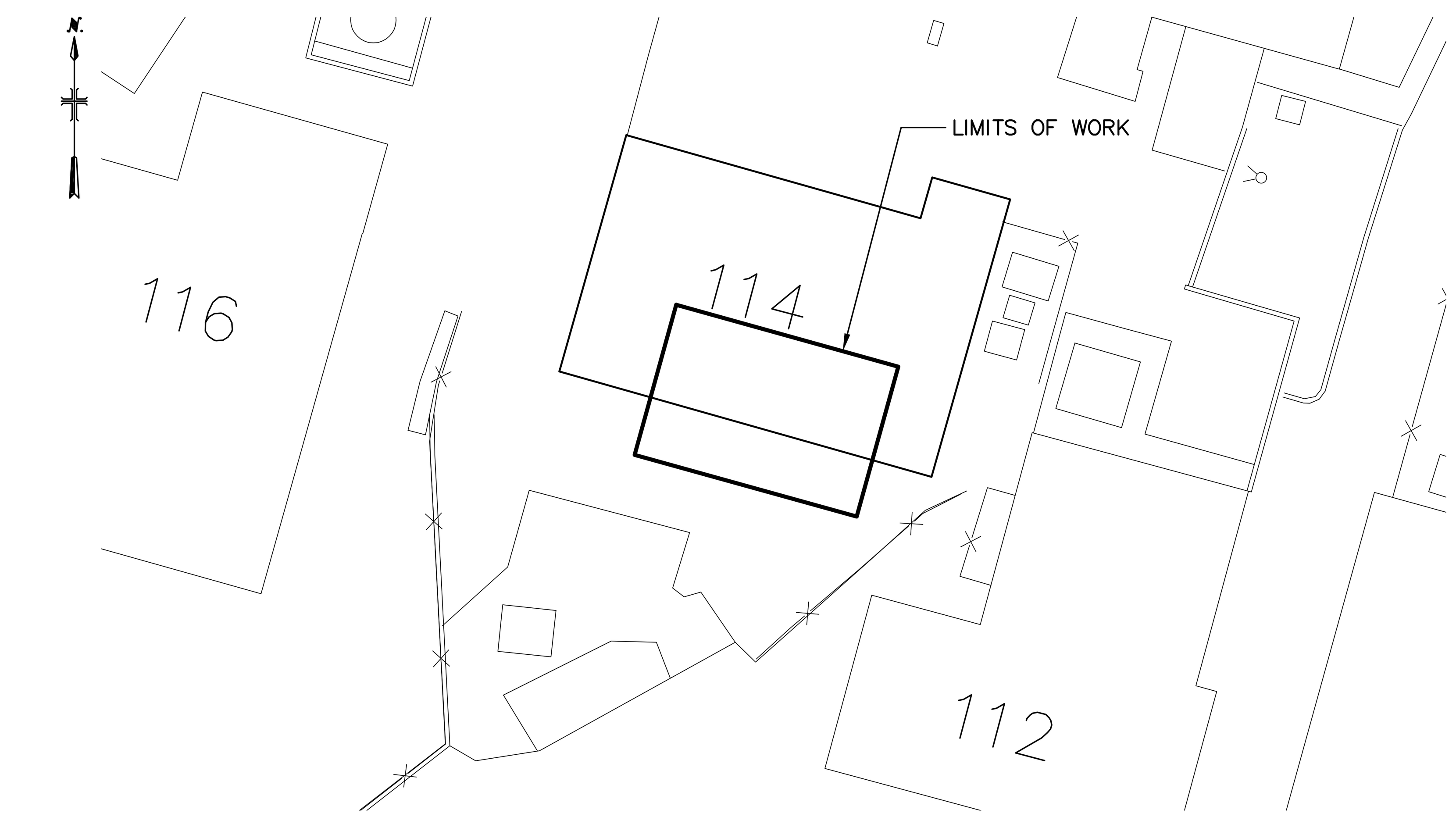
M-5

SHEET 5 OF 15



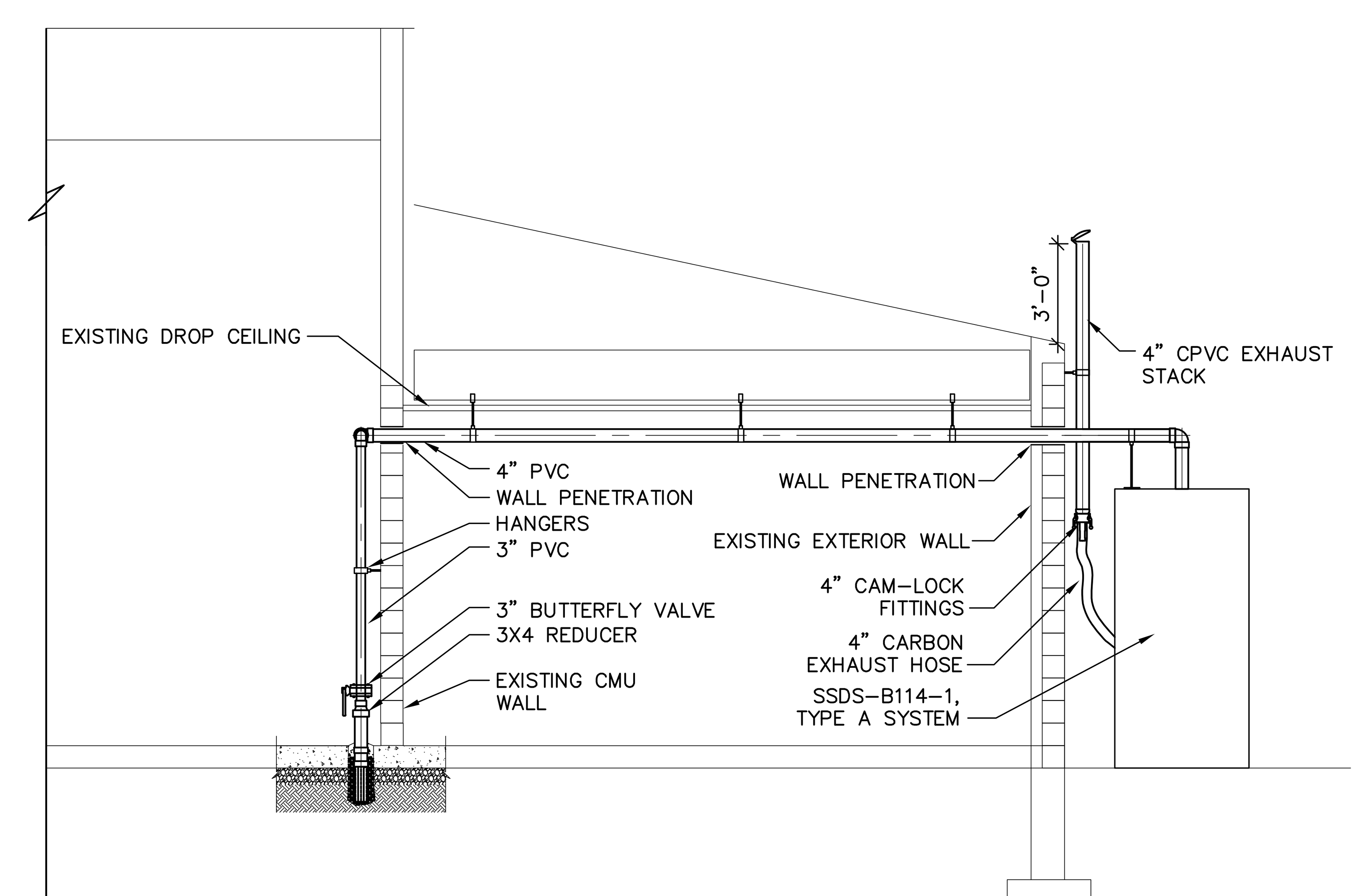
BUILDING 114 – 1ST FLOOR

0 4 12
SCALE: 3/16" = 1'-0"



BUILDING 114 PLAN VIEW

NOT TO SCALE



SECTION 1 M6 M6

2 0 6
SCALE: 1/4" = 1'-0"

NOTES:

1. EXTRACTION WELL ID SSDS-B114-EW-1 WAS PREVIOUSLY INSTALLED DURING THE PILOT TEST AND IS FINISHED 1' ABOVE FINISHED FLOOR. CONTRACTOR SHALL FURNISH AND INSTALL EXTRATION WELL ID SSDS-B114-EW-2.

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BALTIMORE DISTRICT

MARK	DESCRIPTION	DATE	APPR
1	ADDENDUM 1	4/27/2009	MRJ

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DESIGNED BY: MRJ DATE: APRIL 2009
DRAWN BY: FAL DATE: APRIL 2009
REVIEWED BY: DATE:
APPROVED BY: DATE:
FILE NAME: 2118136M006

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BALTIMORE, MARYLAND

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WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

MECHANICAL
BUILDING 114
PLAN AND SECTION VIEW

M-6

SHEET 6 OF 15

XREFS: I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\BASE-MAP.dwg I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\218-B114.dwg I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\2118136-TB.dwg IMAGES:None
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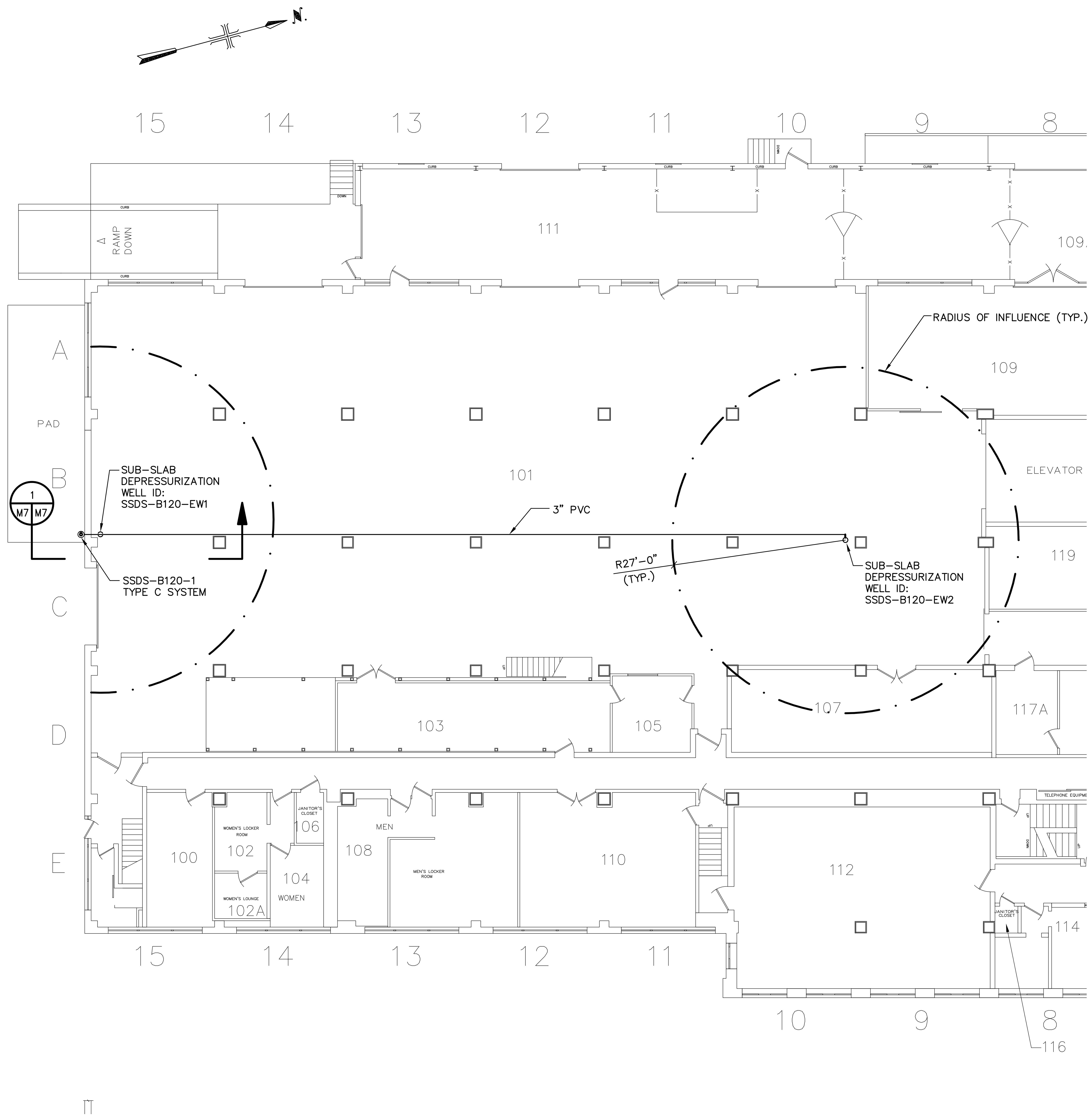


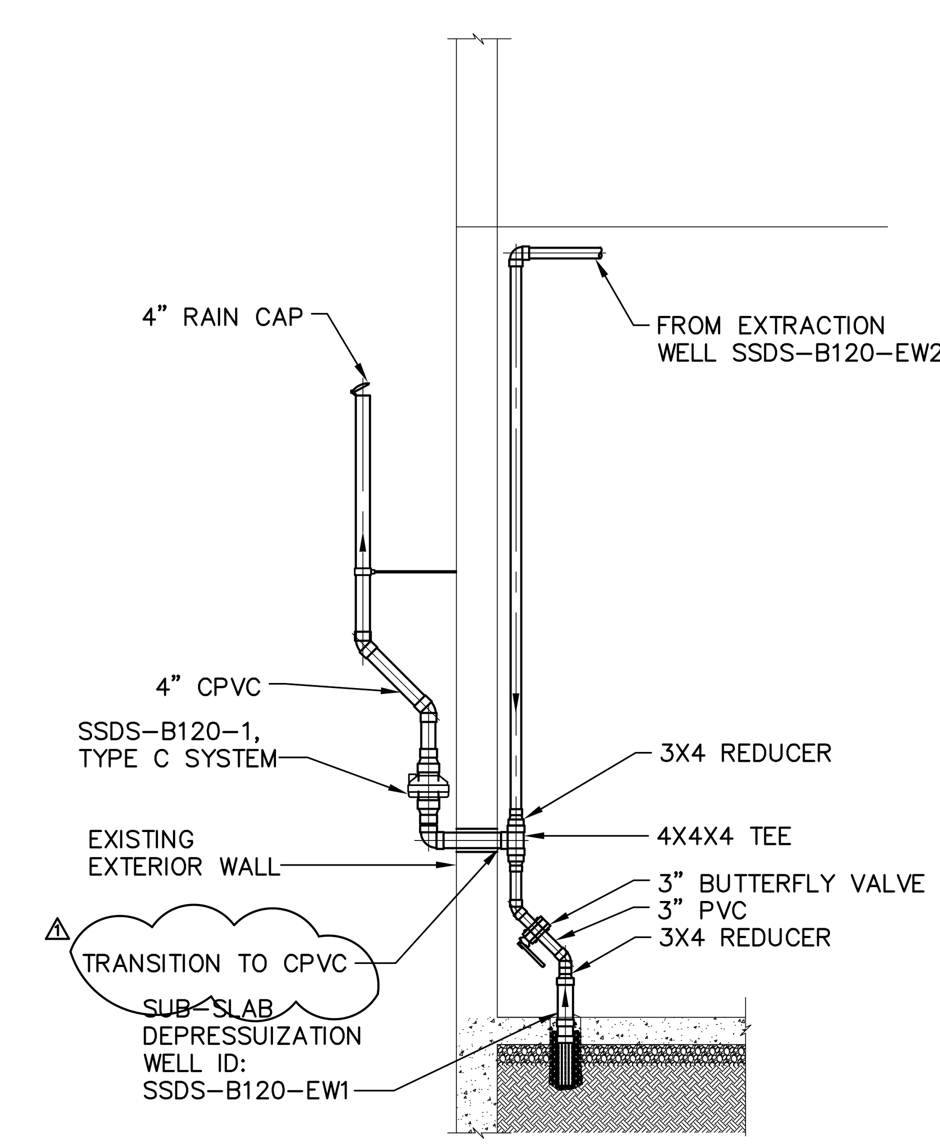
BUILDING 120 – 1ST FLOOR

6 0 6 12

SCALE: 3/32" = 1'-0"

BUILDING 120 PLAN VIEW

NOT TO SCALE



SECTION 1 M7 M7

2 0 6

SCALE: 1/4" = 1'-0"

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MARK	DESCRIPTION	DATE	APPR
1	ADDENDUM 1	4/27/2009	MRJ

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DESIGNED BY: MRJ DATE: APRIL 2009
DRAWN BY: FAL DATE: APRIL 2009
REVIEWED BY: DATE:
APPROVED BY: DATE:
FILE NAME: 2118136M007

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BALTIMORE DISTRICT
BALTIMORE, MARYLAND

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WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

MECHANICAL
BUILDING 120
PLAN AND SECTION VIEW

M-7

SHEET 7 OF 15

XREFS: I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\BASE-MAP.dwg I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\218-B120-01.dwg I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\2118136-TB.dwg IMAGES:None
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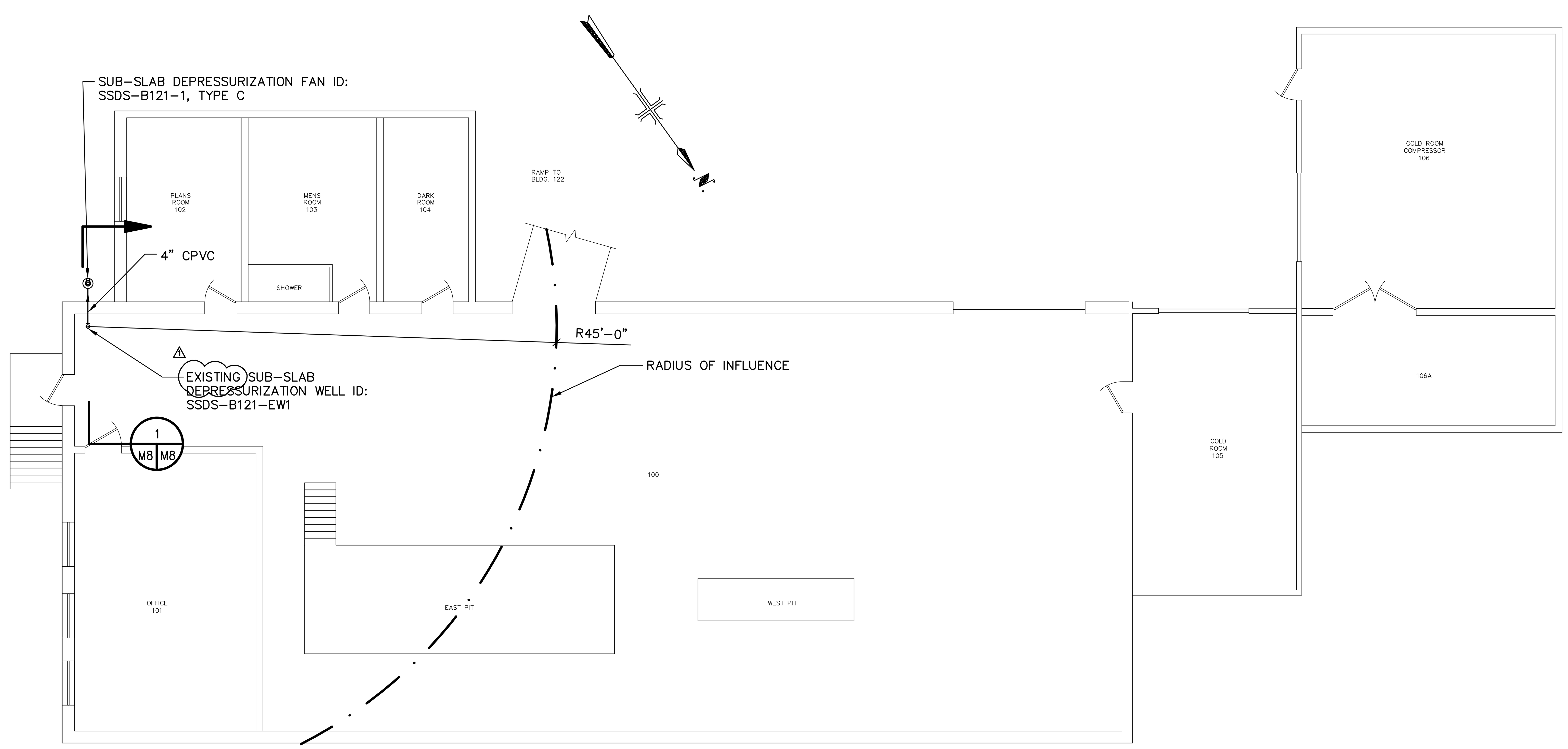
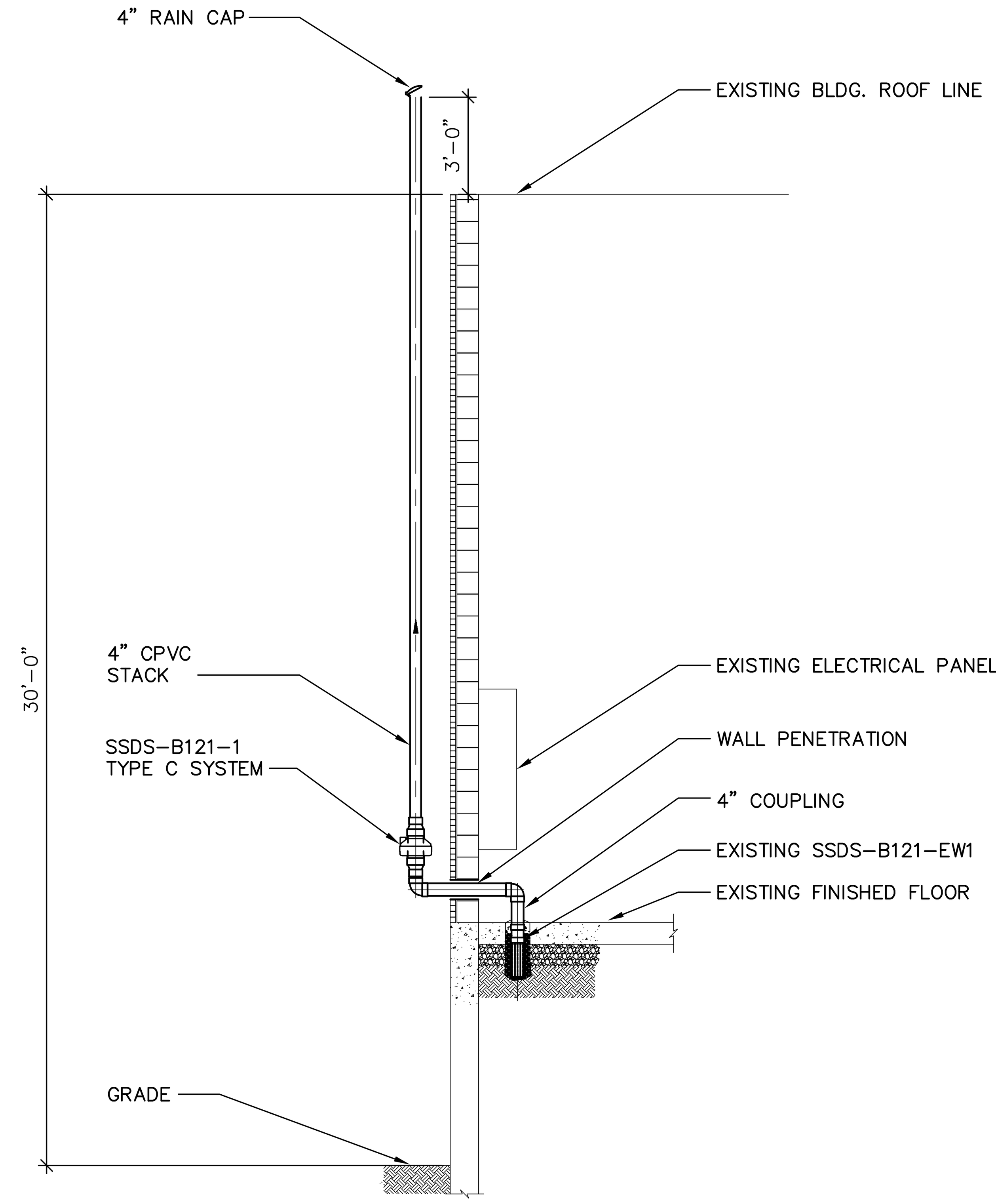
BUILDING 121
PLAN VIEW
NOT TO SCALE



BUILDING 121 – 1ST FLOOR

4 0 4 8
SCALE: 1/8" = 1'-0"



SECTION 1 M8 M8

2 0 6
SCALE: 1/4" = 1'-0"

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△	ADDENDUM 1	4/27/2009	MRJ

DATE:

60% SUBMISSION

DESIGNED BY: MRJ	DATE: APRIL 2009	APPROVED BY: - DATE: -
DRAWN BY: TAL	DATE: APRIL 2009	FILE NAME: 2118136M008
REVIEWED BY: -	DATE: -	

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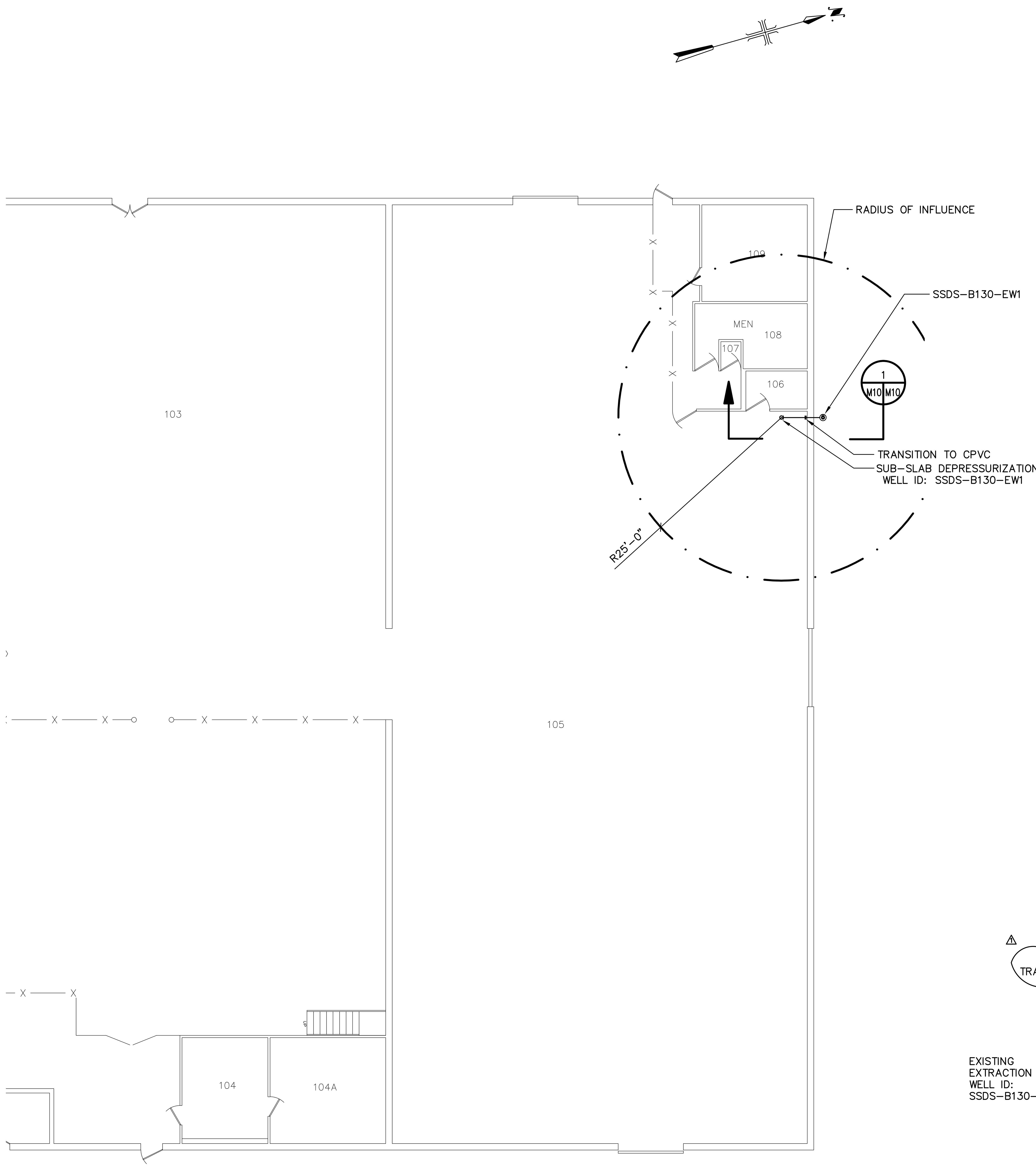
WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

MECHANICAL
BUILDING 121
PLAN AND SECTION VIEW

M-8

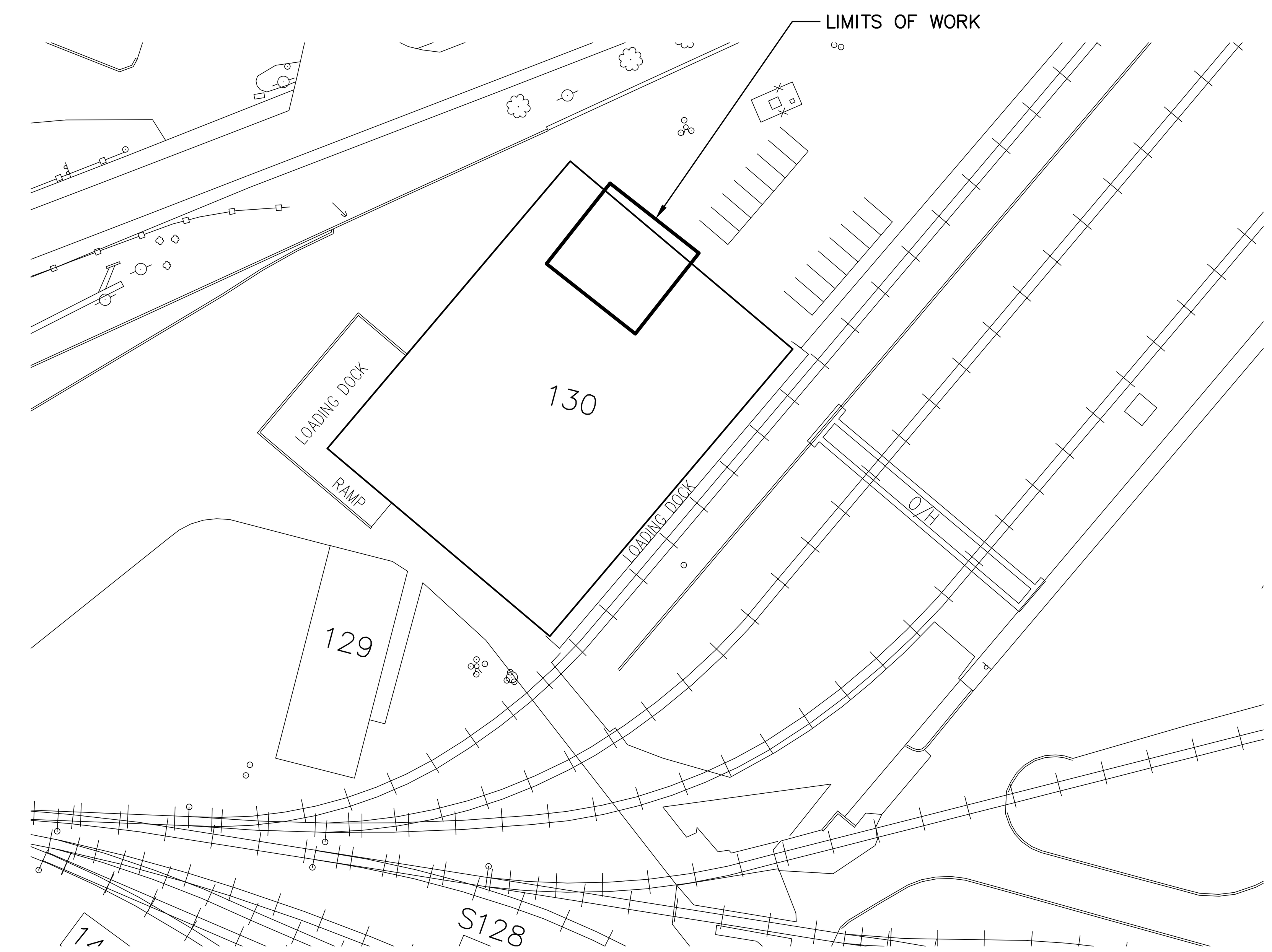
SHEET 8 OF 15

XREFS: I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\BASE-MAP.dwg I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\bldg 121.dwg I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\2118136-TB.dwg IMAGES:None
User:DeJong Spec:PIRNIE STANDARD File:I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\MECH\2118136M008.DWG Scale:1:1 Date:04/27/2009 Time:10:57 Layout:M8



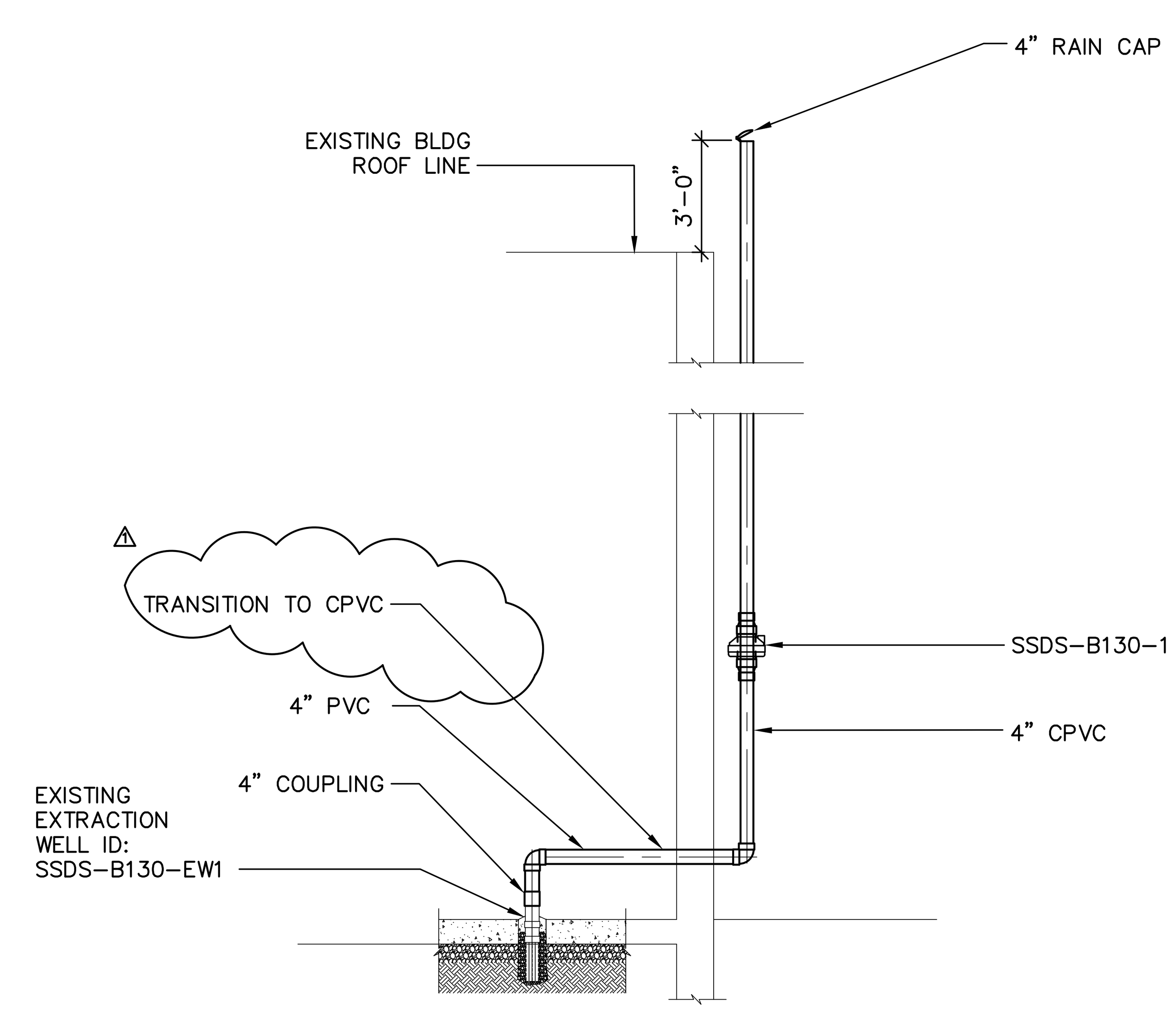
BUILDING 130 – 1ST FLOOR

SCALE: 3/32" = 1'-0"



BUILDING 130
PLAN VIEW

NOT TO SCALE



SECTION 1 M10 M10

SCALE: 1/4" = 1'-0"

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1	ADDENDUM 1	4/27/2009	MRJ

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REVIEWED BY: | DATE:
APPROVED BY: | DATE:
FILE NAME: 2118136M010

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WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

MECHANICAL
BUILDING 130
PLAN AND SECTION VIEW

M-10

SHEET 10 OF 15

XREFS: I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\BASE-MAP.dwg I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\bldg 130.dwg I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\2118136-TB.dwg IMAGES:None
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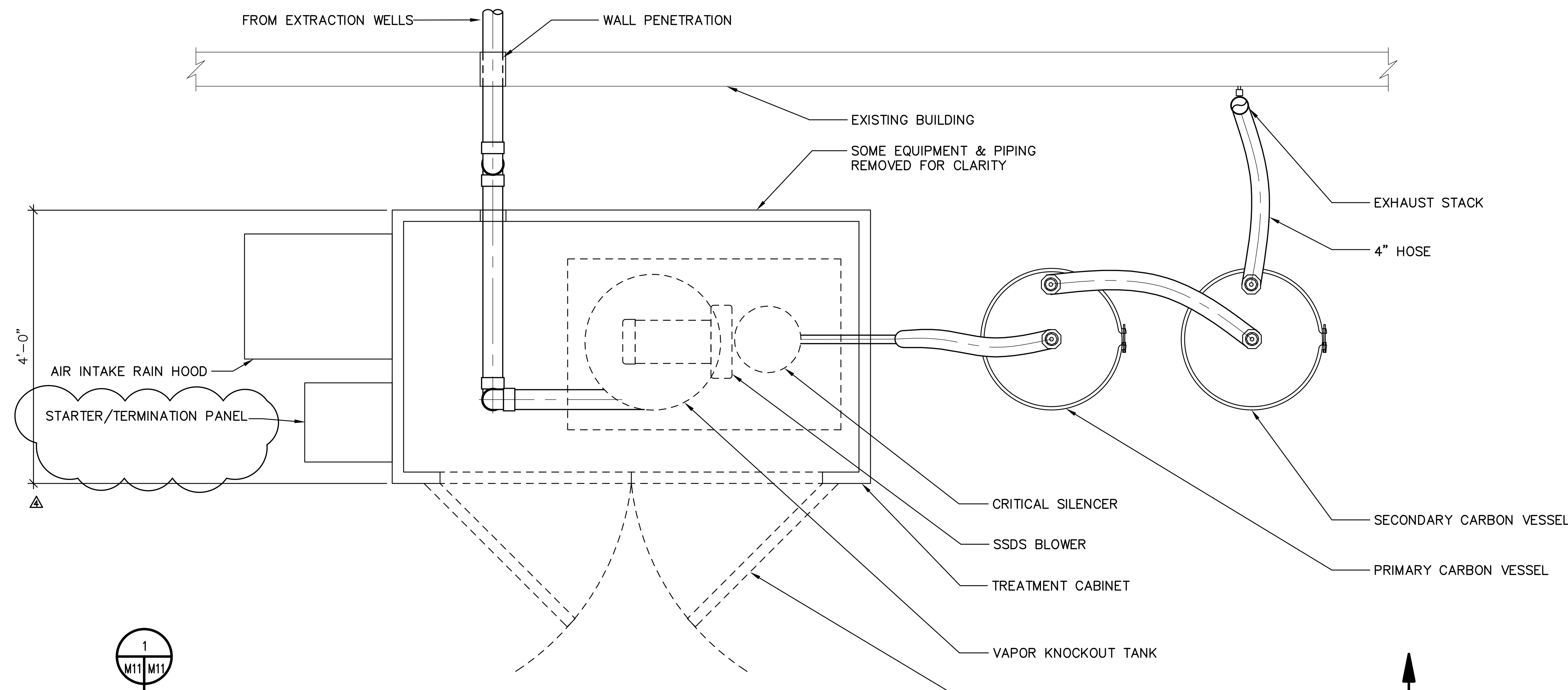
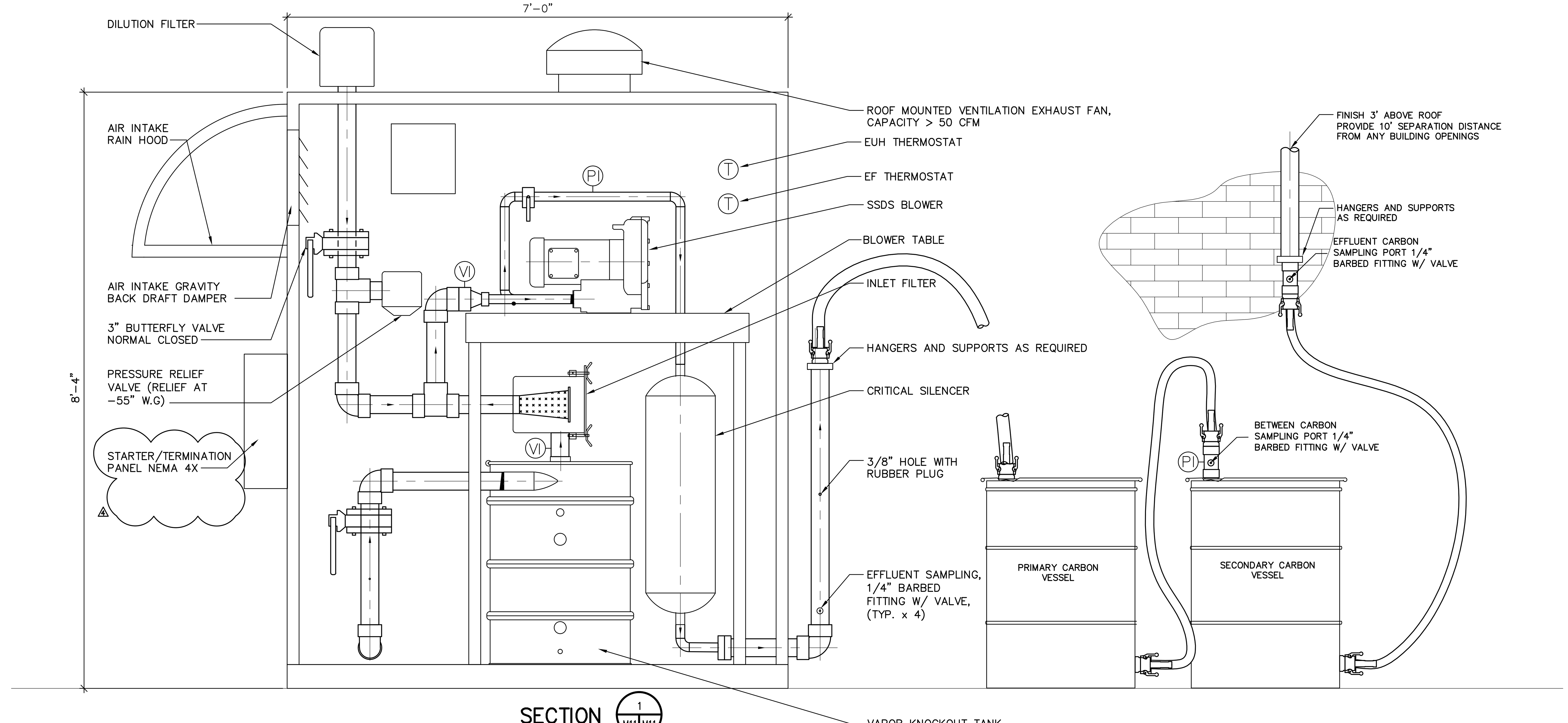


SSDS MITIGATION SYSTEM
TYPE A
PLAN VIEW

SCALE: NOT TO SCALE

NOTES:

1. CARBON VESSELS SHALL NOT BE PROVIDED FOR BUILDING 15 SUB-SLAB DEPRESSUIZATION SYSTEM: SSDS-B15-1.



SECTION 1 M11 M11

SCALE: NOT TO SCALE

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ADDENDUM 4

MARK | DESCRIPTION | DATE | APPR

60% SUBMISSION

DESIGNED BY: | DATE: APRIL 2009
DRAWN BY: | DATE: APRIL 2009
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APPROVED BY: | DATE:
FILE NAME: 2118136M011

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BALTIMORE, MARYLAND

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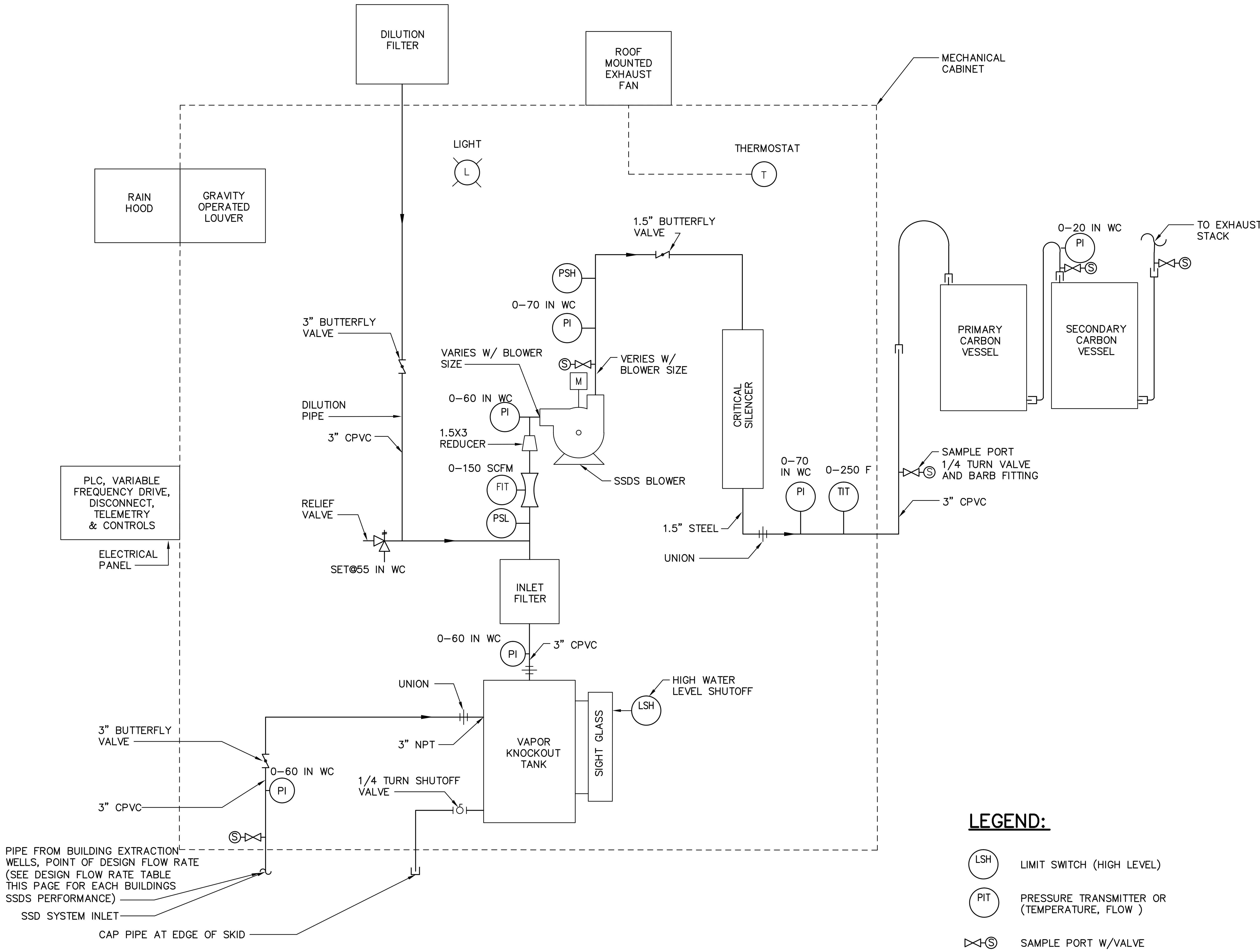
WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

MECHANICAL
SSD SYSTEM TYPE A
PLAN AND SECTION VIEW

M-11

SHEET 11 OF 15

XREFS:I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\2118136-TB.dwg IMAGES:None
User:DeJong Spec:PIRNIE STANDARD File:I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\MECH\2118136M011.DWG Scale:1:1 Date:05/06/2009 Time:10:00 Layout:M11



SSD SYSTEM PROCESS PIPING DETAIL – TYPE A

NOT TO SCALE

LEGEND:

- LSH — LIMIT SWITCH (HIGH LEVEL)
- PIT — PRESSURE TRANSMITTER OR (TEMPERATURE, FLOW)
- SAMPLE PORT W/VALVE
- T — THERMOSTAT
- L — LIGHT
- PI — PRESSURE INDICATOR
- M — MOTORIZED
- VENTURI
- UNION

SPECIFICATIONS – TYPE A:

SSDS BLOWER:

1. TYPE: REGENERATIVE BLOWER
2. PRODUCT: AMETEK ROTRON MODEL NO. EN 454M, SEALED REGENERATIVE BLOWER W/ EXPLOSION-PROOF MOTOR, OR EQUAL.
3. ELECTRICAL: SEE ELECTRICAL SHEETS FOR VOLTAGE AND PHASE
4. PERFORMANCE: SEE DESIGN FLOW RATE TABLE BELOW. PERFORMANCE SHALL BE AT SSD SYSTEM INLET.
5. CONNECTION: FEMALE THREAD INLET AND OUTLET PORTS
6. ACCESSORIES: VAPOR KNOCKOUT TANK, INLET FILTER, PRESSURE GAUGES, VACUUM GAUGES & RELIEF VALVE, EXTERNAL CRITICAL SILENCER, AND VARIABLE FREQUENCY DRIVE PACKAGE.

DESIGN FLOW RATE		
BUILDINGS	DESIGN FLOW	DESIGN PRESSURE
	(SCFM)	(IN.WC)
15	105	-20
21	105	-18
114	100	-22
123	110	-13

VAPOR KNOCKOUT TANK:

1. TYPE: HIGH EFFICIENCY CYCLONIC
2. PRODUCT: AMETEK ROTRON MOISTURE SEPARATOR MODEL NO. MS200DS, OR EQUAL
3. SIGHT GLASS INDICATOR: LIQUID LEVEL INDICATOR - KROHNE BM26, AND STAINLESS STEEL GUIDE TUBE WITH FLAP INDICATOR AND EXPLOSION PROOF LIMIT SWITCH ADJUSTED FOR HIGH LEVEL ALARM. COORDINATE FLANGE MATERIAL AND MOUNTING WITH TANK
4. PERFORMANCE: CONTINUOUS OPERATION WITH A PRESSURE DROP OF LESS THAN 6 IN.WC AT THE RATED FLOW OF 200 SCFM
5. CAPACITY: LIQUID HOLDING CAPACITY 10 GALLONS
6. CONNECTION: 2 INCH INLET & 4.5 INCH OD OUTLET
7. MATERIAL: STEEL

INLET FILTER:

1. TYPE: DUAL CONNECTION REPLACEABLE MEDIA TYPE
2. PRODUCT: AMETEK ROTRON INLET FILTER MODEL NO. 515254, OR EQUAL
3. PERFORMANCE: 97-98% EFFICIENCY (8 TO 10 MICRON PARTICLE SIZE)
4. FILTER ELEMENT: REPLACEABLE: MODEL 516434
5. CONNECTION: 1.5 INCH NPSC INLET AND OUTLET
6. MATERIALS: HOUSING - STEEL, MEDIA - POLYESTER

CRITICAL SILENCER:

1. TYPE: CRITICAL SILENCER
2. PRODUCT: NELSON EXHAUST SILENCER SERIES 300, OR EQUAL
3. PERFORMANCE: REDUCE NOISE 25 dB, <12 IN.WC @ 100 SCFM
4. CONNECTION: 1.5 INCH NPT MALE INLET AND OUTLET
5. MATERIALS: STEEL

CARBON VESSELS:

1. TYPE: VAPOR PHASE GRANULAR ACTIVATED CARBON
2. PRODUCT: SIEMENS, WESTATES® COCONUT SHELL BASED GRANULAR ACTIVATED CARBON - VOCARB® 48C, OR EQUAL
3. SIZE: SEE CARBON SIZE CHART BELOW
4. MATERIAL: STEEL

CARBON VESSEL			
BUILDINGS	SIEMENS MOD. NO.	INLET/OUTLET	SHIPPING WT.
		(IN.)	(LBS)
15	CARBON NOT REQUIRED		
21	VSC 200	2 NPT	250
114	VSC 400	4 NPT	480
123	VSC 400	4 NPT	480

MECHANICAL CABINET:

1. RATING: NEC CLASS 1 DIVISION 1 AREA
2. SIZE: 7 FT. LONG X 4 FT. WIDE X 8.33 FT TALL
3. MATERIAL: STEEL CONSTRUCTION
4. ACCESS: LOCKABLE STEEL DOUBLE DOORS
5. SOUND ATTENUATION: 55 dB @ 3 FT.
6. FAN: 6 ACH MIN.
7. ELECTRIC UNIT HEATER
8. FINISH: TWO COAT EPOXY COATED STEEL, COLOR FOREST GREEN

US Army Corps of Engineers®
BALTIMORE DISTRICT

MARK	DESCRIPTION	DATE	APPR

DATE:

60% SUBMISSION

DESIGNED BY: MMJ | DATE: APRIL 2009 | APPROVED BY: . | DATE: .
DRAWN BY: TAL | DATE: APRIL 2009 | FILE NAME: 2118136M012
REVIEWED BY: . | DATE: .

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CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

MALCOLM PIRNIE
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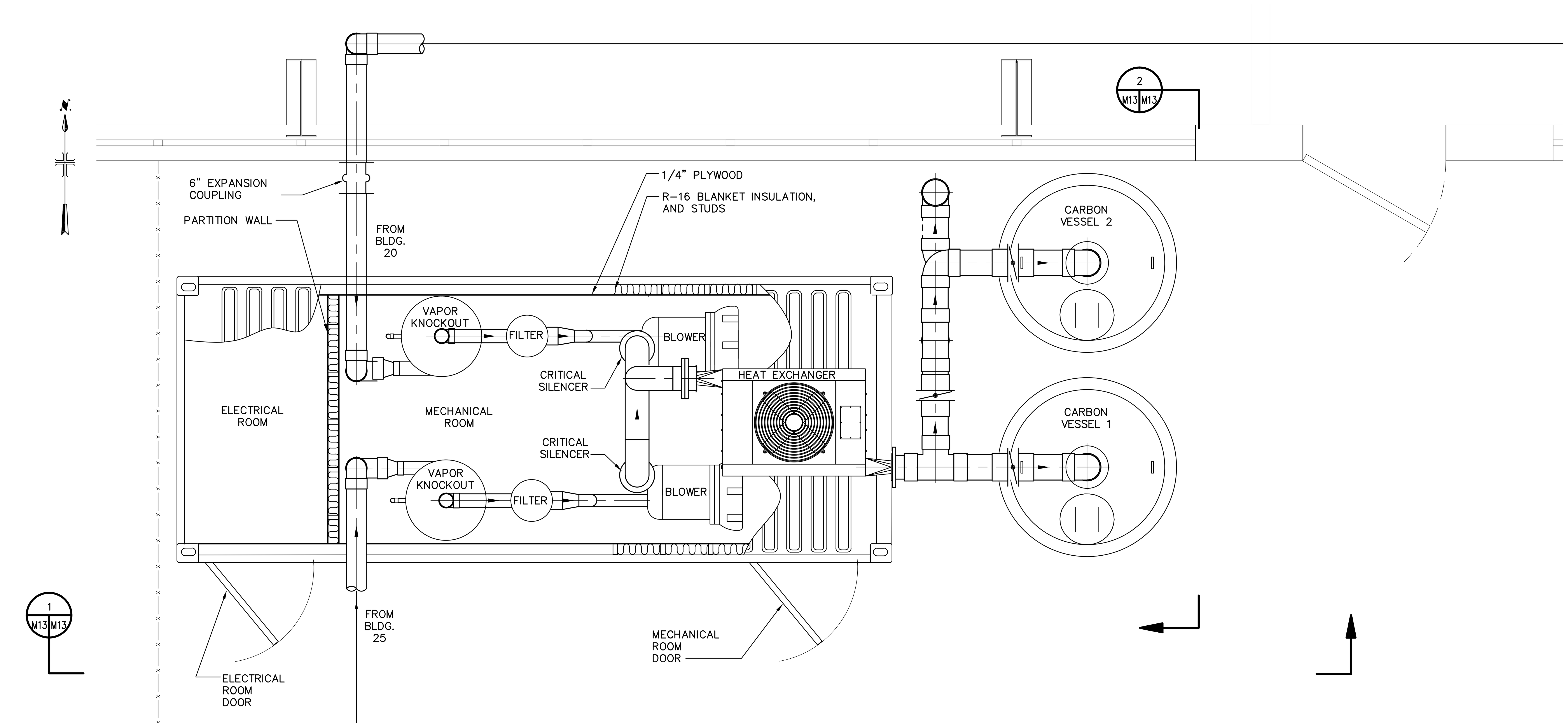
LATHAM, NEW YORK 12110
24GA27971200

WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

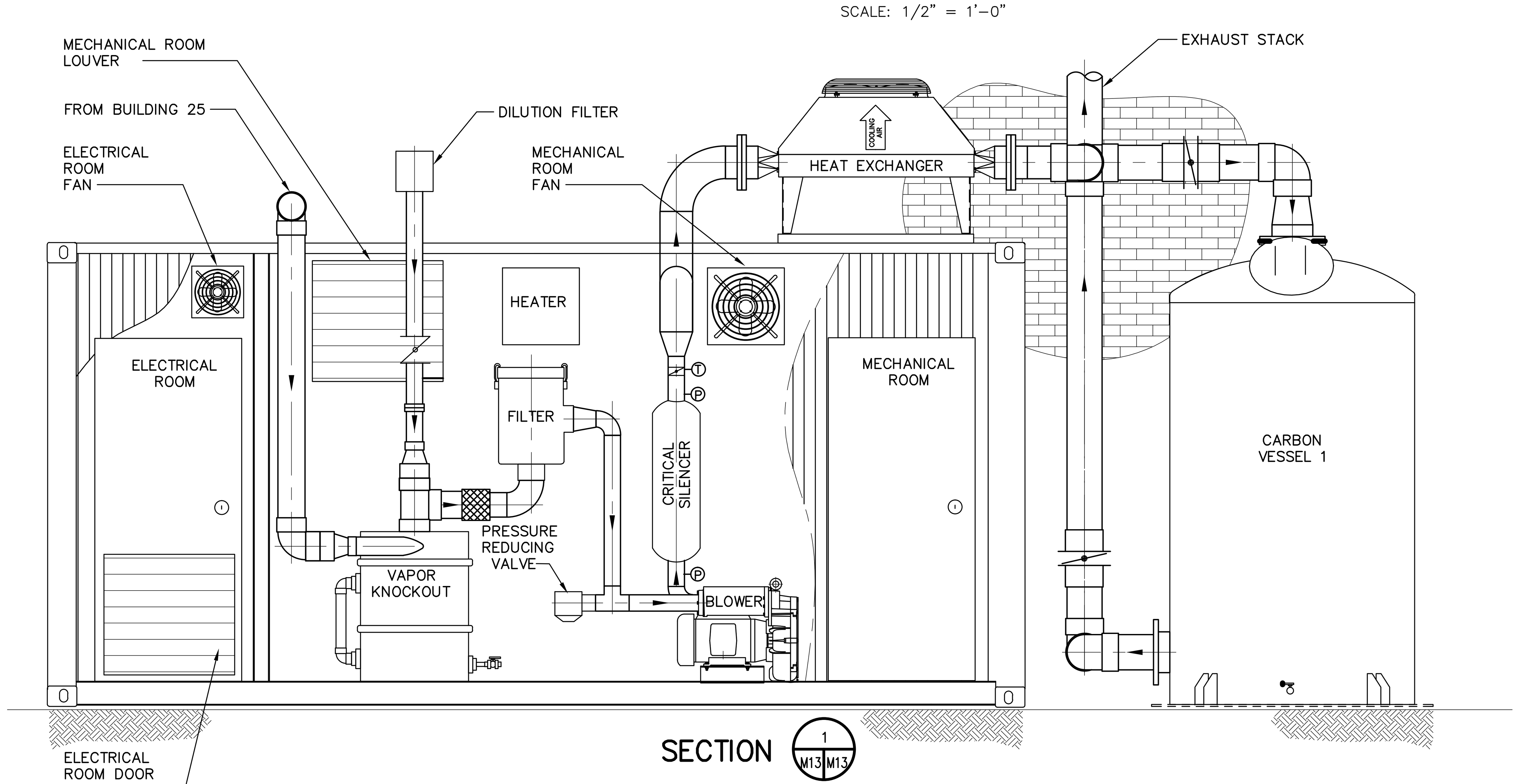
MECHANICAL
SSD SYSTEM TYPE A
P&ID

M-12



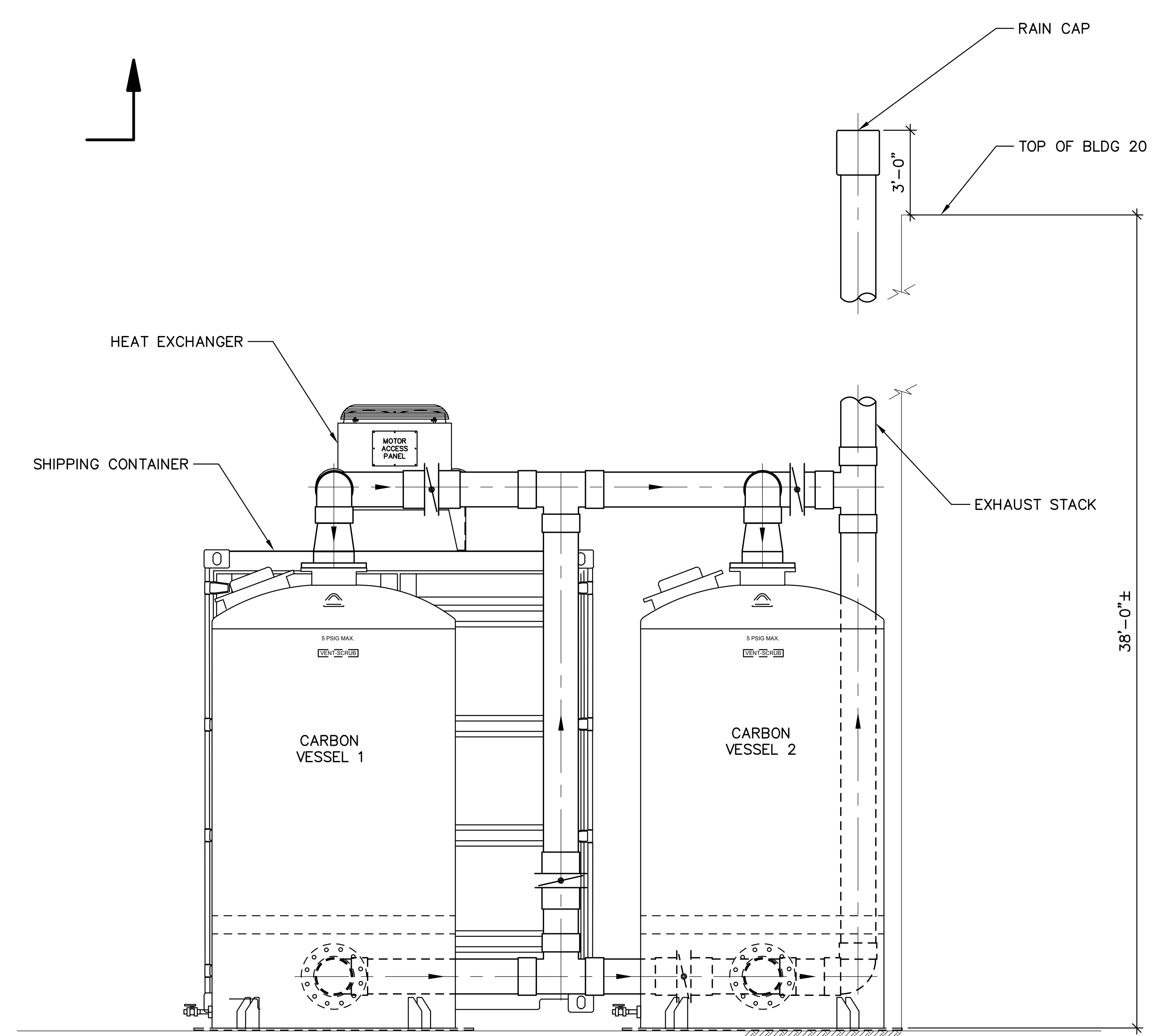
BUILDING 20 AND 25 SSD SYSTEM PLAN VIEW

2 0 2
SCALE: 1/2" = 1'-0"



SECTION 1 M13 M13

2 0 2
SCALE: 1/2" = 1'-0"



SECTION 2 M13 M13

2 0 2
SCALE: 1/2" = 1'-0"

SPECIFICATIONS – TYPE B:

CARBON VESSELS:

1. TYPE: VAPOR PHASE GRANULAR ACTIVATED CARBON
2. SIZE: PROVIDE A MINIMUM OF 2 X 2000 LB CARBON VESSELS. VESSELS SHALL BE CAPABLE OF OPERATING IN SERIES AT A TOTAL MAXIMUM DESIGN FLOW OF 1000 CFM AND A MINIMUM DESIGN FLOW OF 300 CFM.
3. PRODUCT: SIEMANS WESTATES COCONUT SHELL BASED GRANUALR ACTIVATED CARBON – VOCARB 46C, OR EQUAL
4. PRESSURE LOSES AT MAXIMUM DESIGN FLOW OF 1000 CFM SHALL NOT EXCEED –15"W.C.
5. MATERIAL: STEEL
6. COATING: INTERIOR: EPOXY TWO COATS, THICKNESS: 10 MIL MIN COLOR: WHITE
   EXTERIOR:
   PRIMER COAT: EPOXY THICKNESS 4 MILS DFT MIN – COLOR: GRAY
   FINISH COAT: POLYURETHANE PROTECTIVE FINISH THICKNESS 3 MILS DFT MIN – COLOR: WHITE

CARBON VESSELS			
BUILDINGS	QTY.	DESIGN FLOW	INLET/OUTLET
		CFM	(IN.)
20 & 25	2	300–1000	10 FLG

TREATMENT SYSTEM:

1. MECHANICAL ROOM: NEC CLASS 1 DIVISION 1 AREA
2. ELECTRICAL ROOM: NEC NON-RATED
3. SHIPPING CONTAINER SIZE: 20 FT. LONG X 8 FT-6 IN WIDE X 9 FT – 6 IN HIGH
4. MATERIAL: STEEL CONSTRUCTION
5. ACCESS: LOCKABLE STEEL DOORS
6. SOUND ATTENUATION: 55 dB @ 3 FT.
7. FAN: 6 ACH MIN.
8. ELECTRIC UNIT HEATER
9. FINISH: TWO COAT EPOXY COATED STEEL, COLOR FOREST GREEN

US Army Corps of Engineers®
BALTIMORE DISTRICT

MARK | DESCRIPTION | DATE | APPR

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DESIGNED BY: MRJ DATE: APRIL 2009
DRAWN BY: FAL DATE: APRIL 2009
REVIEWED BY: DATE:
APPROVED BY: DATE:
FILE NAME: 2118136M013

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BALTIMORE DISTRICT
BALTIMORE, MARYLAND

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WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

MECHANICAL
SSD SYSTEM TYPE B
PLAN AND SECTION VIEW

M-13

SHEET 13 OF 15

XREFS: I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\SSDS 20,25.dwg ... IMAGES:None
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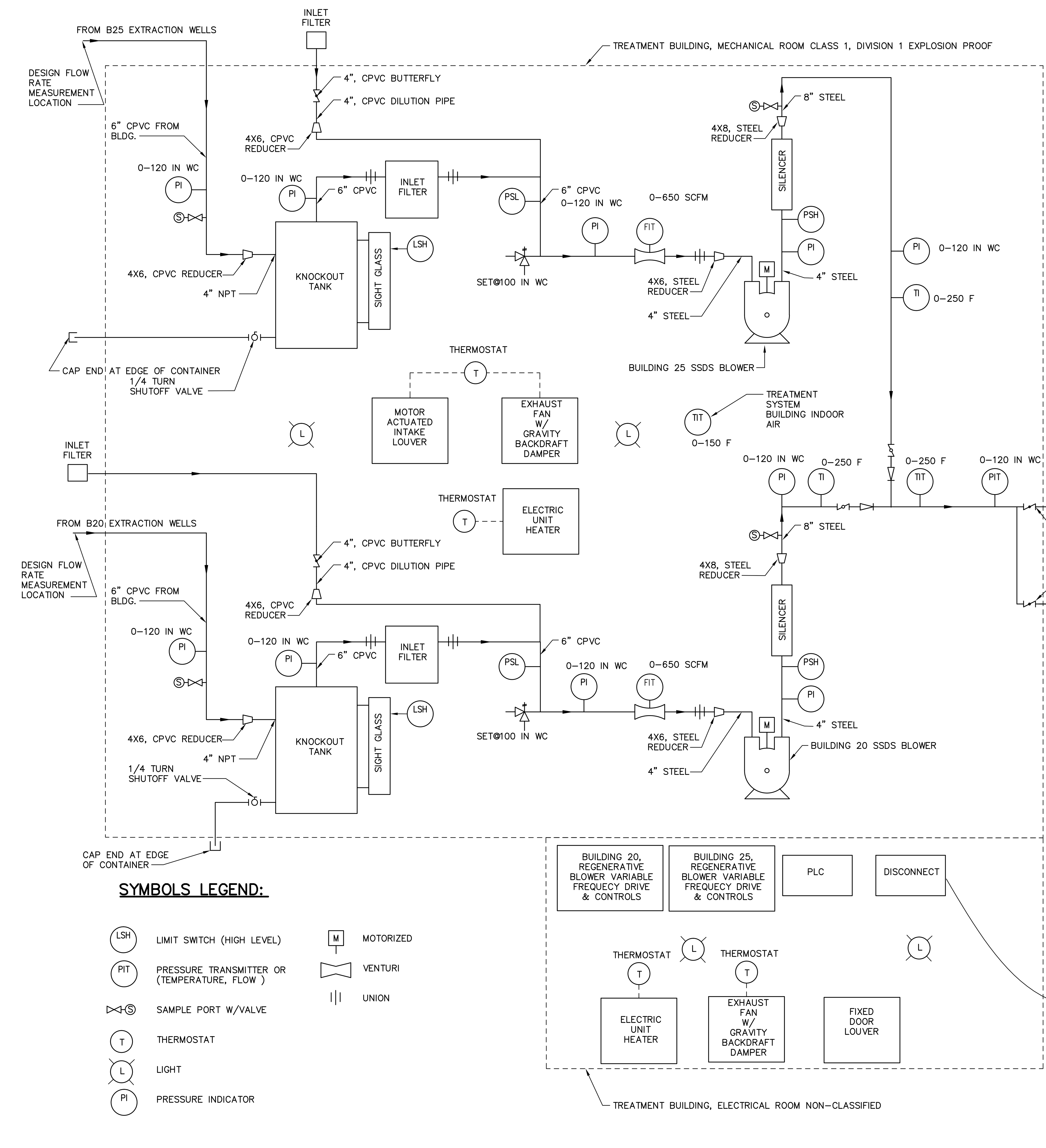

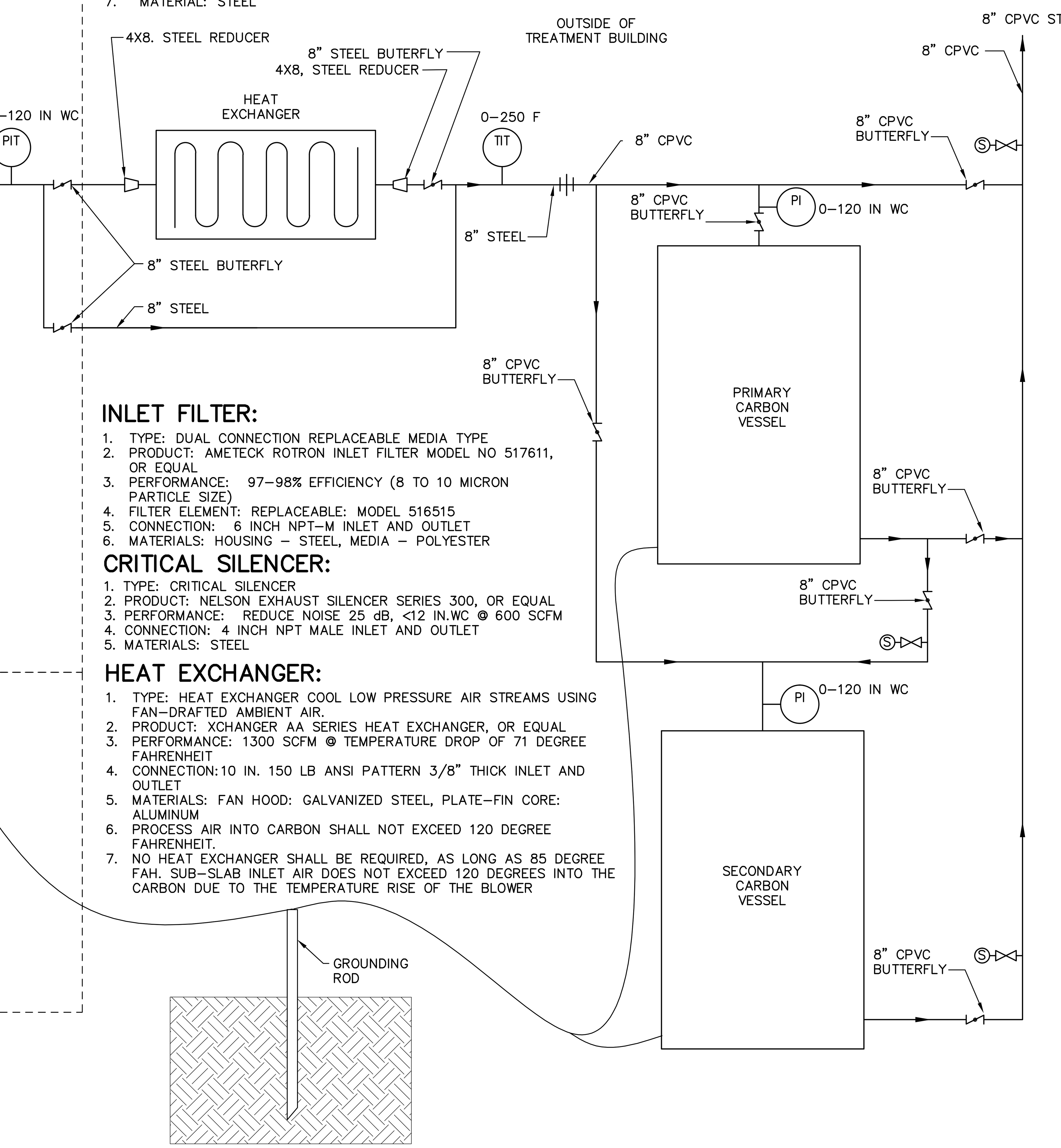

SPECIFICATIONS – TYPE B:

SSDS BLOWER:

1. TYPE: REGENERATIVE TYPE OR POSSITIVE DISPLACEMENT TYPE BLOWER ARE ACCEPTABLE
2. REGENERATIVE TYPE: AMETECK ROTRON MODEL OR POSSITIVE DISPLACEMENT: GARDNER DENVER SUITOR BUILT
3. ELECTRICAL: SEE ELECTRICAL DRAWINGS FOR VOLTAGE AND PHASE
4. PERFORMANCE: SEE BLOWER DESIGN FLOW RATE TABLE BELOW. DESIGN FLOW RATE SHALL BE AT THE INLET TO THE SSDS SYSTEM.
5. CONNECTION: 4" – 8 NPSC FEMALE THREAD INLET AND OUTLET PORTS
6. ACCESSORIES: VAPOR KNOCKOUT TANK, INLET FILTER, PRESSURE GAUGES, VACUUM GAUGES & RELIEF VALVE, EXTERNAL CRITICAL SILENCER, AND VARIABLE FREQUENCY DRIVE PACKAGE.

BLOWER DESIGN FLOW RATE		
BUILDINGS	DESIGN FLOW	DESIGN VACCUM
	(SCFM)	(IN.WC)
20	360	–70
25	450	–50

VAPOR KNOCKOUT TANK:

1. TYPE: HIGH EFFICIENCY CYCLONIC
2. PRODUCT: AMETEK ROTRON MOISTURE SEPARATOR MODEL NO. MS600BSM, OR EQUAL.
3. SIGHT GLASS INDICATOR: LIQUID LEVEL INDICATOR – KROHNE BM26, AND STAINLESS STEEL GUIDE TUBE WITH FLAP INDICATOR AND EXPLOSION PROOF LIMIT SWITCH ADJUSTED FOR HIGH LEVEL ALARM.COORDINATE FLANGE MATERIAL AND MOUNTING WITH TANK.
4. PERFORMANCE: CONTINUOUS OPERATION WITH A PRESSURE DROP OF LESS THAN 6 IN.WC AT THE RATED FLOW OF 200 SCFM
5. CAPACITY: LIQUID HOLDING CAPACITY 40 GALLONS
6. CONNECTION: 4 INCH INLET & 6.63 INCH ID OUTLET
7. MATERIAL: STEEL

INLET FILTER:

1. TYPE: DUAL CONNECTION REPLACEABLE MEDIA TYPE
2. PRODUCT: AMETECK ROTRON INLET FILTER MODEL NO 517611, OR EQUAL
3. PERFORMANCE: 97–98% EFFICIENCY (8 TO 10 MICRON PARTICLE SIZE)
4. FILTER ELEMENT: REPLACEABLE: MODEL 516515
5. CONNECTION: 6 INCH NPT–M INLET AND OUTLET
6. MATERIALS: HOUSING – STEEL, MEDIA – POLYESTER

CRITICAL SILENCER:

1. TYPE: CRITICAL SILENCER
2. PRODUCT: NELSON EXHAUST SILENCER SERIES 300, OR EQUAL
3. PERFORMANCE: REDUCE NOISE 25 dB, <12 IN.WC @ 600 SCFM
4. CONNECTION: 4 INCH NPT MALE INLET AND OUTLET
5. MATERIALS: STEEL

HEAT EXCHANGER:

1. TYPE: HEAT EXCHANGER COOL LOW PRESSURE AIR STREAMS USING FAN–DRAFTED AMBIENT AIR.
2. PRODUCT: XCHANGER AA SERIES HEAT EXCHANGER, OR EQUAL
3. PERFORMANCE: 1300 SCFM @ TEMPERATURE DROP OF 71 DEGREE FAHRENHEIT
4. CONNECTION:10 IN. 150 LB ANSI PATTERN 3/8" THICK INLET AND OUTLET
5. MATERIALS: FAN HOOD: GALVANIZED STEEL, PLATE–FIN CORE: ALUMINUM
6. PROCESS AIR INTO CARBON SHALL NOT EXCEED 120 DEGREE FAHRENHEIT.
7. NO HEAT EXCHANGER SHALL BE REQUIRED, AS LONG AS 85 DEGREE FAH. SUB–SLAB INLET AIR DOES NOT EXCEED 120 DEGREES INTO THE CARBON DUE TO THE TEMPERATURE RISE OF THE BLOWER

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MARK | DESCRIPTION | DATE | APPR

60% SUBMISSION

DESIGNED BY: MNJ DATE: APRIL 2009
DRAWN BY: FAL DATE: APRIL 2009
REVIEWED BY: DATE:
APPROVED BY: DATE:
FILE NAME: 2118136M014

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BALTIMORE DISTRICT
BALTIMORE, MARYLAND

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WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

MECHANICAL
SSD SYSTEM TYPE B
P&ID

M-14

SHEET 14 OF 15

XREFS:I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\2118136–TB.dwg IMAGES:None
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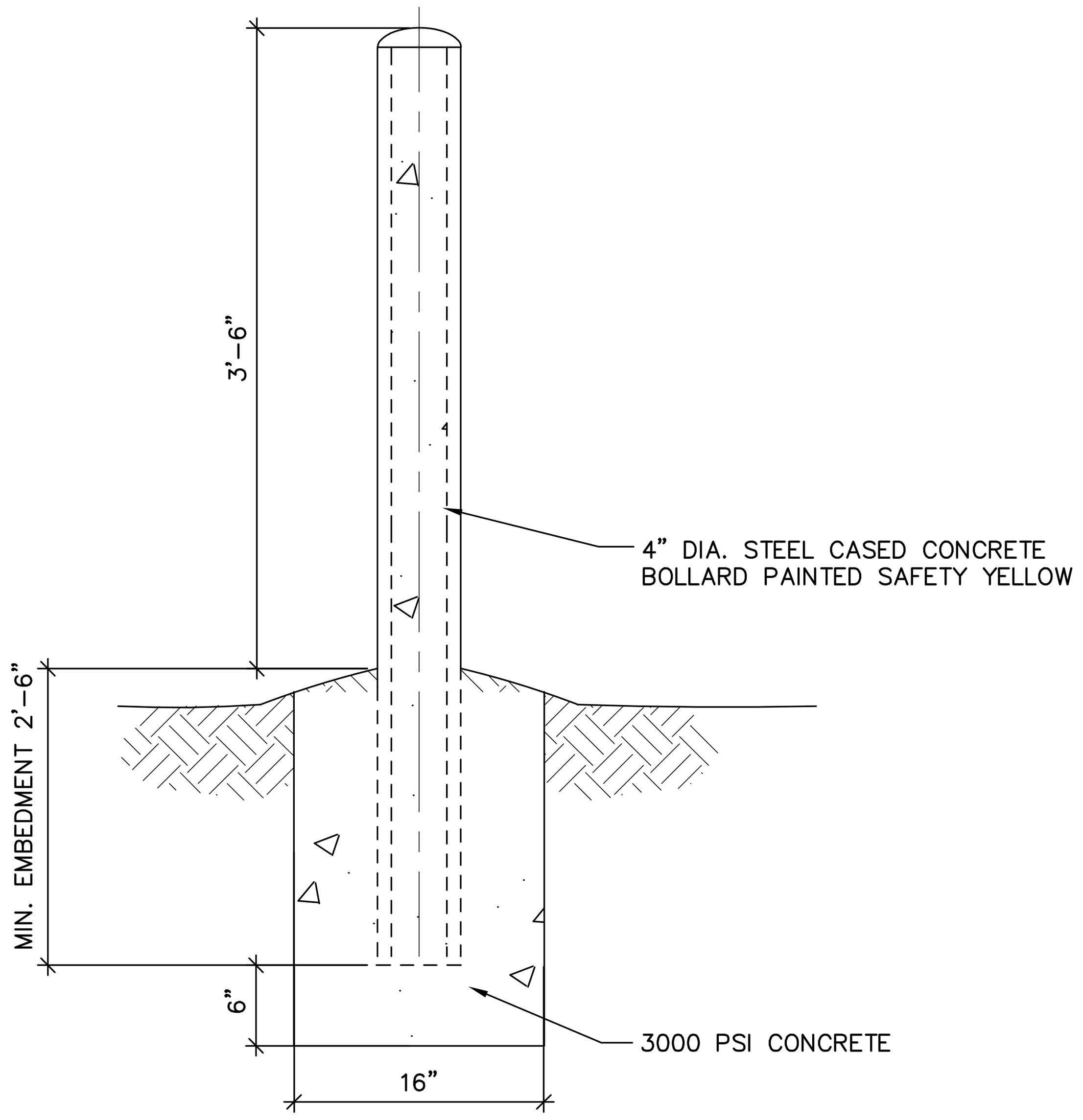
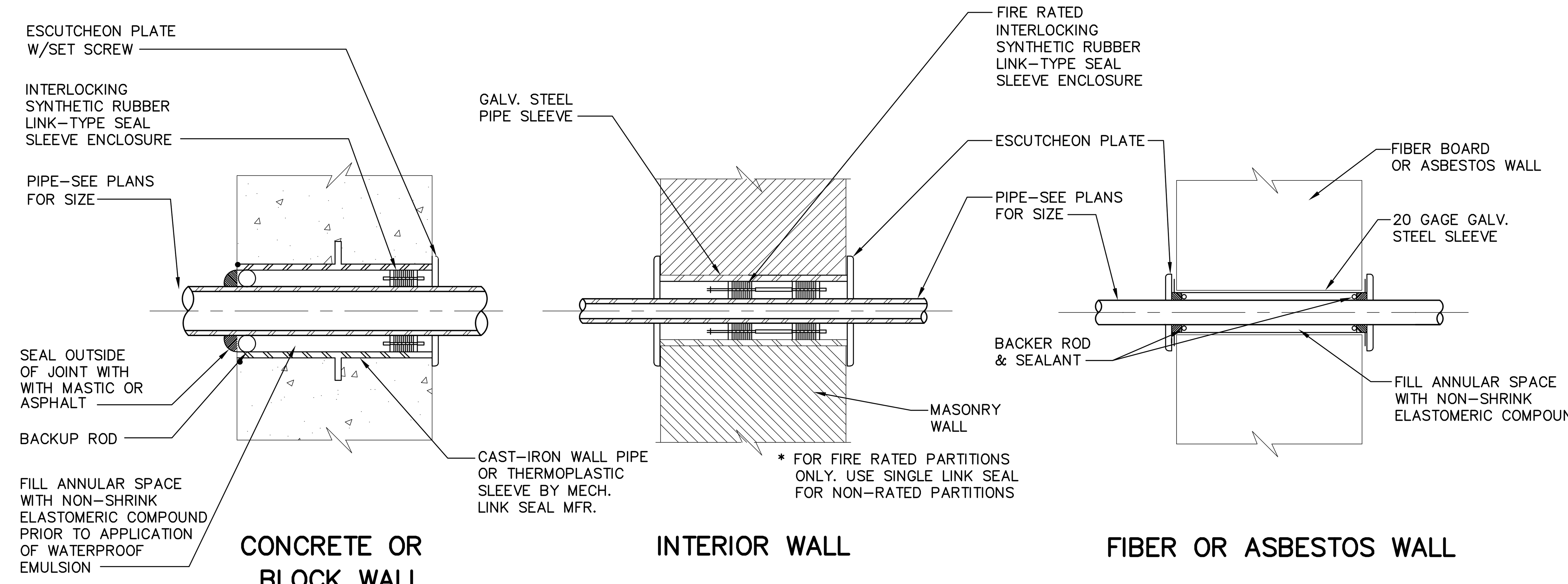
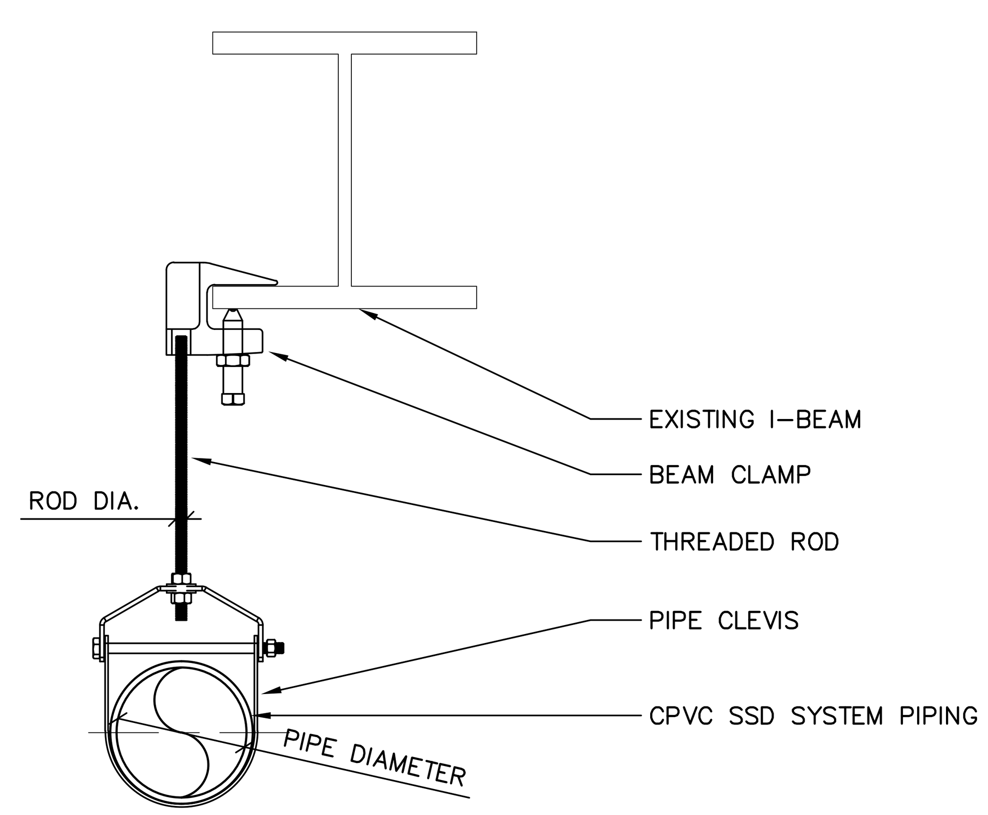


BOLLARD DETAIL
NOT TO SCALE

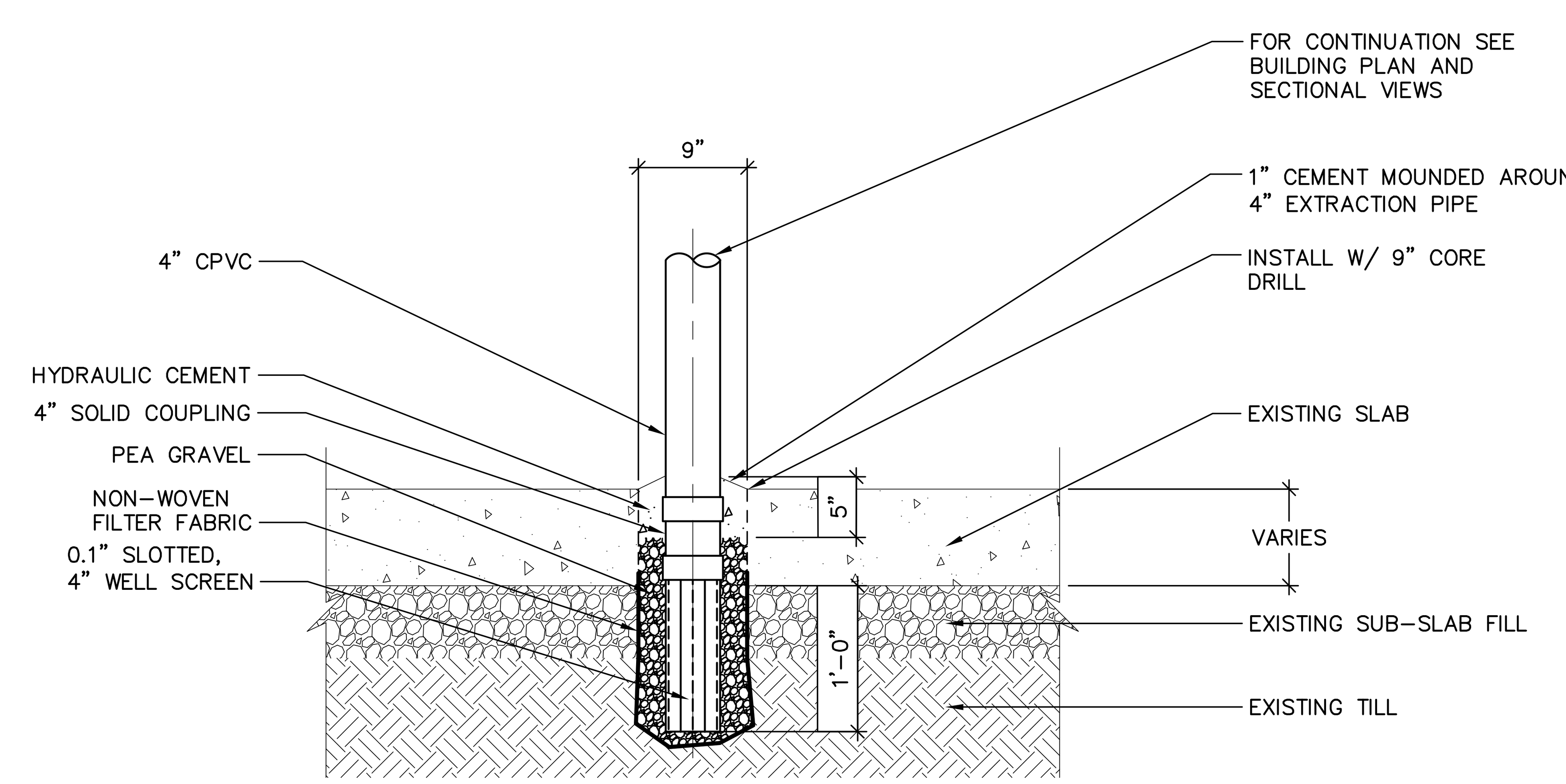


PIPE SLEEVES THRU WALL
NOT TO SCALE

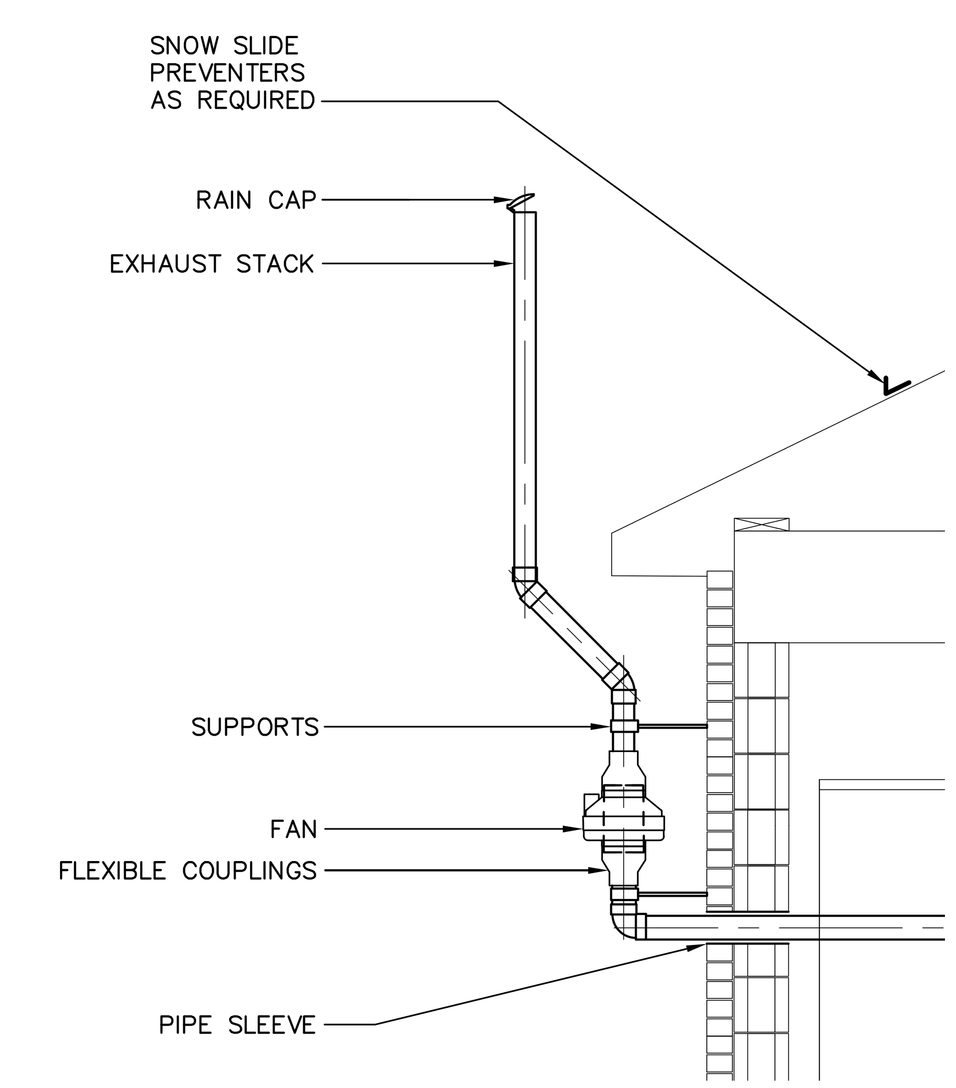


PIPE HANGER DETAIL
NOT TO SCALE

PIPE HANGER SCHEDULE			
PIPE DIAMETER	SPACING	ROD DIA.	CLAMP AND CLEVIS LOAD.
(INCH)	MIN. (FEET)	MIN. (INCH)	MIN. (POUND)
3	8	1/4	150
4	8	1/4	150
6	8	3/8	250
8	8	3/8	250



SUB-SLAB EXTRACTION WELL DETAIL
NOT TO SCALE



SSD SYSTEM – TYPE C DETAIL
NOT TO SCALE

SPECIFICATIONS – TYPE C:

1. TYPE: INLINE RADON MITIGATION FAN
2. PRODUCT: FANTECH MODEL NO. HP 220
3. PERFORMANCE DATA: 58 CFM @ 1.5 IN.WC
4. CONNECTIONS: 6 1/4 IN. OD INLET AND OUTLET
5. ELECTRICAL: 115V, 85 –152 WATTS

US Army Corps of Engineers®
BALTIMORE DISTRICT

MARK	DESCRIPTION	DATE	APPR

DATE:

60% SUBMISSION

DESIGNED BY: MRJ | DATE: APRIL 2009 | APPROVED BY: | DATE:
DRAWN BY: FAL | DATE: APRIL 2009 | FILE NAME: 2118136M015
REVIEWED BY: | DATE:

U.S. ARMY ENGINEER DIVISION
CORPS OF ENGINEERS
BALTIMORE DISTRICT
BALTIMORE, MARYLAND

MALCOLM PIRNIE
MALCOLM PIRNIE, INC.
43 BRITISH AMERICAN BOULEVARD
LATHAM, NEW YORK 12110
24GA27971200

WATERVLIET ARSENAL
VAPOR INTRUSION MITIGATION

MECHANICAL DETAILS

M-15

SHEET 15 OF 15

XREFS: I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\XREF\2118136-TB.dwg IMAGES: None
User: Hausmann Spec: PIRNIE STANDARD File: I:\ACAD\PROJ\2118136\Contract Drawings\60% SUBMISSION\MECH\2118136M015.DWG Scale: 1:1 Date: 04/20/2009 Time: 08:09 Layout: M15