Remedial Systems Evaluation Report

(Former) Davis-Howland Oil Corporation Site Rochester, New York

Site Number 828088

January 2018

Prepared for:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
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List of Abbreviations and Acronyms

AS	air sparge
CATOX	catalytic oxidizer
DCE	dichloroethylene
DER	Division of Environmental Remediation
EEEPC	Ecology and Environment Engineering, P.C.
EPA	U.S. Environmental Protection Agency
GC/MS	gas chromatography/mass spectrometry
NYSDEC	New York State Department of Environmental Conservation
PCE	tetrachloroethylene
scfm	standard cubic feet per minute
Site	(Former) Davis-Howland Oil Corporation Site
SVE	soil vapor extraction
TCE	trichloroethylene
VOC	volatile organic compound

1 Introduction

1.1 Site Description

The former Davis-Howland Oil Corporation (DHOC) remediation site is located in the city of Rochester, Monroe County, New York. Documentation in the New York State Department of Environmental Conservation's (NYSDEC's) Environmental Site Remediation Database currently notes that the site encompasses the parcels located at 190 through 220 Anderson Avenue and the portion of 176 Anderson Avenue located immediately north and west of 190 through 220 Anderson Avenue. The site is defined as a single, 1.5-acre, industrial parcel of land located at 200 Anderson Avenue (see Figures 1-1 and 1-2). This parcel and the adjacent parcels on the east and west are occupied by former DHOC buildings. Historic landfill disposal activities occurred on the 200 Anderson Avenue parcel and two additional parcels located immediately north of the site. The two additional parcels, although managed in the remediation effort, are considered to be off-site parcels. The remedy, as constructed, is actively remediating soil and groundwater over an approximately 1-acre area surrounding the site. Zoning is commercial/industrial and remediation of the site allows the property to continue to be used for industrial purposes.

1.2 Report Overview

As part of the New York State Inactive Hazardous Waste Disposal Site Remedial Program administered by the NYSDEC, this report, *Remedial Systems Evaluation Report, (Former) Davis-Howland Oil Corporation Site* (Site 828088), was prepared by Ecology and Environment Engineering, P.C. (EEEPC).

In accordance with a letter from NYSDEC to EEEPC dated September 14, 2016, NYSDEC requested EEEPC restart the air sparge (AS)/soil vapor extraction (SVE) and groundwater pump and treat systems. The letter also requested EEEPC to implement a sampling work plan that will provide sufficient air quality and groundwater data to help with the evaluation of the remedial treatment systems at the former Davis Howland Oil Corporation site. These data will be used to determine whether the remedial treatment systems continue to effectively remove site contaminants in accordance with NYSDEC Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation (Welling 2016; NYSDEC 2010). As per DER-10, in order for the groundwater and AS/SVE treatment systems to be eligible for shut down, two requirements must be met: 1) the operation of the system(s) must reach asymptotic, or steady-

state, removal rates; and 2) the mass of contaminants extracted over time shall not be dependent on continued treatment operations.

EEEPC completed the following actions to advance NYSDEC's request to meet the NYSDEC DER-10 remedial process closure requirements:

1. Installed the components of the groundwater pumping and AS/SVE system to enable startup of the pumping wells on December 15, 2016;
2. Collected 10 samples of effluent air flow and air quality from the AS/SVE system to assess the changes in volatile organic compound (VOC) concentrations over time;
3. Collected 10 samples of influent and effluent groundwater from the pumping wells following a pulsed pumping schedule to assess changes in VOC concentrations over time; and
4. Performed an evaluation of the groundwater and air quality analytical data.

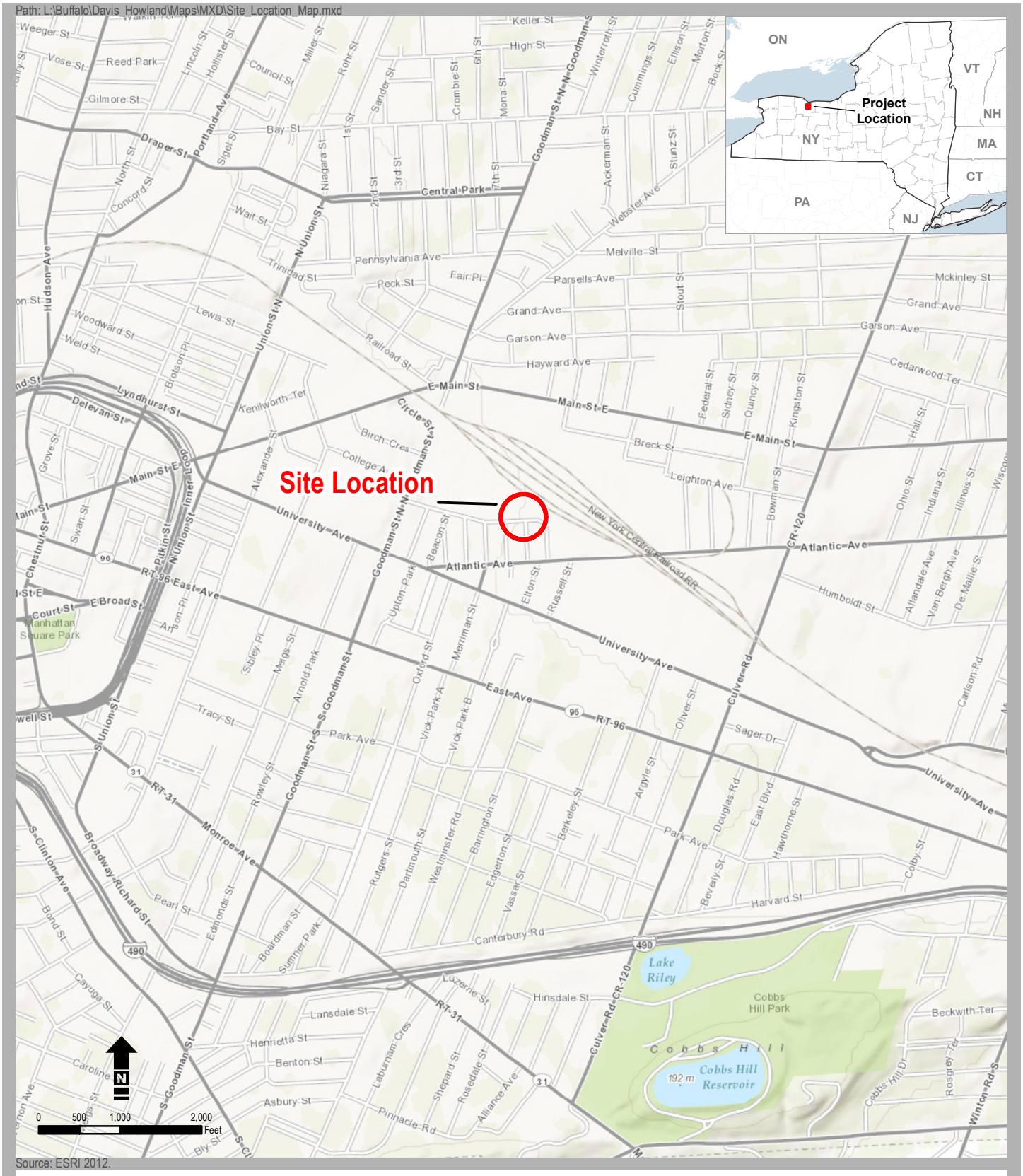

Figure 1-1
Site Location Map
Former Davis-Howland Oil Corporation
Rochester, NY

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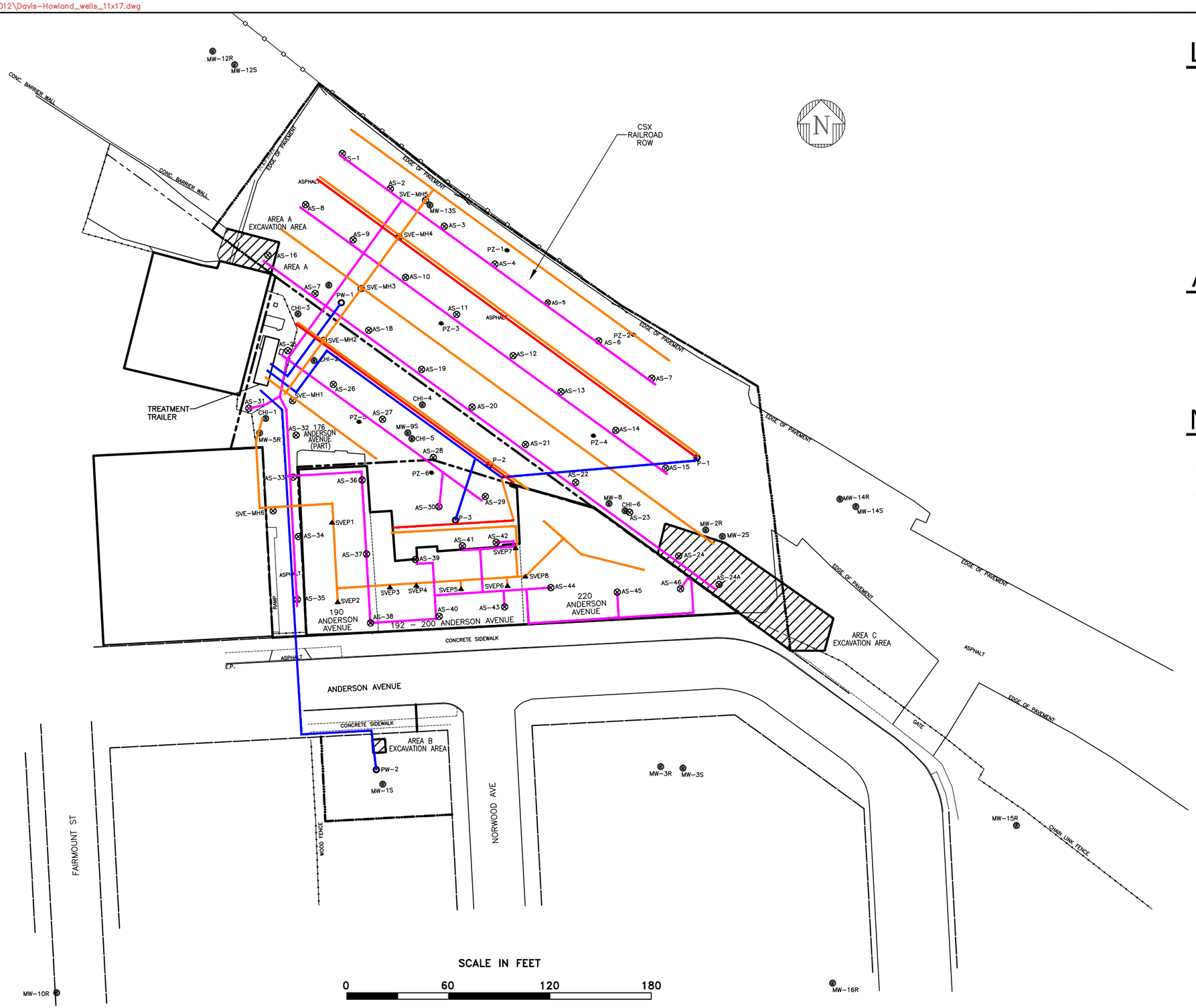


LEGEND

⊙	MONITORING WELL
●	PIEZOMETER
○	PUMPING WELL
⊗	AIR SPARGE POINT
▲	SOIL VAPOR EXTRACTION POINT
	SHALLOW GW PUMPING WELL COLLECTION TRENCH
	SOIL VAPOR EXTRACTION COLLECTION TRENCH/LINE
	PUMPING WELL LINES
	AIR SPARGE LINES

ABBREVIATIONS

AS	AIR SPARGE
CH	CLEAN HARBOR
MH	MANHOLE
MW	MONITORING WELL
PART	PARTIAL
PZ	PIEZOMETER
SVE	SOIL VAPOR EXTRACTION

NOTES

1. PIEZOMETERS, MONITORING WELLS, BUILDINGS AND PROPERTY LINES ARE BASED ON A SURVEY BY POPLI DESIGN GROUP, ARCHITECTURE AND ENGINEERING P.C. DATED DEC 7, 2012.
2. PUMPING WELL LINES, SOIL VAPOR EXTRACTION LINES AND AIR SPARGE LINES BASED ON AS-BUILT DRAWINGS BY ECOLOGY AND ENVIRONMENT P.C DATED NOVEMBER 2006.
3. STREET LOCATIONS ARE APPROXIMATE.

ecology and environment engineering p.c.

FIGURE 1-2 SITE PLAN
FORMER DAVIS HOWLAND OIL CORPORATION SITE
MONROE COUNTY, ROCHESTER, NY

2 System Sampling

This section discusses the groundwater pulse pumping and effluent air sampling schedules implemented to evaluate if the NYSDEC DER-10 remedial process closure requirements have been met for the remedial systems.

2.1 Effluent Air Quality and Flowrate Sampling Schedule and Methodology

Pursuant to Section 6.4 of DER-10, effluent air quality and air flowrate data were collected once per week from January 19, 2017, through March 24, 2017, to obtain 10 samples. Samples were collected from a sampling port on the effluent air piping from the AS/SVE system. Samples were air-collected in specially prepared canisters over a 24-hour period and analyzed by gas chromatography/mass spectrometry (GC/MS; U.S. Environmental Protection Agency [EPA] Method TO-15, 1999) for VOCs. Air-flow rates were collected weekly from a meter installed on the effluent piping. During sampling, it was noted that effluent air flow was low. The flow meter had a detection limit of 0.5 standard cubic feet per minute (scfm). During sampling air flows consistently read as <0.5 scfm, below the detection limit of the meter. To provide a conservative evaluation of VOC removal from the AS/SVE system, an air flow of 0.5 scfm was used.

2.2 Groundwater Sampling Schedule and Methodology

Pursuant to Section 6.4 of DER-10, pulse-pumping data was collected from January 19 through October 5, 2017, to obtain a total of 10 groundwater samples at each of the four pumping wells and of a combined influent and effluent sample from the air stripper treatment system. The pulse-pumping schedule was implemented as shown in Table 2-1. For the test, pumping wells P-2, P-3, PW-1, and PW-2 were pulsed on a monthly basis with samples collected from the individual wells and combined influent and effluent after each cycle and analyzed for VOCs.

Table 2-1 Groundwater Pulse Pumping VOC Sampling Schedule

Operation / Sample Date	Duration
On (as of 12/15/2016)	5 weeks
Sample on 1/20/2017	
Off	4 weeks
Sample on 2/17/2017	
On	4 weeks
Sample on 3/16/2017[1]	
Off	4 weeks
Sample on 4/14/2017	
On	2 weeks
Sample on 4/28/2017	
Off	6 weeks
Sample on 6/12/2017	
On	1 week
Sample on 6/22/2017	
Off	6 weeks
Sample on 8/3/2017	
On	1 week
Sample on 8/10/2017	
Off	8 weeks
Sample on 10/5/2017	
On (as of 10/12/2017)	Until further evaluation

Note:
1. Sampling delayed one week due to weather.

3 Results

3.1 AS/SVE System Evaluation

Analytical results of the 10 VOC air samples collected from the effluent of the AS/SVE system are provided in Table 3-1. Results were compared with the New York State Department of Health, *Guidance for Evaluating Soil Vapor Intrusion*. New York State Department of Health guidance levels for VOCs were met with the exception of three instances of trichloroethylene (TCE) exceedances during week numbers 1, 5 and 6, and one instance of tetrachloroethylene (PCE) exceedance during week 6.

The cumulative pounds of VOCs removed via the AS/SVE system since the inception of the system in August 2004 are shown in Figure 3-1. Between 2004 and 2008, AS/SVE emissions were treated via a catalytic oxidizer (CATOX) system to remove VOCs prior to discharge to ambient air. Monthly airflow and VOC analytical samples were collected during this time.

In March 2008, the CATOX system was decommissioned and extracted air was discharged directly to the atmosphere. Since that time, effluent airflow and analytical data have not been collected. To determine the cumulative pounds of VOCs removed since 2008, an average air flow rate was used. Monitoring during the 2017 air sampling indicated that effluent airflow was less than 0.5 scfm, the detection level of the flow meter. To provide a conservative assumption of the flow rate, 0.5 scfm was used for all evaluations. Effluent VOC levels between 2008 and 2016 were determined using averages of SVE sampling data from 2008, 2013, 2015, and 2016. As indicated in this figure, the AS/SVE system has moved toward an asymptotic point in VOC contaminant removal, indicating that the AS/SVE system is no longer efficiently removing VOCs from site soils.

In accordance with DER-10, a statistical analysis of the effluent VOC concentration was performed on the 10 samples collected in 2017 (using Minitab® statistical software, version 18.1) to determine if the operation of the system has reached or is reaching asymptotic removal rates (i.e., the slope is equal to zero). A student t-test was performed on the slope of the plot of effluent VOC concentration weekly from January through March 2017 (sample size = 10). A hypothesis test was performed on the data, which determined that the slope of the data is not statistically different than zero. The 95% confidence limits on the slope were determined to be between -0.0001 and +0.0001 pounds per day (see Appendix A). A graphical representation of the VOC removal trends during this time period is

shown in the scatterplot in Figure 3-2. The 10 samples demonstrate that asymptotic conditions have been achieved at the 95% confidence interval and the mass of contaminants extracted over time is not dependent on continued operation.

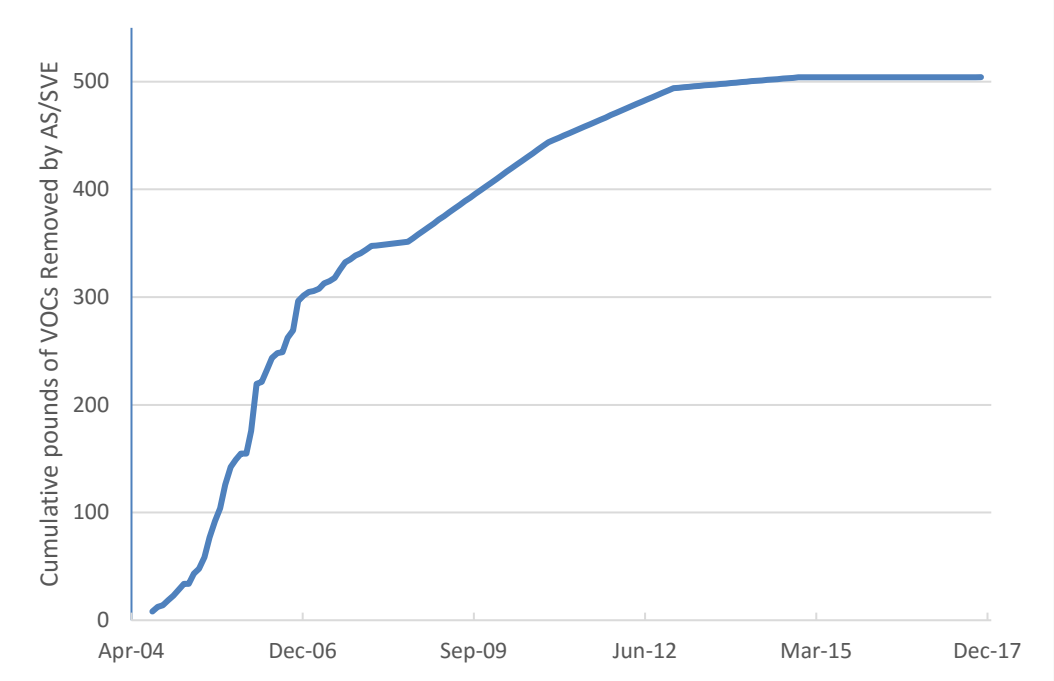


Figure 3-1 Historical Air Sparge/Soil Vapor Extraction System Removal Trends: Cumulative Pounds of VOCs Removed, August 2004 – November 2017

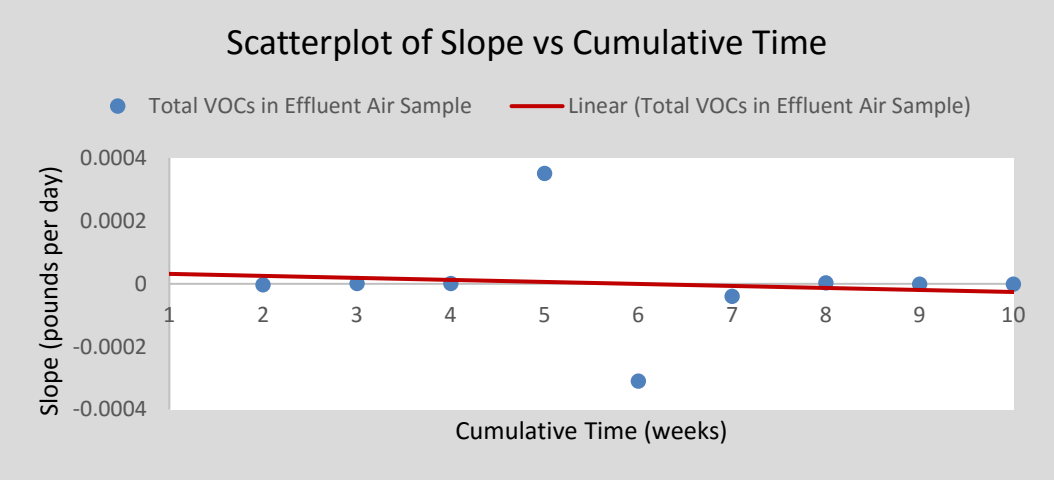


Figure 3-2 Scatterplot of VOC Removal Trends from January – March 2017 (Change in Effluent VOCs vs. Time)

Table 3-1 Summary of Positive Analytical Results for Soil Vapor Samples
Former Davis Howland Oil Corporation Site, Rochester, New York

Analyte	Sample Name: / Date: / Screening Criteria [1]	01-20Jan2017 01/20/17	01-27Jan2017 01/27/17	01-03Feb2017 02/03/17	01-10Feb2017 02/10/17	01-18Feb2017 02/18/17	01-24Feb2017 02/24/17	01-02Mar2017 03/02/17	01-09Mar2017 03/09/17	01-17Mar2017 03/17/17	01-24Mar2017 03/24/17
Volatile Organic Compounds by Method TO-15 (µg/m^3)											
1,1,1-Trichloroethane	N/A	**25**	0.25 U	0.22 U	0.20 U	**33**	**33**	0.23 U	0.30 U	0.28 U	0.22 U
1,1-Dichloroethane	N/A	**20**	0.24 U	0.20 U	0.18 U	**24**	**18**	0.22 U	0.28 U	0.26 U	0.21 U
1,1-Dichloroethene	N/A	**4.6**	0.25 U	0.22 U	0.20 U	**7.2**	**4.1**	0.23 U	0.30 U	0.28 U	0.22 U
2-Hexanone	N/A	**2.3**	0.24 U	0.20 U	**0.27 J**	**120**	**18**	**0.26 J**	0.28 U	**0.78 J**	0.21 U
Acetone	N/A	**15**	1.1 U	**3.9 J**	**8.9**	**1500**	**130**	**7.9**	**46**	**11**	**5.1 J**
Benzene	N/A	0.27 U	0.24 U	**0.58 J**	**0.58**	**0.58 J**	**0.83**	**0.38 J**	0.28 U	**0.87**	**0.51 J**
Carbon Tetrachloride	N/A	**1.1**	0.22 U	**0.43 J**	**0.54 J**	**1.0**	**1.2**	**0.46 J**	0.27 U	**0.41 J**	**0.42 J**
Chloroethane	N/A	0.29 U	0.25 U	0.22 U	0.20 U	**1.0**	0.26 U	0.23 U	0.30 U	**0.42 J**	0.22 U
Chloroform	N/A	**1.1**	0.25 U	0.22 U	0.20 U	**1.9**	**1.6**	**0.29 J**	0.30 U	0.28 U	0.22 U
Chloromethane	N/A	0.25 U	**1.0**	**0.67**	**0.91**	**3.4**	0.23 U	**0.70**	**0.89**	**0.66 J**	**0.47 J**
cis-1,2-Dichloroethylene	N/A	**190**	0.24 U	0.20 U	0.18 U	**220**	**180**	**0.95**	0.28 U	0.26 U	0.21 U
Ethylbenzene	N/A	**1.0**	0.24 U	0.20 U	0.18 U	**0.46 J**	**1.6**	0.22 U	0.28 U	0.26 U	0.21 U
m,p-Xylene	N/A	0.5 U	0.44 U	0.38 U	0.35 U	**0.65 J**	**2.0**	0.41 U	0.53 U	**0.89 J**	0.40 U
Methyl Ethyl Ketone	N/A	**27**	0.31 U	**0.55 J**	**2.3 J**	**4700**	**290**	**2.5 J**	**15**	**7.8 J**	**1.5 J**
Methyl Isobutyl Ketone	N/A	0.27 U	0.24 U	0.20 U	0.18 U	**0.47 J**	0.24 U	0.22 U	0.28 U	0.26 U	0.21 U
Methylene Chloride	60	0.29 U	0.25 U	**0.32 J**	**0.36 J**	0.22 U	**0.95**	**0.46 J**	**6.5**	**0.55 J**	**0.36 J**
o-Xylene	N/A	0.25 U	0.22 U	0.19 U	0.17 U	**0.32 J**	**0.81**	0.21 U	0.27 U	**0.45 J**	0.20 U
Tetrachloroethylene	100	**100**	0.21 U	0.18 U	0.16 U	**50**	**150**	**0.80**	0.25 U	**0.31 J**	**0.32 J**
Toluene	N/A	**1.2**	**0.86**	**1.1**	**0.86**	**2.0**	**1.3**	**0.66 J**	**3.2**	**4.8**	**0.94**
trans-1,2-Dichloroethene	N/A	**3.1**	0.28 U	0.24 U	0.22 U	**3.3**	**3.2**	0.26 U	0.34 U	0.31 U	0.25 U
Trichloroethylene	5	**110**	0.21 U	0.18 U	**0.58**	**100**	**200**	**0.51 J**	0.25 U	0.23 U	**0.23 J**
Trichlorofluoromethane	N/A	**1.9**	**1.4 J**	**1.2**	**1.6 J**	**1.5**	**2.4**	**1.1**	**1.1**	**1.2**	**1.2**
Trichlorotrifluoroethane	N/A	0.29 U	0.25 U	**0.50 J**	**0.58**	**0.36 J**	0.26 U	**0.48 J**	0.30 U	**0.46 J**	**0.42 J**
Vinyl Acetate	N/A	1.1 U	0.96 U	0.83 U	**2.8 J**	0.83 U	0.99 U	**0.99 J**	1.2 U	**1.4 J**	0.86 U
Vinyl Chloride	N/A	**37**	0.25 U	0.22 U	0.20 U	**72**	**34**	**0.32 J**	0.30 U	0.28 U	0.22 U

Key:

Qualifiers

J = Estimated value

U = Not detected (method detection limit shown)

Notes

N/A = Not regulated/no available criteria

µg/m^3 = Micrograms per cubic meter

Bold values denote positive hits.

Shaded values exceed soil vapor guideline values.

1. New York State Department of Health, Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006 (with September 2013 and August 2015 updates).

Source: Ecology and Environment Engineering, P.C. 2017

Additionally, a comparison of removal rates of the AS/SVE system was performed with VOC removal rates of the system during the initial years of operation with more recent operational data. Data associated with this evaluation is presented in Appendix B. Between August 2004 and March 2008 when the CATOX was decommissioned, VOCs were removed via the AS/SVE system at an average rate of 0.3054 lbs/day. Between March 2008 and November 2017, VOCs were removed via the AS/SVE system at an average rate of 0.0417 lbs/day, 13% of the initial removal rate of the system. Evaluating the most recent data between January 2016 and November 2017, the average removal rate of the AS/SVE system was 0.00001 lbs/day, 0.003% of initial system removal rates.

3.2 Groundwater Pumping System Evaluation

3.2.1 Evaluation of Air Stripper Treatment System

Analytical results for pumping wells P2, P3, PW-1, and PW-2 from the pulsed pumping evaluation are provided in Table 3-2. Analytical results were compared to the NYSDEC Technical and Operational Guidance Series Memorandum #1.1.1: Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitation, Class GA Groundwater Standards and Guidance Values. Exceedances of guidance values were observed for 1,1,1-trichloroethane, 1,1- dichloroethane , cis-1,2-dichloroethylene, PCE, trans-1,2- dichloroethylene (DCE), TCE, and vinyl chloride.

Effluent VOC concentrations are collected monthly in compliance with site permits. Figure 3-3 shows the cumulative pounds of VOCs removed each month by the groundwater system from September 2002 through October 2017 when the pulse-pumping evaluation was completed. The groundwater treatment system has moved toward an asymptotic point in VOC contaminant removal, indicating that the system no longer efficiently removes VOC contamination from the site groundwater.

In accordance with DER-10, a statistical analysis of the influent VOC concentrations was performed on the 10 samples collected as part of the pulse pumping evaluation (using Minitab® statistical software, version 18.1) to determine if the operation of the system has reached asymptotic removal rates (i.e., the slope is equal to zero). A student t-test was performed on the slope of the plot of influent VOC concentrations over time from January through October 2017 (sample size = 10). During this time period of nine months, the treatment system removed between 0.01 and 0.74 pounds of VOCs each month. A hypothesis test was performed on the data, which determined that the slope of the data is not statistically different than zero. The 95% confidence limits on the slope were determined to be between -0.018 and 0.0091 lbs/day (see Appendix A). A graphical representation of the VOC removal trends during this time period is shown in the scatterplot (see Figure 3-4). The 10 samples demonstrate that asymptotic groundwater conditions have been achieved at the 95% confidence interval and the mass of contaminants extracted over time is not dependent on continued groundwater pump-and-treat operations.

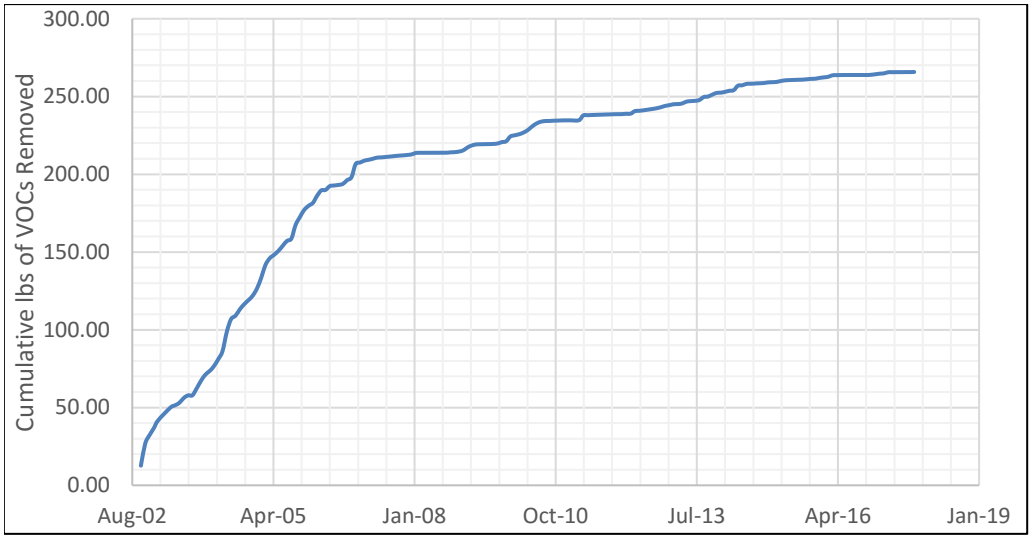


Figure 3-3 Historical Groundwater Treatment Trends: Cumulative Pounds of VOCs Removed, September 2002 – October 2017

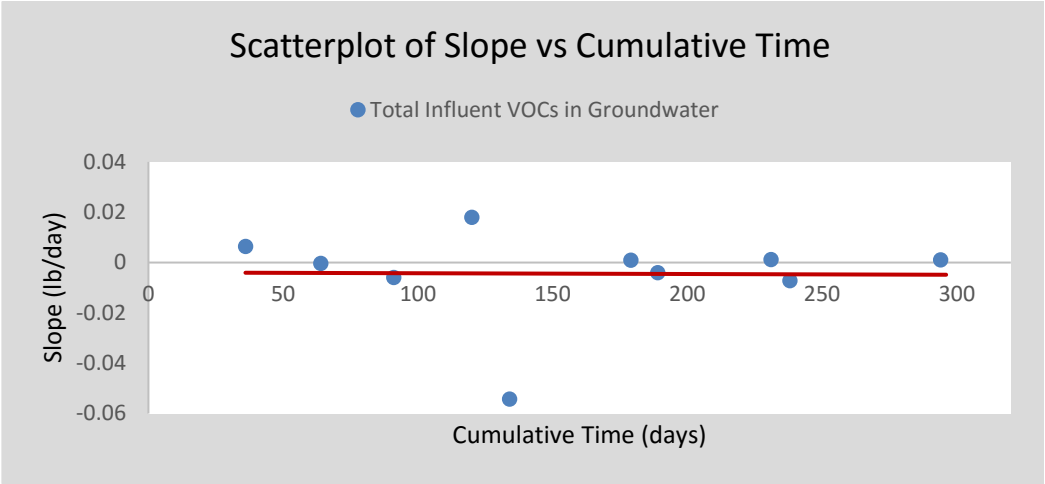


Figure 3-4 Scatterplot of Asymptotic VOC Removal Trends from December 2016 – October 2017 (Change in Influent VOCs vs. Time)

Table 3-2 Summary of Positive Analytical Results for Pulse Pumped Groundwater Samples
Davis Howland Oil Company, Monroe County, NY

Analyte	Screening Criteria [1]	Notes	Location ID: / Sample Name: / Date:									
			P-2 P-2-A-APR17 04/14/17	P-2 P-2-B-APR17 04/28/17	P-2 P-2-A-JUN17 06/12/17	P-2 P-2-B-JUN17 06/22/17	P-2 P-2-A-AUG17 08/03/17	P-2 P-2-B-AUG17 08/10/17	P-2 P-2-OCT17 10/05/17	P-3 P-3-JAN17 01/20/17	P-3 P-3-FEB17 02/17/17	P-3 P-3-MAR17 03/16/17
Volatile Organic Compounds by Method 8260C (µg/L)												
1,1,1-Trichloroethane	5		**23**	**16**	**27**	**13**	**27**	0.4 U	**2.8**	**68**	**80**	**64**
1,1,2-Trichloroethane	1		1 U	1 U	0.4 U	0.4 U	1 U	0.4 U	0.4 U	2 U	2 U	2 U
1,1-Dichloroethane	5		**150**	**56**	**130**	**50**	**69**	**15**	**21**	**46**	**40**	**46**
1,1-Dichloroethene	5		1 U	1 U	**2.7**	**3.4**	1 U	**3.3**	**3.4**	**14**	**14**	**18**
1,2-Dichlorobenzene	3		1.3 U	1.3 U	0.5 U	0.5 U	1.3 U	0.5 U	0.5 U	2.5 U	2.5 U	2.5 U
1,3-Dichlorobenzene	3		1.1 U	1.1 U	0.44 U	0.44 U	1.1 U	0.44 U	0.44 U	2.2 U	2.2 U	2.2 U
Carbon Tetrachloride	5		1 U	1 U	0.4 U	0.4 U	1 U	0.4 U	0.4 U	2 U	2 U	2 U
Chloroethane	5		1.2 U	1.2 U	**3.8**	0.48 U	1.2 U	0.48 U	0.48 U	2.4 U	2.4 U	2.4 U
Chloroform	7		1 U	1 U	0.4 U	0.4 U	1 U	0.4 U	0.4 U	2 U	2 U	2 U
Cis-1,2-Dichloroethylene	5		**510**	**710**	**260**	**510**	**460**	**210**	**290**	**1700**	**1400**	**1900**
Tetrachloroethylene (PCE)	5		**11**	**8.9**	**43**	**34**	**130**	0.4 U	**31**	**1000**	**1400**	**850**
Trans-1,2-Dichloroethene	5		**8.2**	1 U	**4.5**	**4.1**	1 U	**2.1**	**2.5**	2 U	2 U	2 U
Trichloroethylene (TCE)	5		**34**	**71**	**45**	**47**	**53**	**13**	**26**	**370**	**430**	**430**
Vinyl Chloride	2		**87**	**7.6**	0.4 U	**17**	1 U	**20**	**24**	2 U	2 U	2 U

Key:

Qualifiers

J = Estimated value

U = Not detected (method detection limit shown)

Notes

1. New York State Department of Environmental Conservation, Technical and Operational Guidance Series Memorandum #1.1.1: *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations,* 1998 (with updates), Class GA Groundwater Standards and Guidance Values.
2. Shaded cells exceed the screening value.
3. Bold values denote positive hits.

Other

µg/L = Micrograms per liter

Key at end of table.

Source: Ecology and Environment Engineering, P.C. 2015

Table 3-2 Summary of Positive Analytical Results for Pulse Pumped Groundwater Samples
Davis Howland Oil Company, Monroe County, NY

Analyte	Screening Criteria [1]	Notes	Location ID: / Sample Name: / Date:										
			P-3 P-3-A-APR17 04/14/17	P-3 P-3-B-APR17 04/28/17	P-3 P-3-A-JUN17 06/12/17	P-3 P-3-B-JUN17 06/22/17	P-3 P-3-A-AUG17 08/03/17	P-3 P-3-B-AUG17 08/10/17	P-3 P-3-OCT17 10/05/17	PW-1 PW-1-JAN17 01/20/17	PW-1 PW-1-FEB17 02/17/17	PW-1 PW-1-MAR17 03/16/17	PW-1 PW-1-A-APR17 04/14/17
Volatile Organic Compounds by Method 8260C (µg/L)													
1,1,1-Trichloroethane	5		**130**	**5.2**	**110**	**27**	**95**	0.2 U	**61**	0.5 U	0.4 U	0.4 U	0.2 U
1,1,2-Trichloroethane	1		2 U	0.4 U	1 U	1 U	1 U	0.2 U	**2**	0.5 U	0.4 U	0.4 U	0.2 U
1,1-Dichloroethane	5		**65**	**26**	**42**	**34**	**31**	**17**	**36**	**23**	**22**	**19**	**25**
1,1-Dichloroethene	5		**25**	**3.4**	**11**	**7.2**	**7.8**	**3.2**	**16**	**5.2**	**3.4**	**3.2**	**3**
1,2-Dichlorobenzene	3		2.5 U	0.5 U	1.3 U	1.3 U	1.3 U	0.25 U	**3.7**	0.63 U	0.5 U	0.5 U	0.25 U
1,3-Dichlorobenzene	3		2.2 U	0.44 U	1.1 U	1.1 U	1.1 U	0.22 U	**2.5**	0.55 U	0.44 U	0.44 U	0.22 U
Carbon Tetrachloride	5		2 U	0.4 U	1 U	1 U	1 U	0.2 U	**2.5**	0.5 U	0.4 U	0.4 U	0.2 U
Chloroethane	5		2.4 U	0.48 U	1.2 U	1.2 U	1.2 U	0.24 U	0.48 U	0.6 U	0.48 U	0.48 U	0.24 U
Chloroform	7		2 U	0.4 U	1 U	1 U	1 U	0.2 U	**5.2**	0.5 U	0.4 U	0.4 U	0.2 U
Cis-1,2-Dichloroethylene	5		**2700**	**330**	**1300**	**860**	**1400**	**220**	**210**	**380**	**240**	**280**	**260**
Tetrachloroethylene (PCE)	5		**2000**	**270**	**1400**	**510**	**1300**	0.2 U	**38**	**3.8**	0.4 U	0.4 U	0.2 U
Trans-1,2-Dichloroethene	5		2 U	**2.3**	1 U	1 U	1 U	**2.2**	**3.6**	0.5 U	**2**	**2.3**	**2.1**
Trichloroethylene (TCE)	5		**630**	**55**	**380**	**220**	**310**	**14**	**42**	**23**	**19**	**16**	**13**
Vinyl Chloride	2		2 U	0.4 U	1 U	1 U	1 U	**33**	**30**	**22**	**8.5**	**39**	**73**

Key:

Qualifiers

J = Estimated value

U = Not detected (method detection limit shown)

Notes

1. New York State Department of Environmental Conservation, Technical and Operational Guidance Series Memorandum #1.1.1: *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations,* 1998 (with updates), Class GA Groundwater Standards and Guidance Values.
2. Shaded cells exceed the screening value.
3. Bold values denote positive hits.

Other

µg/L = Micrograms per liter

Key at end of table.

Source: Ecology and Environment Engineering, P.C. 2015

Table 3-2 Summary of Positive Analytical Results for Pulse Pumped Groundwater Samples
Davis Howland Oil Company, Monroe County, NY

Analyte	Screening Criteria [1]	Notes	Location ID: / Sample Name: / Date:	PW-1 PW-1-B-APR17 04/28/17	PW-1 PW-1-A-JUN17 06/12/17	PW-1 PW-1-B-JUN17 06/22/17	PW-1 AUG17 08/03/17	PW-1 PW-1-B-AUG17 08/10/17	PW-1 PW-1-OCT17 10/05/17	PW-2 PW-2-JAN17 01/20/17	PW-2 PW-2-FEB17 02/17/17	PW-2 PW-2-MAR17 03/16/17	PW-2 PW-2-A-APR17 04/14/17
Volatile Organic Compounds by Method 8260C (µg/L)													
1,1,1-Trichloroethane	5			0.4 U	0.4 U	0.4 U	0.2 U	0.2 U	0.4 U	**1.2**	**1.2**	0.2 U	0.2 U
1,1,2-Trichloroethane	1			0.4 U	0.4 U	0.4 U	0.2 U	0.2 U	0.4 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-Dichloroethane	5			**16**	**16**	**13**	**12**	**15**	**16**	**11**	**14**	**16**	**13**
1,1-Dichloroethene	5			**3.8**	**2.1**	**3.1**	0.2 U	**3.3**	**3.8**	**2.4**	0.2 U	**2.8**	**2.4**
1,2-Dichlorobenzene	3			0.5 U	0.5 U	0.5 U	0.25 U	0.25 U	0.5 U	0.25 U	0.25 U	0.25 U	0.25 U
1,3-Dichlorobenzene	3			0.44 U	0.44 U	0.44 U	0.22 U	0.22 U	0.44 U	0.22 U	0.22 U	0.22 U	0.22 U
Carbon Tetrachloride	5			0.4 U	0.4 U	0.4 U	0.2 U	0.2 U	0.4 U	0.2 U	0.2 U	0.2 U	0.2 U
Chloroethane	5			0.48 U	0.48 U	0.48 U	0.24 U	0.24 U	0.48 U	0.24 U	0.24 U	0.24 U	0.24 U
Chloroform	7			0.4 U	0.4 U	0.4 U	0.2 U	0.2 U	0.4 U	0.2 U	0.2 U	0.2 U	0.2 U
Cis-1,2-Dichloroethylene	5			**260**	**190**	**250**	**100**	**280**	**290**	**140 J**	**1.5**	**190**	**140**
Tetrachloroethylene (PCE)	5			0.4 U	0.4 U	0.4 U	**7.9**	0.2 U	0.4 U	**1.9**	**2.2**	**1.2**	**1.1**
Trans-1,2-Dichloroethene	5			0.4 U	0.4 U	**2**	0.2 U	**2.7**	**3.1**	0.2 U	0.2 U	0.2 U	0.2 U
Trichloroethylene (TCE)	5			**15**	**13**	**13**	**15**	**15**	**12**	**14**	**12**	**11**	**8.7**
Vinyl Chloride	2			**18**	**23**	**38**	0.2 U	**37**	**62**	**9.1**	0.2 U	**6.7**	**2.3**

Key:

Qualifiers

J = Estimated value

U = Not detected (method detection limit shown)

Notes

1. New York State Department of Environmental Conservation, Technical and Operational Guidance Series Memorandum #1.1.1: *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations,* 1998 (with updates), Class GA Groundwater Standards and Guidance Values.
2. Shaded cells exceed the screening value.
3. Bold values denote positive hits.

Other

µg/L = Micrograms per liter

Key at end of table.

Source: Ecology and Environment Engineering, P.C. 2015

Table 3-2 Summary of Positive Analytical Results for Pulse Pumped Groundwater Samples
Davis Howland Oil Company, Monroe County, NY

Analyte	Screening Criteria [1]	Notes	Location ID: / Sample Name: / Date:	PW-2 / PW-2-B-APR17 / 04/28/17	PW-2 / PW-2-A-JUN17 / 06/12/17	PW-2 / PW-2-B-JUN17 / 06/22/17	PW-2 / PW-2-A-AUG17 / 08/03/17	PW-2 / PW-2-B-AUG17 / 08/10/17	PW-2 / PW-2-OCT17 / 10/05/17
Volatile Organic Compounds by Method 8260C (µg/L)									
1,1,1-Trichloroethane	5			0.2 U	**1.2**	0.2 U	**2.1**	0.2 U	0.2 U
1,1,2-Trichloroethane	1			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-Dichloroethane	5			**27**	**20**	**22**	**17**	**14**	**17**
1,1-Dichloroethene	5			**4.2**	**1**	**3.1**	0.2 U	**2.9**	**4.3**
1,2-Dichlorobenzene	3			0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
1,3-Dichlorobenzene	3			0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U
Carbon Tetrachloride	5			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Chloroethane	5			0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U
Chloroform	7			0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Cis-1,2-Dichloroethylene	5			**340**	**8.5**	**260**	**27**	**220**	**260**
Tetrachloroethylene (PCE)	5			0.2 U	**1.6**	**1**	**13**	0.2 U	0.2 U
Trans-1,2-Dichloroethene	5			**1.5**	0.2 U	**1.1**	0.2 U	**2.4**	**3.2**
Trichloroethylene (TCE)	5			**9.6**	**7**	**7.8**	**9.6**	**15**	**13**
Vinyl Chloride	2			**7.4**	0.2 U	**7.1**	0.2 U	**29**	**66**

Key:

Qualifiers

J = Estimated value

U = Not detected (method detection limit shown)

Notes

1. New York State Department of Environmental Conservation, Technical and Operational Guidance Series Memorandum #1.1.1: *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations,* 1998 (with updates), Class GA Groundwater Standards and Guidance Values.
2. Shaded cells exceed the screening value.
3. Bold values denote positive hits.

Other

µg/L = Micrograms per liter

Key at end of table.

Source: Ecology and Environment Engineering, P.C. 2015

Additionally, a comparison of removal rates of the air stripper system was performed. VOC removal rates of the system during the initial years of operation were compared with more recent operational data. Data associated with this evaluation is presented in Appendix B. Between September 2002 and August 2008, VOCs were removed via the pumping wells system at an average rate of 0.1082 lbs/day. Between September 2008 and November 2017, VOCs were removed via the pumping wells system at an average rate of 0.0163 lbs/day, 15% of the initial removal rate of the system. When the most recent data between January 2016 and November 2017 was evaluated, it was determined that the average removal rate of the pumping wells system is 0.005 lbs/day, 4% of initial system removal rates.

3.2.2 Evaluation of Individual Pumping Wells

Pursuant to Section 6.4(b)2.i. of DER-10, the 10 pulse pumping samples were used to evaluate how the period of inactivity impacted contaminant concentrations. The pre- and post-shutdown removal concentrations at pumping wells P-2, P-3, PW-1, and PW-2 were analyzed for PCE, TCE, cis-1,2-DCE, and vinyl chloride to provide guidance as to the point at which the natural degradation of PCE occurs (see Figures 3-5 through 3-8).

Concentrations of PCE, TCE, and vinyl chloride at pumping wells P-2, PW-1, and PW-2, remained relatively consistent before and after the pumps were pulsed, indicating that they are independent of pulse pumping efforts. At pumping well P-3, concentrations of TCE and vinyl chloride remained relatively consistent before and after the pumps were pulsed. Concentrations of cis-1,2-DCE were the most variable at all pumping wells and, in some instances, increased slightly when the pump was turned off at P-3 indicating that pulsed pumping of this well may increase contaminate removal. PCE also followed this trend at pumping well P-3. At pumping wells P-2, PW-1, and PW-2, cis-1,2-DCE concentrations increased slightly when the pumps were turned on, indicating no correlation to pumping efforts.

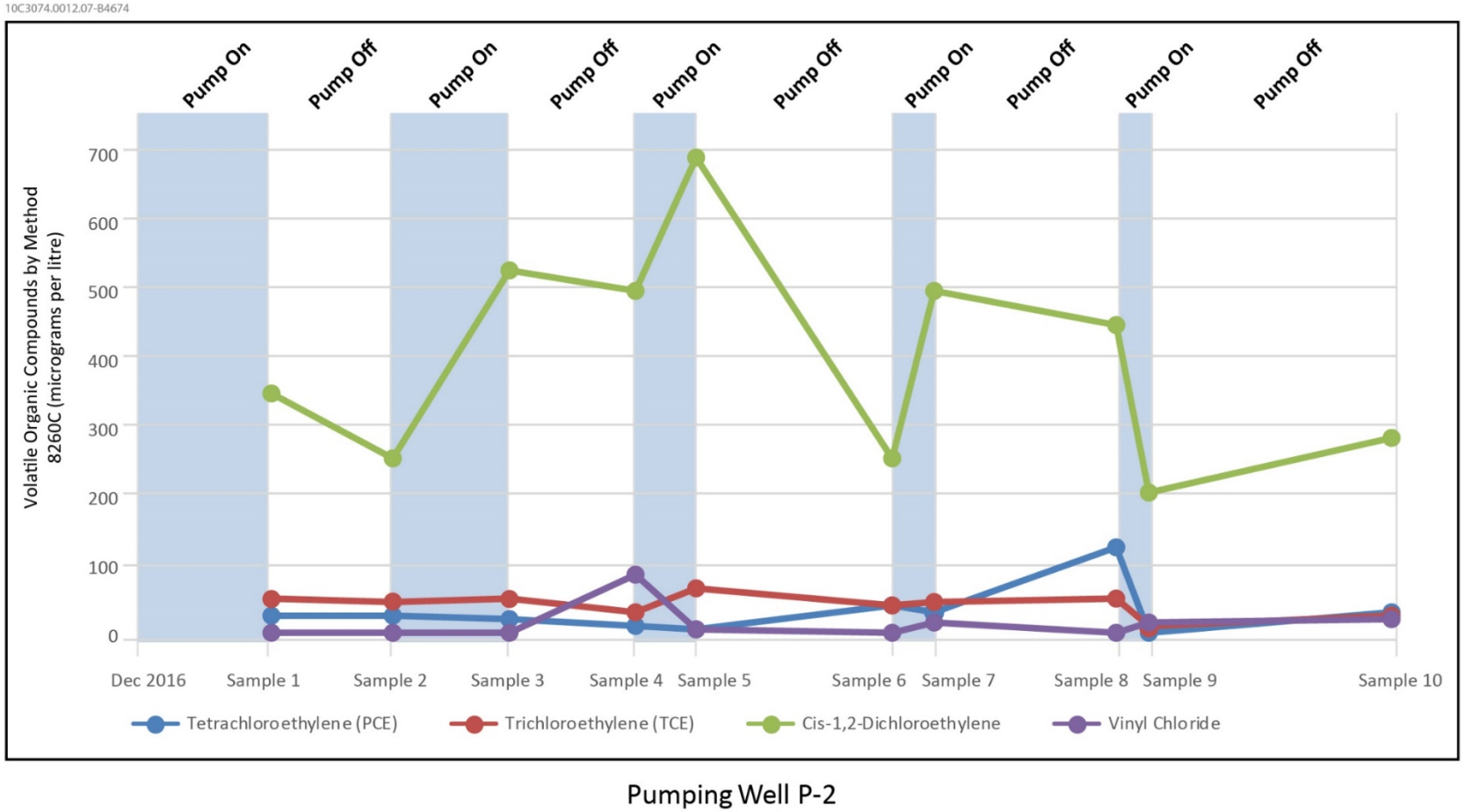


Figure 3-5 Pulse Pumping Groundwater Sampling Results for Pumping Well P-2, 2017

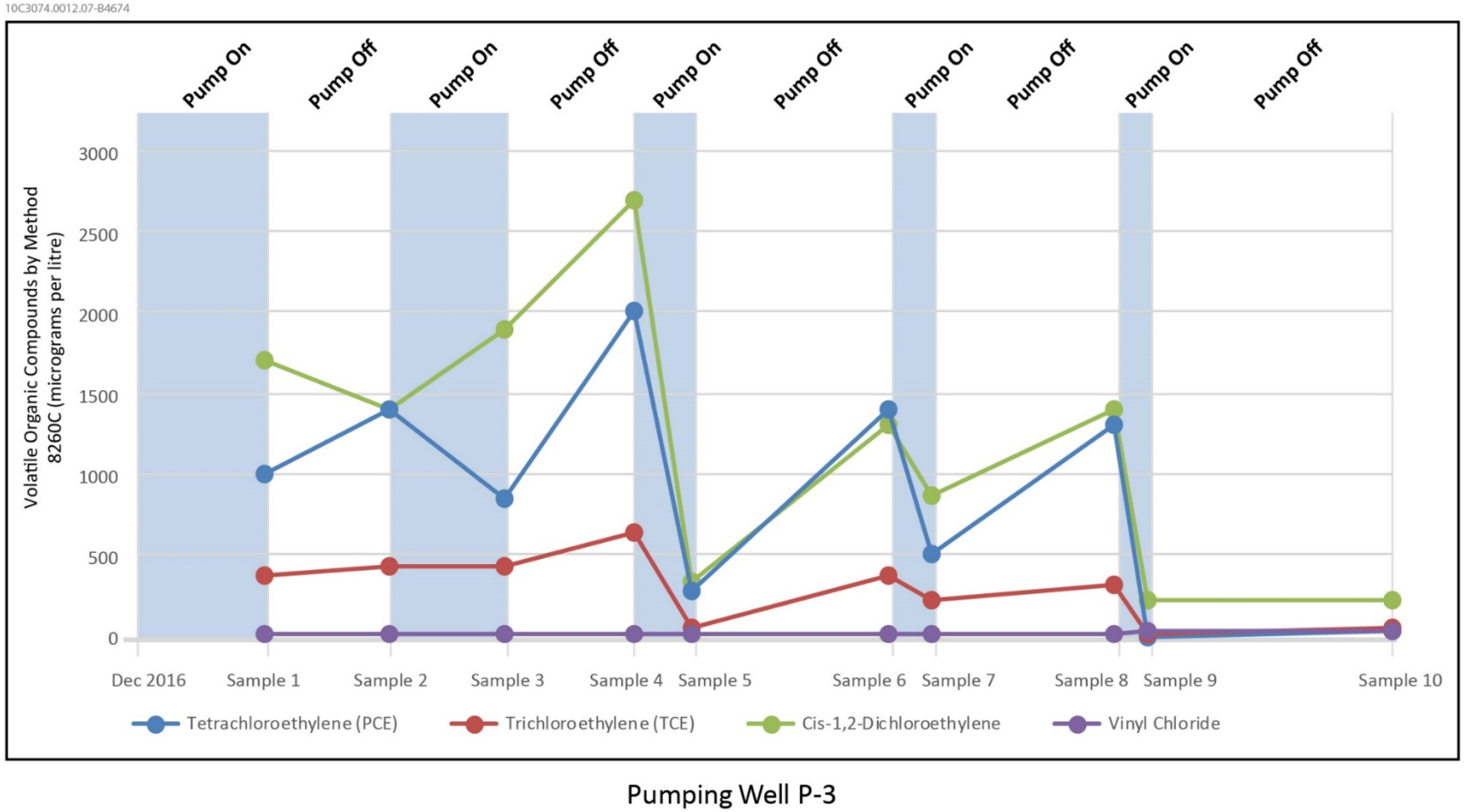


Figure 3-6 Pulse Pumping Groundwater Sampling Results for Pumping Well P-3, 2017

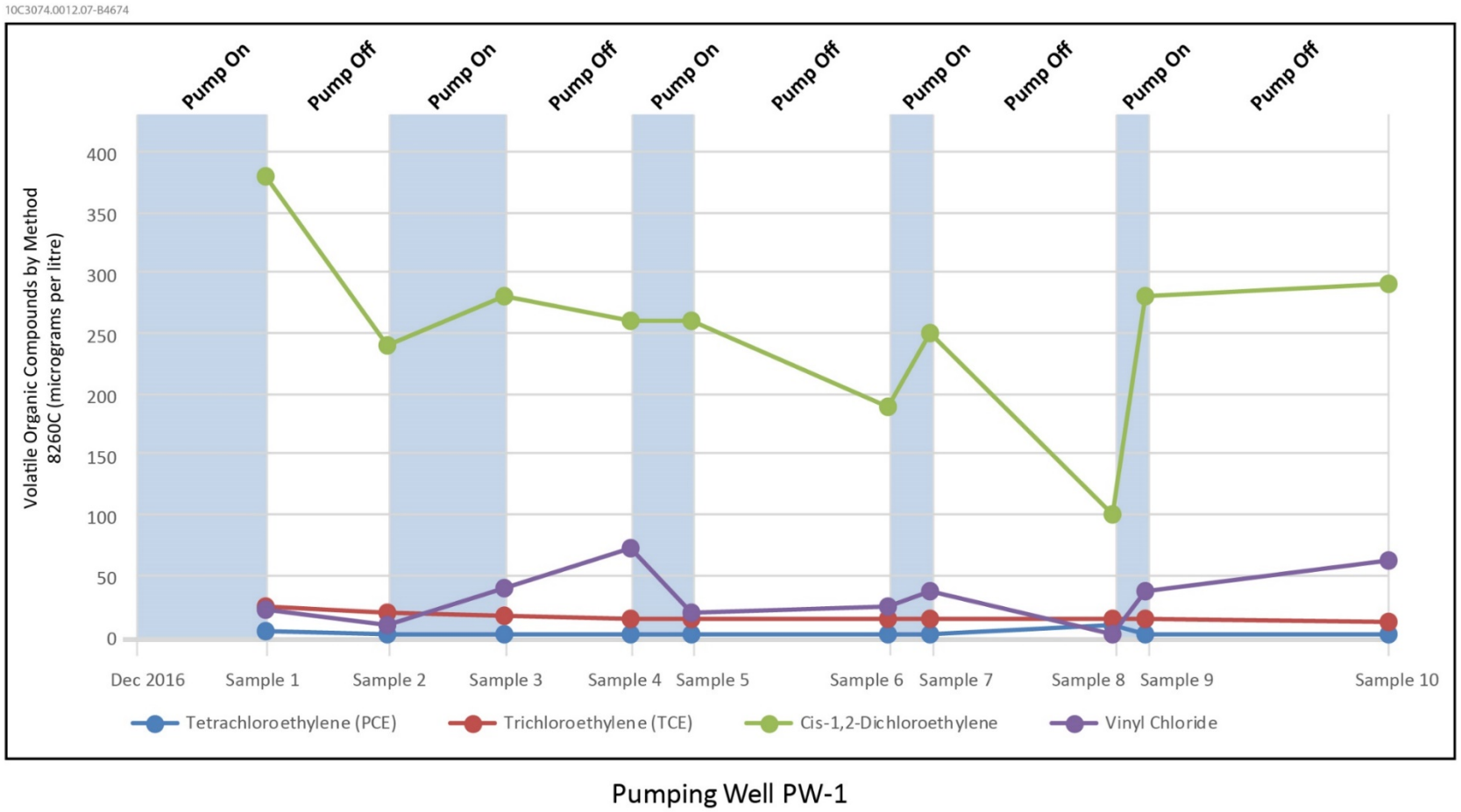


Figure 3-7 Pulse Pumping Groundwater Sampling Results for Pumping Well PW-1, 2017

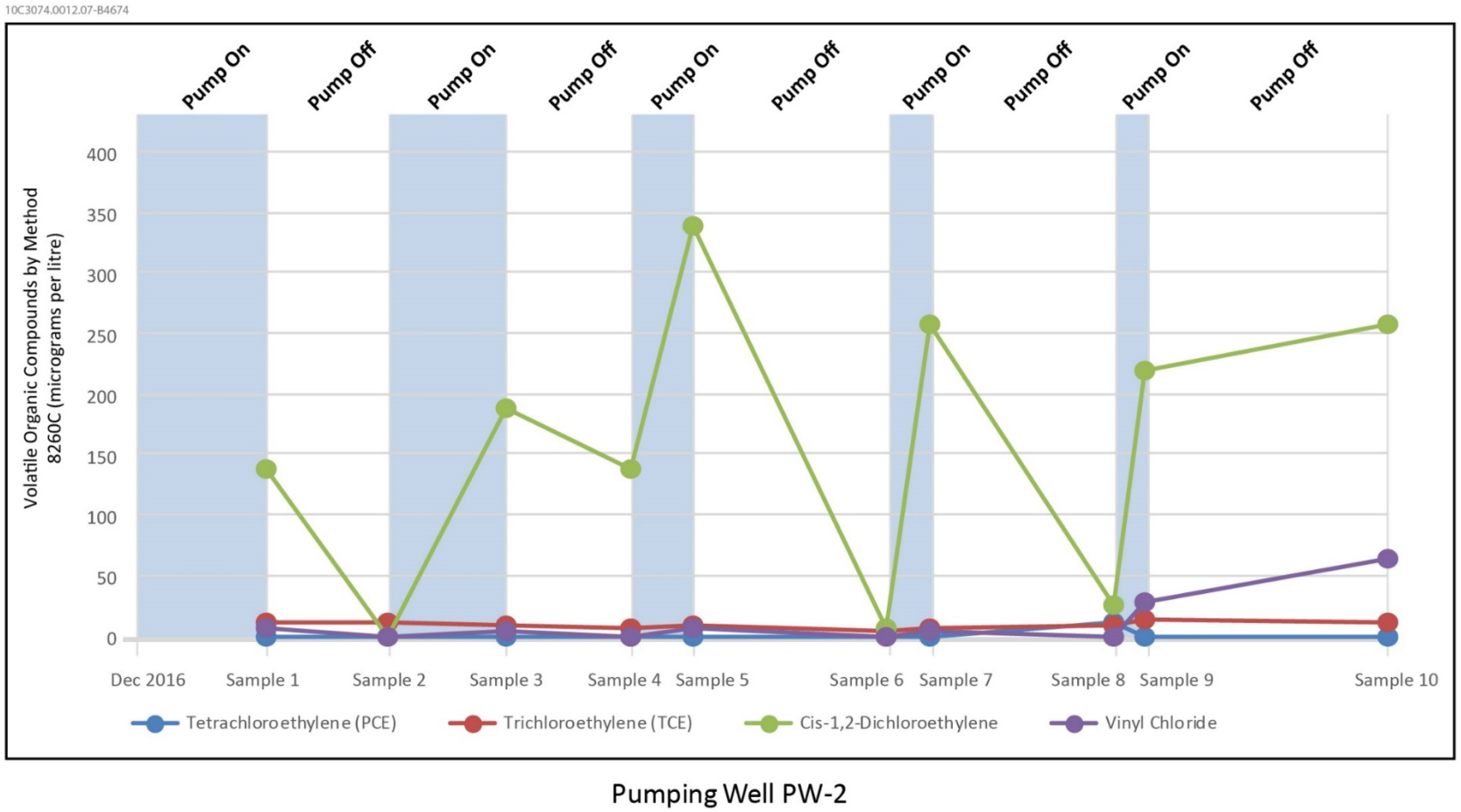


Figure 3-8 Pulse Pumping Groundwater Sampling Results for Pumping Well PW-2, 2017

4 Conclusion

4.1 AS/SVE System

Statistical analysis of the VOC concentrations in the effluent air from the AS/SVE system was performed pursuant to Section 6.4 of DER-10. The analytical results from the 10 air quality samples indicate that the cumulative pounds of VOCs removed in the effluent air has statistically remained the same, therefore the treatment system has reached an asymptotic state and no longer efficiently removes VOCs from the site. The sampling indicates that asymptotic conditions have been achieved within the 95% confidence interval and the mass of contaminants extracted over time is not dependent on continued operation of the system.

4.2 Pumping Well System

Statistical analysis of the influent VOC concentrations of the pumping well system was performed pursuant to Section 6.4 of DER-10. The analytical results from the 10 pulse pumping well samples collected indicate that the cumulative pounds of VOCs removed from the groundwater has statistically remained the same, therefore the treatment system has reached an asymptotic state and is no longer efficiently removing VOCs from the site. The sampling indicates that asymptotic conditions have been achieved within the 95% confidence interval and the mass of contaminants extracted over time is not dependent on continued operation of the system.

The analytical results from the individual pumping well samples indicate that pre- and post-shutdown removal concentrations of PCE, TCE, and vinyl chloride were consistent at pumping wells P-2, PW-1, and PW-2, demonstrating the inefficiency of continued pumping at those locations. Further, pre- and post-shutdown removal concentrations of TCE and vinyl chloride were also consistent at pumping well P-3.

5 References

Ecology and Environment Engineering, P.C. (EEEPC). 2016. *Sampling Work Plan and Equipment Repairs, Former Davis-Howland Oil Corporation Site, NYSDEC Site No. 8-28-088, City of Rochester, Monroe County, New York.*

United States Environmental Protection Agency (EPA). 1999. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition*, EPA/625/R-96/010b. Prepared by W.A. McClenny.

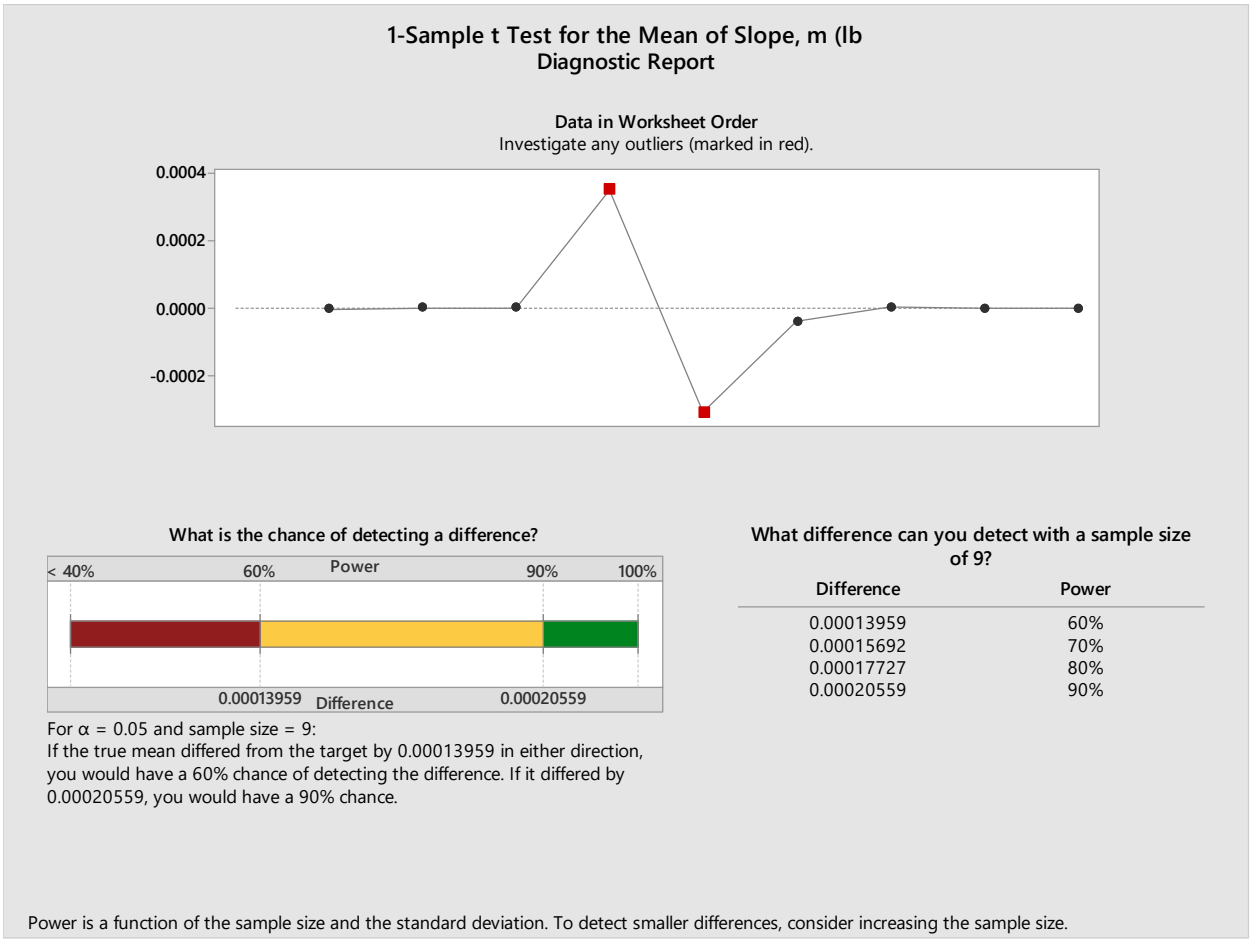
New York State Department of Environmental Conservation (NYSDEC). 2010. Division of Environmental Remediation (DER) DER-10 *Technical Guidance for Site Investigation and Remediation.* May 2010.

Welling, William. 2016. Personal communication. William Welling of the New York State Department of Environmental Conservation (NYSDEC). Letter to Ashlee Patnode; Ecology and Environment Engineering, P.C. (EEEPC) regarding Davis-Howland, Site ID No. 828088. September 14, 2016.

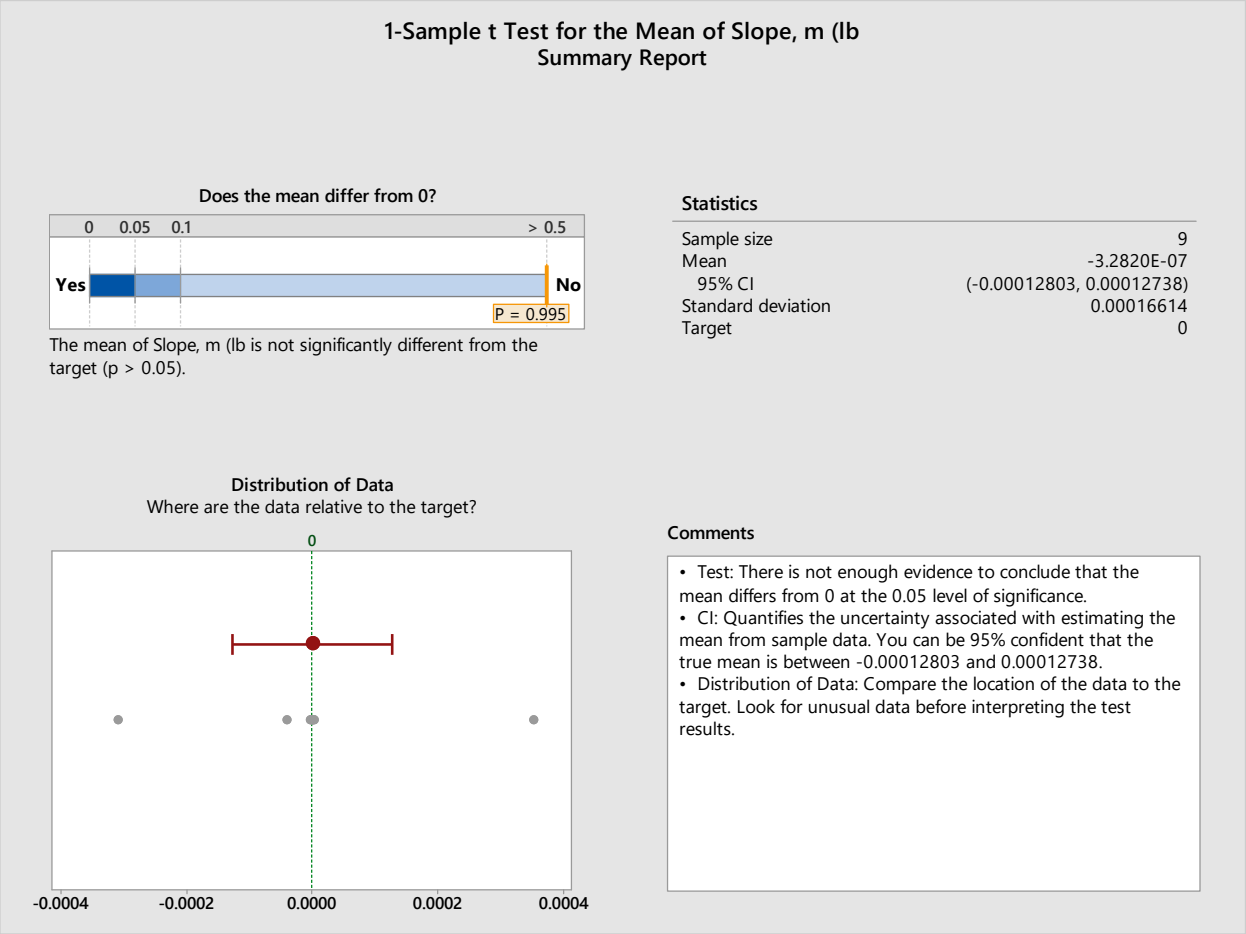
A Minitab Project Reports

Statistical Analysis of Effluent Air Concentrations

Purpose: Determine whether an asymptote (slope = 0) has been reached
Methodology: Student 1-Sample t-test and Hypothesis Test on the slope
Sample Size: 10
Sample Date: January – March 2017
Conclusion: Operational data indicates that the VOC concentrations in the effluent air have reached asymptotic removal rates at the 95% confidence limit on the slope (between -0.0001 and +0.0001).



Source: Minitab® version 18.1



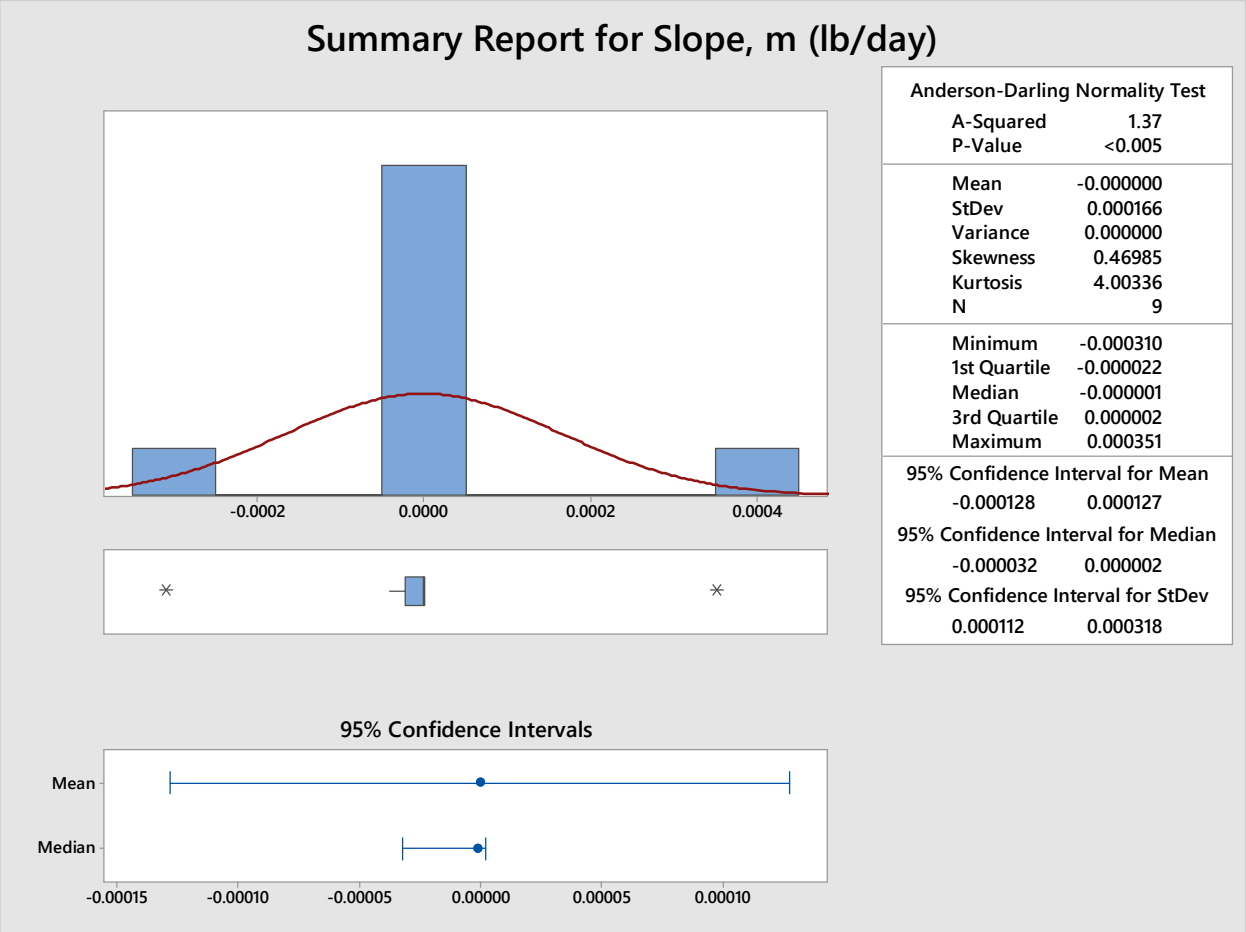
Source: Minitab® version 18.1

1-Sample t Test for the Mean of Slope, m (lb
Report Card

Check	Status	Description
Unusual Data		Some of the data points are unusual compared to the others. Because unusual data can have a strong influence on the results, you should try to identify the cause of their unusual nature. These points are marked in red on the Diagnostic Report. You can hover over a point or use Minitab's brushing feature to identify the worksheet row. Correct any data entry or measurement errors. Consider removing data that are associated with special causes and repeating the analysis.
Normality		Because your sample size is less than 20, normality can be an issue. If the data are not normally distributed, the p-value may be inaccurate with small samples. In addition, unusual data can have a strong influence on the test results. Because normality cannot be reliably checked with small samples, you should use caution when interpreting the test results.
Sample Size		Your data does not provide sufficient evidence to conclude that the mean differs from the target. This may result from having a sample size that is too small. Based on your sample size, standard deviation, and α, you would have a 90% chance of detecting a difference of 0.00020559. To determine how large your sample needs to be to detect a difference that has practical implications, repeat the analysis and enter a value for the difference.

Source: Minitab® version 18.1

Due to the sample size being less than 20 (n=10) normality can be an issue (see 1-Sample t Test for the Mean of the Slope, Report Card above); therefore the data has been graphically summarized below to identify the distribution. The data shows a normal distribution.

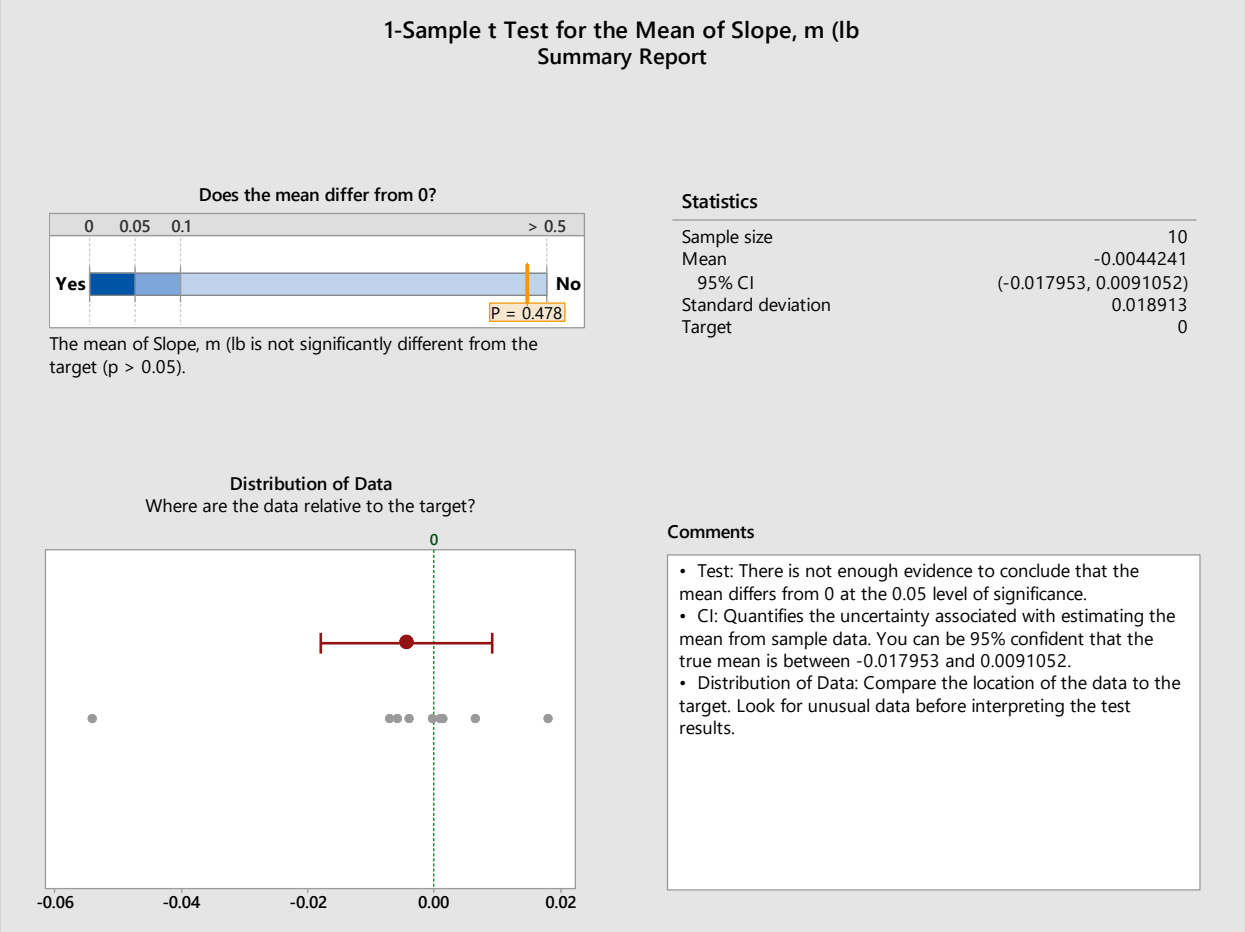


Source: Minitab® version 18.1

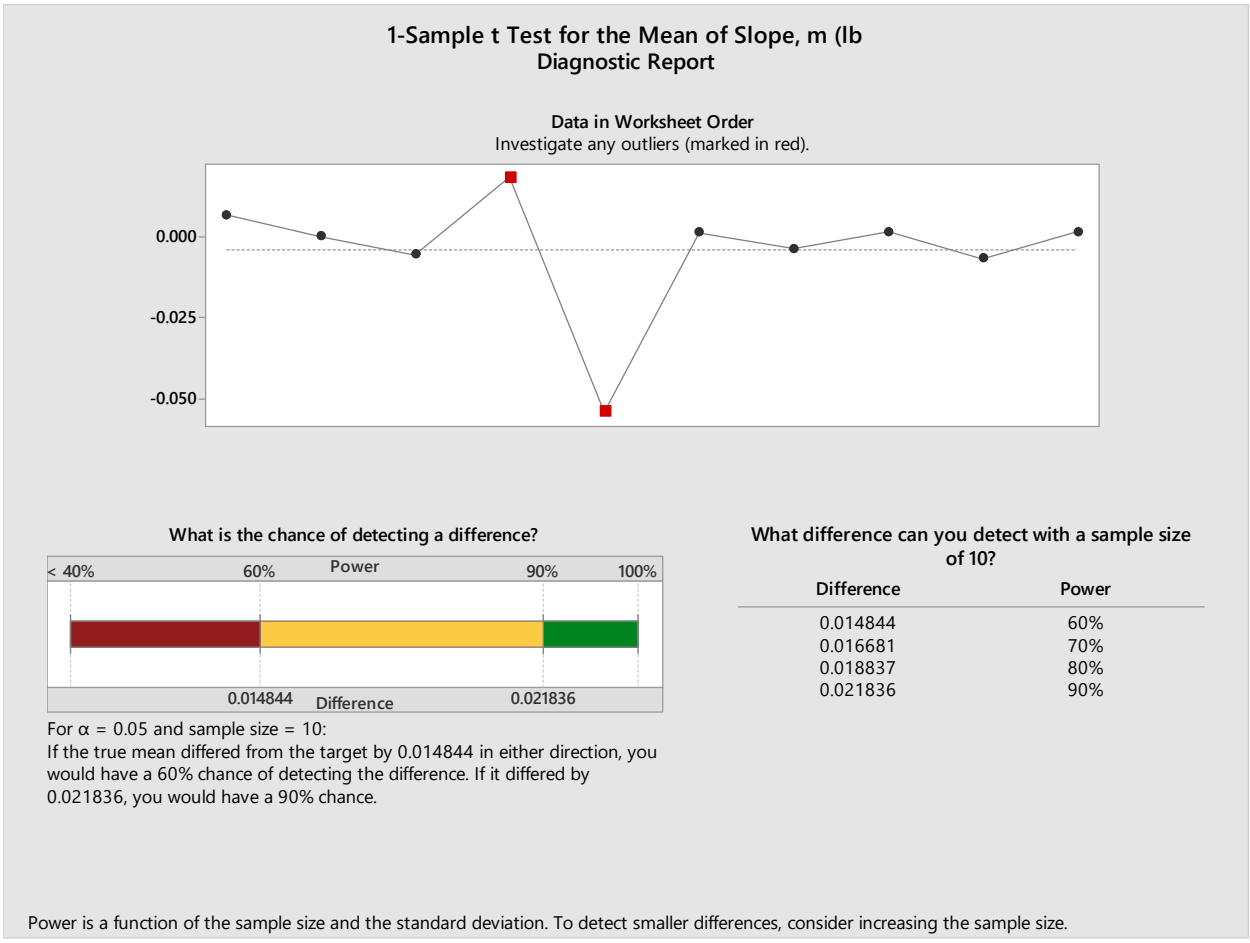
Sample No.	Sample Date	Total VOCs (µg/m3)	Total VOCs (µg/L)	Total VOCs (µg)	Time between Sample (days)	Slope, m (lb/day)
1	1/20/2017	540.3	0.5403	3.2418	7	--
2	1/27/2017	3.3	0.0033	0.0198	7	-3.32102E-06
3	2/3/2017	9.25	0.00925	0.0555	7	2.67441E-07
4	2/10/2017	20.28	0.02028	0.12168	7	4.95777E-07
5	2/18/2017	6843.14	6.84314	41.05884	7	0.000350615
6	2/24/2017	1072.99	1.07299	6.43794	7	-0.000310188
7	3/2/2017	18.76	0.01876	0.11256	7	-4.06162E-05
8	3/9/2017	72.69	0.07269	0.43614	7	2.54451E-06
9	3/17/2017	32	0.032	0.192	7	-1.62346E-06
10	3/24/2017	11.47	0.01147	0.06882	7	-1.12826E-06

Statistical Analysis of Groundwater Treatment Removal Rate

Purpose: Determine whether an asymptote (slope = 0) has been reached
Methodology: Student 1-Sample t-test and Hypothesis Test on the slope
Sample Size: 10
Sample Date: December 2016 – October 2017
Conclusion: Operational data indicates that the remedial groundwater pumping and air-stripping treatment system has reached asymptotic removal rates at the 95% confidence limit on the slope (between -0.018 and 0.0091).



Source: Minitab® version 18.1



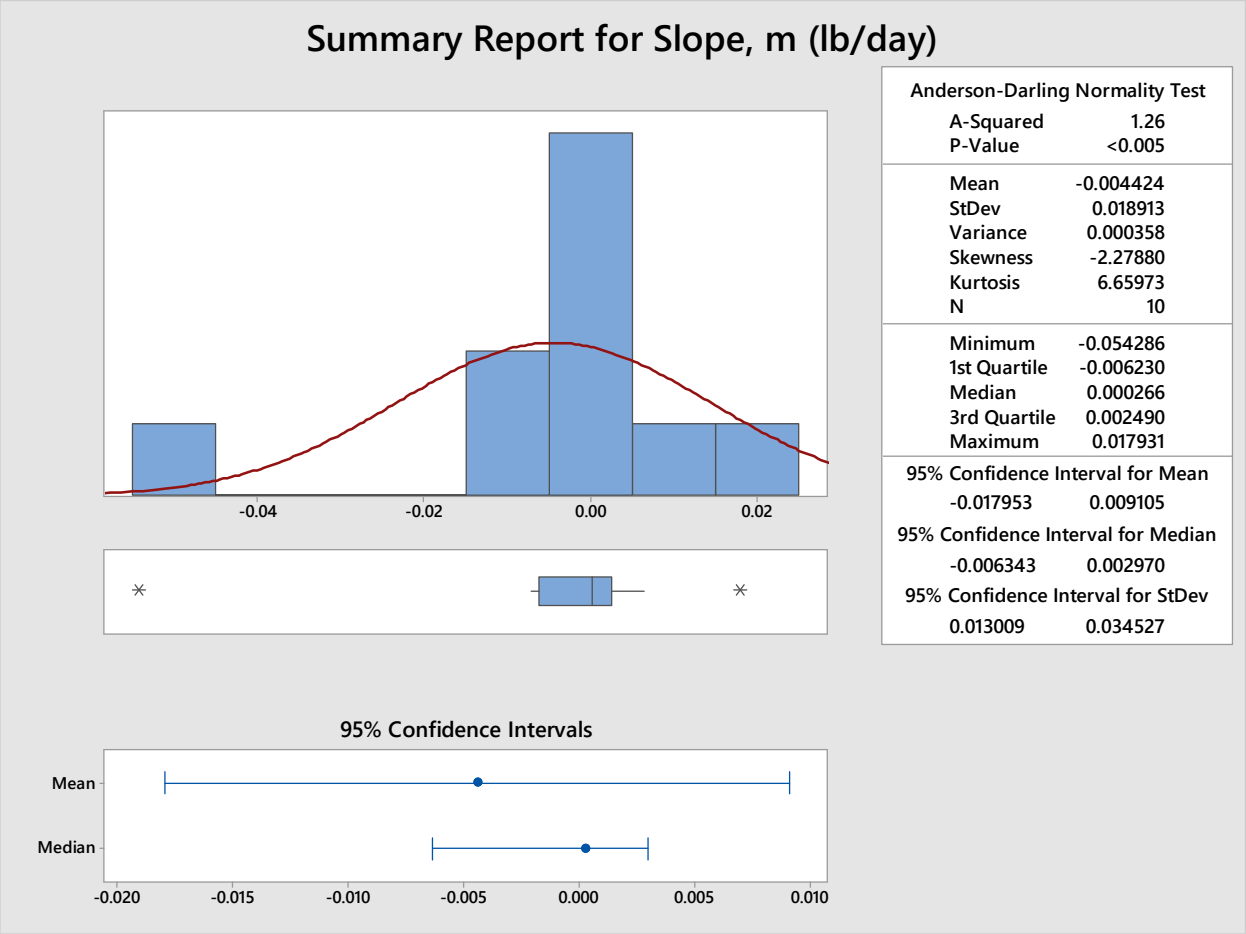
Source: Minitab® version 18.1

1-Sample t Test for the Mean of Slope, m (lb
Report Card

Check	Status	Description
Unusual Data	⚠	Some of the data points are unusual compared to the others. Because unusual data can have a strong influence on the results, you should try to identify the cause of their unusual nature. These points are marked in red on the Diagnostic Report. You can hover over a point or use Minitab's brushing feature to identify the worksheet row. Correct any data entry or measurement errors. Consider removing data that are associated with special causes and repeating the analysis.
Normality	⚠	Because your sample size is less than 20, normality can be an issue. If the data are not normally distributed, the p-value may be inaccurate with small samples. In addition, unusual data can have a strong influence on the test results. Because normality cannot be reliably checked with small samples, you should use caution when interpreting the test results.
Sample Size	ⓘ	Your data does not provide sufficient evidence to conclude that the mean differs from the target. This may result from having a sample size that is too small. Based on your sample size, standard deviation, and α, you would have a 90% chance of detecting a difference of 0.021836. To determine how large your sample needs to be to detect a difference that has practical implications, repeat the analysis and enter a value for the difference.

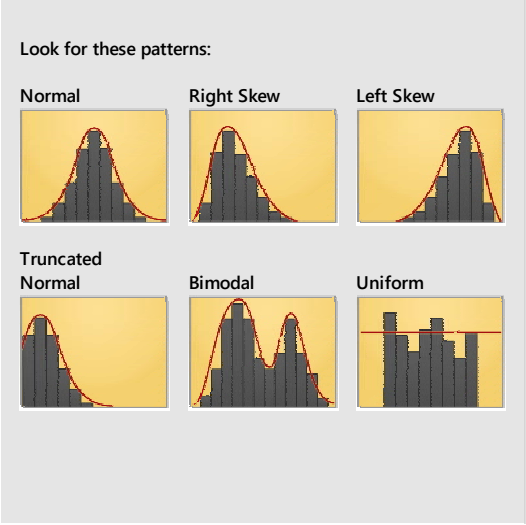
Source: Minitab® version 18.1

Due to the sample size being less than 20 (n=10) normality can be an issue (see 1-Sample t Test for the Mean of the Slope, Report Card above); therefore the data has been graphically summarized below to identify the distribution. The data shows a left skew distribution.



Source: Minitab® version 18.1

Graphical Summary Examples:



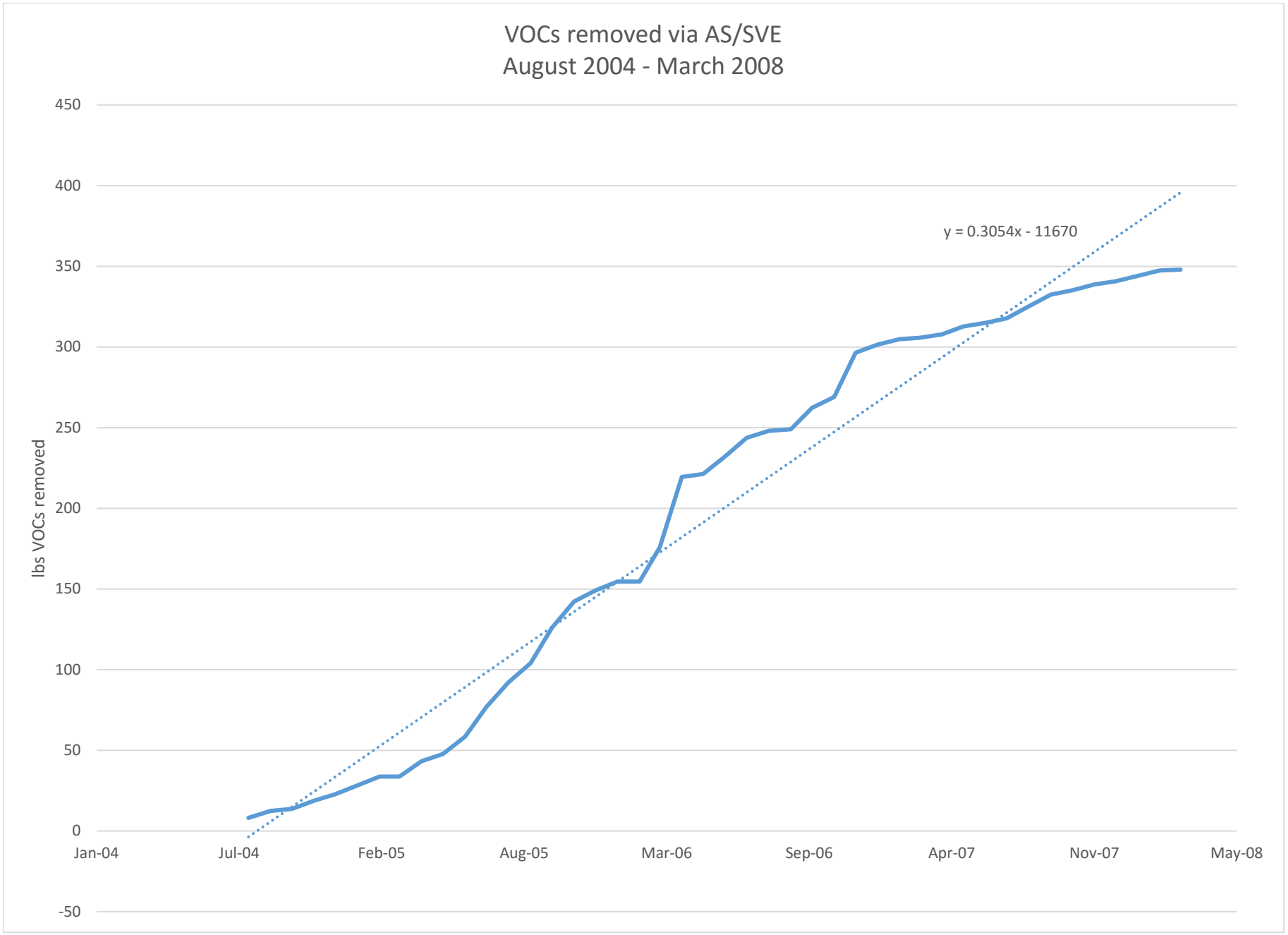
Source: Minitab® version 18.1

Sample No.	Groundwater Influent VOCs (lb/time)	Date Range		Time (days)	Time (cumulative days)	Slope, m (Δlb/Δday)
		From	To			
--	0.18	12/8/2016	12/15/2016	7	0	--
1	0.41	12/15/2016	1/20/2017	36	36	0.006388889
2	0.40	1/20/2017	2/17/2017	28	64	-0.000357143
3	0.24	2/17/2017	3/16/2017	27	91	-0.005925926
4	0.76	3/16/2017	4/14/2017	29	120	0.017931034
5	0.00	4/14/2017	4/28/2017	14	134	-0.054285714
6	0.04	4/28/2017	6/12/2017	45	179	0.000888889
7	0.00	6/12/2017	6/22/2017	10	189	-0.004
8	0.05	6/22/2017	8/3/2017	42	231	0.001190476
9	0.00	8/3/2017	8/10/2017	7	238	-0.007142857
10	0.06	8/10/2017	10/5/2017	56	294	0.001071429

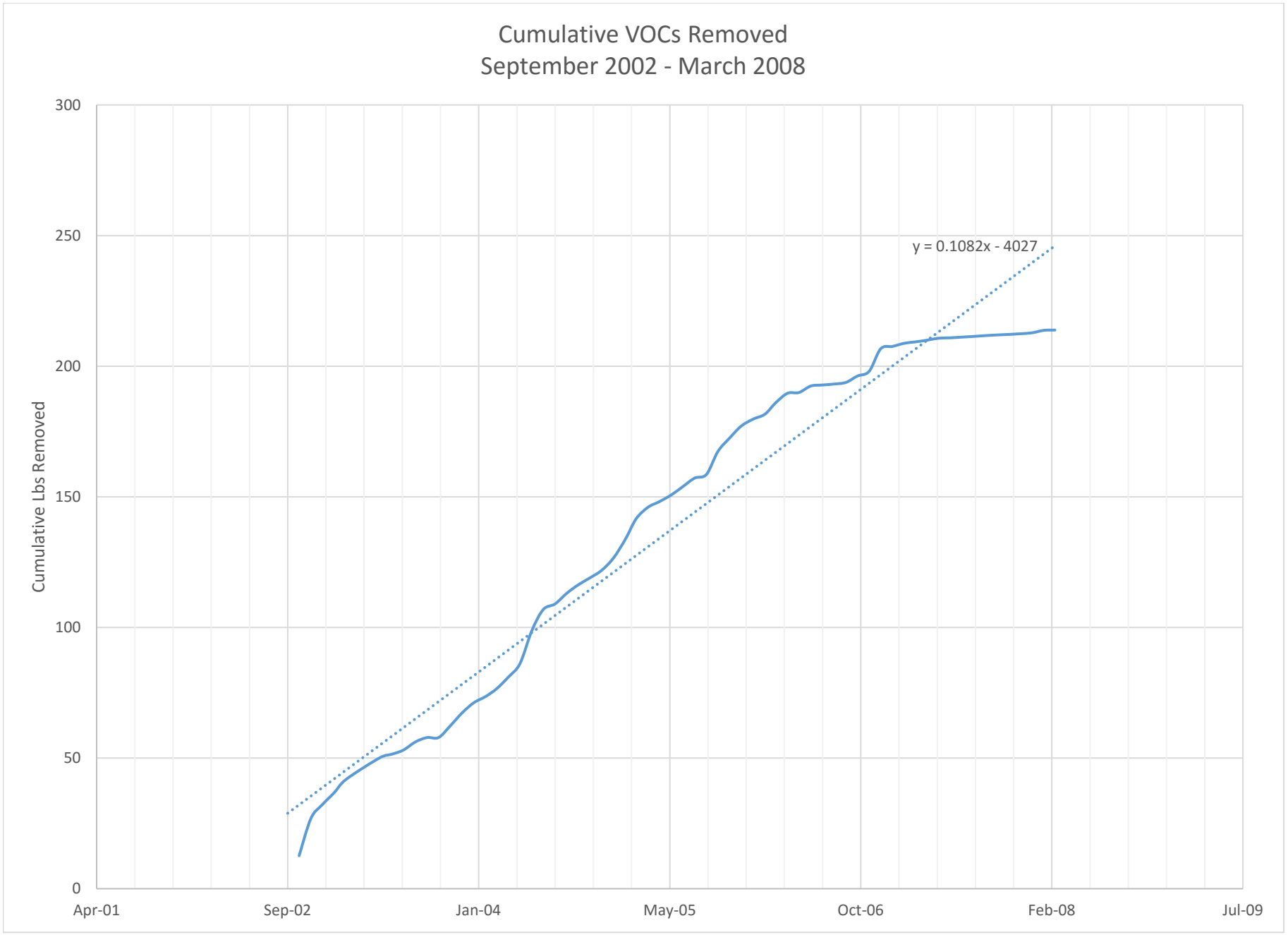
B Treatment System Removal Rates

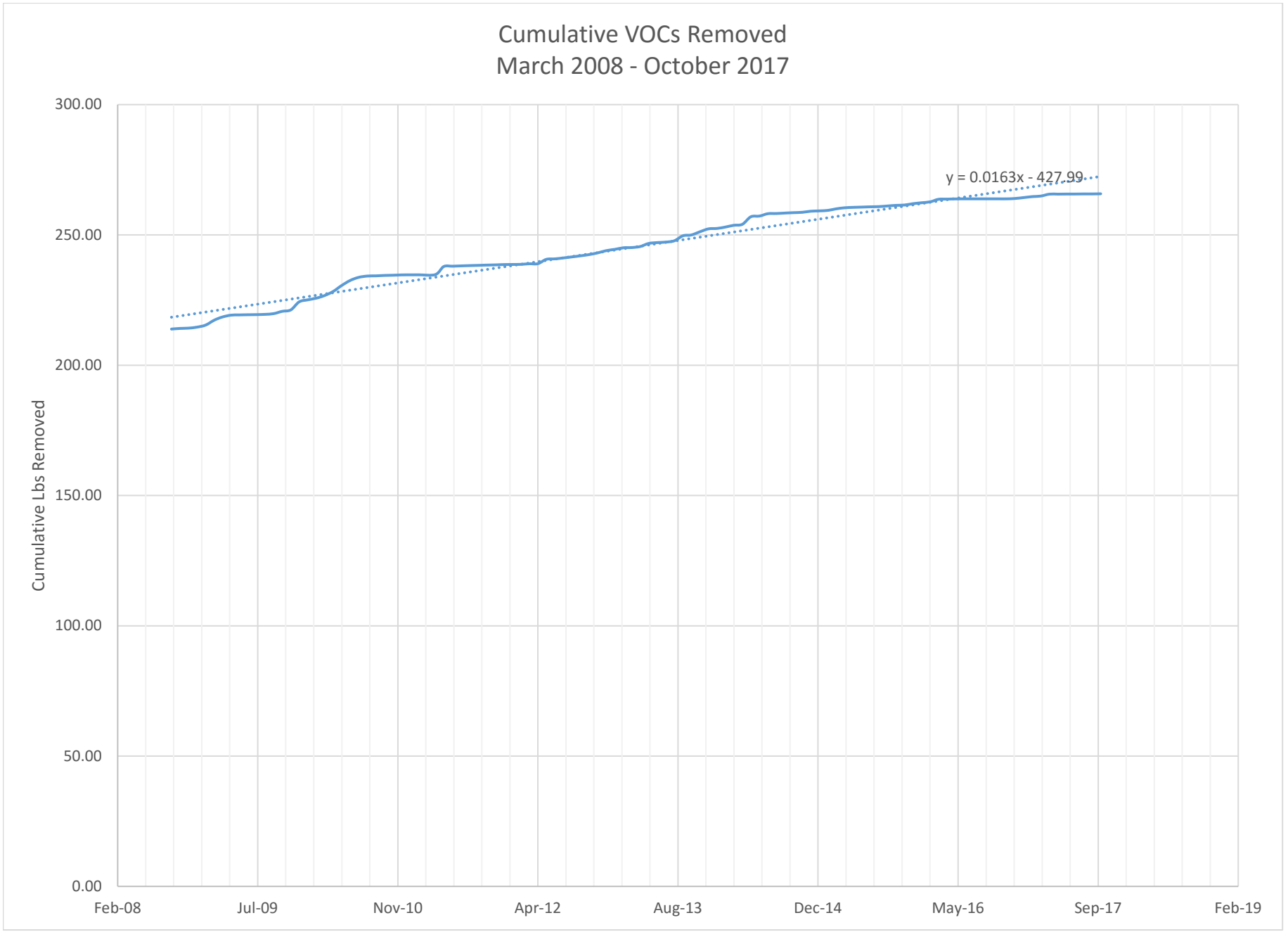
B-1: AS/SVE System
B-2: Pumping Well System

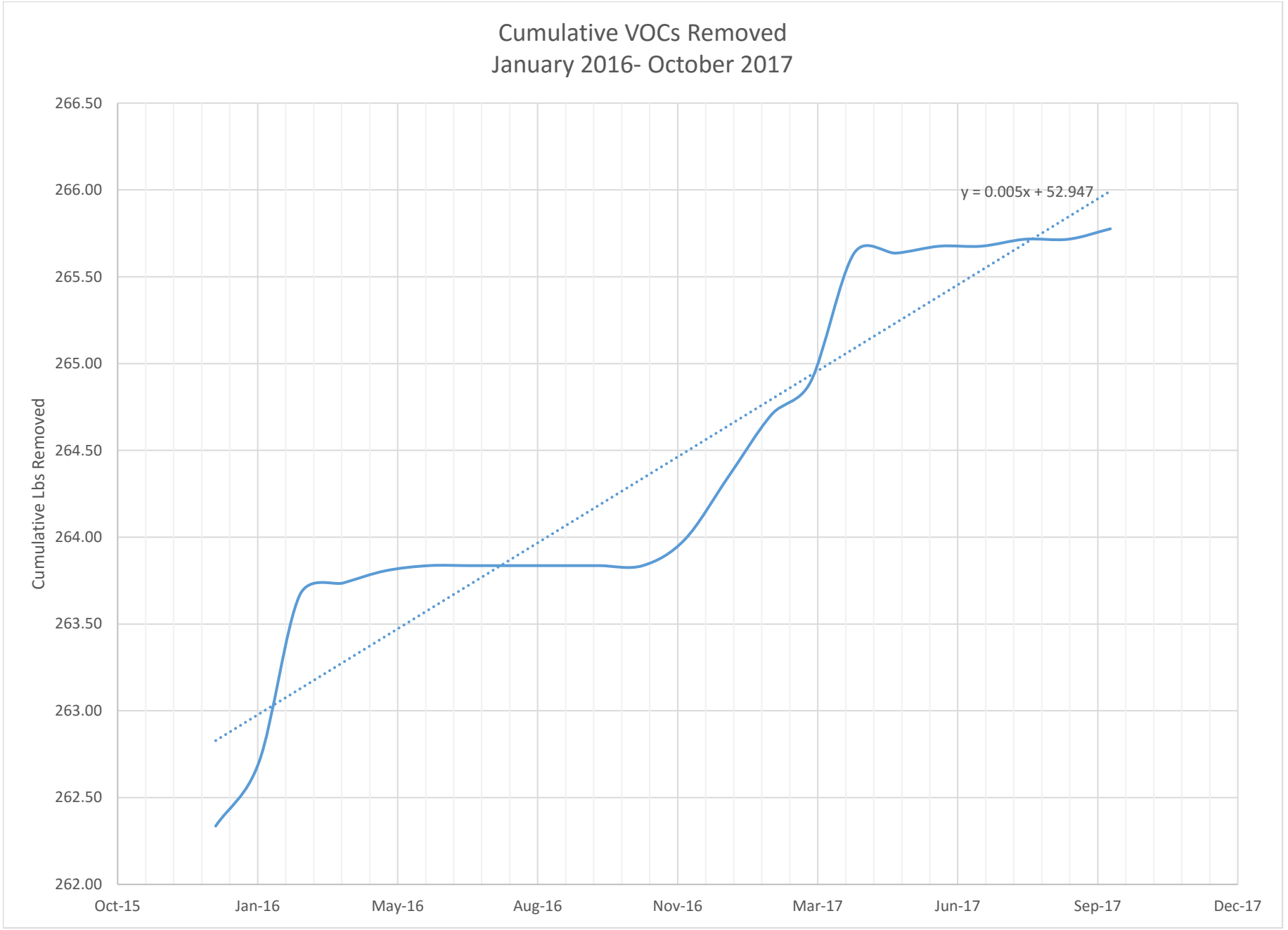
B-1: AS/SVE System


VOCs removed via AS/SVE
August 2004 - March 2008
lbs VOCs removed
450
400
350
300
250
200
150
100
50
0
-50
y = 0.3054x - 11670
Jan-04
Jul-04
Feb-05
Aug-05
Mar-06
Sep-06
Apr-07
Nov-07
May-08

B-2: Pumping Well System


Cumulative VOCs Removed
September 2002 - March 2008
Cumulative Lbs Removed
300
250
200
150
100
50
0
y = 0.1082x - 4027
Apr-01
Sep-02
Jan-04
May-05
Oct-06
Feb-08
Jul-09


Cumulative VOCs Removed
March 2008 - October 2017
y = 0.0163x - 427.99
Cumulative Lbs Removed
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Feb-08
Jul-09
Nov-10
Apr-12
Aug-13
Dec-14
May-16
Sep-17
Feb-19


Cumulative VOCs Removed
January 2016- October 2017
Cumulative Lbs Removed
266.50
266.00
265.50
265.00
264.50
264.00
263.50
263.00
262.50
262.00
y = 0.005x + 52.947
Oct-15
Jan-16
May-16
Aug-16
Nov-16
Mar-17
Jun-17
Sep-17
Dec-17