ARCADIS Design & Consultancy for natural and built assets

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Subject:
2018 Third Quarter System Operation and Monitoring,
Bethpage Park Soil Gas Containment System (BPSGCS),
Operable Unit 3 (OU3; Former Grumman Settling Ponds),
Bethpage, New York, NYSDEC Site #1-30-003A

Date:
November 21, 2018

Contact:
Christopher Engler

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Our ref:
NY001496.33TM.RPTI4

Dear Jason:

Enclosed is one electronic PDF copy of the 2018 Third Quarter results of the OU3 BPSGCS operation and monitoring, performed in accordance with the NYSDEC-approved OU3 Soil Gas IRM OM&M Manual (Arcadis 2016) and the NYSDEC-approved Sampling and Analysis Plan (SAP; Arcadis 2016). As we have transitioned to electronic submittals (via PDF) in line with NYSDEC's paper reduction program, hard copies of the report can be provided on request.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Arcadis of New York, Inc.

Christopher D. Engler

Christopher Engler PE

Vice President

Enclosure

Copies:
Ed Hannon, Northrop Grumman
Donald Hesler, NYSDEC
Steven Karpinski, NYS Dept. of Health
John Lovejoy, Nassau County Dept. of Health
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TABLES

Table 1
General System Operating Parameters
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

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	DW-7S Parameters			DW-7D Parameters			DW-3S Parameters			DW-3D Parameters			DW-5S Parameters			DW-5D Parameters			DW-6S Parameters			DW-6D Parameters		
	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum
Date	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc
12/11/17	103	-23	-1.7	8.0	-7.5	-0.49	8.0	-7.0	-0.25	13	-6.5	-0.42	99	-16.0	-1.6	14	-12	-2.5	95	-19	-1.9	7.0	-5.2	-1.4
2/6/18	85	-21	-1.5	7.5	-7.5	-0.49	7.0	-5.0	-0.22	10	-6.0	-0.33	85	-15.0	-1.4	16	-9	-2.7	75	-15	-1.6	6.4	-5.5	-1.2
5/30/18	95	-17	-1.6	7.5	-7.5	-0.55	7.5	-5.0	-0.31	11	-6.0	-0.42	88	-13.5	-1.4	14	-14	-2.7	86	-15	-1.69	6.6	-5.2	-1.4
8/9/18	94	-15	-1.7	7.5	-7.0	-0.52	7.0	-11.5	-0.29	7	-8.5	-0.38	87	-13.0	-1.4	16	-11	-2.7	87	-15	-1.75	6.5	-5.2	-1.3

Abbreviations, Notes, and Units on last page.

Table 1
General System Operating Parameters
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

ARCADIS Design & Consultancy for natural and built assets

	DW-1S Parameters			DW-1D Parameters			DW-4S Parameters			DW-4D Parameters			DW-8S Parameters			DW-9S Parameters			DW-2S Parameters			DW-2D Parameters		
	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum
Date	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc	scfm	iwc	iwc
12/11/17	100	-22	-2.4	5.5	-2.5	-1.6	95	-17	-2.1	9.0	-7.0	-0.87	75	-25	-2.2	42	-13	-1.7	23	-23	-1.6	43	-25	-2.6
2/6/18	95	-18	-2.3	5.2	-3.0	-1.6	75	-16	-1.7	7.0	-6.0	-0.68	75	-21	-2.5	35	-12	-1.4	24	-25	-1.5	38	-22	-2.3
5/30/18	80	-22	-1.7	5.2	-2.5	-1.6	84	-15	-1.7	8.0	-5.5	-0.76	90	-23	-2.6	38	-13	-1.5	26	-24	-1.8	43	-26	-2.6
8/9/18	75	-22	-1.7	5.1	-2.5	-1.6	83	-14	-1.7	7.5	-5.5	-0.79	86	-13	-2.8	36	-12	-1.5	28	-24	-1.7	41	-25	-2.7

Abbreviations, Notes, and Units on last page.

Table 1
General System Operating Parameters
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

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	DW-10S Parameters			DW-11S Parameters			Knock Out Tank Parameters - Vacuum			Condensate Water Collected [1]	Blower Parameters BL-200			Blower Parameters BL-300			Blower Parameters BL-400			Combined Effluent Parameters				
	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Flow Rate at Manifold	Vacuum at Manifold	Wellhead Vacuum	Influent KO-200	Influent KO-300	Influent KO-400	Influent ST-510	Influent Vacuum	Effluent Pressure	Blower Speed	Influent Vacuum	Effluent Pressure	Blower Speed	Influent Vacuum	Effluent Pressure	Blower Speed	Total Effluent Flow Rate [2]	Total Effluent PID	Heat Exchanger Influent Temp.	Total Effluent Pressure	Heat Exchanger Effluent Temp.
Date	scfm	iwc	iwc	scfm	iwc	iwc	iwc	iwc	iwc	Gallons	iwc	iwc	Hz	iwc	iwc	Hz	iwc	iwc	Hz	scfm	ppmv	°F	iwc	°F
12/11/17	40	-19	-2.2	30	-24	-2.1	NA	NA	-30	0	NA	NA	NA	NA	NA	NA	-35	3.0	60	653	0.1	104	3.0	85
2/6/18	60	-22	-3.6	31	-23	-1.5	NA	NA	-39	210	NA	NA	NA	NA	NA	NA	-39	1.5	60	759	0.0	103	2.7	83
5/30/18	43	-15	-2.4	33	-20	-2.4	NA	NA	-30	160	NA	NA	NA	NA	NA	NA	-33	1.7	60	769	0.0	105	3.1	98
8/9/18	40	-15	-2.7	31	-20	-2.4	NA	NA	-29	0	NA	NA	NA	NA	NA	NA	-33	2.0	60	668	0.0	120	3.0	109

Abbreviations, Notes, and Units on last page.

Table 1
General System Operating Parameters
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Abbreviations, Notes, and Units:

DW	Depressurization Well
NA	Not Applicable
PID	Photoionization Detector

1. Total gallons of water accumulated at storage tank ST-510 per quarter. Values are taken from site operator condensate event logs.

2. Total effluent air velocity in feet per minute was measured using a hand-held anemometer at the stack effluent location. The total effluent flow rate in scfm was calculated by multiplying the measured air velocity by the pipe area, the ratio of the standard air temperature to the measured air temperature, and the ratio of the measured air pressure to the standard air pressure.

°F	degrees Fahrenheit
gal	gallons
Hz	Hertz
iwc	inches of water column
ppmv	parts per million by volume
scfm	standard cubic feet per minute

Table 2
Summary of Induced Vacuum Readings at Compliance Monitoring Points
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

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Well ID:	DW-7S		DW-7D	DW-3S	DW-3D	DW-5S		DW-5D	DW-1S			DW-1D	DW-4D	DW-8S		DW-2S		DW-2D		DW-11S	
MP ID:	VMWC-14A	VMWC-14B	VMWC-14D	VMWC-11B	VMWC-12D	VMWC-15A	VMWC-15B	VMWC-15D	VMWC-3A	VMWC-3B	VMWC-3C	VMWC-3D	VMWC-16D	VMWC-16A	VMWC-16B	VMWC-7A	VMWC-7B	VMWC-13D	VMWC-17D	VMWC-18A	VMWC-18B
Date	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc	iwc
12/11/17	-0.10	-0.18	-0.20	-0.12	-0.08	-0.10	-0.11	-0.10	-0.13	-0.14	-0.14	-0.11	-0.77	-0.21	0.00	-0.11	-0.13	-0.27	-0.26	-0.08	-0.09
02/06/18	-0.09	-0.17	-0.19	-0.21	-0.09	-0.13	-0.13	-0.09	-0.16	-0.17	-0.18	-0.19	-0.14	-0.21	-0.23	-0.15	-0.17	-0.16	-0.25	-0.12	-0.14
05/30/18	-0.13	-0.22	-0.24	-0.16	-0.23	-0.18	-0.16	-0.17	-0.16	-0.16	-0.17	-0.24	-0.21	-0.23	-0.25	-0.13	-0.14	-0.15	-0.22	-0.11	-0.14
08/09/18	-0.12	-0.20	-0.22	-0.15	-0.25	-0.17	-0.18	-0.18	-0.24	-0.17	-0.17	-0.26	-0.31	-0.22	-0.23	-0.13	-0.13	-0.27	-0.33	-0.11	-0.14
Time Weighted Rolling Average[1]	**-0.12**	**-0.20**	**-0.21**	**-0.16**	**-0.17**	**-0.15**	**-0.15**	**-0.14**	**-0.17**	**-0.16**	**-0.16**	**-0.20**	**-0.36**	**-0.22**	**-0.18**	**-0.13**	**-0.14**	**-0.21**	**-0.26**	**-0.11**	**-0.13**

Gross Average Compliance Points[2]	
08/09/18	-0.20

Abbreviations, Notes, and Units:

DW Depressurization Well
VMWC Vapor Monitoring Well Cluster

1. Compliance goal is -0.1 iwc of vacuum at all compliance monitoring points, based on a twelve-month rolling average. Time weighted rolling average calculated by summing the products of the instantaneous induced vacuum readings and the number of days between readings for a 12-month monitoring period, and dividing by the total time period between the first and last quarterly induced vacuum readings.
2. Gross average compliance points calculated by summing the induced vacuum values for the noted monitoring event and dividing by the number of readings.

iwc inches of water column

Table 3
Total Effluent Vapor Sample Analytical Results
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

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Compound (units in µg/m^3)	Sample ID[1]: Sample Date:	VSP-601 12/11/2017	VSP-601 2/6/2018	VSP-601 5/30/2018	VSP-601 8/9/2018
Project VOCs	**CAS No.**				
1,1,1-Trichloroethane	71-55-6	**10**	**8.7**	**6.5**	**13**
1,1-Dichloroethane	75-34-3	**9.7**	**7.7**	**5.7**	**8.9**
1,1-Dichloroethene	75-35-4	< 3.2 U	< 0.63 U	< 0.32 U	**1.1**
1,2-Dichloroethane	107-06-2	< 3.2 U	< 3.2 U	< 1.6 U	< 0.65 U
Benzene	71-43-2	< 2.6 U	**1.4 J**	< 1.3 U	< 0.51 U
cis-1,2-Dichloroethene	156-59-2	**358**	**310**	**304**	**229**
Tetrachloroethene	127-18-4	**8.8**	**6.6**	**8.1**	**17**
Toluene	108-88-3	< 3.0 U	< 3.0 U	< 1.5 U	< 0.60 U
trans-1,2-Dichloroethene	156-60-5	**2.6 J**	**1.6 J**	**1.6**	**3.3**
Trichloroethylene	79-01-6	**378**	**306**	**301**	**398**
Vinyl chloride	75-01-4	< 0.41 U	< 0.41 U	< 0.20 U	**0.64**
Xylenes - O	95-47-6	< 3.5 U	< 3.5 U	< 1.7 U	< 0.69 U
Xylenes - M,P	1330-20-7	< 3.5 U	< 3.5 U	< 1.7 U	< 0.69 U
Subtotal Project VOCs		767	642	627	671
Non-Project VOCs					
1,1,2,2-Tetrachloroethane	79-34-5	< 2.7 U	< 2.7 U	< 1.4 U	< 0.55 U
1,1,2-Trichloroethane	79-00-5	< 2.2 U	< 2.2 U	< 1.1 U	< 0.44 U
1,2-Dichloropropane	78-87-5	< 3.7 U	< 3.7 U	< 1.8 U	< 0.74 U
1,3-Butadiene	106-99-0	< 1.8 U	< 1.8 U	< 0.88 U	< 0.35 U
1-Chloro-1,1-difluoroethane (Freon 142b)	75-68-3	**69.1**	**48.5**	< 1.6 U	**162**
2-Butanone	78-93-3	< 2.4 U	< 2.4 U	< 1.2 U	**0.53**
2-Hexanone	591-78-6	< 3.3 U	< 3.3 U	< 1.6 U	< 0.65 U
4-Methyl-2-Pentanone	108-10-1	< 3.3 U	< 3.3 U	< 1.6 U	< 0.66 U
Acetone	67-64-1	**4.3**	**3.1**	**4.5**	**3.1**
Bromodichloromethane	75-27-4	< 2.7 U	< 2.7 U	< 1.3 U	< 0.54 U
Bromoform	75-25-2	< 1.7 U	< 1.7 U	< 0.83 U	< 0.33 U
Bromomethane	74-83-9	< 3.1 U	< 3.1 U	< 1.6 U	< 0.62 U
Carbon Disulfide	75-15-0	< 2.5 U	< 2.5 U	< 1.2 U	< 0.50 U
Carbon Tetrachloride	56-23-5	< 1.0 U	< 1.0 U	< 0.50 U	**1.3**

Abbreviations, Notes, Qualifiers, and Units on last page.

Table 3
Total Effluent Vapor Sample Analytical Results
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

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Compound (units in µg/m^3)	Sample ID[1]: Sample Date:	VSP-601 12/11/2017	VSP-601 2/6/2018	VSP-601 5/30/2018	VSP-601 8/9/2018
Non-Project VOCs	CAS No.				
Chlorobenzene	108-90-7	< 3.7 U	< 3.7 U	< 1.8 U	< 0.74 U
Chlorodibromomethane	124-48-1	< 3.4 U	< 3.4 U	< 1.7 U	< 0.68 U
Chloroethane	75-00-3	< 2.1 U	< 2.1 U	< 1.1 U	< 0.42 U
Chlorodifluoromethane (Freon 22)	75-45-6	< 2.8 U	< 2.8 U	**1.6**	**3.5**
Chloroform	67-66-3	**33**	**29**	**23**	**29**
Chloromethane	74-87-3	< 1.7 U	< 1.7 U	< 0.83 U	< 0.33 U
cis-1,3-Dichloropropene	10061-01-5	< 3.6 U	< 3.6 U	< 1.8 U	< 0.74 U
Dichlorodifluoromethane (Freon 12)	75-71-8	**3.0** J	**2.4 J**	**2.2**	**2.7**
Ethylbenzene	100-41-4	< 3.5 U	< 3.5 U	< 1.7 U	< 0.69 U
Methylene Chloride	75-09-2	**3.8**	< 2.8 U	**3.4**	**1.4**
Methyl Tert-Butyl Ether	1634-04-4	< 2.9 U	< 2.9 U	< 1.4 U	< 0.58 U
Styrene	100-42-5	< 3.4 U	< 3.4 U	< 1.7 U	< 0.68 U
Trans-1,3-Dichloropropene	10061-02-6	< 3.6 U	< 3.6 U	< 1.8 U	< 0.73 U
Trichlorofluoromethane (Freon 11)	75-69-4	< 2.2 U	< 2.2 U	< 1.1 U	**1.8**
Trichlorotrifluoroethane (Freon 113)	76-13-1	< 3.1 U	< 3.1 U	< 1.5 U	**0.7**
Subtotal Non-Project VOCs		113	83	35	206
TVOC[2]		880	725	662	877

Abbreviations, Notes, Qualifiers, and Units on last page.

Table 3
Total Effluent Vapor Sample Analytical Results
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

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Abbreviations, Notes, Qualifiers, and Units:

CAS No.	Chemical Abstracts Service list number
ELAP	Environmental Laboratory Approval Program
NYSDOH	New York State Department of Health
NYSDEC	New York State Department of Environmental Conservation.
TVOC	Total Volatile Organic Compounds
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1. Vapor samples collected by Arcadis and submitted to a NYSDOH ELAP certified laboratory for VOC analyses per Modified USEPA Method TO-15.
2. TVOC determined by summing individual detections and rounding to the nearest whole number.

398	Bolding indicates that the analyte was detected at or above laboratory reporting limit
< 1.0 U	Compound not detected above its laboratory quantification limit
J	Compound detected below laboratory reporting limit; result is estimated
$\mu g/m^3$	micrograms per cubic meter

Table 4
Total Effluent Vapor Sample Analytical Results
Tentatively Identified Compounds
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

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Sample ID: Sample Date[1]: Units: Tentatively Identified Compounds[2]	VSP-601 12/11/2017 ppbv	VSP-601 2/6/2018 ppbv	VSP-601 5/30/2018 ppbv	VSP-601 8/9/2018 ppbv
Carbon Dioxide	**690 JNB**	ND	**40 JNB**	**130 JNB**
Ethane, 1-Chloro-1, 1-Difluoro-	ND	ND	**12 JN**	ND
Alkane	ND	ND	**2.6 J**	ND
Alkane	ND	ND	**3.8 J**	ND
Alkane	ND	ND	**5.5 J**	ND

Abbreviations, Notes, Qualifiers, and Units:

ND	Not Detected
ELAP	Environmental Laboratory Approval Program
NYSDOH	New York State Department of Health
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound

1. Vapor samples collected by Arcadis on the dates shown and submitted to a NYSDOH ELAP certified laboratory for VOC analyses per Modified USEPA Method TO-15.
2. Tentatively identified compounds are identified based on review of mass spectrometry results via a comprehensive library search of all organic compounds.

B	Indicates analyte found in associated method blank
J	Indicates an estimated value
JN	Compound tentatively identified, concentration is estimated
ppbv	parts per billion by volume

Table 5
Air Quality Impact Analysis
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

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Toxic Air Contaminant	CAS#	VSP-601 Vapor Effluent (µg/m^3) 8/9/2018	Emission Rate[1]			Scaled Impact - Hourly[2] (µg/m^3)	Scaled Impact - Annual[2] (µg/m^3)	SGC[3] (µg/m^3)	AGC[3] (µg/m^3)	% of SGC	% of AGC
			lb/yr	lb/hr	g/s						
Project VOCs											
1,1,1 - Trichloroethane	71-55-6	**13**	2.8E-01	3.2E-05	4.1E-06	1.9E-03	8.2E-05	9,000	5,000	0.0%	0.0%
1,1 - Dichloroethane	75-34-3	**8.9**	1.9E-01	2.2E-05	2.8E-06	1.3E-03	5.6E-05	NS	1	NS	0.0%
1,1 - Dichloroethene	75-35-4	**1.1**	2.4E-02	2.7E-06	3.5E-07	1.6E-04	6.9E-06	--	200	--	0.0%
cis- 1,2-Dichloroethene	156-59-2	**229**	5.0E+00	5.7E-04	7.2E-05	3.3E-02	1.4E-03	NS	63	NS	0.0%
Tetrachloroethene	127-18-4	**17**	3.7E-01	4.2E-05	5.3E-06	2.5E-03	1.1E-04	300	4	0.0%	0.0%
trans- 1,2-Dichloroethene	156-60-5	**3.3**	7.2E-02	8.2E-06	1.0E-06	4.8E-04	2.1E-05	NS	63	NS	0.0%
Trichloroethene	79-01-6	**398**	8.7E+00	9.9E-04	1.3E-04	5.8E-02	2.5E-03	20	0	0.3%	1.3%
Vinyl Chloride	75-01-4	**0.64**	1.4E-02	1.6E-06	2.0E-07	9.3E-05	4.0E-06	180,000	0	0.0%	0.0%
Non-Project VOCs											
1-Chloro-1,1-difluoroethane (Freon 142b)	75-68-3	**162**	3.5E+00	4.0E-04	5.1E-05	2.4E-02	1.0E-03	NS	50,000	NS	0.0%
2-Butanone	78-93-3	**0.53**	1.2E-02	1.3E-06	1.7E-07	7.7E-05	3.3E-06	13,000	5,000	0.0%	0.0%
Acetone	67-64-1	**3.1**	6.8E-02	7.7E-06	9.8E-07	4.5E-04	2.0E-05	180,000	30,000	0.0%	0.0%
Carbon Tetrachloride	56-23-5	**1.3**	2.8E-02	3.2E-06	4.1E-07	1.9E-04	8.2E-06	1,900	0	0.0%	0.0%
Chlorodifluoromethane (Freon 22)	75-45-6	**3.5**	7.7E-02	8.7E-06	1.1E-06	5.1E-04	2.2E-05	--	50,000	--	0.0%
Chloroform	67-66-3	**29**	6.3E-01	7.2E-05	9.1E-06	4.2E-03	1.8E-04	150	15	0.0%	0.0%
Dichlorodifluoromethane (Freon 12)	75-71-8	**2.7**	5.9E-02	6.7E-06	8.5E-07	3.9E-04	1.7E-05	NS	12,000	NS	0.0%
Methylene Chloride	75-09-2	**1.4**	3.1E-02	3.5E-06	4.4E-07	2.0E-04	8.8E-06	14,000	60	0.0%	0.0%
Trichlorofluoromethane (Freon 11)	75-69-4	**1.8**	3.9E-02	4.5E-06	5.7E-07	2.6E-04	1.1E-05	9,000	5,000	0.0%	0.0%
Trichlorotrifluoroethane (Freon 113)	76-13-1	**0.67**	1.5E-02	1.7E-06	2.1E-07	9.8E-05	4.2E-06	960,000	180,000	0.0%	0.0%

Abbreviations, Notes, and Units on last page.

Table 5
Air Quality Impact Analysis
Bethpage Park Soil Gas Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Abbreviations, Notes, and Units:

AGC	Annual Guideline Concentration
CAS#	Chemical Abstracts Service Registry Number
DAR-1	Division of Air Resources-1
NS	None Specified
NYSDEC	New York State Department of Environmental Conservation
SGC	Short-term Guideline Concentration
VSP	Vapor Sampling Point

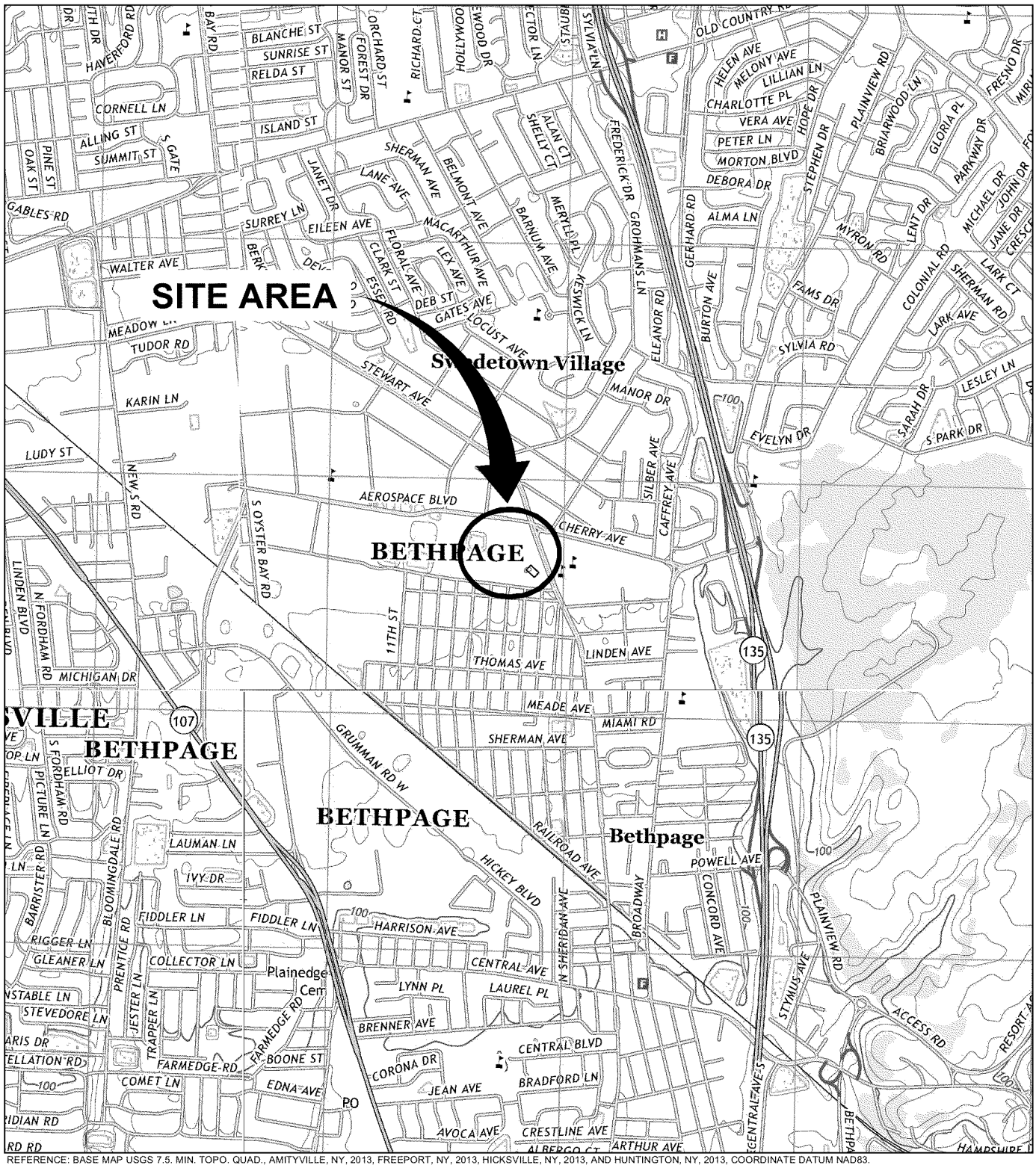
1. Emission rate calculated based on VSP-601 effluent concentration and an exit air flow rate of 668 ft^3/min for 08/09/2018.
   TCE (lb/hr) = TCE [$\mu g/m^3$] x Air Flow Rate [ft^3/min] x (1 m^3/35.3147 ft^3) x (60 min/hr) x (0.000001 g/1 ug) x (0.0022 lb/g)
   lb/yr = lb/hr x 8,760 hrs/yr
   g/s = lb/hr x 1 hr/ 3,600 sec x 453.59 g/lb
2. Ambient impact based on AERMOD modeling using normalized rate of 1 g/s is scaled to the actual emission rate of the pollutant. Modeling was performed using the representative meteorological data from the nearest station (Farmingdale) for the years 2011 through 2015. The maximum impact from all the years was used for the calculations.
   Scaled hourly impact ($\mu g/m^3$) = AERMOD predicted hourly ambient impact at 1 g/s ([$\mu g/m^3$]/[g/s]) x Actual emission rate (g/s)
   Scaled annual impact ($\mu g/m^3$) = AERMOD predicted annual ambient impact at 1 g/s ([$\mu g/m^3$]/[g/s]) x Actual emission rate (g/s)

AERMOD Normalized Ambient Impact at 1 g/s	
Hourly ([$\mu g/m^3$]/[g/s])	Annual ([$\mu g/m^3$]/[g/s])
462.83	20.02

3. Short-term and annual guideline concentrations specified in the NYSDEC DAR-1 AGC/SGC tables revised August 10, 2016.
4. Only contaminants with detected concentrations are included in the table.

ft^3/min	cubic feet per minute
g/s	grams per second
$\mu g/m^3$	micrograms per cubic meter
lb/hr	pounds per hour

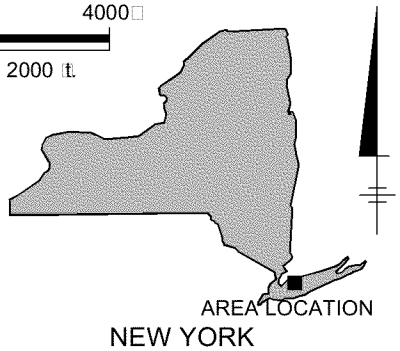
FIGURES



REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., AMITYVILLE, NY, 2013, FREEPORT, NY, 2013, HICKSVILLE, NY, 2013, AND HUNTINGTON, NY, 2013, COORDINATE DATUM NAD83.

0 2000 4000

Approximate Scale: 1 in. = 2000 ft.



NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE PARK SOIL GAS CONTAINMENT SYSTEM
BETHPAGE, NEW YORK
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

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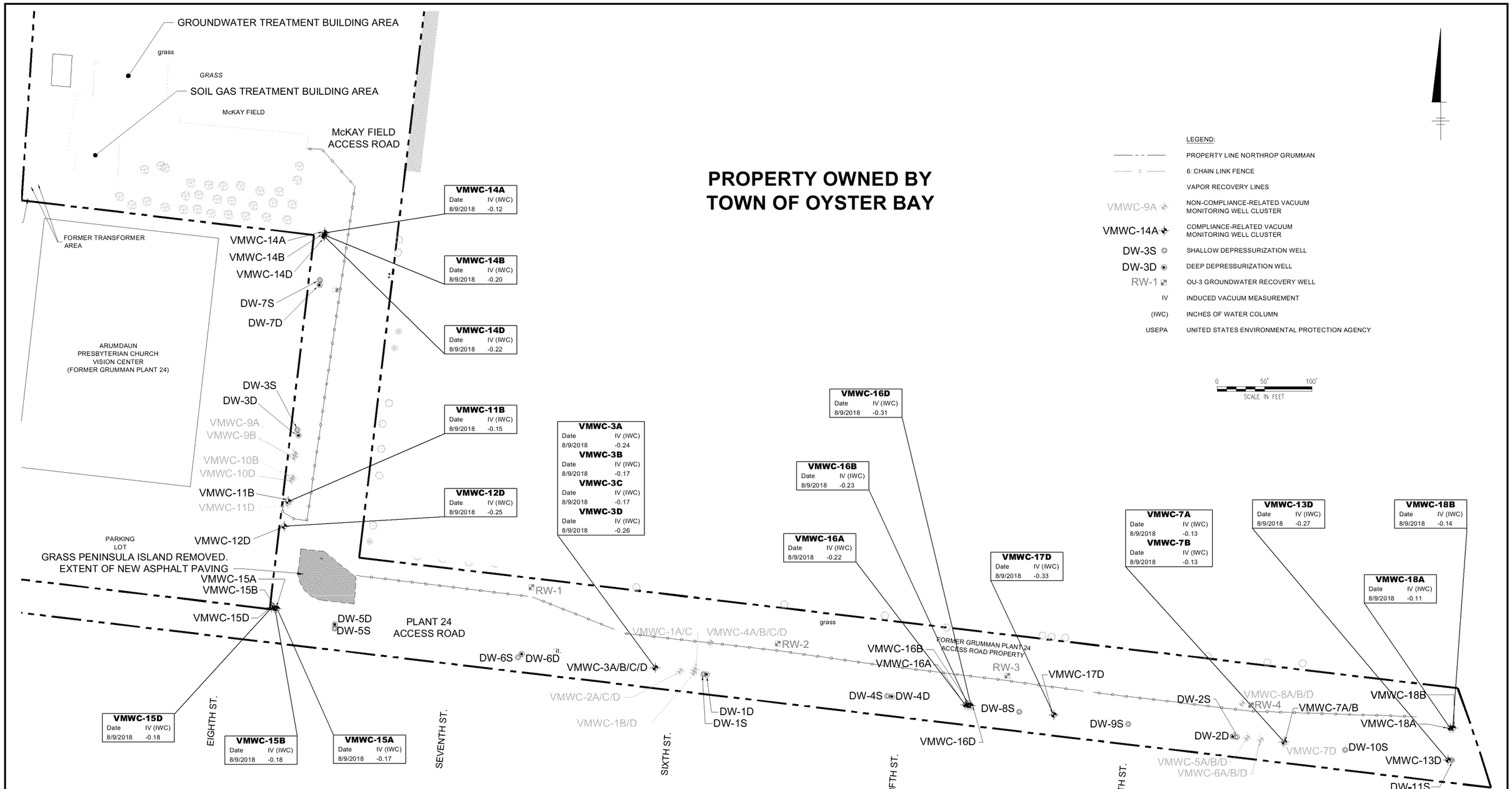

NOTES:

1. USEPA'S RADON GUIDANCE RECOMMENDS NEGATIVE PRESSURE OF 0.035 INCHES OF WATER FOR THE CONTROL OF SOIL VAPOR (EPA 625/R-93-011, 1993).
2. SYSTEM DESIGN OBJECTIVE IS TO MAINTAIN -0.1 IWC OF INDUCED VACUUM AT ALL COMPLIANCE-RELATED VACUUM MONITORING WELLS ON A 12-MONTH ROLLING AVERAGE (ARCADIS 2007).
3. DATA SHOWN HEREIN ARE COLLECTED FROM COMPLIANCE-RELATED VACUUM MONITORING WELLS ONLY.

NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE PARK SOIL GAS CONTAINMENT SYSTEM
BETHPAGE, NEW YORK
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)

GENERAL SITE PLAN AND MONITORING WELL VACUUM MEASUREMENTS THIRD QUARTER 2018

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2

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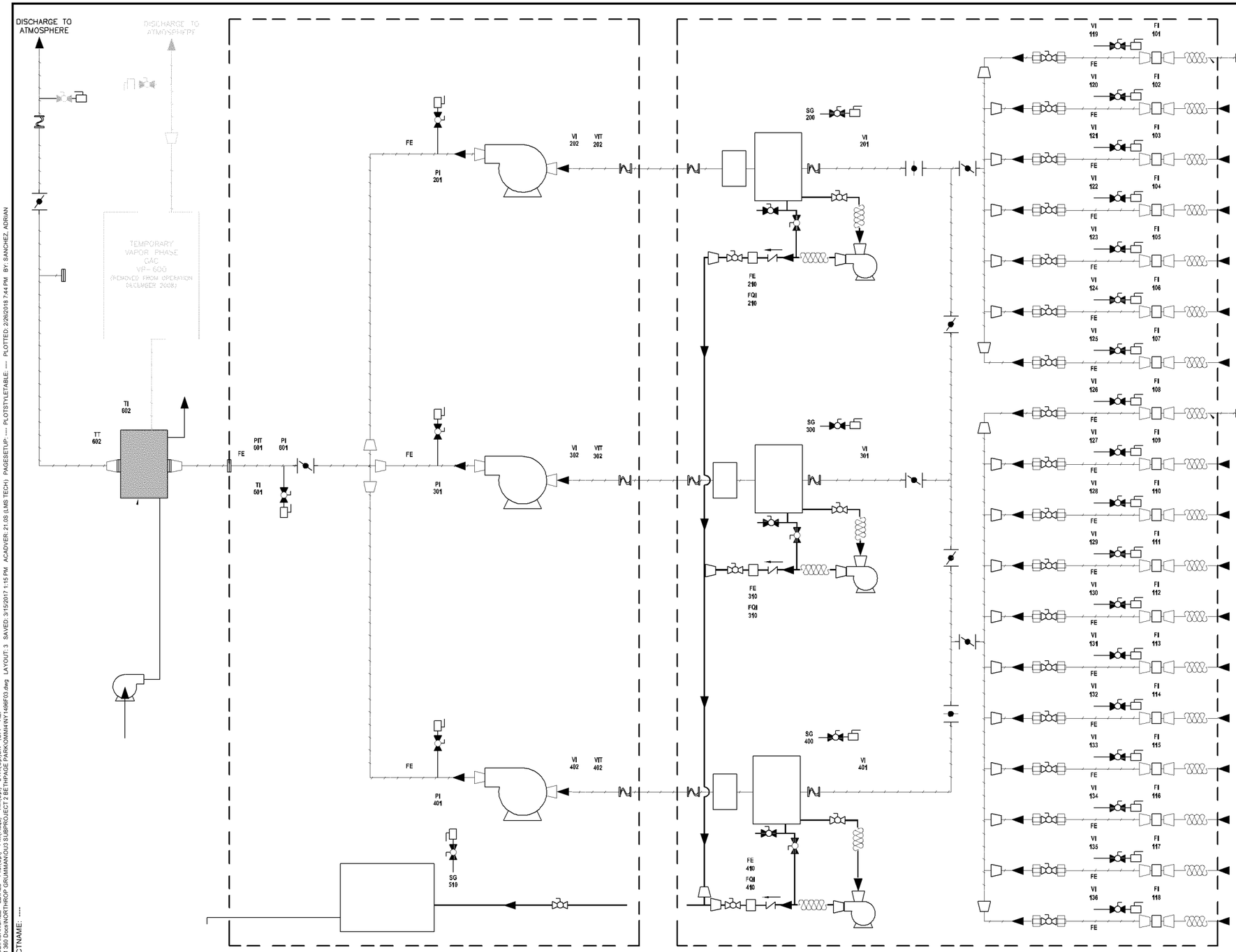
X-ONSITE-BASE SITE



LEGEND:

- CONDENSATE LINE
- LIMITS OF TREATMENT BUILDING
- PROCESS VAPOR LINE
- BALL VALVE (NORMALLY OPEN)
- BALL VALVE (NORMALLY CLOSED)
- BUTTERFLY VALVE (NORMALLY OPEN)
- BUTTERFLY VALVE (NORMALLY CLOSED)
- CHECK VALVE
- UNION
- SAMPLE PORT/DRAIN
- REDUCER
- FERNCO
- FLEXIBLE HOSE
- FLANGE
- FE — FLOW ELEMENT ACCESS
- VI 119 — 1/4" BARB INDUCED VACUUM MONITORING CONNECTION
- INLINE INSTRUMENT
- ISOLATED INSTRUMENT CONNECTED TO PROCESS LINE
- INSTRUMENT CONNECTED TO PROCESS LINE
- FE — FLOW MONITORING ELEMENT
- FI — FLOW RATE INDICATOR
- FQI — FLOW TOTALIZER INDICATOR
- PI — PRESSURE INDICATOR
- PIT — PRESSURE INDICATING TRANSMITTER
- SG — SIGHT GLASS
- TT — TEMPERATURE TRANSMITTER
- VI — VACUUM INDICATOR
- VIT — VACUUM INDICATING TRANSMITTER
- VSP — VAPOR SAMPLE POINT
- WSP — WATER SAMPLE POINT

NOTES:

1. SEE TABLE 1 FOR BLOWER OPERATING STATUS.

NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE, NEW YORK

PROCESS FLOW DIAGRAM

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FIGURE
3

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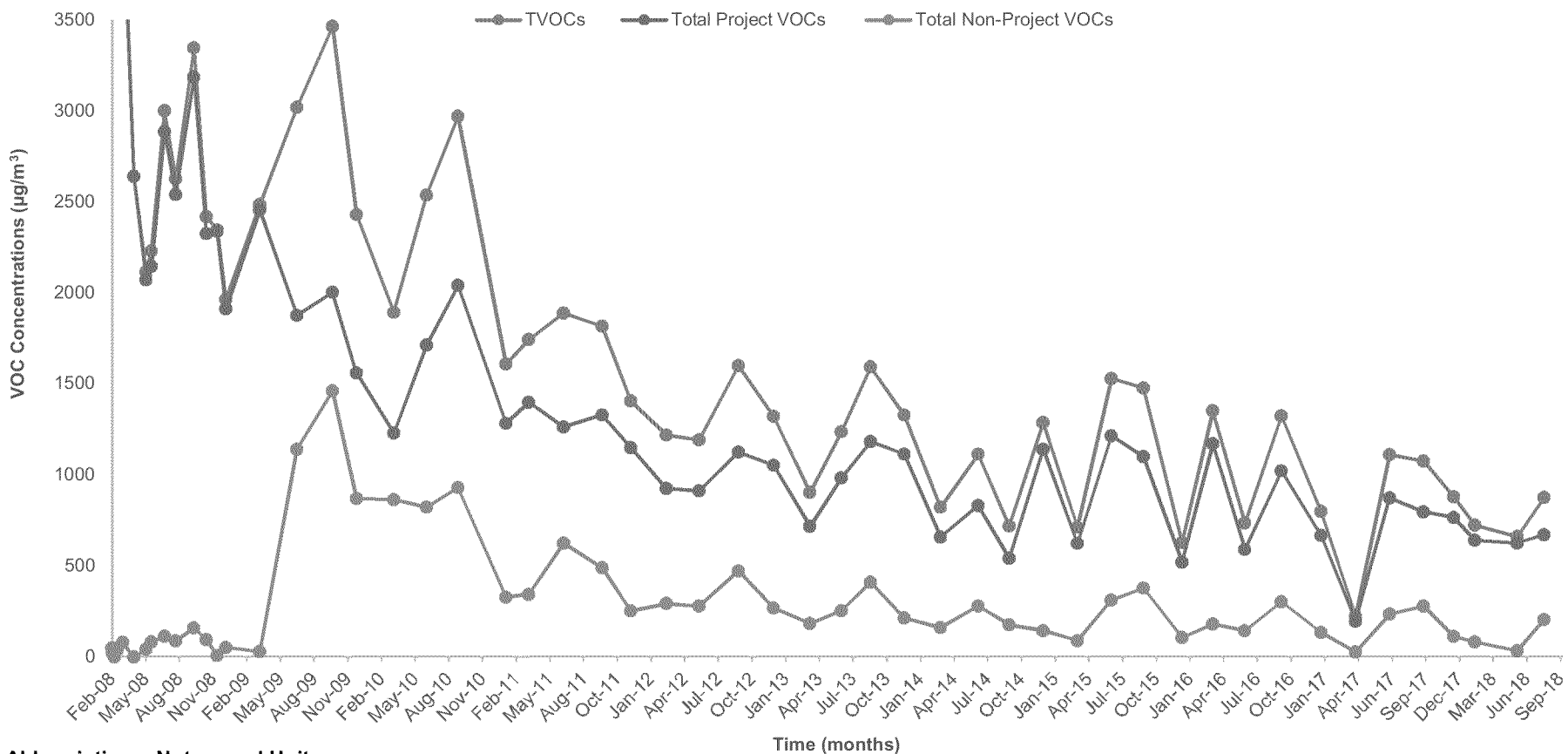

Abbreviations, Notes, and Units:

VOCs = Volatile Organic Compounds
TVOCs = Total VOCs detected

Total Project VOCs = Sum of 1,1,1-trichloroethane; 1,1-dichloroethane; 1,2-dichloroethane; 1,1-dichloroethene; tetrachloroethene; trichloroethene; vinyl chloride; cis-1,2-dichloroethene; trans-1,2-dichloroethene; benzene; toluene; and total xylenes.
Total Non-Project VOCs = Sum of VOCs that are not Project VOCs.

1. Samples were collected at Vapor Sample Port-601 (VSP-601); refer to Figure 3 of this OM&M report for the location of VSP-601.
2. Results prior to April 16, 2008 are not shown to improve figure clarity. The TVOC and Total Project VOC concentrations are greater than 3,500 µg/m^3. See previous reports for full data set.
3. The sample results from December 3, 2010 are not consistent with historical data and the results are excluded from this figure. The TVOC concentration for December 3, 2010 was 13 µg/m^3.

µg/m^3 = micrograms per cubic meter

NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE PARK SOIL GAS CONTAINMENT SYSTEM
BETHPAGE, NEW YORK, OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)

SOIL GAS VOC CONCENTRATIONS

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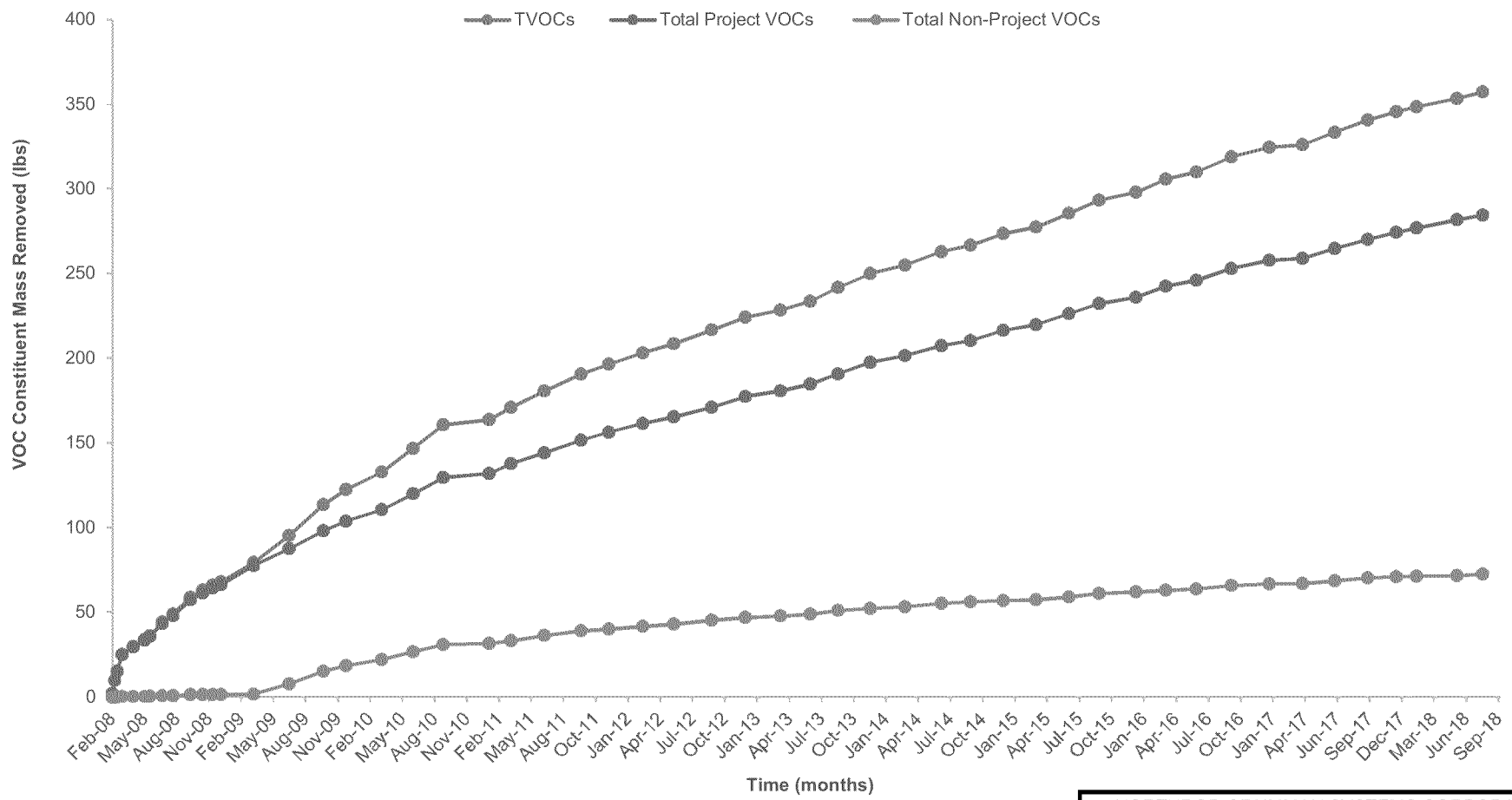
FIGURE
4



Abbreviations, Notes, and Units:

VOCs = Volatile Organic Compounds

TVOCs = Total VOCs detected

Total Project VOCs = Sum of 1,1,1-trichloroethane; 1,1-dichloroethane; 1,2-dichloroethane; 1,1-dichloroethene; tetrachloroethene; trichloroethene; vinyl chloride; cis-1,2-dichloroethene; trans-1,2-dichloroethene; benzene; toluene; and total xylenes.

Total Non-Project VOCs = Sum of VOCs that are not Project VOCs.

1. The sample results from December 3, 2010 are not consistent with historical data and the results are excluded from this figure.

lbs = pounds

NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE PARK SOIL GAS CONTAINMENT SYSTEM
BETHPAGE, NEW YORK, OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)

CUMULATIVE TOTAL, PROJECT, AND NON-PROJECT VOC MASS REMOVED

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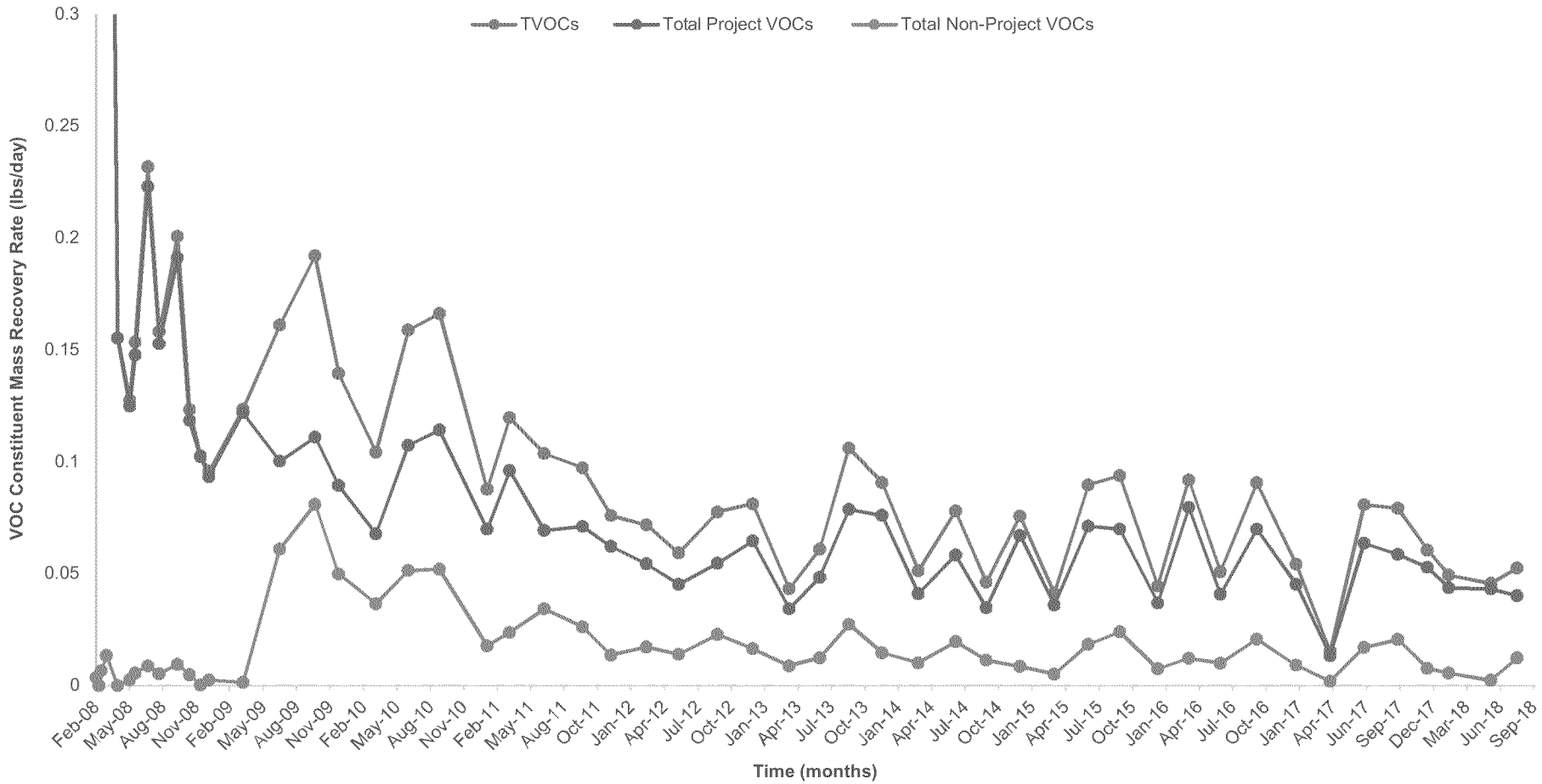
FIGURE
5



Abbreviations, Notes, and Units:

VOCs = Volatile Organic Compounds
TVOCs = Total VOCs detected

Total Project VOCs = Sum of 1,1,1-trichloroethane; 1,1-dichloroethane; 1,2-dichloroethane; 1,1-dichloroethene; tetrachloroethene; trichloroethene; vinyl chloride; cis-1,2-dichloroethene; trans-1,2-dichloroethene; benzene; toluene; and total xylenes.
Total Non-Project VOCs = Sum of VOCs that are not Project VOCs.

1. Results prior to April 16, 2008 are not shown to improve figure clarity. The TVOC and Total Project VOC concentrations are greater than 0.3 lbs/day. See previous reports for full data set.
2. The sample results from December 3, 2010 are not consistent with historical data and the results are excluded from this figure. The TVOC concentration for December 3, 2010 was 13 µg/L.

lbs/day = pounds per day

NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE PARK SOIL GAS CONTAINMENT SYSTEM
BETHPAGE, NEW YORK, OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)

VOC MASS RECOVERY RATES

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FIGURE
6