JACOBS®

Former Hampshire Chemical Corp. Facility
Waterloo, New York
Site No. 850001A

2019 Subslab Depressurization System Pilot Test Construction Completion Report

April 2020

Hampshire Chemical Corp.

Contents

Acronyms and Abbreviations

bgs	below ground surface
CCR	construction completion report
cfm	cubic feet per minute
CH2M	CH2M HILL Engineers Inc.
DFA	detonation flame arrestor
Evans	Evans Chemetics
HCC	Hampshire Chemical Corp.
Jacobs	Jacobs Engineering Group Inc
LEL	lower explosive limit
MSA	Mine Safety Appliances
NYSDEC	New York State Department of Environmental Conservation
PPE	personal protective equipment
psig	pounds per square inch gauge
PSSR	pre-startup safety review
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RTD	resistance temperature detectors
Site	former Hampshire Chemical Corp., Waterloo, New York
SSDS	Subslab depressurization system
VFD	variable-frequency drive
w.c.	water column

1. Introduction

Jacobs Engineering Group Inc (Jacobs) has prepared this construction completion report (CCR) for the subslab depressurization system (SSDS) pilot test implemented within Building 4 at the former Hampshire Chemical Corp. (HCC), Waterloo, New York facility (site). **Figure 1** presents the location of the SSDS pilot test at the site.

1.1 Site Setting and Background

The site is located at 228 East Main Street in the village of Waterloo, Seneca County, New York. Evans Chemetics (Evans) operates a specialty sulfur compound manufacturing facility at the site. The property contains several interconnected buildings that house chemical manufacturing facilities, offices, a quality control laboratory, maintenance, and shipping/receiving operations, as well as an industrial wastewater treatment plant. The site also includes outside drum storage areas and several tank farms.

The site is regulated under the Resource Conservation and Recovery Act (RCRA) with the New York State Department of Environmental Conservation (NYSDEC) as the lead agency regarding environmental releases. RCRA facility investigation efforts have been performed at the site since 1993 to evaluate the nature and extent of releases. Vapor sampling completed in 2016 and 2017 by CH2M HILL Engineers Inc. (CH2M – a wholly owned subsidiary of Jacobs Engineering Group) revealed that methane and hydrogen sulfide are being generated in the subsurface. CH2M concluded that a strongly anaerobic zone present under Building 4 is acting as the source of the hydrogen sulfide and methane. CH2M recommended that both institutional and engineering controls be evaluated to reduce the risks associated with high concentrations of hazardous vapors beneath Building 4. In addition, CH2M completed an evaluation of alternatives for long-term mitigation/remediation of the hydrogen sulfide and methane. The alternative selected is implementation of SSDS beneath the Building 4 slab coupled with vapor treatment.

1.2 Pilot Test Objectives

The design objective of the SSDS pilot test is to demonstrate that a sustained negative pressure (vacuum) differential of at least 1 pascal (0.004 inches water column [w.c.]) when measured under cold weather conditions, or 2.5 pascal (0.01 inches w.c.) when measured under warm weather conditions, can be maintained at existing subslab vapor sampling probes within the radius of vacuum influence induced at vapor extraction nodes (EX wells). Reversing the pressure differential across the slab and capturing the vapors will reduce the potential for hazardous subslab vapor migration into indoor air at Building 4. Captured vapors will be treated using an existing scrubber system before discharge to the atmosphere.

1.3 Report Organization

This CCR contains the following sections:

- Section 1 – Introduction
- Section 2 – SSDS Construction
- Section 3 – SSDS Commissioning and Performance Testing

Supporting tables and figures are included at the end of the above-referenced sections. Appendixes are included at the end this document.

2. SSDS Construction

This section presents a summary of the SSDS components installed by Jacobs as part of the pilot test construction activities. The SSDS pilot system is located within Building 4 and comprised of two extraction (EX) wells, subslab soil vapor sampling probes, resistance temperature detectors (RTDs) installed in thermowells, newly installed conveyance piping, instrumentation, system controls, and a vacuum blower. The EX wells and subslab vapor sampling probes were previously installed by Jacobs and not part of SSDS pilot test construction activities; therefore, installation of these components is not covered in this CCR. The process vapor stream is conveyed to and treated by Evans' existing S-6 scrubber system.For the following sections please refer to the construction drawings presented in Appendix A and the Construction photos presented in Appendix B.

2.1 Process Summary

Subslab vapors are extracted from the EX wells (EX-2 and EX-3) installed through the concrete floor of Building 4 (Appendix A, M-101). The EX wells and isolation valves were previously installed by Jacobs and are constructed of 3-inch-diameter Schedule 80 polyvinyl chloride (PVC) materials. The process vapors are conveyed through individual well legs constructed of 3-inch-diameter Type 316 stainless steel pipe. The well legs are each equipped with instruments, sample ports, and valves for process monitoring and control purposes. The well legs combine into a common 3-inch-diameter stainless steel header. The header is equipped with sample ports, an automated block valve (XV-101) with a pneumatic (spring-return) actuator, and a manual isolation valve. The furthest upstream portion of the header pipe is also equipped with a check valve and isolation valve. These upstream valves are used to purge the header pipe of process vapors with ambient air following test completion or a lower explosive limit (LEL) alarm condition.

The 3-inch-diameter header pipe tees into a 10-inch-diameter Type 316 stainless steel dilution air pipe. The section of 10-inch metal pipe downstream of this tie point (hereafter referred to as the mixing plenum) is designed to reduce the LEL of the methane and the toxicity of hydrogen sulfide. Dilution air is introduced into the plenum under vacuum upstream of the tie point through an inlet duct. The duct is equipped with back draft and manual balancing dampers. The downstream mixing plenum is equipped with instruments and two manual isolation valves. One of the isolation valves is used to isolate an existing Evans process line from the scrubber, and the other isolation valve is used to isolate the mixing plenum from the scrubber. This arrangement allows for the scrubber to be operated using the pilot test process vapor, Evans process vapor, or both process vapor feeds.

Prior to being discharged to atmosphere, the diluted process vapor stream will be treated using Evans' existing S-6 scrubber. The process vapors are conveyed through piping and scrubber under an induced vacuum using an explosion-proof blower installed on the roof of Building 4A.

2.2 Conveyance Piping

Between August and October 2019, dedicated conveyance piping was fabricated and installed between the EX well isolation valves (BFV-2-1 and BFV-3-1) and the connection at Evans' S-6 scrubber by C&S Companies of Syracuse, NY. All conveyance piping was installed overhead using new pipe hangers and support brackets mounted to existing facility structures. The following is a summary of the conveyance piping:

- Well Legs
  - 3-inch-diameter Type 316 stainless steel
    - NOTE – Approximately 3 feet of the pipe on each well leg was reduced to 1.5-inch diameter to accommodate the in-line flow meters
  - Pressure instrumentation
  - Flow instrumentation
  - Temperature and humidity instrumentation

  - Type 316 stainless steel detonation flame arrestor (DFA)
  - Sample port
  - Isolation valve
- Header Pipe
  - 3-inch-diameter Type 316 stainless steel
  - Manual isolation valves
  - Pneumatically actuated valve
  - Check valve
  - Sample port
- Mixing Plenum
  - 10-inch-diameter Type 316 stainless steel
  - 20-inch square sheet metal duct with backdraft and balancing dampers
  - Pressure instrumentation
  - Flow instrumentation
  - Methane LEL analyzer
  - Hydrogen sulfide toxicity analyzer
  - Sample port
  - Isolation valves

Stainless steel piping installed on the well legs and header pipe was pickled and passivated by the manufacturer. During the welding process, the pickling along the weld joint gets removed. For the purpose of the pilot test, Jacobs did not require the subcontractor to field pickle and passivate the welded joints. Stainless steel piping installed on the mixing plenum was not pickled and passivated.

On October 21, 2019, the conveyance piping was pressure tested by applying 25 pounds per square inch gauge (psig) of air and holding for approximately 55 minutes. The conveyance piping passed the leak test, and the results were communicated to Evans, which subsequently endorsed the results.

Following installation, labels and directional arrows were affixed to the SSDS conveyance piping to communicate the contents and flow direction of the process vapor. These labels were not added to existing Evans process vapor piping that ties into the SSDS conveyance piping at the scrubber inlet.

2.3 Instrument Tubing

Dedicated instrument tubing was installed by C&S Companies in September and October 2019. The following is a summary of tubing installed:

- 0.25-inch-diameter Type 316 stainless steel connecting the LEL and toxicity analyzer inlet to the mixing plenum
- 0.375-inch-diameter Type 316 stainless steel connecting the LEL and toxicity analyzer aspirator pump to the facility air supply
- 0.375-inch-diameter Type 316 stainless steel connecting the LEL and toxicity analyzer outlet to the mixing plenum
- 0.125-inch-diameter Type 316 stainless steel routed between the site laboratory and header pipe
  - Installation of the tubing connections inside the site laboratory was complete by Jacobs as part of the field gas chromatograph setup.

The tubing was flow tested by C&S Companies to confirm that it had not been kinked or blocked during installation. Jacobs vacuum tested the 0.125-inch-diameter tubing using ambient air after setup of the gas chromatograph. A loss of vacuum was observed during the test, and Jacobs tightened the tubing fittings installed by the subcontractor until a vacuum loss was not observed.

2.4 Instrumentation and Controls

In October 2019, C&S Companies installed the pressure, flow, temperature, and humidity instruments on the extraction well legs and the pressure, flow, and gas analyzers on the mixing plenum. The LEL and toxicity analyzers are housed in a stainless-steel cabinet located on the south exterior side of Building 4. The analyzer assembly and cabinet were provided by Mine Safety Appliances (MSA) as package equipment. The cabinet was mounted on brackets anchored to the building. A protective barricade was fabricated and installed in front of the analyzer cabinet to protect the instruments from fork truck traffic.

Evans completed the electrical installation of the powered flow, temperature, and humidity instruments and gas analyzers. Evans also completed the wiring interface between the gas analyzers and pneumatically actuated isolation valve (XV-101). An alarm condition sourced from the gas analyzers results in closure of XV-101. All instruments are read locally and not connected to a central control panel. The instruments are not configured to transmit alarms or control the blower as part of pilot operations.

Manufacturer field technicians from Endress + Hauser and MSA tested, configured, and calibrated the flow meters and gas analyzers, respectively.

2.5 Resistance Temperature Detectors

In October 2019, Jacobs installed 10 RTD thermowells through the concrete pad into subsurface soil. After the epoxy seal between the thermowell and concrete had cured, the RTD probes were inserted into the thermowell. Seven of the RTDs are shallow (approximately 19.5 inches below ground surface [bgs]), and three of the RTDs are deep (approximately 42 inches bgs). The design had planned for a total of 10 shallow and 10 deep RTDs; however, unforeseen site conditions including excessive concrete thickness and subsurface refusal of the drill limited the number actually installed. Thermowell installation was conducted in Level B personal protective equipment (PPE) when C&S Companies was not onsite. At Jacobs' direction, Evans installed one of the spare RTDs on the south wall of Building 4 to measure ambient air temperature.

Jacobs purchased a multi-channel portable datalogger (Fluke 2638A Hydra Series III) for installation in anon-electrically classified area of Building 3, which is located adjacent to Building 4. Evans fabricated a cabinet to house the datalogger and protect it from damage and dust accumulation. Evans routed the wire between the RTDs and datalogger, landed the wire connections, and configured the datalogger. Jacobs verified that the alarm setpoints were correctly programmed and that the instruments appeared to be functioning properly.

Datalogger alarms are transmitted to an autodialer purchased by Jacobs and installed by Evans in Building 3. The autodialer is programmed by Jacobs to transmit alarm notifications to select Jacobs and Evans staff.

2.6 Vacuum Blower

A new explosion-proof blower was installed by Evans on the roof of Building 4A (Aerovent Model HPBF), downstream of the scrubber. The blower can produce 1,000 cubic feet per minute (cfm) flow at 23.7 inches w.c. vacuum. The blower is equipped with a variable-speed drive that is manually adjusted as part of the pilot test to achieve target flow setpoints. Process vapor is discharged from the blower through a stack to atmosphere.

Photographs which document construction are presented as Appendix B.

3. SSDS Commissioning and Performance Testing

Field commissioning of the SSDS occurred following completion of construction activities and the pre-startup safety review (PSSR). Because the scrubber is an existing piece of equipment operated by Evans, formal commissioning of the scrubber equipment was not completed. However, Jacobs met with Evans to discuss the pilot test schedule and establish roles, responsibilities, and communications associated with scrubber operations. Evans cleaned and rebuilt portions of the scrubber prior to pilot test operations and was responsible for scrubber operations during the pilot test.

3.1 Pre-Startup Safety Review

The PSSR was held on November 20, 2019, and attended by representatives from Jacobs and Evans. No significant design, construction, or safety issues were identified during the PSSR. Items that had been identified and required completion prior to the pilot test included:

- Program alarm setpoints in the LEL analyzer;
- Verify LEL alarm condition results in closure of XV-101;
- Evaluate why the flow meter on the mixing plenum (FIT-101-1) is not reading correctly;
- Install caution tape on low overhead obsticles (i.e. “head knockers”);
- Install grating over sump located adjacent to datalogger;
- Seal RTD conduits; and
- Purchase and install red locks on the EX well isolation valves.

These items were reconciled by Jacobs and Evans prior to the pilot testing. The PSSR form is presented as Appendix C.

3.2 “Dry” Commissioning

During the “dry” phase of field commissioning, Jacobs personnel and subcontractors conducted the following:

1) MSA field technician calibrated the gas analyzers and tested the inputs and outputs between the LEL analyzer and XV-101, and alarm functionality for both gas analyzers.
2) Endress + Hauser field technician configured and tested the flow meters.
3) Evans tested the blower rotation.

All of these activities were completed with the dilution air damper open and EX isolation valves closed. With exception to testing blower rotation, the above activities were completed with the blower offline.

3.3 “Wet” Commissioning

Following completion of dry commissioning activities, ambient air was introduced to the SSDS. During this “wet” commissioning period, the dilution air damper was open and EX isolation valves were closed. Air Systems Balancing and Test Services, Inc. of Rochester, New York worked with Jacobs to test and balance the blower and variable-frequency drive (VFD).

The VFD and dilution air intake damper were adjusted to determine the vacuum applied to the EX wells based on the damper position and VFD setpoint. A corresponding flow could not be reasonably determined because it was discovered, during “wet commissioning,” that the EX well legs were not fabricated with a 3-inch-diameter access. Therefore, the ¾-inch pipe to which the pressure gauges were connected had to be used to introduce ambient air to the well legs. The head loss through the smaller-diameter piping limited the maximum flow that could be measured at a given damper position and VFD setpoint.

Although a flow rate could not be confirmed at a given damper position and VFD setpoint, Jacobs recognized, based on the manufacturer data and system design, that the blower was capable of achieving higher flows than observed during “wet” commissioning.

During “wet commissioning”, Jacobs confirmed that the other instrumentation on the well legs and header pipe were functioning correctly.

Conclusion

The SSSDS construction project was completed in general accordance with the final design drawings, including the exceptions discussed herein. The record drawings presented in Appendix A incorporate any Jacobs-approved changes that occurred during construction and are the complete record for the construction project. Construction activities complied with federal, state, and local regulations; protected human health and the environment; and provided the client with usable product that meets the project objectives.

This SSDS system will be maintained using a regimen of inspections and necessary maintenance measures per the pending Former HCC Site Management Plan currently being developed by Jacobs.

Figure

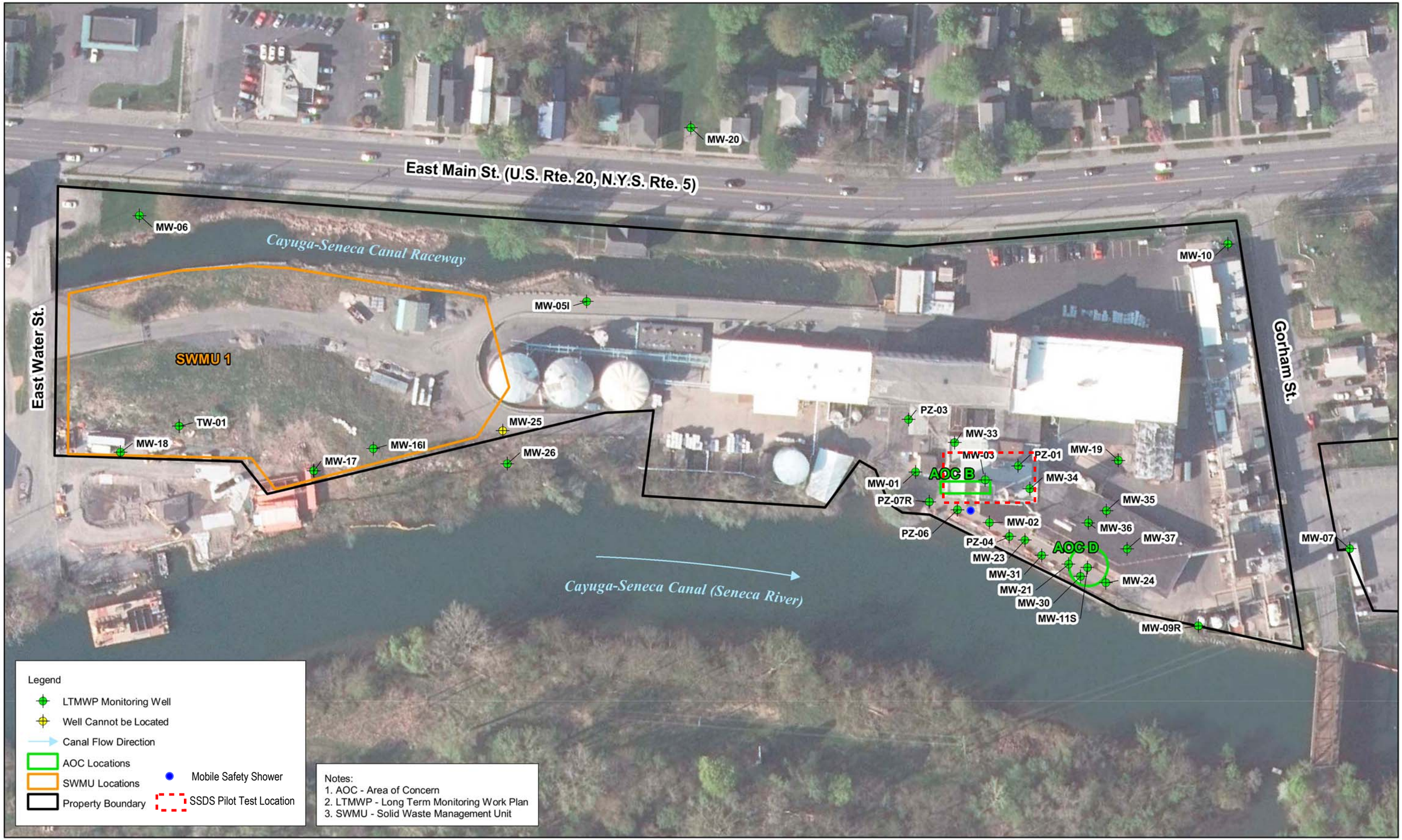

Figure 1
Site Layout Map
2019 SSDS Pilot Test
Hampshire Chemical Corp. Facility
Waterloo, New York

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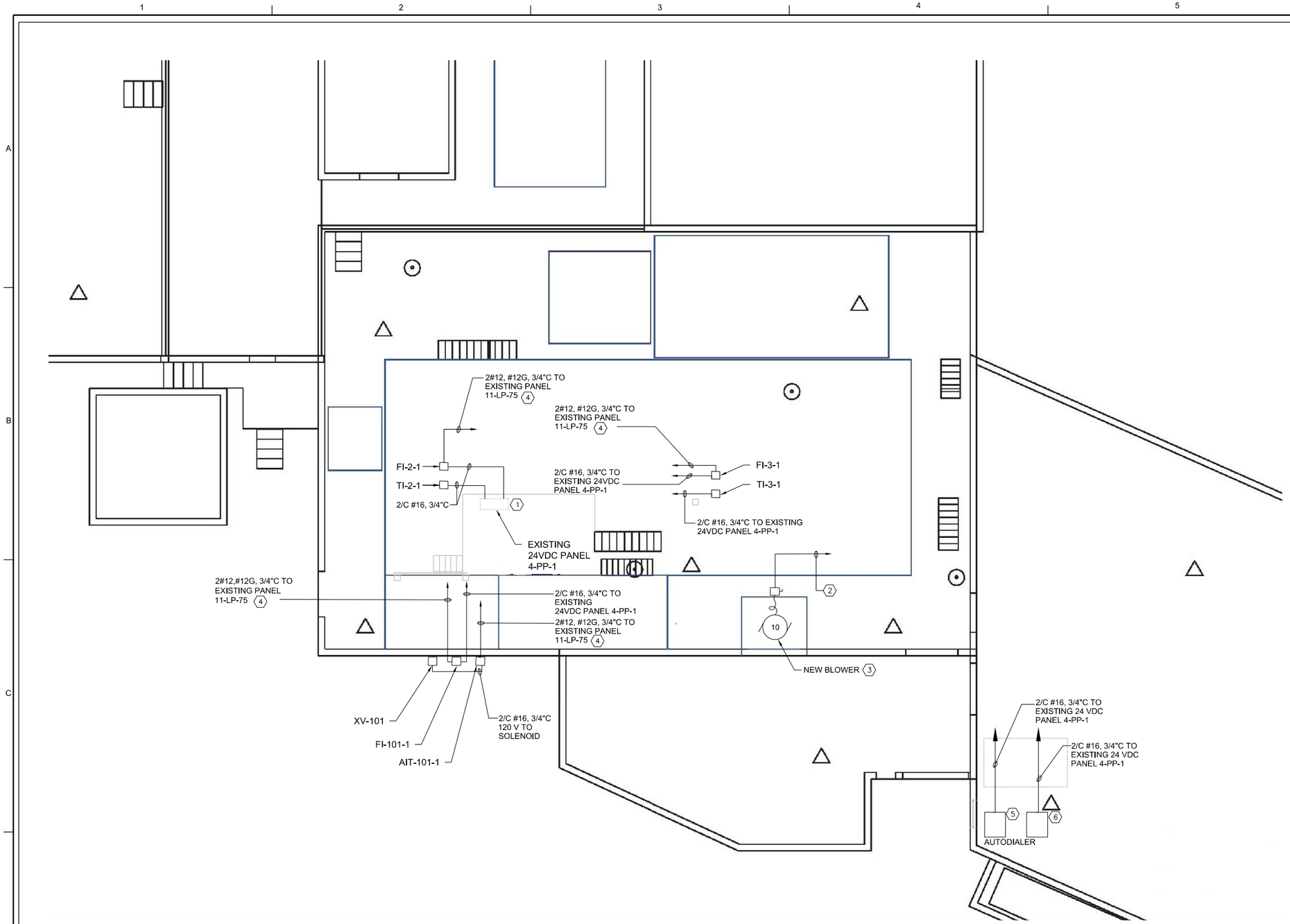
Appendix A
Drawings



FLOOR PLAN - GROUND LEVEL - POWER PLAN

1/8"=1'-0"

GENERAL SHEET NOTES

A. ELECTRICAL INSTALLATIONS INSIDE THE BUILDING SHALL COMPLY WITH CLASS I, DIVISION 2 REQUIREMENTS. AREAS OUTSIDE THE BUILDING ARE GENERAL PURPOSE.

B. ELECTRICAL CONDUIT "HOMERUNS" ARE DIAGRAMMATIC IN NATURE. EXACT CONDUIT ROUTING TO BE COORDINATED IN THE FIELD.

C. REFER TO MECHANICAL DRAWING FOR EXACT LOCATION OF INSTRUMENTS.

SHEET KEYNOTES

1. TERMINATION POINTS IN EXISTING 24VDC 4-PP-1 PANEL TO BE COORDINATED IN FIELD.
2. BLOWER TO BE CONTROLLED FROM A NEW VFD TO BE INSTALLED IN EXISTING VFD PANEL LOCATED IN BUILDING 11 (LOCATION TO BE DETERMINED IN FIELD). VFD TO BE FURNISHED BY JACOBS (EQUAL TO YASKAWA CIMR-VU-4A-0023-FAA, WITH LCD INTERFACE MODEL JVOP-108) AND INSTALLED BY OWNER. VFD REMOTE LCD INTERFACE TO BE MOUNTED ON THE DOOR OF THE EXISTING VFD PANEL BY OWNER. FEEDER FROM VFD TO BLOWER WILL CONSIST OF 3/C #10 W/ 3-1/C #14G VFD CABLE IN 1" CONDUIT, TO BE FURNISHED BY JACOBS AND INSTALLED BY OWNER. INPUT POWER TO VFD AND CONTROL WIRING TO BE PROVIDED BY OWNER.
3. NEW BLOWER (MOUNTED ON ROOF) AND DISCONNECT SWITCH TO BE FURNISHED BY JACOBS AND INSTALLED BY OWNER.
4. 120VAC TO BE PROVIDED FROM EXISTING PANEL 11-LP-75 VIA EXISTING FIELD JUNCTION BOX "BLDG 4 FJB" (LOCATION TO BE DETERMINED IN FIELD). TERMINATION POINTS INSIDE BLDG 4 FJB TO BE COORDINATED IN FIELD. PROVIDE OVERCURRENT PROTECTION FOR EACH INSTRUMENT PER MANUFACTURERS RECOMMENDATIONS NOT TO EXCEED 20A).
5. PROVIDE 120V OUTLET AS NEEDED TO CONNECT DATALOGGER. OUTLET TO BE FED FROM EXISTING PANEL 11-LP-75 AND SHALL BE SUITABLE FOR THE ELECTRICAL AREA CLASSIFICATION.
6. PROVIDE A JUNCTION BOX OF APPROPRIATE SIZE WITH TERMINALS TO PROVIDE 24VDC LOOP POWER TO RTD'S 400-XX AND 300-XX SERIES (20 RTD'S IN TOTAL). REFER TO P&ID IN DRAWING M-001.

1

LEGEND

- INSTRUMENT LOCATION
- HEAVY DUTY DISCONNECT SWITCH, 30A, 600V, 3-POLE, NON-FUSIBLE, NEMA 3R
- MOTOR
- CONDUIT HOMERUN CONDUCTOR, CONDUIT SIZE AND DESTINATION AS SHOWN
  2/C#16,3/4"C

STATE OF NEW YORK — ROSEBROOK — LICENSED PROFESSIONAL ENGINEER

NO.	DATE	DSGN	DR	CHK	REVISION
1	10/10/19	R. VALENTIN	D. RIOS / S. GRAHAM	L. CAMPSEN	ELECTRICAL AND INSTRUMENTATION UPDATES BASED ON DESIGN CHANGES
0	7/24/19				ISSUED FOR CONSTRUCTION

JCH	RAV	APVD
JK/RV	KR	APVD
BY		E. WEINHOUSE

WATERLOO SSDS PILOT TEST
WATERLOO, NEW YORK
FORMER NEW HAMPSHIRE CHEMICAL CORPORATION

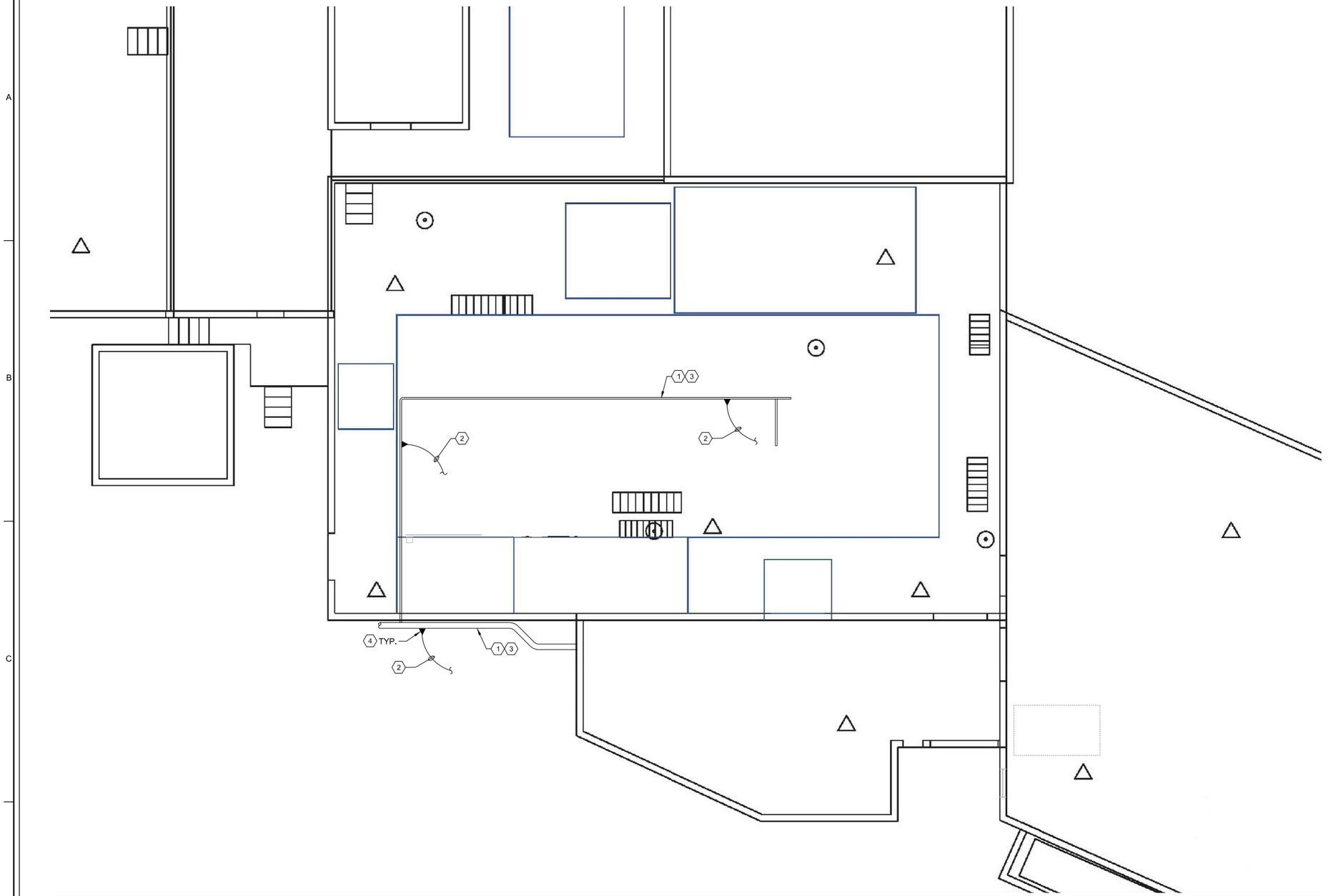
JACOBS

ELECTRICAL
FLOOR PLAN - GROUND LEVEL POWER PLAN

AS CONSTRUCTED

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	AUGUST 2019
PROJ	707538
DWG	E-101
SHEET	1 of 2



GENERAL SHEET NOTES

A. REFER TO MECHANICAL DRAWINGS FOR EXACT PIPING LAYOUT.

B. REFER TO SPECIFICATION 26 05 26 FOR GROUNDING REQUIREMENTS.

SHEET KEYNOTES

1. NEW STAINLESS STEEL PIPING.
2. PROVIDE #2 AWG BARE COPPER GROUNDING CONDUCTOR AND CONNECT TO NEAREST BUILDING STEEL COLUMN BY EXOTHERMIC CONNECTION.
3. PROVIDE #2 BARE COPPER GROUNDING CONDUCTORS WITH LUGS ON EACH END ACROSS ALL FLANGE CONNECTIONS IN NEW STAINESS-STEEL PIPING TO MAINTAIN CONTINUITY. ATTACH TO FLANGE BOLTS
4. PIPING GROUNDING CLAMP CONNECTION. PROVIDE GROUNDING CLAMP OF APPROPRIATE SIZE. COORDINATE SIZE OF PIPING WITH MECHANICAL CONTRACTOR. EXACT LOCATION OF GROUNDING CLAMP TO BE COORDINATED IN THE FIELD.

FLOOR PLAN - GROUND LEVEL - GROUNDING PLAN

1/8"=1'-0"

NO.	DATE	DSGN	DR	CHK	APVD
0	7/24/19	R. VALENTIN	D. RIOS / S. GRAHAM	L. CAMPSEN	E. WEINHOUSE
			REVISION		
			ISSUED FOR CONSTRUCTION	RAV	KR

WATERLOO SSDS PILOT TEST
WATERLOO, NEW YORK
FORMER NEW HAMPSHIRE CHEMICAL CORPORATION

JACOBS

ELECTRICAL

FLOOR PLAN - GROUND LEVEL GROUNDING PLAN

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	AUGUST 2019
PROJ	707538
DWG	E-110
SHEET	2 of 2

AS CONSTRUCTED

INDEX TO DRAWINGS

SHEET NO.	DRAWING NO.	TITLE
GENERAL		
1	G-001	INDEX TO DRAWINGS
PROCESS		
2	M-001	PIPING AND INSTRUMENTATION DIAGRAM
3	M-101	FLOOR PLAN - GROUND LEVEL INTERIOR PIPING
4	M-102	PLAN VIEW EXTERIOR PIPING
5	M-200	WELL LEG DETAILS
6	M-300	ELEVATIONS
7	M-400	SCHEDULES AND SPECIFICATIONS
8	M-500	PHOTO DETAILS
9	M-600	STANDARD DETAILS
10	M-900	ISOMETRIC VIEW

STATE OF NEW YORK
PETER ROSEBROOK
LICENSED PROFESSIONAL ENGINEER

NO.	DATE	DSGN	DR	CHK	APVD	REVISION
1	3/13/20	J MCMURREN	P KARABAN	C JOHNSON	E WEINHOUSE	CONSTRUCTION REDLINE
0	8/13/19	JCH	EBW	KR	PK	ISSUED FOR CONSTRUCTION
				BY	APVD	

WATERLOO SSDS PILOT TEST
WATERLOO, NEW YORK
FORMER NEW HAMPSHIRE
CHEMICAL CORPORATION

JACOBS

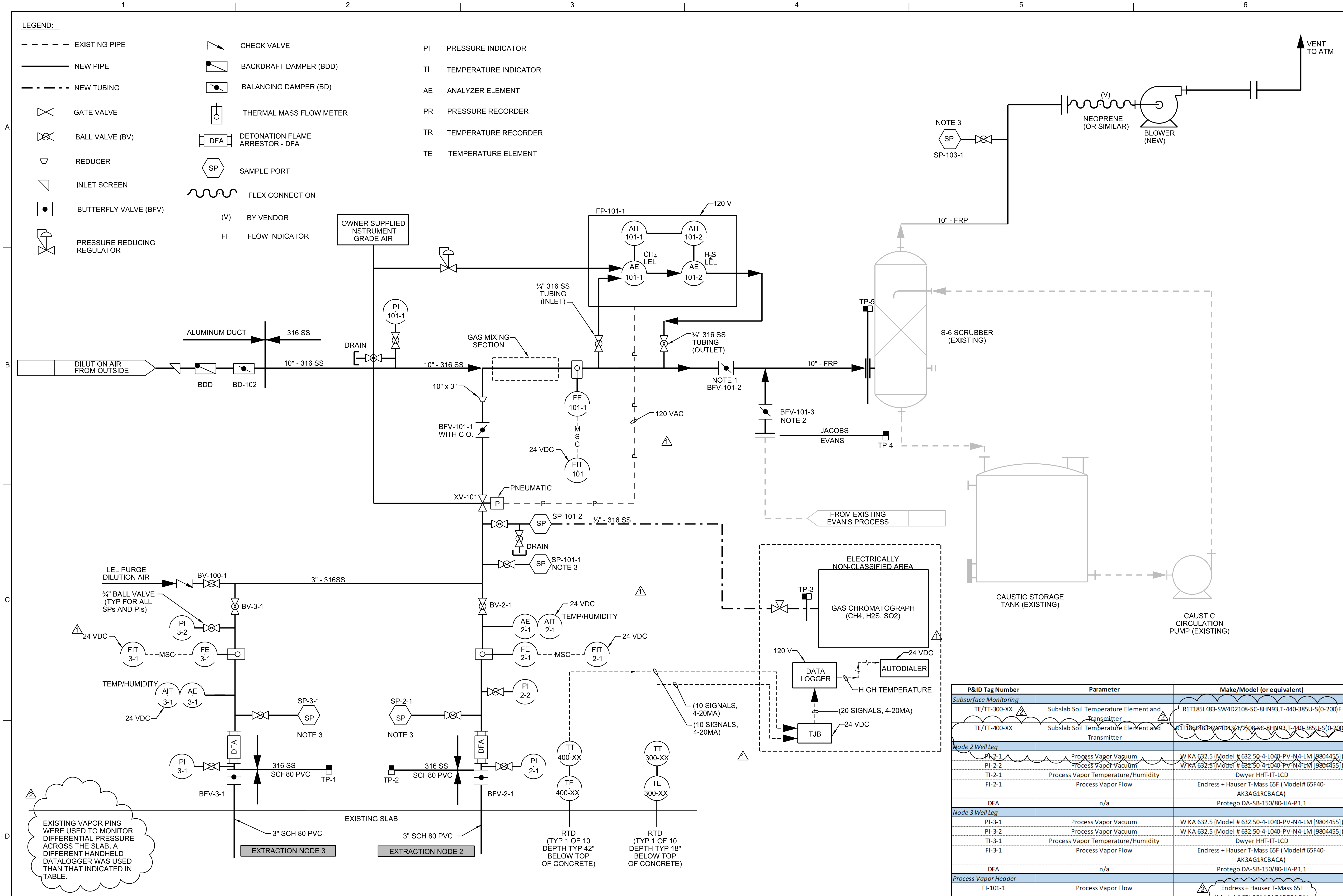
INDEX TO DRAWINGS

AS CONSTRUCTED

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	AUGUST 2019
PROJ	707538
DWG	G-001
SHEET	1 of 10



P&ID Tag Number	Parameter	Make/Model (or equivalent)
Subsurface Monitoring		
TE/TT-300-XX	Subslab Soil Temperature Element and Transmitter	R1T185L483-SW4D2108-SC-8HN93,T-440-385U-S(0-200)F
TE/TT-400-XX	Subslab Soil Temperature Element and Transmitter	R1T185L483-SW4D43(1/2)08-SC-8HN93,T-440-385U-S(0-200)F
Node 2 Well Leg		
PI-2-1	Process Vapor Vacuum	WIKA 632.5 (Model # 632.50-4-L040-PV-N4-LM [9804455])
PI-2-2	Process Vapor Vacuum	WIKA 632.5 (Model # 632.50-4-L040-PV-N4-LM [9804455])
TI-2-1	Process Vapor Temperature/Humidity	Dwyer HHT-IT-LCD
FI-2-1	Process Vapor Flow	Endress + Hauser T-Mass 65F (Model# 65F40-AK3AG1RCBACA)
DFA	n/a	Protego DA-SB-150/80-IIA-P1,1
Node 3 Well Leg		
PI-3-1	Process Vapor Vacuum	WIKA 632.5 (Model # 632.50-4-L040-PV-N4-LM [9804455])
PI-3-2	Process Vapor Vacuum	WIKA 632.5 (Model # 632.50-4-L040-PV-N4-LM [9804455])
TI-3-1	Process Vapor Temperature/Humidity	Dwyer HHT-IT-LCD
FI-3-1	Process Vapor Flow	Endress + Hauser T-Mass 65F (Model# 65F40-AK3AG1RCBACA)
DFA	n/a	Protego DA-SB-150/80-IIA-P1,1
Process Vapor Header		
FI-101-1	Process Vapor Flow	Endress + Hauser T-Mass 65I (Model # 65I-30AA0AD1RCBACA)
AIT/AE-101-1/2	H2S Toxicity CH4 Flammability	MSA Prefabricated Gas Analyzer including X5000-0-F-0-1-0-22-00-0 Sensor (H2S 0-100 ppm) and X5000-0-F-0-1-0-AA-00-0 Sensor (Combustible IR 5% CH4)
Dilution Air Header		
PI-101-1	Dilution Air Vacuum	WIKA 632.5 (Model # 632.50-4-L040-PV-N4-LM [9804455])

NOTES:

1. VALVE OPEN DURING PILOT TEST.
2. VALVE CLOSE DURING PILOT TEST.
3. PROVIDE THREADED PLUG ON ALL SAMPLE VALVES OUTLETS.

NO.	DATE	REVISION	BY	CHK	APVD
2	3/10/20	AS-BUILT DRAWINGS	EBW	KR	
1	10/10/19	ELECTRICAL AND INSTRUMENTATION UPDATES BASED ON DESIGN CHANGES	JCH	JK/RV	
0	8/13/19	ISSUED FOR CONSTRUCTION	EBW	KR	

DSGN J HABERL | DR D BELLARD-BENNETT | CHK C KATZEN | APVD E WEINHOUSE

WATERLOO SSDS PILOT TEST
WATERLOO, NEW YORK
FORMER NEW HAMPSHIRE CHEMICAL CORPORATION

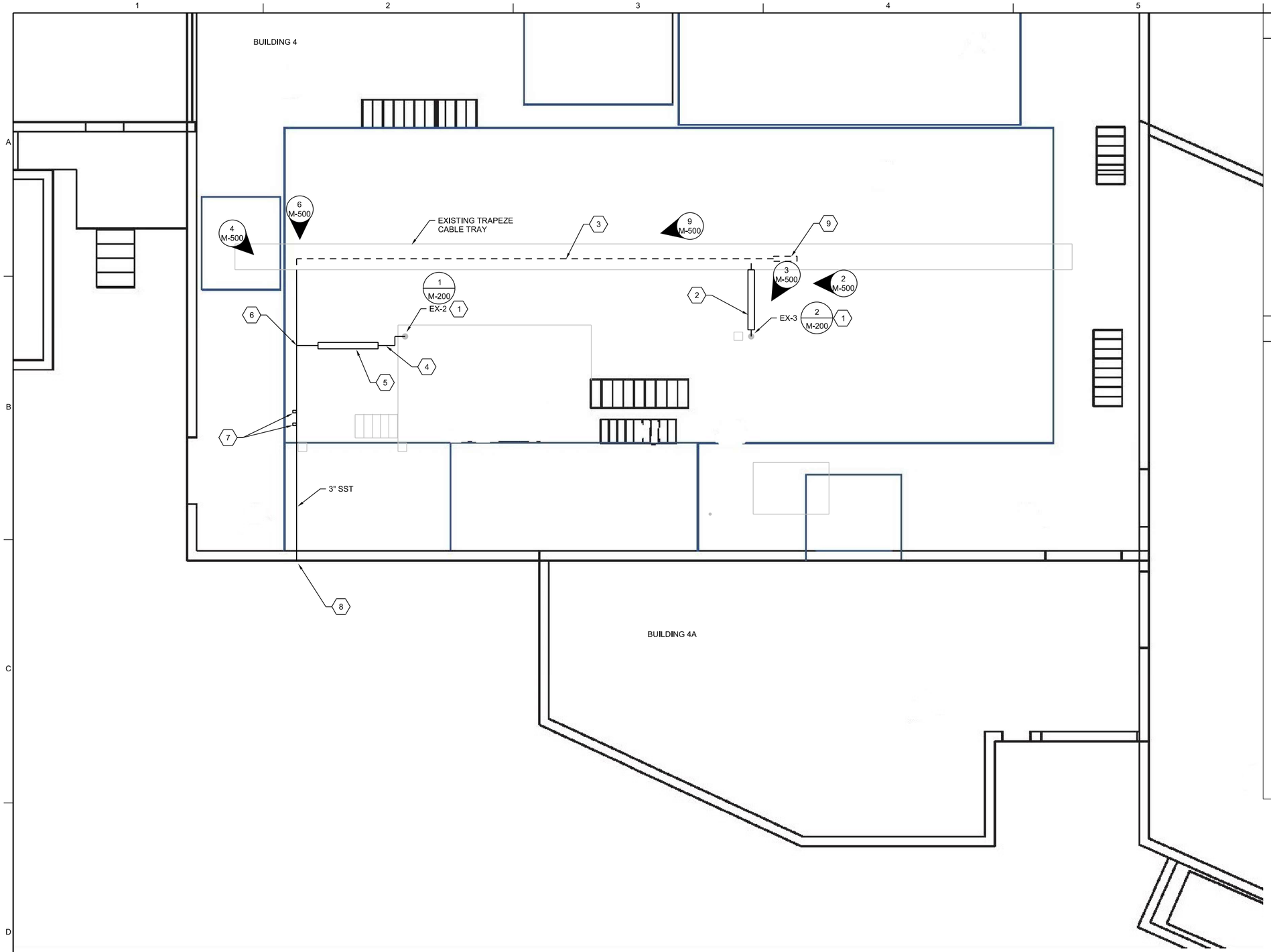
JACOBS

PIPING AND INSTRUMENTATION DIAGRAM

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE AUGUST 2019
PROJ 707538
DWG M-001
SHEET 2 of 10

AS CONSTRUCTED



FLOOR PLAN - GROUND LEVEL - INTERIOR PIPING

3/16"=1'-0"

GENERAL NOTES

1. EXISTING WELL HEADS SHOWN AT APPROXIMATE LOCATIONS IN BUILDING.
2. WELL LEG ARRANGEMENT AND ROUTING WILL VARY DUE TO EXISTING OBSTRUCTIONS. SEE DETAILS DRAWING M-200.
3. COORDINATE ROUTING OF ALL PIPING WITH OWNER, UNLESS OTHERWISE INDICATED AND APPROVED. EXISTING PIPING AND STRUCTURES WILL NOT BE INTERRUPTED UNDER THIS PROJECT.
4. PROVIDE SUPPORTS FOR ALL PIPING AND VALVES, COORDINATE SELECTION AND INSTALLATION WITH EXISTING CONDITIONS. SEE DETAIL 4005-557 AND 4005-558.
5. REFER TO M-300 FOR PIPING SCHEDULE.
6. INSTALL HORIZONTAL PIPING WITH 1/8 INCH PER FOOT SLOPE TO LOW POINT DRAINS. COORDINATE LOCATIONS OF LOW POINT DRAINS WITH JACOB'S.

SHEET KEYNOTES

1. CONNECT NEW 316 SST PIPING TO EXISTING PVC FLANGE, SEE PHOTO 5/M-500.
2. PRESSURE INDICATOR AND BV-3-1 IN HORIZONTAL. COORDINATE WITH EXISTING SUPPORTS AND OBSTRUCTIONS.
3. SUSPEND 3" SST EX-3 BRANCH PIPING FROM EXISTING TRAPEZE CABLE TRAY. COORDINATE SUPPORTS WITH CONDUIT AND OTHER OBSTRUCTIONS. SEE DETAIL 4005-559/M-600.
4. TRANSITION TO HORIZONTAL AS REQUIRED TO ROUTE 3" SST AROUND STAIR STRUCTURE. ROUTE PIPE TO MEZZANINE COLUMN LINE FOR SUPPORT OF ADDITIONAL COMPONENTS.
5. PRESSURE INDICATOR, FLOW ELEMENT, TEMPERATURE/HUMIDITY SENSOR, AND BV-2-1 IN HORIZONTAL. PROVIDE UNISTRUT SUPPORT FROM MEZZANINE AND COLUMNS, COORDINATE WITH EXISTING SUPPORTS AND OBSTRUCTIONS. CHEMICAL TOTE AND SAMPLE SHELF TO BE REMOVED BY OWNERS.
6. 3" SST FROM EX-2 RISE AT COLUMN AND CONNECT TO 3" SST FROM EX-3. COORDINATE ROUTING AND CONNECTION LOCATION WITH FIELD CONDITIONS, SEE PHOTOS 4 AND 6/M-500.
7. SAMPLE PORTS SP-101-1 AND SP-101-2 IN 3" SST NEAR MEZZANINE. SEE M-200 FOR TYPICAL ASSEMBLY DETAIL. COORDINATE EXACT LOCATIONS WITH OWNER.
8. 3" SST WELL HEADER, REFER TO M-102 FOR CONTINUATION OUTSIDE BUILDING AND ADDITIONAL REQUIREMENTS.
9. PURGE AIR INTAKE ASSEMBLY, STAINLESS CHECK VALVE AND ISOLATION BALL VALVE BV-101-1.

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FLOOR PLAN - GROUND LEVEL
INTERIOR PIPING

AS CONSTRUCTED

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

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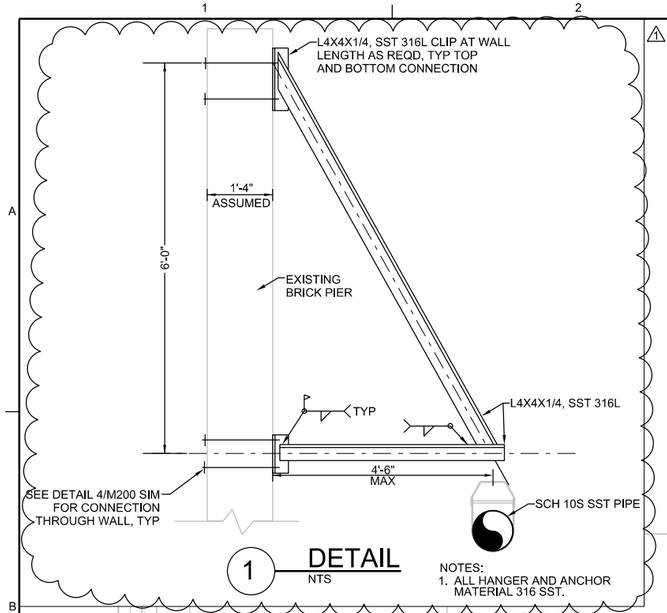
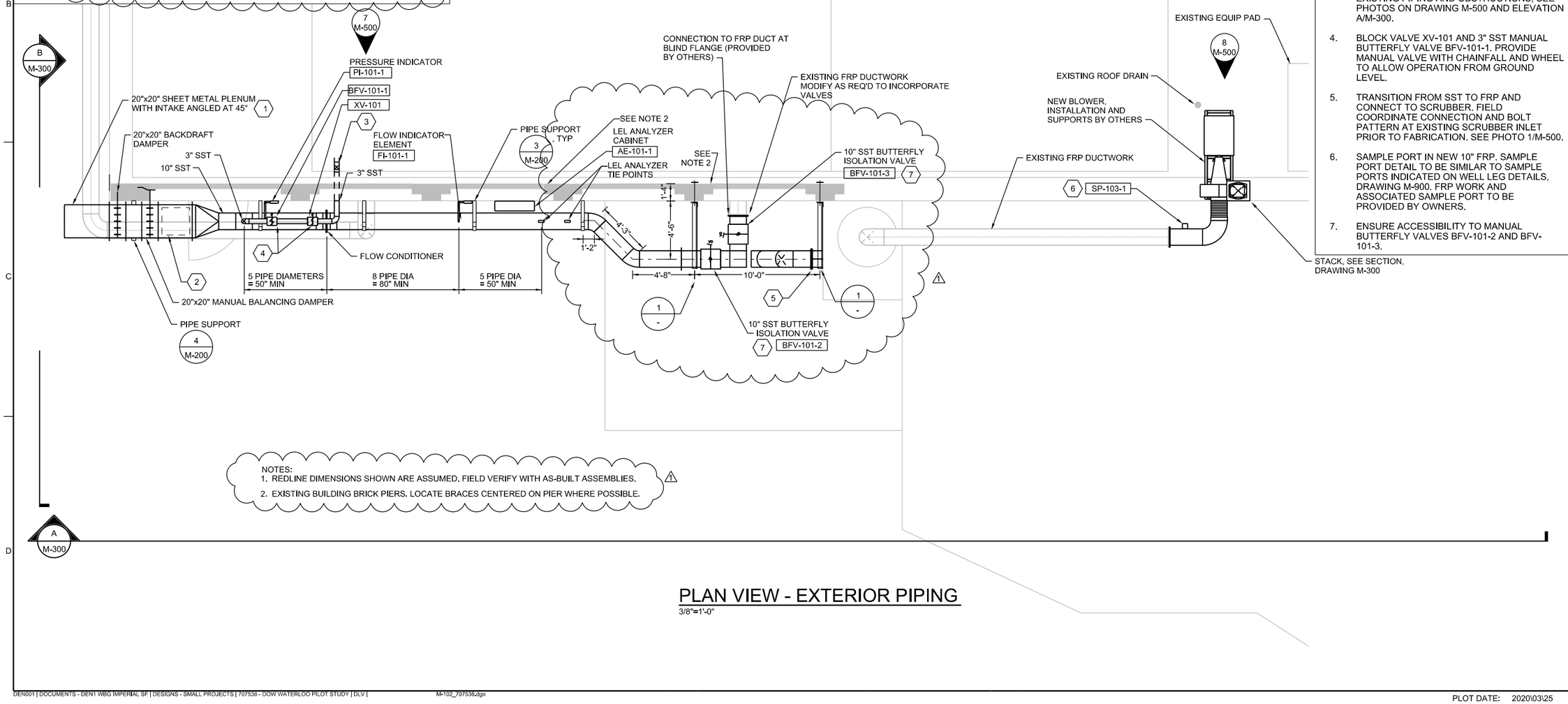
DWG	M-101
SHEET	3 of 10



1 DETAIL
NTS

NOTES:
1. ALL HANGER AND ANCHOR MATERIAL 316 SST.



NOTES:
1. REDLINE DIMENSIONS SHOWN ARE ASSUMED. FIELD VERIFY WITH AS-BUILT ASSEMBLIES.
2. EXISTING BUILDING BRICK PIERS. LOCATE BRACES CENTERED ON PIER WHERE POSSIBLE.

PLAN VIEW - EXTERIOR PIPING
3/8"=1'-0"

GENERAL NOTES

1. PROVIDE FLANGED CONNECTIONS IN THE EXISTING FRP DUCT, AS REQ'D TO CONNECT NEW SST DUCTS.
2. COORDINATE TIE-INS TO EXISTING FRP DUCT WITH FIELD CONDITIONS, LOCATIONS INDICATED ARE APPROXIMATE.
3. REFER TO DRAWING M-400 FOR PIPING AND DUCTWORK, AND EXHAUST FAN SCHEDULES.
4. PROVIDE SUPPORTS FOR ALL PIPING AND VALVES, COORDINATE SELECTION AND INSTALLATION WITH EXISTING CONDITIONS.
5. INSTALL HORIZONTAL PIPING WITH 1/8 INCH PER FOOT SLOPE TO LOW POINT DRAINS. COORDINATE LOCATIONS OF LOW POINT DRAINS WITH JACOB'S.

SHEET KEYNOTES

1. PROVIDE 1/2" MESH OVER INTAKE.
2. DUCT RELIEF DOOR, SET @ -10" WC.
3. 3" SST WELL HEADER, REFER TO M-101 FOR CONTINUATION INSIDE BUILDING. COORDINATE PENETRATION LOCATION WITH EXISTING PIPING AND OBSTRUCTIONS, SEE PHOTOS ON DRAWING M-500 AND ELEVATION A/M-300.
4. BLOCK VALVE XV-101 AND 3" SST MANUAL BUTTERFLY VALVE BFV-101-1. PROVIDE MANUAL VALVE WITH CHAINFALL AND WHEEL TO ALLOW OPERATION FROM GROUND LEVEL.
5. TRANSITION FROM SST TO FRP AND CONNECT TO SCRUBBER. FIELD COORDINATE CONNECTION AND BOLT PATTERN AT EXISTING SCRUBBER INLET PRIOR TO FABRICATION. SEE PHOTO 1/M-500.
6. SAMPLE PORT IN NEW 10" FRP. SAMPLE PORT DETAIL TO BE SIMILAR TO SAMPLE PORTS INDICATED ON WELL LEG DETAILS, DRAWING M-900. FRP WORK AND ASSOCIATED SAMPLE PORT TO BE PROVIDED BY OWNERS.
7. ENSURE ACCESSIBILITY TO MANUAL BUTTERFLY VALVES BFV-101-2 AND BFV-101-3.

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PLAN VIEW
EXTERIOR PIPING

AS CONSTRUCTED

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	AUGUST 2019
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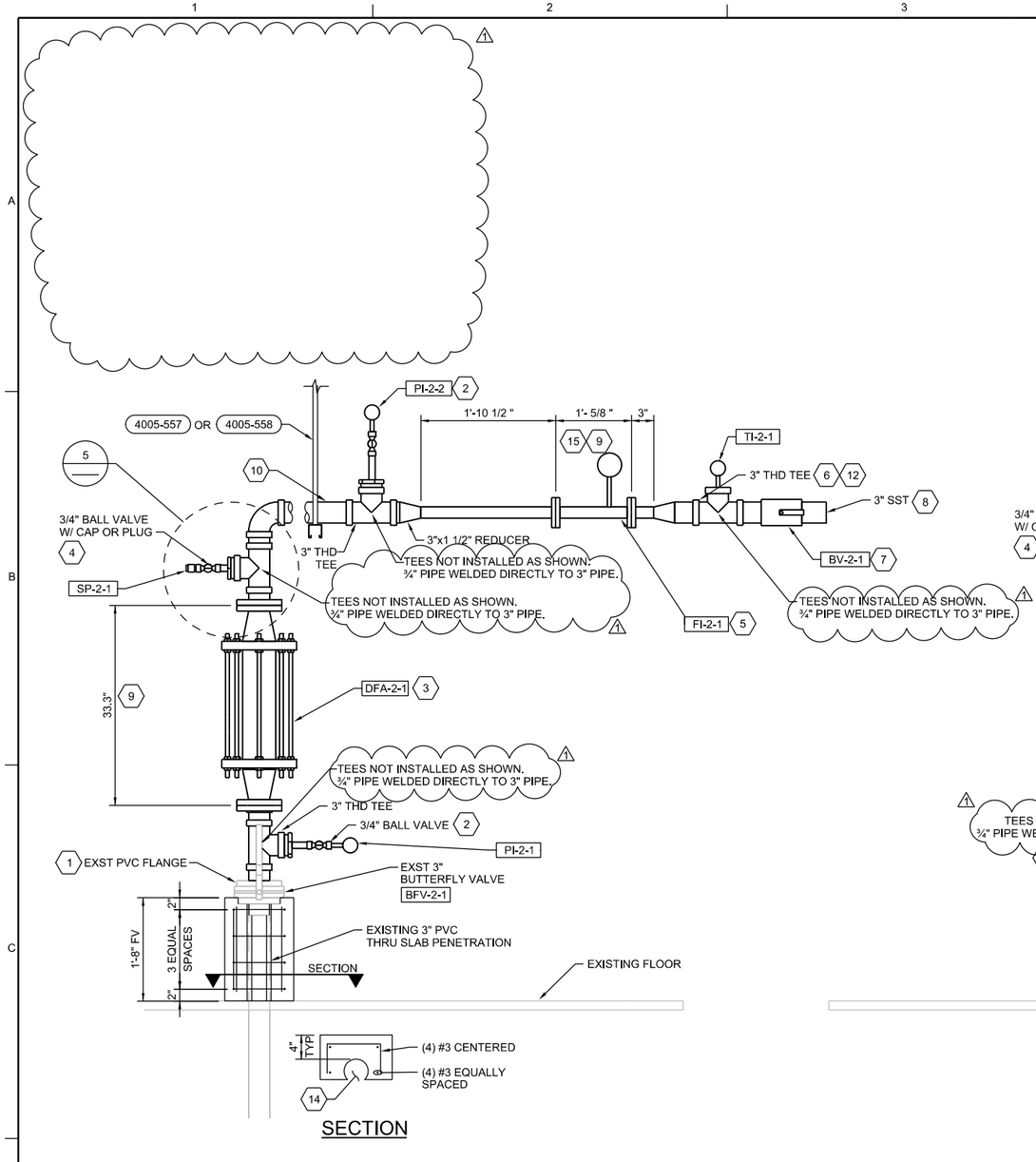
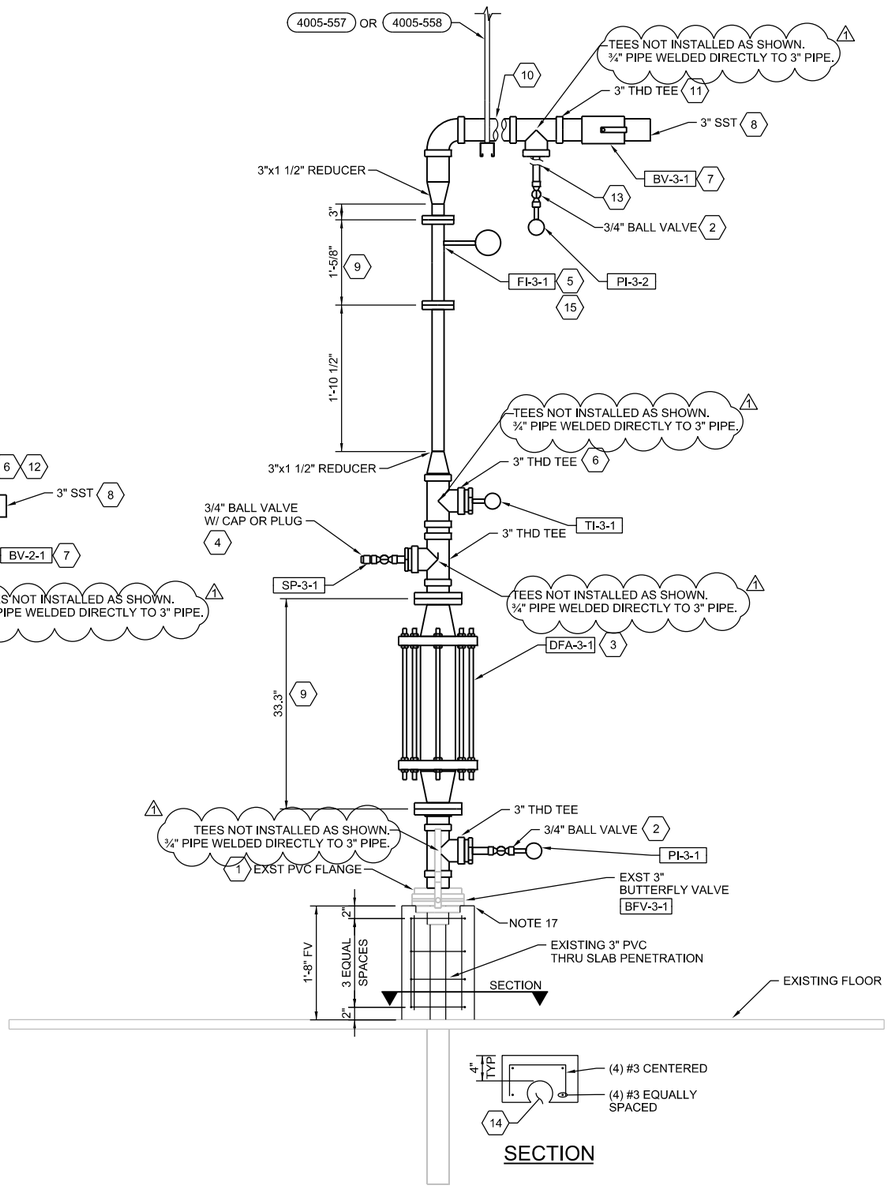
DWG	M-102
SHEET	4 of 10



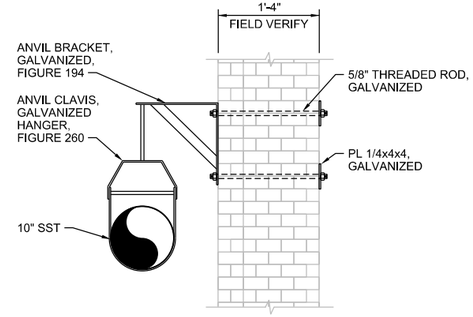
1 EX-2 ELEVATION VIEW

1"=1'-0"



2 EX-3 ELEVATION VIEW

1"=1'-0"



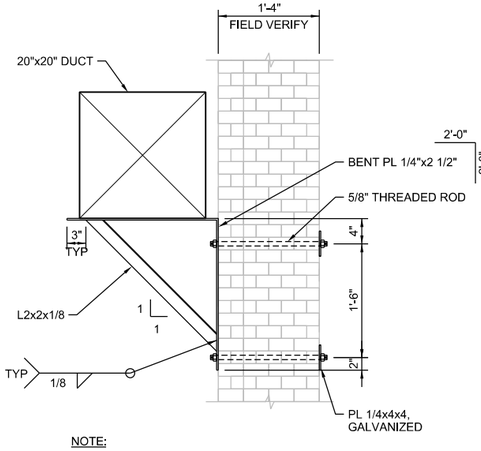
NOTE:

1. LOCATE SUPPORTS IN CENTER OF PILASTER (CENTERED BETWEEN WINDOW OPENINGS).

3 DETAIL

1"=1'-0"

M-102, M-300



NOTE:

1. LOCATE SUPPORTS AS CLOSE TO BUILDING CORNER AS POSSIBLE.

4 DETAIL

1"=1'-0"

M-102, M-300

GENERAL NOTES

1. WELL LEG DETAILS ARE DIAGRAMATIC. ADDITIONAL ELBOWS AND SPOOLS ARE REQUIRED BUT NOT SHOWN. FIELD COORDINATE. SEE PLAN FOR APPROXIMATE LOCATION OF WELLS AND ROUTING OF 3" COMMON HEADER.
2. FITTINGS ARE DRAWN TO SCALE AT STANDARD DIMENSIONS. VALVES ARE DRAWN TO SCALE BASED ON NAMED MANUFACTURER AND MODEL, REFER TO SPECIFICATIONS.
3. ALL 3/4" ISOLATION VALVES INDICATED SHALL BE STAINLESS BALL VALVES PER SPECIFICATION.
4. PROVIDE 3/4" THREADED BUSHING IN BRANCH OF 3" TEE FITTING FOR ALL CONNECTIONS INDICATED.
5. PROVIDE THREADED PLUG ON ISOLATION VALVE OUTLET, TYPICAL AT SAMPLE PORTS AND WHERE INDICATED.
6. REFER TO PIPING AND INSTRUMENTATION DIAGRAM FOR INSTRUMENT TAGS, SPECIFICATIONS AND ADDITIONAL INFORMATION.
7. INSTALL HORIZONTAL PIPING WITH 1/8 INCH PER FOOT SLOPE TO LOW POINT DRAINS. COORDINATE LOCATIONS OF LOW POINT DRAINS WITH JACOBS.

SHEET KEYNOTES

1. EXISTING PVC FLANGE, THREADED. REMOVE PLUG AND CONNECT NEW SST PIPING.
2. PRESSURE INDICATOR CONNECTION. PROVIDE REDUCER TO MATCH INSTRUMENT.
3. DETONATION FLAME ARRESTER.
4. SAMPLE PORT CONNECTION, TYPICAL.
5. FLOW ELEMENT WITH MANUFACTURER-PROVIDED INSERTION TUBE. COORDINATE INSERTION TUBE LENGTH WITH INSTRUMENT ACTUALLY PROVIDED.
6. TEMPERATURE/HUMIDITY SENSOR CONNECTION. PROVIDE REDUCER TO MATCH INSTRUMENT.
7. 3" STAINLESS BALL VALVE.
8. SEE PLAN FOR CONTINUATION AND ADDITIONAL PORTS AND VALVES.
9. ASSEMBLY LENGTH IS BASED ON COMPONENT DIMENSIONS INDICATED AND ASSUMED MINIMUM SPOOL LENGTHS BETWEEN JOINTS. COORDINATE FINAL ASSEMBLY LENGTH WITH COMPONENTS, SPOOLS, AND JOINTS ACTUALLY PROVIDED.
10. TRANSITION TO HORIZONTAL. ROUTE 3" SST PIPING AS REQUIRED TO AVOID FIELD OBSTRUCTIONS, LOCATE FITTINGS AND INSTRUMENTATION IN HORIZONTAL AS INDICATED. REFER TO PLAN M-101 AND PROCESS AND INSTRUMENTATION DIAGRAM FOR ADDITIONAL INFORMATION.
11. ORIENT TEE SO BRANCH IS IN THE HORIZONTAL POSITION.
12. ROTATE TEE SUCH THAT INSTRUMENT FACE IS ANGLED DOWNWARD AND READABLE BY THE OPERATOR.
13. EXTEND 3/4" SST TO 5'-6" AFF, INSTALL VALVE AND INSTRUMENT IN ACCESSIBLE LOCATION. COORDINATE EXACT LOCATION WITH OWNER.
14. TERMINATE ENCASEMENT SO IT DOES NOT INTERFERE WITH VALVE OPERATOR HANDLE MOVEMENT.
15. COORDINATE FLOW TRANSMITTER LOCATION AND HEIGHT WITH OWNER.
16. TEMPORARY AIR INLET ASSEMBLY FOR TEST AND BALANCE WORK, TYPICAL OF 2. PROVIDE 3" SST BALL VALVE AND 3" SST NIPPLE, INSTALL ON SAMPLE PORT ABOVE DFA ASSEMBLY ON EACH WELL LEG FOR BALANCING. REFER TO TEST AND BALANCE, GENERAL WORK NOTES, SHEET M-400. AT CONCLUSION OF TEST AND BALANCE WORK, REMOVE TEMPORARY ASSEMBLY AND INSTALL SAMPLE PORT ASSEMBLY INDICATED.
17. RISER CLAMP MAYBE PLACED BETWEEN VALVE BASE AND SUPPORT AFTER APPROVAL OF RISER CLAMP SPECIFICATION BY JACOBS.

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WELL LEG
DETAILS

AS CONSTRUCTED

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

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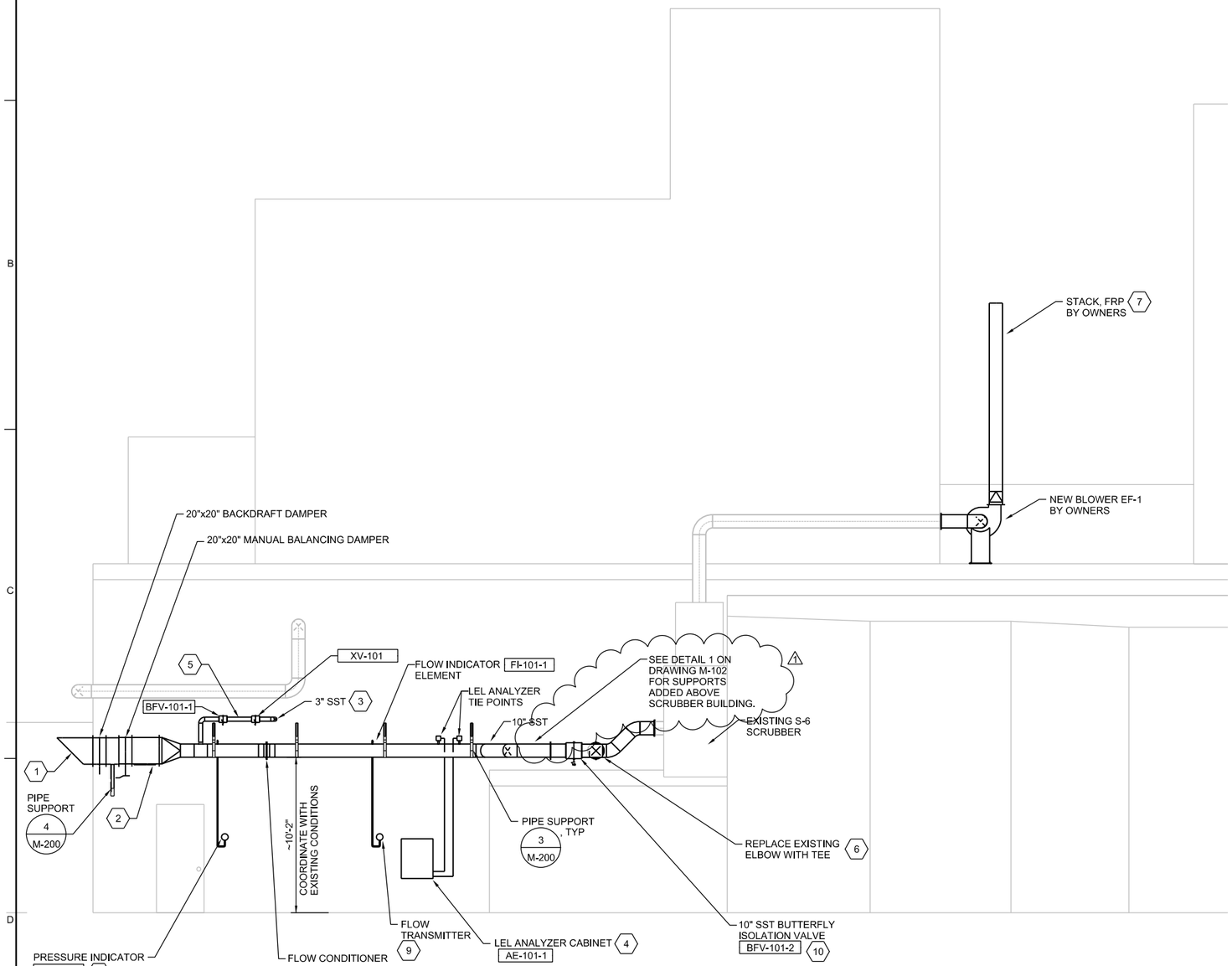
PROJ	707538
DWG	M-200
SHEET	5 of 10

GENERAL NOTES

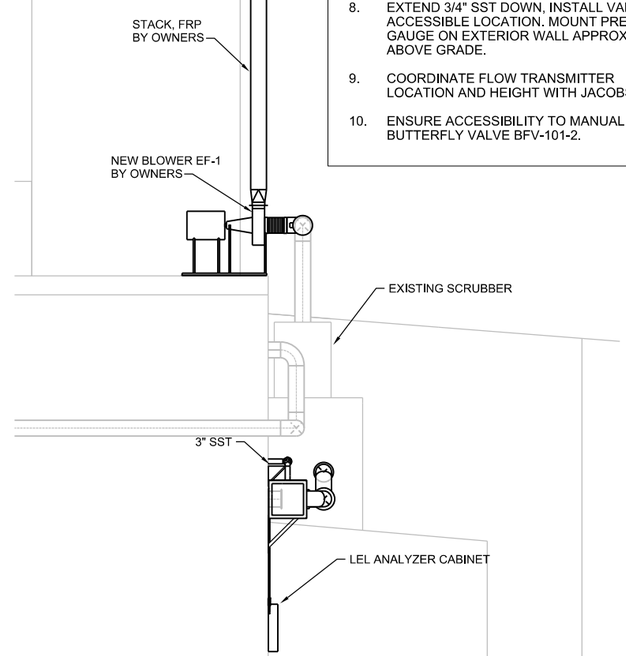
1. PROVIDE FLANGED CONNECTIONS IN THE EXISTING FRP DUCT, AS REQ'D TO CONNECT NEW SST DUCTS.
2. COORDINATE TIE-INS TO EXISTING DUCT WITH FIELD CONDITIONS. LOCATIONS INDICATED ARE APPROXIMATE.
3. REFER TO DRAWING M-300 FOR PIPING AND DUCTWORK, AND EXHAUST FAN SCHEDULES.
4. PROVIDE ALL INSTRUMENT TAPS IN TOP OF 10" SST PIPE.

SHEET KEYNOTES

1. PROVIDE 1/2" MESH OVER INTAKE.
2. DUCT RELIEF DOOR, SET @ -10" WC.
3. PENETRATE THROUGH WOOD PANELING IN EXISTING OPENING.
4. COORDINATE ANALYZER CABINET LOCATION WITH OWNER.
5. OFFSET 3" SST WELL HEADER AS REQUIRED TO INSTALL 3" SST BUTTERFLY ISOLATION VALVE BFV-101-1 AND BLOCK VALVE XV-101. PROVIDE MANUAL BUTTERFLY VALVE WITH CHAINFALL TO ALLOW OPERATION FROM GROUND LEVEL.
6. REPLACE EXISTING FRP ELBOW WITH SST TEE AND 10" SST BUTTERFLY ISOLATION VALVE BFV-101-3 (BEYOND). SEE PLAN M-102 AND ISOMETRIC M-900.
7. STACK OUTLET TO MATCH HEIGHT OF EXISTING STACK. SEE PHOTO 8/M-500.
8. EXTEND 3/4" SST DOWN, INSTALL VALVE IN ACCESSIBLE LOCATION. MOUNT PRESSURE GAUGE ON EXTERIOR WALL APPROX 5'-6" ABOVE GRADE.
9. COORDINATE FLOW TRANSMITTER LOCATION AND HEIGHT WITH JACOBS.
10. ENSURE ACCESSIBILITY TO MANUAL BUTTERFLY VALVE BFV-101-2.



A ELEVATION
1/4"=1'-0"
M-102



B ELEVATION
1/4"=1'-0"
M-102

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ELEVATIONS

AS CONSTRUCTED

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	AUGUST 2019
PROJ	707538
DWG	M-300
SHEET	6 of 10

SPECIFICATIONS:

STAINLESS STEEL BALL VALVE (TYPICAL OF BV-2-1, BV-3-1, XV-101, BV-101-1, and all Instrument port isolation valves):

1. Two-piece, standard port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end piece, NPT threaded ends.
2. ASTM A276 Type 316 stainless steel ball, reinforced PTFE seats and seals, graphite packing, adjustable packing gland, blowout proof ASTM A276 Type 316 stainless steel stem and gland.
3. ISO 5211 actuator mounting pad.
4. Rated 1,000 psig CWP, vacuum service to 29 Inches Hg.
5. Complies with MSS SP110.
6. Manufacturers and Products:
   a.Conbraco Apollo; 76-AR Series.
   b.Or equal.

STAINLESS STEEL CHECK VALVE (TYPICAL OF 3-inch Purge Air Inlet Check Valve):

1. Ball cone type, ASTM A276 GR 316 stainless steel body and disc, straight-through flow.
2. Valve body seam welded together. No O-ring or gasket required.
3. Inconel-X-750 spring, 0.25-PSIG cracking pressure.
4. Maximum Operating Pressure 500 PSIG; Maximum Allowable Temperature 850°F at 420 PSIG.
5. Bubble-tight shut-off, suitable for gaseous service.
6. Manufacturers and Products:
   a. Watson McDaniel: Model WSSCV.
   b. Or equal.

HIGH PERFORMANCE BUTTERFLY VALVE (TYPICAL OF BFV-101-1, BFV-101-2 and BFV-101-3):

1. ASME B16.1 Class 150 lug style, high performance type, ASTM A351/A351M GR CF8M or ASTM A276 GR 316 stainless steel body.
2. ASTM A276 Type 316 stainless steel single or double offset disc, 2205 duplex stainless steel shaft, Type 316 stainless steel taper pins.
3. ASTM A276 Type 316 stainless steel seat, carbon graphite stem packing, Type 316 stainless steel nickel coated and heat-treated bearing with Type 316 stainless steel thrust washer.
4. Manufacturers and Products:
   a. DeZurik: BHP Series.
   b. Or equal.

FAIL-SAFE QUARTER-TURN ACTUATOR (Intended for application with XV-101 block valve, refer to Stainless Steel Ball Valve specification):

1. Quarter-turn actuator, power open, for open/close service.
   a. Adjustable positioning time from 14-420 seconds.
   b. Non-intrusive limit setting with mechanical end stops.
2. Fail-safe to closed position on loss of power or control signal.
   a. Mechanical spring type requiring no batteries, hydraulics, or external power supply.
   b. Fail-safe speed adjustable from 1 to 5 seconds.
3. Integrated controls with frequency inverter and direct-coupled brushless DC motor.
   a. Backlit LCD display, dockable in 90-degree increments.
4. Wireless configuration, data logger for diagnostics, self-testing diagnostic function.
   a. Sufficient torque for valve provided, in both electric and mechanical operation.
5. 24 VDC control signal, 24 VDC power.
6. Suitable for Installation outdoors
   a. NEMA 4 enclosure, aluminum housing.
   b. Ambient temperature rating -40°F to 140°F.
   c. Manufacturer's standard corrosion protection and color.
7. Lockable LOCAL-OFF-REMOTE selector switch
8. Manufacturers and Products:
   a. Emerson: EIM Series RTS FQ-03.
   b. Or equal.

EXPANSION JOINT:

1. Single wide arch flowing type, rated for operation at 170°F and 26 inHg vacuum.
2. Neoprene cover with chlorosulfonated polyethylene UV-resistant coating.
3. Neoprene tube.
4. Provide with zinc-plated steel limit rods and inboard hardware.
5. Provide with zinc-plated carbon steel limit rod plates and backing flanges, and Neoprene gaskets. Coordinate flange geometry with FRP work.
6. Refer to Pipe and Duct Schedule for fastener requirements.
7. Manufacturer and Product:
   a. PROCO: Style 271.
   b. Or equal.

MANUAL BALANCING DAMPER (BD-102):

1. Opposed blade balancing damper. Fabricate from 6063T5 aluminum, mill finish.
2. Suitable for up to 13 inwc pressure differential and provided with mechanically locked blade seals and flexible metal compression jamb seals. Size as indicated on Drawings.
3. Blades airfoil type with integral structural reinforcing tube running full length of each blade. Frame 4" deep extruded hat channel with minimum 0.081" wall thickness.
4. Bearings: Corrosion-resistant, long-life, synthetic, formed as single piece with axles.
5. Linkage: Minimum 1/2inch (13 mm) aluminum tie bar with stainless steel pivot pins mounted on blades.
6. Provide with lockable hand quadrant for balancing.
7. Damper Manufacturers:
   a. Ruskin; CD40.
   b. American Warming and Ventilating.
   c. Or equal.
8. Operator Manufacturers:
   a. Ruskin.
   b. Ventlok.
   c. Or equal.

BACKDRAFT DAMPER; ALUMINUM, HEAVY DUTY (BDD):

1. Parallel blade backdraft damper. Fabricate from 6063T5 aluminum, mill finish.
2. Provided with mechanically locked blade seals. Blades shall overlap frame. Configured for position indicated on Drawings.
3. Blades 0.070" wall thickness. Frame 2-1/4" extruded hat channel with minimum 0.125" wall thickness.
4. Bearings: Corrosion-resistant, long-life, synthetic, formed as single piece with axles.
5. Linkage: Minimum 1/2inch (13 mm) aluminum tie bar with stainless steel pivot pins mounted on blades.
6. Provide with insect screen and optional static pressure control with mounting bracket.
7. Manufacturer and Product:
   a. Ruskin; Model BD6 with SPC.
   b. Or equal.

GENERAL WORK NOTES

A. COORDINATE ALL WORK WITH OTHER TRADES THROUGH JACOBS' REPRESENTATIVE.

B. ENSURE ALL PIPING, VALVES AND EQUIPMENT ARE INSTALLED AND SUITABLY SUPPORTED, WITH ADEQUATE SPACE FOR ACCESS AND MAINTENANCE. COORDINATE ALL WORK WITH EXISTING CONDITIONS, SOME FIELD ROUTING WILL BE REQUIRED.

C. EXISTING EXTRACTION NODE ISOLATION VALVES BFV-2-1 AND BFV-3-1 SHALL REMAIN CLOSED DURING CONSTRUCTION, LEAK TESTING AND SYSTEM STARTUP, TEST, AND BALANCE.

D. PIPE LEAKAGE TESTING (PNEUMATIC TESTING):
   a. PRIOR TO SYSTEM START-UP, MECHANICAL CONTRACTOR SHALL PERFORM PRESSURE TESTING OF PIPING.
   b. COORDINATE WITH CONSTRUCTION MANAGER PRIOR TO TESTING TO ENSURE SELECT INSTRUMENTS ARE REMOVED PRIOR TO TESTING TO AVOID DAMAGE TO COMPONENTS.
   c. PROVIDE ALL NECESSARY TEST FANS AND CALIBRATED MEASURING DEVICES TO ACCOMPLISH LEAKAGE TEST AND TO DEMONSTRATE THAT PIPING SYSTEMS LEAKAGE RATE IS LESS THAN MAXIMUM RATE SPECIFIED.
   d. DUCTWORK LEAKAGE CLASS IS AS INDICATED IN THE PIPE AND DUCT SCHEDULE.
   e. SYSTEM SET-UP FOR LEAKAGE TESTING:
      i. EXTRACTION NODE ISOLATION VALVES BFV-2-1 AND BFV-3-1 SHALL REMAIN CLOSED.
      ii. PURGE AIR VALVE BV-101-1 SHALL BE CLOSED.
      iii. VALVES XV-101, BFV-101-1, AND BFV-101-2 SHALL BE FULLY OPEN.
      iv. VALVE BFV-101-3 SHALL BE CLOSED.
      v. ALL INSTRUMENT PORT ISOLATION VALVES SHALL BE CLOSED.
      vi. SEAL ALL OTHER INLET AND OUTLETS SUCH AS DILUTION AIR AND BLOWER CONNECTIONS. REMOVE OR SUITABLY ISOLATE ALUMINUM DILUTION AIR INTAKE PLENUM DURING LEAKAGE TEST.

PIPE AND DUCT SCHEDULE

SEGMENT	SIZE	MATERIAL	WEIGHT	JOINTS	FITTINGS	BOLTING (NOTE 6)	GASKETS (NOTE 6)
WELL LEG, WELL BRANCH	3" Ø	STAINLESS TYPE 316L	SCHEDULE 10S	WELDED	WELDED	NOTE 5	PTFE
MIXING, DILUTION, FAN INLET	10" Ø	STAINLESS TYPE 316L	SCHEDULE 5S	WELDED	WELDED	NOTE 5	PTFE
AIR INTAKE PLENUM	20"x20"	ALUMINUM 3003-H14	-10 INWC PRESSURE CLASS	NOTE 4	NOTE 4	NOTE 5	PTFE
SCRUBBER	10" Ø	FIBERGLASS (NOTE 8)	100 PSI PER ASTM D2310	NOTE 7	ASTM C582 AND D2996	NOTE 5	PTFE

NOTES:
1. PIPE SHALL BE ASTM A312 GRADE STAINLESS, PICKLED AND PASSIVATED. PROVIDE LEVEL SP1 SOLVENT CLEANING IN ACCORDACNE WITH SOCIETY FOR PROTECTIVE COATINGS (SSPC) SPECIFICATIONS. REMOVE VISIBLE OIL, GREASE, SOIL, DRAWING AND CUTTING COMPOUNDS, AND OTHER SOLUBLE CONTAMINANTS FROM INTERIOR AND EXTERIOR OF PIPE. PROTECT FACTORY-CLEANED AND PREPARED PIPE WITH END CAPS PRIOR TO INSTALLATION.
2. PROVIDE PIPE WITH WELDED JOINTS. JOINTS SHALL BE BUTT-WELD OR SOCKET-WELD TYPE. PROVIDE FLANGED CONNECTIONS WHERE CONNECTING STAINLESS PIPE TO INTAKE PLENUM AND WHERE CONNECTING STAINLESS PIPE TO EXISTING OR NEW EQUIPMENT AND DUCT.
3. PROVIDE PIPE WITH BUTT-WELD OR SOCKET-WELD FITTINGS, ASTM A403/A403M TYPE 304L, PICKLED AND PASSIVATED.
4. PROVIDE DUCT CONSTRUCTION IN ACCORDANCE WITH SMACNA INDUSTRIAL DUCT CONSTRUCTION STANDARDS, ROUND OR RECTANGULAR. PROVIDE SEAL CLASS A.
5. BOLTS SHALL BE TYPE 304 STAINLESS, ASTM A320/A320M, GRADE B8M. NUTS SHALL BE ASTM A194/A194M, GRADE 8M. PROVIDE WASHERS ASTM F436 TYPE 3.
6. PROVIDE SLEEVES AND WASHERS AS NECESSARY TO MAINTAIN DIELECTRIC SEPARATION BETWEEN ALUMINUM DUCT AND STAINLESS PIPE.
7. CUT IN AND PROVIDE NEW FRP FLANGES TO EXISTING FRP PIPING WHERE INDICATED, BOLT PATTERNS TO MATCH CONNECTING PIPE FLANGES AND EXISTING SCRUBBER, AS APPLICABLE. REFER TO PHOTO 1/M-500. AT CUT EDGES OF LAMINATES, TREAT EDGE FULLY WETTED AND CURED WITH THINNED LAMINATE, ALLOWED TO CURE, THEN COATED WITH SURFACING RESIN TO 10-15 MILS DFT. COAT FIELD WELDED JOINTS WITH RESIN PASTE BEFORE
8. ASTM D2996 FIBERGLASS REINFORCED PLASTIC, HELICALLY WOUND, ASTM D2310 TYPE 1, VINYL ESTER RESIN, DERAKANE 411-45 OR EQUAL, TYPE C GLASS MONOFILAMENT SURFACING MAT OR DYNEL ORGANIC FIBER SYNTHETIC VEIL OR EQUAL. MINIMUM WALL THICKNESS 5/16 INCH. PROVIDE CYABSORB UV-9, OR EQUAL, TO WAX COAT FOR UV PROTECTION.

E. PROCEDURE:
   i. APPLY PRELIMINARY PNEUMATIC TEST PRESSURE OF 25 PSIG MAXIMUM TO PIPING SYSTEM PRIOR TO FINAL LEAK TESTING, TO LOCATE VISIBLE LEAKS. APPLY SOAP BUBBLE MIXTURE TO ACCESSIBLE JOINTS AND CONNECTIONS; EXAMINE FOR LEAKAGE.
   ii. CORRECT VISIBLE LEAKS AND REPEAT PRELIMINARY TEST UNTIL VISIBLE LEAKS ARE CORRECTED.
   iii. GRADUALLY INCREASE PRESSURE IN SYSTEM TO HALF OF SPECIFIED TEST PRESSURE. THEREAFTER, INCREASE PRESSURE IN STEPS OF APPROXIMATELY ONE-TENTH OF SPECIFIED TEST PRESSURE UNTIL REQUIRED TEST PRESSURE IS REACHED.
   iv. MAINTAIN PNEUMATIC TEST PRESSURE CONTINUOUSLY FOR MINIMUM OF 10 MINUTES AND FOR SUCH ADDITIONAL TIME AS NECESSARY TO CONDUCT SOAP BUBBLE EXAMINATION FOR LEAKAGE.
   v. CORRECT VISIBLE LEAKAGE AND RETEST AS SPECIFIED.
   vi. ALLOWABLE LEAKAGE: PIPING SYSTEM, EXCLUSIVE OF POSSIBLE LOCALIZED INSTANCES AT BLOWER OR VALVE PACKING, SHALL SHOW NO VISUAL EVIDENCE OF LEAKAGE.
   vii. AT CONCLUSION OF TEST, RECONNECT ALUMINUM DILUTION AIR INTAKE PLENUM TO SYSTEM PRIOR TO STARTUP.

F. PROVIDE TEST REPORT DOCUMENTATION TO INCLUDE THE FOLLOWING
   i. TEST DATE.
   ii. DESCRIPTION AND IDENTIFICATION OF PIPING TESTED.
   iii. TEST FLUID.
   iv. TEST PRESSURE.
   v. REMARKS, INCLUDING: LEAKS (TYPE, LOCATION) AND REPAIR OR REPLACEMENT PERFORMED TO REMEDY EXCESSIVE LEAKAGE.
   vi. SIGNED BY CONTRACTOR AND CONSTRUCTION MANAGER TO REPRESENT THAT TEST HAS BEEN SATISFACTORILY COMPLETED AND SYSTEM IS READY FOR STARTUP.

G. BLOWER START-UP:
   a. MECHANICAL CONTRACTOR SHALL PERFORM START-UP PROCEDURES ON THE BLOWER, INSTALLED BY OTHERS.
   b. SCHEDULE START-UP WORK WITH CONSTRUCTION MANAGER.
   c. SYSTEM SET-UP FOR BLOWER START-UP:
      i. EXTRACTION NODE ISOLATION VALVES BFV-2-1 AND BFV-3-1 SHALL REMAIN CLOSED.
      ii. DILUTION AIR INTAKE BACKDRAFT DAMPER (BDD) SHALL BE FREE TO OPEN, WITH STATIC PRESSURE CONTROL SET TO 0.25 INWC DIFFERENTIAL.
      iii. DAMPER BD-102 SHALL BE APPROXIMATELY 25% OPEN AND BALANCING QUADRANT INSTALLED.
      iv. VALVES BFV-101-1 AND BFV-101-2 SHALL BE FULLY OPEN, VALVE BFV-101-3 SHALL BE FULLY CLOSED.

H. TEST AND BALANCE:
   a. PERFORM TAB OF SYSTEM IN ACCORDANCE WITH THE FOLLOWING:
   b. TEST AND BALANCE SUBCONTRACTOR SHALL PERFORM TAB AFTER ACCEPTANCE OF THE PRESSURE TESTING.
   c. PERFORM TAB OF SYSTEM IN ACCORDANCE WITH THE FOLLOWING:
   d. PROVIDE MATERIALS, TOOLS, TEST EQUIPMENT, COMPUTERS AND INSTRUMENTATION REQUIRED TO COMPLETE THE WORK INCLUDED.
   e. UTILIZE EXISTING INSTRUMENTATION AND CONNECTIONS IN THE SYSTEM TO MEASURE AND MONITOR SETPOINTS AND PERFORMANCE. DO NOT CREATE ADDITIONAL TEST HOLES IN THE PIPING.
   f. SYSTEM SET-UP FOR SYSTEM TEST AND BALANCE:
      i. EXTRACTION NODE ISOLATION VALVES BFV-2-1 AND BFV-3-1 SHALL REMAIN CLOSED.
      ii. PURGE AIR VALVE BV-101-1 SHALL BE CLOSED.
      iii. VALVES XV-101, BFV-101-1, AND BFV-101-2 SHALL BE FULLY OPEN.
      iv. VALVE BFV-101-3 SHALL BE CLOSED.
      v. ALL INSTRUMENT PORT ISOLATION VALVES SHALL BE CLOSED.
   g. DILUTION AIR INITIAL SETTING:
      i. ADJUST BD-102 TO ESTABLISH AND MAINTAIN APPROXIMATELY -10 IN WC IN DILUTION HEADER AS MEASURED AT PI-101-1.
      ii. ADJUST BLOWER VFD TO ESTABLISH AND MAINTAIN APPROXIMATELY 1000 CFM IN DILUTION HEADER AS MEASURED AT FI-101-1.
      iii. ITERATE ABOVE PROCEDURE UNTIL STABLE SETTINGS ARE ESTABLISHED FOR BD-102 AND BLOWER VFD.
   h. EXTRACTION RISERS:
      i. BALANCE EACH EXTRACTION RISER SEPARATELY, ISOLATING ONE RISER AT A TIME WITH THE 3-INCH BALL VALVE BV-2-1 OR BV-3-1, AS APPLICABLE.
      ii. INSERT A TEMPORARY 3-INCH BALL VALVE AT THE EXTRACTION RISER SAMPLE PORT LOCATION (SP-2-1 OR SP-3-1, AS APPLICABLE) TO BE USED TO SIMULATE EXPECTED PRESSURE LOSSES UPSTREAM.
      iii. ADJUST TEMPORARY 3-INCH BALL VALVE TO ESTABLISH AND MAINTAIN APPROXIMATELY -8 IN WC IN RISER AS MEASURED AT PI-2-1 OR PI-3-1, AS APPLICABLE.
      iv. USING THE BALL VALVE (BV-2-1 OR BV-3-1) BALANCE EACH LEG TO 150 CFM MAXIMUM FLOW MEASURED AT FI-2-1 OR FI-3-1, AS APPLICABLE.
      v. ITERATE (iii) AND (iv) UNTIL STABLE SETTINGS ARE ESTABLISHED FOR TEMPORARY 3-INCH BALL VALVE AND BV-2-1 OR BV-3-1, AS APPLICABLE.
   i. DILUTION AIR, BLOWER, AND TOTAL SYSTEM FLOW:
      i. BALANCE TOTAL SYSTEM FLOW WITH EACH RISER SEPARATELY, ISOLATING ONE RISER AT A TIME WITH THE TEMPORARY 3-INCH BALL VALVE AT THE EXTRACTION RISER SAMPLE PORT.
      ii. USE DAMPER BD-102 TO ADJUST DILUTION AIR FLOW TO MAINTAIN THE MINIMUM REQUIRED TOTAL SYSTEM FLOW OF 1000 CFM AS MEASURED AT FI-101-1.
      iii. CHECK FLOW AT THE ACTIVE EXTRACTION RISER AND ITERATE EXTRACTION RISER BALANCING STEPS (iii) AND (iv) AS NECESSARY TO MAINTAIN SPECIFIED PRESSURE AND FLOW AT THE EXTRACTION RISER.
      iv. REPEAT (iii) FOR SECOND RISER, WITH FIRST RISER ISOLATED PER (i).
      v. ADJUST BLOWER VFD SPEED AS NECESSARY TO ADJUST PRESSURE IN DILUTION/MIXING SECTIONS, AS REQUIRED FOR EXTRACTION RISER FLOWS AND TOTAL SYSTEM FLOW.
      vi. ONCE EXTRACTION RISER FLOWS AND SYSTEM FLOW ARE MET, SET VFD SPEED ON HOLD AND LOG THE SYSTEM SETTINGS AND CONDITIONS.
   j. WHEN ADJUSTMENTS ARE MADE TO A PORTION OF THE SYSTEM, REREAD OTHER PORTIONS OF THAT SAME SYSTEM TO DETERMINE EFFECTS IMPOSED BY ADJUSTMENTS, READJUST AS NECESSARY.
   k. LOCK AND MARK FINAL POSITIONS OF BALANCING DAMPERS AND VALVES WITH PERMANENT FELT PEN.

EXHAUST FAN SCHEDULE

DESIGNATION	EF-1
CFM	1000
ESP IN WG	23.7
RPM	3450
WHEEL DIAMETER IN	18
ORIENTATION	SWSI CENTRIFUGAL
DRIVE TYPE	DIRECT
ARRANGEMENT	8
CONFIGURATION	UP BLAST
OPERATING BHP	6.77
MOTOR HP	10
MOTOR VOLTAGE	460/3PH
LOCATION	ROOF
WIDTH	36"
HEIGHT	38"
LENGTH	31"
WEIGHT	850 LBS
MODEL	HPBF 18/8
MANUFACTURER	AEROVENT

NOTES:
1. FAN SHALL BE UL 705 LISTED FOR POWER VENTILATOR.
2. FAN SHALL OPERATE CONTINOUSLY UNDER VFD CONTROL. SPEED SETTING SHALL BE SET MANUALLY AT THE VFD AS REQUIRED TO MAINTAIN DESIGN FLOW.
3. PROVIDE WITH INVERTER DUTY EXPL TEFC MOTOR SUITABLE FOR OUTDOOR INSTALLATION.
4. FAN HOUSING, WHEEL, AND ALL PARTS EXPOSED TO THE AIRSTREAM SHALL BE FIBERGLASS.
5. PROVIDE FLANGED INLET AND OUTLET, VOLUTE DRAIN WITH PLUG, AND WEATHER COVER.
6. SCHEDULED DIMENSIONS AND WEIGHT DO NOT INCLUDE WEATHER COVER.

STATE OF NEW YORK — LICENSED PROFESSIONAL ENGINEER

NO.	DATE	DSGN	DR	CHK	APVD
0	8/13/19	J MCMURREN	J PIGMAN	C JOHNSON	E WEINHOUSE

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REVISION

WATERLOO SSDS PILOT TEST
WATERLOO, NEW YORK
FORMER NEW HAMPSHIRE CHEMICAL CORPORATION

JACOBS

SCHEDULES AND SPECIFICATIONS

AS CONSTRUCTED

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	AUGUST 2019
PROJ	707538
DWG	M-400
SHEET	7 of 10

1 PHOTO
NTS

2 PHOTO
NTS

3 PHOTO
NTS

4 PHOTO
NTS

5 PHOTO 10
NTS

6 PHOTO
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7 PHOTO
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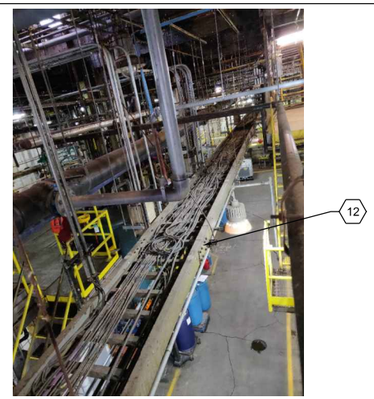
8 PHOTO
NTS



9 PHOTO
NTS

SHEET KEYNOTES

1. PRESSURE INDICATOR CONNECTION AND BV-3-1 IN HORIZONTAL. COORDINATE WITH EXISTING SUPPORTS AND OBSTRUCTIONS.
2. EXISTING TRAPEZE. SUSPEND 3" SST EX-3 BRANCH PIPING BENEATH EXISTING CONDUITS. COORDINATE SUPPORTS WITH CONDUIT AND OTHER OBSTRUCTIONS.
3. TRANSITION TO HORIZONTAL AS REQUIRED TO ROUTE EX-2 PIPING AROUND STAIR STRUCTURE. ROUTE 3" SST TO MEZZANINE COLUMN LINE FOR SUPPORT OF ADDITIONAL COMPONENTS.
4. PRESSURE INDICATOR, FLOW ELEMENT, TEMPERATURE/HUMIDITY SENSOR, AND BV-2-1 IN HORIZONTAL. PROVIDE UNISTRUT SUPPORT FROM MEZZANINE AND COLUMNS. COORDINATE WITH EXISTING SUPPORTS AND OBSTRUCTIONS.
5. CHEMICAL TOTE TO BE REMOVED BY OWNERS.
6. ELECTRICAL PANEL TO BE REMOVED BY OTHERS. COORDINATE LOCATION OF PI-3-2 WITH JACOBS.
7. 3" SST FROM EX-2 RISE AT COLUMN AND CONNECT TO 3" SST FROM EX-3. COORDINATE ROUTING AND CONNECTION LOCATION WITH FIELD CONDITIONS. PROVIDE PIPE SUPPORTS AT 10'-0" MAX SPACING. AT COLUMN USE GALVANIZED PS1200 CLAMP WITH PS100 STRUT CHANNEL, BY POWER STRUT. ATTACH TO STEEL COLUMN WITH BEAM CLAMP.
8. ROUTE 3" SST ALONG MEZZANINE, COORDINATE PENETRATION LOCATION WITH STRUCTURE AND EXISTING OBSTRUCTIONS. SEE EXTERIOR ELEVATION ON DRAWING M-300 FOR ADDITIONAL REQUIREMENTS.
9. EXISTING FRP STACK TO BE REPLACED BY OWNERS.
10. TYPICAL WELL HEAD. RECONFIGURE BOLLARD AS NECESSARY FOR WELL COMPONENTS INSTALLATION AND ACCESS.
11. LOCATION OF BLOWER, INSTALLED BY OWNERS.
12. SUPPORT 3" SST FROM EXISTING CONDUIT TRAY. SEE DETAIL 4005-559.

PHOTOS REPRESENT PRE-CONSTRUTION CONDITIONS. 1

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081171
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0	8/13/19	EBW	KR	EBW	KR
				BY	APVD

AS-BUILT DRAWINGS
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WATERLOO SSDS PILOT TEST
WATERLOO, NEW YORK
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PHOTO DETAILS

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VERIFY SCALE
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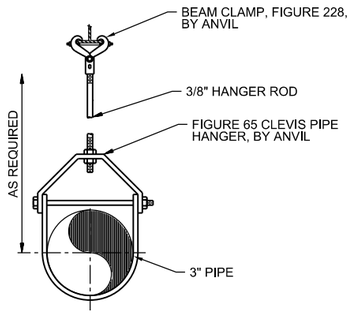
0 1"

DATE	AUGUST 2019
PROJ	707538
DWG	M-500
SHEET	8 of 10



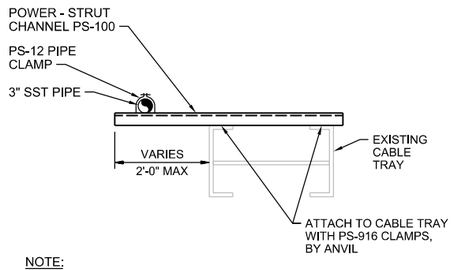
NOTES:

1. MAXIMUM SPACING OF SUPPORTS SHALL BE 10'-0".
2. ALL ITEMS SHALL BE GALVANIZED.

PIPE HANGER

NTS

4005-557



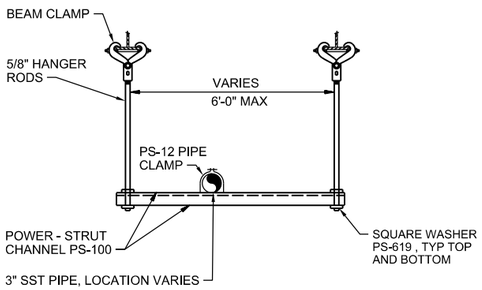
NOTE:

1. 10'-0" MAXIMUM SPACING BETWEEN SUPPORTS.

PIPE SUPPORT AT CABLE TRAY

NTS

4005-559



NOTES:

1. 10'-0" MAXIMUM SPACING BETWEEN TRAPEZE HANGER SUPPORTS.
2. ALL ITEMS SHALL BE GALVANIZED.

TRAPEZE PIPE HANGER

NTS

4005-558

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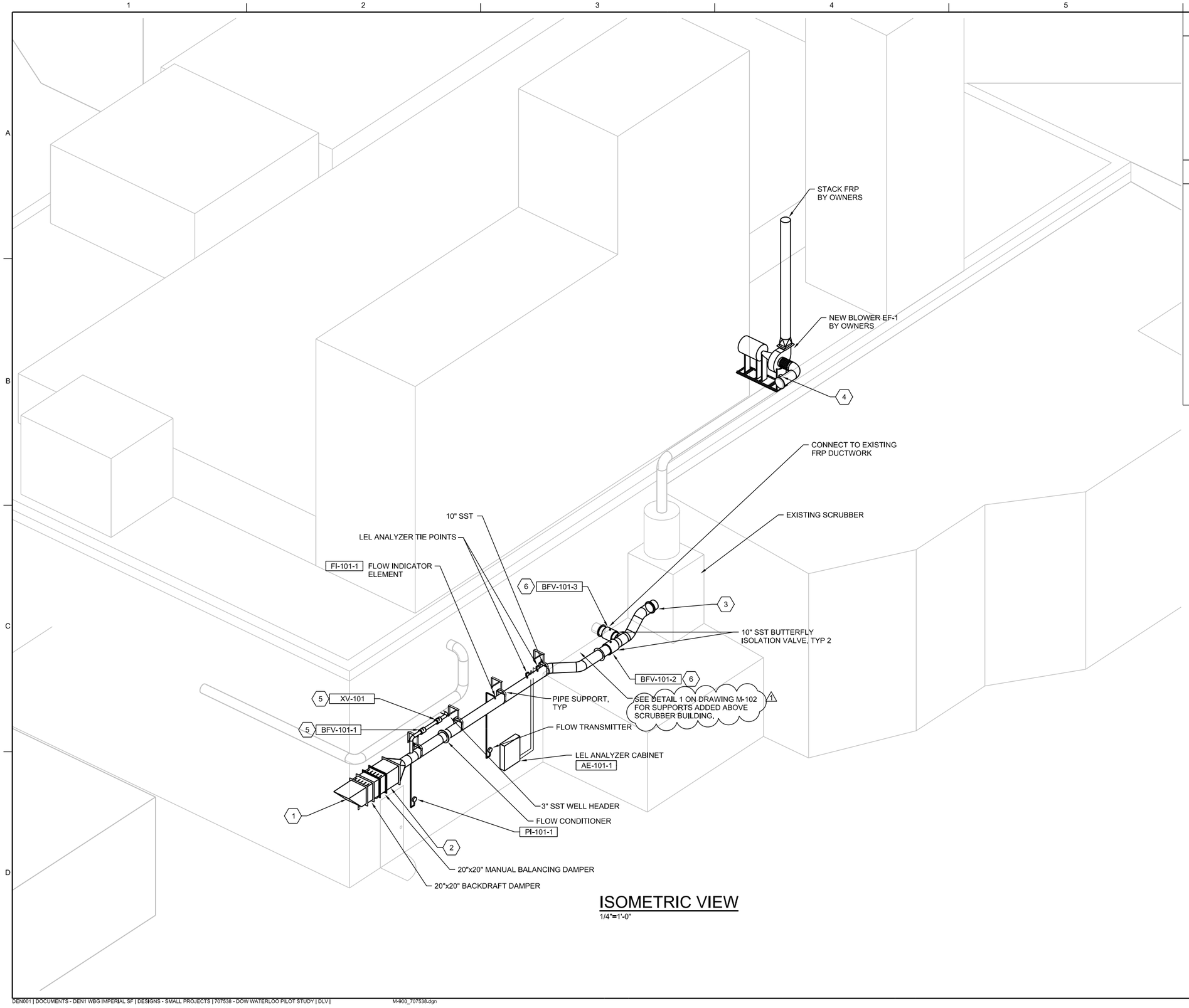
STANDARD DETAILS

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	AUGUST 2019
PROJ	707538
DWG	M-600
SHEET	9 of 10



ISOMETRIC VIEW

1/4"=1'-0"

GENERAL NOTES

1. PROVIDE FLANGED CONNECTIONS IN THE EXISTING FRP DUCT, AS REQ'D TO CONNECT NEW SST DUCTS.
2. COORDINATE TIE-INS TO EXISTING DUCT WITH FIELD CONDITIONS. LOCATIONS INDICATED ARE APPROXIMATE.
3. REFER TO DRAWING M-400 FOR PIPING AND DUCTWORK, AND EXHAUST FAN SCHEDULES.

SHEET KEYNOTES

1. PROVIDE 1/2" MESH OVER INTAKE.
2. DUCT RELIEF DOOR, SET @ -10" WC.
3. TRANSITION FROM SST TO FRP AND CONNECT TO SCRUBBER. FIELD COORDINATE CONNECTION AND BOLT PATTERN AT EXISTING SCRUBBER INLET PRIOR TO FABRICATION. SEE PHOTO 1/M-500.
4. SAMPLE PORT IN NEW 10" FRP. SAMPLE PORT DETAIL TO BE SIMILAR TO SAMPLE PORTS INDICATED ON WELL LEG DETAILS, DRAWING M-200. FRP WORK AND ASSOCIATED SAMPLE PORT TO BE PROVIDED BY OWNERS.
5. BLOCK VALVE XV-101 AND 3" SST BUTTERFLY ISOLATION VALVE WITH CHAINFALL.
6. ENSURE ACCESSIBILITY TO MANUAL BUTTERFLY VALVE BFV-101-2.

STATE OF NEW YORK
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EBW KR
BY APVD

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WATERLOO SSDS PILOT TEST
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ISOMETRIC VIEW

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VERIFY SCALE

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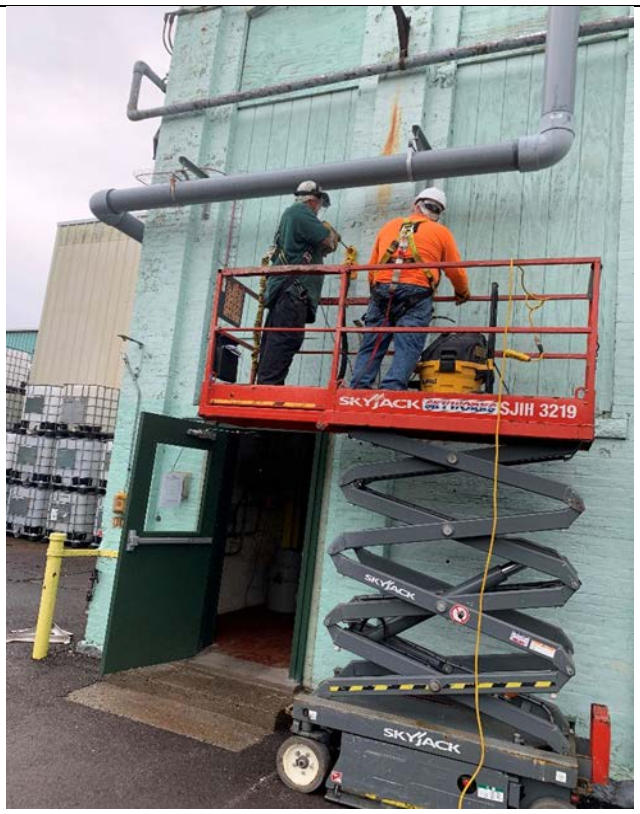
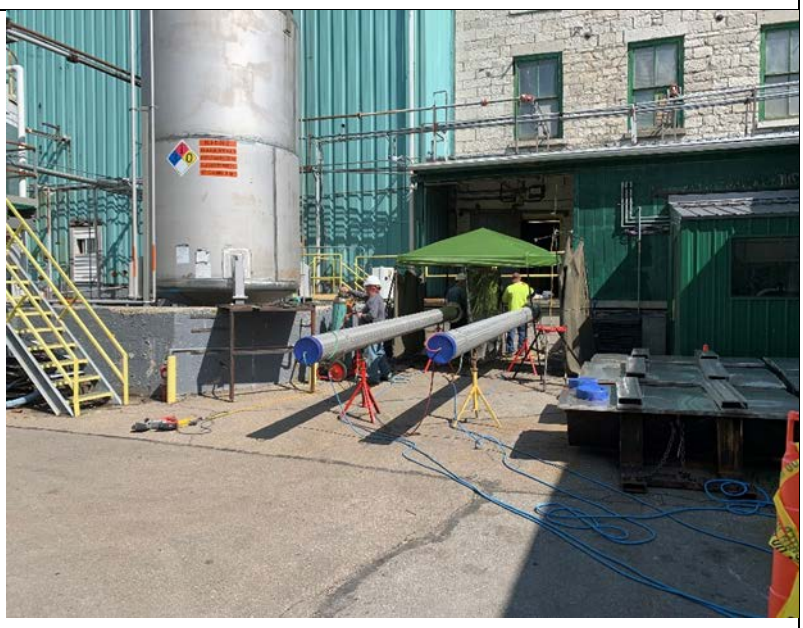
0 1"

DATE	AUGUST 2019
PROJ	707538
DWG	M-900
SHEET	10 of 10

Appendix B
Construction Photographs

PHOTOGRAPHS

Subject/Description: Installation of wall mounted pipe hangers Photo Log 2019-08-28 001	
Subject/Description: Exterior pipe hangers installed Photo Log No: 2019-08-28 002	

Subject/Description: Concrete pedestal completed for vapor extraction valve (typical of 2) Photo Log No: 2019-09-03 004	
Subject/Description: Welding station-welding flanges to the 10” stainless Steel pipe Photo Log 2019-09-06 005	
Subject/Description: Section leader for the tie up with the system heather Photo Log 2019-09-10 008	

Subject/Description: Section with the transitions towards the tie in to the scrubber system Photo Log No: 2019-09-11 011	
Subject/Description: Welding an elbow to the 10” pipe run Photo Log No: 2019-09-12 013	

Subject/Description: Mounting 10” pipe conveance run Photo Log 2019-09-16 014	
Subject/Description: Installation of athe 10” section of the conveyance system leading to the air scrubber and to the header inside the building. Photo Log 2019-09-30 016	

Subject/Description: conveyance system connected to the plant scrubber Photo Log 2019-10-02 018	
Subject/Description: Welding the 3” flange on to the 3.5” tubing Photo Log 2019-10-10 020	

Subject/Description: Flame arrestor installed Photo Log 2019-10-11 021	
Subject/Description: section of 3” reduced down to 1.5” with flange for flow meter installation Photo Log No: 2019-10-11 022	

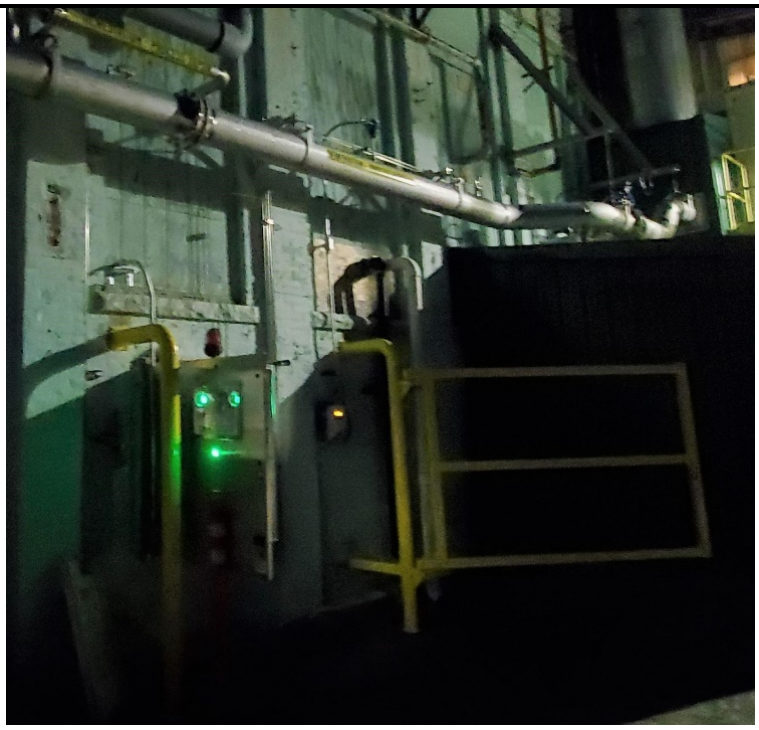
Subject/Description: Flow meter assembly in place connected to overhead leader line Photo Log 2019-10-14 026	
Subject/Description: connection leading to the 3” overhead line Photo Log 2019-10-16 030	

Subject/Description: instruments installed along exterior wall; LEL, flow meter and pressure gauge Photo Log No: 2019-10-16 031	
Subject/Description: 3” overhead line leading to the souther portion of the building, both valves installed Photo Log 2019-10-18 034	

Subject/Description: System piping closed and complete (make up air damper system not installed) Photo Log No: 2019-10-19 036	
Subject/Description: Pressure test assembly installed on to the sub slab vapor extraction system Photo Log 2019-10-21 037	

Subject/Description: support bracket for the 10” pipeline section connected on to the scrubber Photo Log 2019-10-22 039	
Subject/Description: support brackets partially installed Photo Log No: 2019-10-22 040	

Subject/Description: Gas analyzer tubing installed Photo Log 2019-10-24 042	
Subject/Description: Dilution air inlet duct	

Subject/Description: Protective barrier installed around gas analyzer (gate is open)	
Subject/Description: Datalogger inside cabinet	

Subject/Description: Autodialer	
Subject/Description: Installed RTDs	

Appendix C
Pre-Startup Safety Review (PSSR)

FI&E Prestartup Review Checklist – GPM Step 18.04

http://gpmrc.intranet.dow.com/fi&estage4.htm
http://gpmrc.intranet.dow.com/virtual/docs/FI&E/Elements/SCStage/Prestartup/PrestartupReviewChecklist.xls

Project Title: Dow Waterloo SSDS Pilot Study
Project number: DWAT004

Date of Prestartup Review: 11/20/2019

Checklist

This checklist consists of items that should be complete before, or soon after, startup. Indicate status of all items. Loss Prevention Principles have been referenced for several of the checklist items as an aid to the reviewer should they wish to explore further the basis behind a question.

Attendees

Jacobs: Jeff Haberl, Jason Kearns, Brian Carling, Patrick Kish, Dave Newman Evans Chemtics: Stan Hatch, Steve Brusso

A. Previous Audits and Reviews

		Yes	No	N/A	Hold	Comments / Action
A.1	Attach action items and responses or current status to the recommendations from previous evaluations if performed:	X				
A.1.1	· Technology/Operations (II) Evaluation and Input			X		
A.1.2	· Simulation Testing of process control program			X		
A.1.3	· Project Safety/Environmental Checklists (EMETL Series G10Q-0011-00)			X		
A.1.4	· Environmental, Health and Safety Review (GPM Steps 12.17 and 14.14)			X		
A.1.5	· Process Safety Reactive Chemicals Review/Process Hazard Analysis (RC/PHA) (both Project and Existing Facility versions) See Process Safety Expertise Center web site	X				HAZOP
A.1.6	· Layers of Protection Analysis (LOPA)	X				

B. Plant Staffing

B.1	Are manufacturing and related support groups (Maintenance, Process Control, Instrumentation, analytical, engineering, etc.) sufficiently staffed to manage the operations?	X				Jacobs staff will operate the pilot system with support from Evans who will operate the scrubber.
B.2	Have employees been adequately trained for the operation of this plant? (Include startup, normal operations, shutdown, and emergencies.)		X			Training will be completed prior to startup of the pilot system. Anticipated the week of December 2.
B.3	Have special staffing needs during startup been adequately addressed? (Including temporary shift schedules, around the clock staff coverage, area responsibilities, etc.)			X		

C. Records and Record Keeping

C.1	Pipe tested and documented? (LPP 17.8)	X				Piping leak tested during construction
C.2	Unit alarm lists?			X		
C.3	Loop testing of Safety Instrumented Systems? (LPP 15.4)			X		
C.4	Safety Valve Procedures? (LPP 14.1)			X		
C.5	Equipment Startup Procedures?	X				Pilot operations manual
C.6	Freeze Protection Procedures?	X				Scrubber is insulated, and recirculation system is located inside heated buildings. Need to discuss with Evans what parameters are monitored to ensure freezing conditions are not occurring in scrubber (e.g. fluid temperature, recirculation flow rate, pump discharge pressure, scrubber packing d.p., etc...)
C.7	Operating procedures and operating parameters?	X				Pilot operations manual

		Yes	No	N/A	Hold	Comments / Action
C.8	Emergency procedures (Consider hurricane, vapor cloud, Spill Prevention, Control and Countermeasures (SPCC), etc.)? (LPP 18.2)	X				HSP
C.9	Computer Point Identification (PTID's) (Tag in Heritage UCC Process Control System) (LPP 15.4)			X		
C.10	Differential Scanning Calorimetry (DSC) or other reactive chemical testing documentation?			X		
C.11	Are updated manuals available to the operators? (Considering Operating Procedures, COP, Material Safety Data Sheet (MSDS), Emergency Procedures, etc.)?	X				Pilot operations manual
C.12	Maintenance and Unit equipment files?			X		
C.13	Relief system design documentation and registration? (LPP 14.1)			X		
C.14	Equipment list?	X				Pilot operations manual
C.15	Isolation of Energy Sources documentation?	X				Evans will be responsible for de-energizing equipment
C.16	Master copies of loop diagrams, P&ID's, ESD logic diagrams, electrical diagrams, process flow diagrams, area electrical hazard classification drawings, sprinkler/deluge system drawings, building ventilation drawings and underground piping diagrams? (LPP 3.1, 4.3, 3.8, 7.7-7.12, 10.3, 10.4, 15.4)	X				P&ID, layout, mechanical, and electrical drawings
C.17	Special maintenance procedures where needed? (lubrication program, preventive maintenance program, spare parts).			X		
C.18	Fugitive Emission Points List?			X		
C.19	Equipment Leak System Documents?			X		
C.20	Emission Device Calculations?	X				Emissions estimates prepared as part of design
C.21	Startup/Shutdown Malfunction Plan?			X		
C.22	Resource Conservation & Recovery Act (RCRA) inspection sheets?			X		
C.23	Environmental Permits?	X				Air permit letter and work plan submitted to state agency about pilot test; both accepted by agency
C.24	If equipment is "covered" by the OSHA Process Safety Management of Highly Hazardous Chemicals (PSM) standard, have necessary files, equipment documentation, mechanical integrity lists, etc. been updated? (RC/PHA Questionnaire, Appendix B1)			X		
C.25	Updates to Mass and Energy Balances?	X				Design confirmed ability of Evans scrubber to treat process vapor stream. Evans will not be discharging process vapor to scrubber during the pilot test.
C.26	Is equipment entered on the Preventive/Routine Maintenance program? (Consider new equipment, safety relief devices, process equipment, electrical equipment, instruments, piping, pumps, etc. Also consider equipment classification and inspection frequency updates and OSHA Process Safety Management of Highly Hazardous Chemicals (PSM) mechanical integrity requirements).			X		

D. Have the following been tested or are adequate test plans in place?

D.1	Safety Equipment	X				
D.1.1	· Sprinkler systems, monitor systems, backup firewater pump (LPP 10.11)			X		
D.1.2	· Smoke, fire detection systems (LPP 9.1)			X		
D.1.3	· Combustible gas detection (LPP 9.2)	X				In-line LEL and toxicity analyzers (CH4 & H2S, respectively)
D.1.4	· Emergency breathing air (LPP 7.8)			X		
D.1.5	· Validation of Safety Instrumented system (whole function) (if the project or the facility has SIS's) (LPP 15.4)			X		
D.2	Rotating Equipment (LPP 16.1-16.4)	X				Blower installed by Evans
D.2.1	· Factory Testing	X				
D.2.2	· Installation testing such as alignment, rotation	X				Evans verified blower rotation
D.2.3	· Safety trips			X		No interlock between blower and other equipment.
D.3	Fired Equipment (LPP 13.1-13.4)			X		
D.3.1	· Lightoff					
D.3.2	· Trial run					
D.3.3	· Safety trips					
D.4	Lines and Vessels (LPP 6.3, 17.4-17.9)	X				
D.4.1	· Pressure test	X				

		Yes	No	N/A	Hold	Comments / Action
D.4.2	· X-ray of weld			X		
D.4.3	· Method to ensure that the lines and vessels are clean and free of blinds or obstruction	X				No obstructions in lines. Verified valves in correct position.
D.5	Instrumentation/control system (LPP 15.1-15.4)	X				
D.5.1	· DOWTRAN program or other DCS control system code simulation tested			X		
D.5.2	· Loop check (the inputs and outputs go where they are supposed to)		X			Need to verify LEL analyzer alarm results in closure of XV-101. Bump test with calibration gas.
D.5.3	· Field instruments ranged correctly		X			During blower balancing, observed FIT-101-1 is reading 10x's lower than manual reading. Evans to work with Endress + Hauser tech support to evaluate/correct the issue.
D.5.4	· Correct version of the DOWTRAN program loaded			X		
D.5.5	· Shutdowns in DOWTRAN programs have been tested during simulation (and testing is documented)			X		
D.5.6	· Displays on Operator Stations/GPI configured correctly – inputs and outputs shown at the correct location			X		
D.5.7	· History package configured			X		
D.5.8	· Safety Interlock Programming implemented and reviewed (if the project or the facility has SIS's)			X		
D.5.9	· Important software functions (critical alarms, ESD's, process control logic)			X		
D.6	Electrical Testing including manufacturer's acceptance testing (LPP 3.5, 3.8)	X				
D.6.1	· Major switchgear			X		
D.6.2	· Transformers			X		
D.6.3	· Motor rotation	X				Evans verified blower rotation
D.6.4	· Uninterruptible power supply (UPS) systems			X		
D.7	Air and water been removed from the equipment			X		This system handles air/subslab vapor
D.8	Shutdown alarm set points in relation to the equipment design and process conditions (LLP 15.2, 15.4)		X			Check setpoint and adjust prior to Phase 1 of pilot based on final operations manual currently being developed.

E. Design and Construction

E.1	Are all hot surfaces above the process chemical's auto ignition temperature covered ?			X		
E.2	Is construction and equipment in accordance with design specifications?	X				
E.3	Has a field inspection been performed?	X				Construction completion inspection - October 2019 Engineering walkthrough - November 2019
E.4	Has the job site been sufficiently cleaned up to allow safe transit of operating and support staff during startup?	X				
E.5	Has adequate surface drainage been provided? (LPP 7.5)			X		Located in existing Evans process building (Building 4). We do not have control over drainage in building.
E.6	Are walking/working surfaces level, secured and non-slippery?	X				
E.7	Have emergency access and egress been properly provided for and labeled or marked? (LPP 10.13, 12.2, 12.5)			X		Located in existing Evans process building (Building 4).
E.8	Are personnel protected from contact with hot (>140°F) surfaces?	X				
E.9	Is there adequate and safe access to all levels?	X				Aerial lift will be used to access valves on damper and 10-inch piping outside Building 4 and valves on 3-inch piping inside Building 4. Ladders also available to access items outside area where aerial lift can access.
E.10	Can elevated work be performed safely?	X				
E.11	Do signs identify work area hazards and provide instruction?			X		
E.12	Is unused equipment properly isolated and identified?			X		
E.13	Is the work area adequately ventilated?	X				
E.14	Have exposed or easily contacted sharp edges on insulation or other equipment been removed?	X				Resposne only pertains to SSDS system and not existing Evans equipment/infrastructure.

F. Valve and Piping

F.1	Are open-ended valves of the correct type and plugged or blinded where required? (LPP 17.5)	X				

		Yes	No	N/A	Hold	Comments / Action
F.2	Are hoses and fittings of the approved type? (LPP 7.7, 7.10-7.12, 17.15)			X		
F.3	Are check valves installed in the correct orientation and direction? (LPP 17.6.2 R15)	X				
F.4	Have tripping hazards or head knockers been eliminated?		X			Evans will apply hazard tape to stairwell frame that is located next to EX-02. Frame is at height that it can be struck by a hardhat. Additionally, Evans will fabricate grating to place over a 6-inch deep pump sump so persons operating the datalogger don't step backwards and fall into sump.
F.5	Is the piping adequately supported? (LPP 17.6)	X				
F.6	Has a line-by-line inspection been done, including validation of material of construction? (Not necessarily by the Prestartup Safety Review (PSSR) Team).	X				
F.7	Have features that can cause excessive pipe stress, such as excessive nipple lengths and cantilevered branch connections, been minimized or avoided?	X				
F.8	Is cathodic protection provided, if specified?			X		
F.9	Are line expansion provisions installed?			X		
F.10	Are dead-end pipe, pocketed lines, and unused piping branches eliminated?	X				
F.11	Have valves and flanges subject to fugitive emission monitoring been tagged as required by regulations?			X		

G. Equipment

G.1	Has protection been provided against over-pressure and vacuum? (LPP 14.1)	X				Dilution air inlet duct equipped with duct relief door; no other overpressure/overvacuum scenarios anticipated
G.2	Have guards such as coupling and seal guards been installed on moving equipment? (LPP 16.1-16.4)	X				
G.3	Does equipment location provide safe access for operation and maintenance?	X				
G.4	Is equipment adequately supported?	X				
G.5	Are tests/inspections current for reused equipment?			X		
G.6	Was rotation checked? (LPP 16.1-16.4)	X				Evans checked rotation.
G.7	Are appropriate spare parts and maintenance materials available?			X		No spare parts for pilot test.

H. Instrument and Electrical

H.1	Has potential for instrument hardware failure been adequately addressed (i.e., burn-out, wire breaks, instrument internal failure)? (LPP 15.1-15.4)	X				If failure of instrument not in critical service occurs, the pilot will be stopped. The team will assess whether instrument is critical for pilot objectives. Pilot may be restared if test can continue without instrument. If instrument is critical for pilot objectives, the test will not be restarted until the instrument is replaced. If instrument is in critical service (e.g. instrument with safety interlock), the pilot will be stopped and not restarted until the instrument has been repaired/replaced.
H.2	Was the fail-safe position of valves verified by functional testing?		X			Need to verify LEL analyzer alarm results in closure of XV-101. Bump test with calibration gas. Jacobs verified that resetting of LEL analyzer results in opening of XV-101.
H.3	Were instruments/analyzers functionally tested? (LPP 15.1-15.4)	X				
H.4	Are alarm classifications properly distinguished?			X		
H.5	X+D131:H151			X		
H.6	Has revised OSHA Process Safety Management of Highly Hazardous Chemicals (PSM)-covered instrument documentation been reviewed by the unit trustee?			X		
H.7	Are guards provided to prevent accidental tripping of switches?	X				
H.8	Are indicating lights operational?	X				
H.9	Are conduit fittings sealed? (LPP 3.1)		X			Evans to seal conduit fittings after Jacobs has verified functionality of RTDs and datalogger.
H.10	Have all junction boxes and electrical switch boxes been properly covered or closed?	X				
H.11	Are junction boxes labeled?				X	Did not verify
H.12	Is electrical heat tracing labeled?			X		
H.13	Are start/stop switches and electrical switchgear labeled?			X		

		Yes	No	N/A	Hold	Comments / Action
H.14	Have the correct electrical area classification rules been followed? (LPP3.1)	X				
H.15	Have the electrical protective devices and safety features (i.e., relays, circuit breakers, door interlocks, emergency stop button, etc.) been properly calibrated, set, and tested?			X		
H.16	Does the electrical equipment have lockout devices (i.e., switches, breakers, panel boards, starters, etc.)?			X		Evans is responsible for power supply equipment in their facility
H.17	Have the commissioning test results been reviewed?	X				
H.18	Is equipment properly grounded and functionally checked? (LPP 17.6.2 M6)	X				
H.19	Are ground wires available for tank trucks, tank cars, drums, etc.? (LPP 3.6, 8.1)			X		
H.20	Is there adequate lighting? (LPP 3.3)	X				
H.21	Is ventilation for batteries/electrical components adequate?			X		

I. Operations

I.1	Are National Fire Protection Association (NFPA) chemical hazard identification symbols in place? (LPP 1.5)			X		
I.2	Is equipment labeled with names that can be traced to the appropriate Material Safety Data Sheets? (LPP 1.5)			X		
I.3	Are routinely operated valves accessible and easy to operate (gear operators and chain operators provided where necessary)?	X				Aerial lift needed to access BD-102 (or ladder in absence of lift).
I.4	Are vents and drains visible, easily accessible and safely located?	X				
I.5	Have temporary or unnecessary cross-ties, which could contribute to contamination, pressure, or temperature problems, been removed?			X		
I.6	Are sample points properly configured for safe sampling?	X				
I.7	Have provisions been made for safe handling of drums and gas cylinders (dollies, paved area, grounds, etc.)? (LPP 6.5)	X				
I.8	Are new lines and equipment adequately labeled, including flow arrows? (LPP 17.2, 17.8)	X				
I.9	Are special procedures for commissioning/decommissioning or first time startup provided?	X				
I.10	Have changes to control systems been reflected in applicable operating procedures?			X		
I.11	Have changes to operating procedures been appropriately reviewed and approved?			X		
I.12	Have Operator and Supervisory personnel training sessions (Operating Procedures, communications relating to newly introduced hazardous chemicals , , new Safety Instrumented Systems, Critical Operating Procedures , Emergency Procedures, etc.) been held?		X			Training will be completed prior to startup of the pilot system. Anticipated the week of December 2.
I.13	Are provisions made for technical or supervisory support during initial operation?	X				
I.14	Are action plans for the failure of monitoring devices or analyzers required for environmental permits in place?			X		
I.15	Is there an adequate process change control policy (include equipment, operating procedures (including set point/alarm point) and software changes) in place? (LPP 1.4, 15.1-15.4)			X		
I.16	Was the change communicated to affected adjacent units or other affected groups (e.g., upstream or downstream units, Shift, Staff, Lab, Utilities, Economic Profit (EP), Maintenance)?	X				Jacobs has worked with Evans through design and construction. Evans has reviewed design deliverables.
I.17	Are there specifications for all products and feeds?			X		
I.18	Are there adequate quality control procedures for feedstocks and products (including, a routine sampling schedule; “off-spec/in-spec” decisions; feedstock and product quality records keeping; and communication to suppliers and customers)?			X		

J. Maintenance

J.1	Can equipment be cleaned, isolated, and locked out for maintenance?	X				
J.2	Are motor valves and other instruments reasonably accessible for inspection and maintenance?	X				Aerial lift needed to access some of the instrument isolation valves and process isolation valves.
J.3	Are capacities of lifting equipment, floors, and hoists clearly displayed and visible to the personnel?			X		

		Yes	No	N/A	Hold	Comments / Action
J.4	Have regularly assigned unit maintenance personnel whose job task will be affected by the change been informed of and trained in the change?			X		

K. Relief Devices (LPP 14.1)

K.1	Have all relief devices been installed per design and set/tested by the valve shop?			X		
K.2	Are any block valves on inlet and outlet of relief devices in the open position and compliant with GMISS and GMIM 4.2?			X		
K.3	Are safety valves discharges directed to a safe location?			X		
K.4	Is the inlet or outlet piping at least the same size as the connection on the relief device?			X		
K.5	Has the relief device been approved by the site Process Engineering Relief Device Approver?			X		
K.6	Are heat exchangers protected on the shell and tube side?			X		
K.7	Are weep holes, drains, and/or weather barriers provided in the discharge piping of pressure relief devices which go to atmosphere?			X		
K.8	Have tie-ins, appendages on the relief device (including in-and outlet piping) be minimized which can fail due to vibration induced by oscillating flow during relief situations.			X		

L. Fire Protection and Personnel Safety Equipment

L.1	Have inert gas blankets and purges been provided where required? (LPP 7.1)			X		
L.2	Is fireproofing installed where required? (consider tank legs, structural steel, cable trays, etc.)			X		
L.3	Has the Process Safety Technology Center approved all changes to fixed fire protection facilities? (LPP10.1)			X		
L.4	Has steam or nitrogen been provided for snuffing fires in safety valve vent headers?			X		
L.5	Have Operations and Emergency Response Team personnel been adequately instructed in appropriate support and response procedures?			X		
L.6	Are fire shields installed below and water spray nozzles above new cable trays, if required? (LPP 3.2)			X		
L.7	Have approved fire extinguishers, safety showers, eye baths, fresh air equipment, etc. been installed as specified in the design?			X		Existing safety showers/eye baths in Evans facility

M. Occupational Health/Industrial Hygiene

M.1	Are provisions for monitoring potential high noise areas made? (LPP 14.2.3 M1)			X		
M.2	If regulated chemicals are involved (vinyl chloride, benzene, etc.), have the special requirements been observed?			X		
M.3	Does the system appropriately minimize personnel exposure to chemicals?	X				
M.4	Has the need for flame-resistant personnel protective equipment been considered, and needed equipment provided?			X		
M.5	Were radiation source requirements met?			X		
M.6	Has Reproductive Systems/Embryo-Fetal training occurred if required?			X		
M.7	Are provisions made for Industrial Hygiene monitoring during initial or routine operations?	X				Personal H2S sensors will be worn when operaitng pilot system. Multi-Gas meters will be carried by staff involved in pilot operations.
M.8	Have medical clearance requirements been considered and obtained as needed for employees who have new job tasks as a result of the change?	X				
M.9	Has exposed asbestos insulation been properly sealed or disposed of?			X		

N. Environmental Protection

N.1	Were changes in air emissions, process waste, wastewater and storm water flows properly communicated?	X				Air permit letter and work plan submitted to state agency about pilot test; both accepted by agency

		Yes	No	N/A	Hold	Comments / Action
N.2	Can hazardous materials from spills or maintenance preparation be safely handled?			X		
N.3	Are environmental permits and inspections/certifications (such as RCRA), which are required for operation, on file and the requirements understood by unit personnel?			X		
N.4	Are provisions made for disposal of all wastes, including startup wastes, off specification product, filter elements, residues, drums, etc.?	X				Project waste management plan
N.5	Have fugitive emission requirements for all valves, equipment been satisfied, and Environmental Protection Department and unit records of fugitive emission points been updated?			X		
N.6	Have new potential discharge points been reviewed to ensure that unintended releases of process materials can be quickly detected and/or mitigated?			X		

O. Location Questions – List Local Requirements

O.1						
O.2						
O.3						
O.4						
O.5						

FI&E Prestartup Review Checklist – GPM Step 18.04

Items to be completed prior to start up.

No.	Action Item Description	Responsible Person	ECD (Est. Comp. Date)	Status
1	Review operations manual and health/safety planning documents with field team.	Haberl	12/6/2019	Will be reviewed prior to startup of Phase 1 of pilot
2	Verify LEL analyzer alarm results in closure of XV-101.	Haberl/Lettich	12/6/2019	**COMPLETED**
3	Verify FIT-101-1 has been corrected to read flow correctly. During testing, was off by a factor of 10 when compared to handheld flow measurements.	Haberl/Evans Chemetics	12/6/2019	**COMPLETED**
4	Program alarm setpoints in LEL analyzer. Should be 25% of LEL with conditional allwoance to increase to 50% during pilot when conditions are dynamic (e.g. initial startup and operation)	Lettich	12/6/2019	**COMPLETED**
5	Install caution tape on stairwell frame located adjacent to EX-02	Evans Chemitics	12/6/2019	**COMPLETED**
6	Fabricate and install grating over pump pit adjacent to datalogger.	Evans Chemitics	12/6/2019	**COMPLETED**
7	Purchase and install red locks more suitable for valve isolation. Will be located at BFV-2-1 and BFV-3-1.	Lettich	12/6/2019	**COMPLETED**
8	Seal RTD conduits	Evans Chemitics	12/6/2019	**COMPLETED**

FI&E Prestartup Review Checklist – GPM Step 18.04

Items to be completed after start up.

No.	Action Item Description	Responsible Person	ECD (Est. Comp. Date)	Status
1	None			
2				
3				
4				

Additional Comments: