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MEMORANDUM

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James Cashwell, Olin Corporation
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FROM: Paul Porada

DATE: April 5, 2018

RE: Landfill Gas Data, Landfill & Resource Recovery, North Smithfield, Rhode Island

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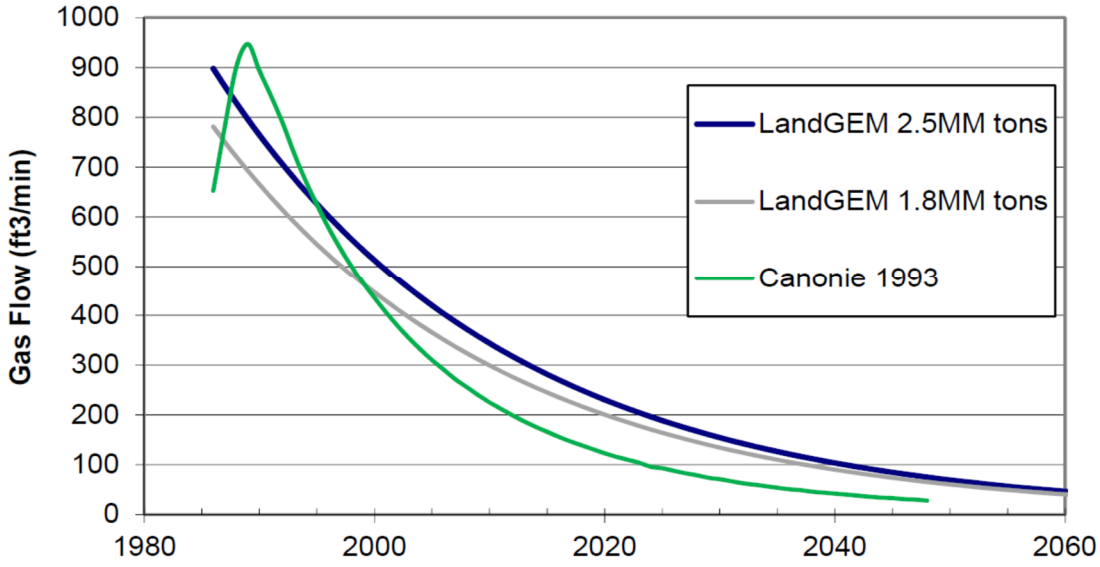
As requested in your email message of March 26, 2018, we are providing Rhode Island Department of Environmental Management (RIDEM) with a landfill gas data summary for the Landfill & Resource Recovery (L&RR) site in North Smithfield, Rhode Island. The data consists of gas volume modeling, a summary of inlet gas test results, and a trending of the contaminant benzene.

Gas Volume

The volume of landfill gas produced at L&RR had been estimated using the U.S. Environmental Protection Agency's (USEPA's) Landfill Gas Emissions Model (LandGEM). Waste volume in the landfill is not accurately known so two different waste tonnages were modeled to bracket a range. We also had record of a gas generation estimate prepared during the remedial activities by Canonie in 1993. A plot of the estimated gas generation rates from this past work demonstrates the landfill's gas generation has decreased in the preceding years and will continue to decrease.

LANDFILL GAS GENERATION ESTIMATES

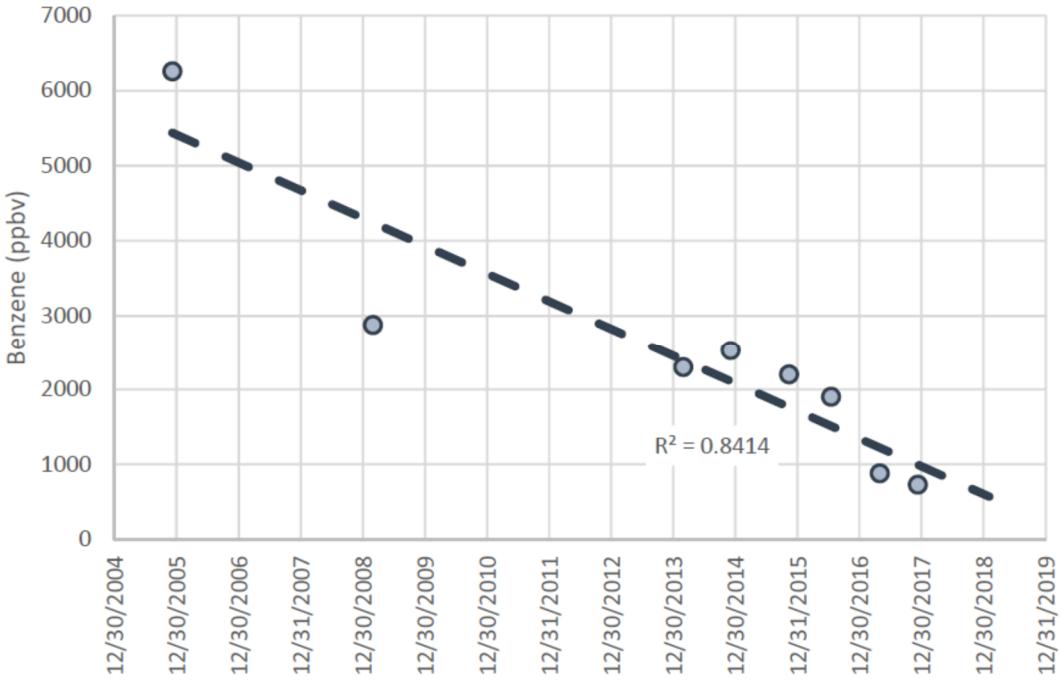


Emissions Data

Gas from the landfill is periodically sampled at the inlet to the combustion flare and tested. Attached is a summary table of the laboratory results for sample events conducted during the past 12 years. Highlighted in bold font on the attached table are the air contaminants of concern for L&RR identified in the Record of Decision, Table VI-L, September 29, 1988.

Benzene is one contaminants of concern identified in the sampling that has a relatively low Acceptable Ambient Level for air toxics. A plot of the inlet gas benzene concentration demonstrates the benzene concentration has been decreasing with time.

FLARE INLET GAS BENZENE CONCENTRATION TREND



L&RR Landfill, North Smithfield, RI
Flare Inlet Gas Samples,
TO-15 Data Summary

Notes:
Analytes in **BOLD** font are the L&RR Site Contaminants of Concern for air listed in the 1988 Record of Decision Summary, Table VI-1

ND = Not detected, below method detection limit

DATE SAMPLED		12/6/2005 Stack Test {TO-14}			12/23/09 Stack Test			02/27/14	12/03/14 Stack Test			11/12/15	7/15/2016	4/28/2017	12/8/2017
		Run 1	Run 2	Run 3	Run 1	Run 2	Run 3		Run 1	Run 2	Run 3				
ANALYTE															
Acetone (2-propanone)	ppbv				2430	2560	6960	3500	<780	<500	<420	3000	6400	4100	3300
Benzene	**ppbv**	**5800**	**4550**	**8420**	**2800**	**3100**	**2730**	**2300**	**2450**	**2330**	**2800**	**2200**	**1900**	**880**	**730**
Benzyl chloride	ppbv				<130	<280	<560	<1.0	<190	<180	<190	<30	<30	<3.0	<4.0
Bromodichloromethane	ppbv				<25	<56	<110	<1.0	<38	<36	<38	<30	<30	<3.0	<4.0
Bromoform	ppbv				<25	<56	<110	<1.0	<38	<36	<38	<30	<30	<3.0	<4.0
Bromomethane	ppbv				<23	<50	<100	<1.0	<34	<32	<34	<30	<30	<3.0	<4.0
1,3-Butadiene	ppbv				<63	<140	<280	<1.0	<95	<90	<95	<30	<30	<3.0	<4.0
2-Butanone (Methyl Ethyl Ketone)	ppbv				2260	2410	3320	2000	<570	<540	<570	3800	2800	1900	1900
Carbon Disulfide	ppbv				70	<140	<280	20	<95	<90	<95	<300	<300	<30	<40
Carbon Tetrachloride	**ppbv**				**<38**	**<84**	**<170**	**<1.0**	**<57**	**<54**	**<57**	**<30**	**<30**	**<3.0**	**<4.0**
Chlorobenzene	ppbv			2980	192	224	175	200	263	265	344	550	580	65	150
Chloroethane	ppbv				185	278	203	79	119	112	133	97	120	73	110
Chloroform	**ppbv**				**<19**	**<42**	**<84**	**<1.0**	**<29**	**<27**	**<29**	**<30**	**<30**	**<3.0**	**<4.0**
Chloromethane (methyl chloride)	ppbv				<38	<84	<170	6.6	63	<54	<57	<60	84	16	15
Cyclohexane	ppbv				1860	2050	1940	590	1050	992	1200	1500	1400	780	720
Dibromochloromethane	ppbv				<25	<56	<110	<1.0	<38	<36	<38	<30	<30	<3.0	<4.0
1,2-Dibromoethane (Ethylene Dibromide)	ppbv				<21	<48	<95	<1.0	<32	<31	<32	<30	<30	<3.0	<4.0
1,2-Dichlorobenzene	ppbv				<50	<110	<220	<1.0	<76	<72	<76	56	49	<3.0	<4.0
1,3-Dichlorobenzene	ppbv				<50	<110	<220	<1.0	<76	<72	<76	<30	<30	<3.0	<4.0
1,4-Dichlorobenzene	ppbv				178	231	220	460	179	177	238	370	220	<3.0	22
Dichlorodifluoromethane (Freon 12)	ppbv				291	328	320	280	120	120	138	590	290	250	270
1,1-Dichloroethane	ppbv				202	213	193	76	177	191	230	230	240	78	78
1,2-Dichloroethane	**ppbv**				**<25**	**<56**	**<110**	**<1.0**	**<38**	**<36**	**<38**	**<30**	**<30**	**<3.0**	**6.5**
1,1-Dichloroethylene	**ppbv**				**<31**	**<70**	**<140**	**<1.0**	**<48**	**<45**	**<48**	**<30**	**<30**	**6.7**	**<4.0**
cis-1,2-Dichloroethylene	ppbv			2730	433	472	422	280	552	536	674	910	800	230	150
trans-1,2-Dichloroethylene	ppbv				32	<56	<110	14	<38	<36	<38	<30	35	9.9	10
1,2-Dichloropropane	ppbv				<50	<110	<220	15	<76	<72	<76	<30	49	16	14
cis-1,3-Dichloropropene	ppbv				<23	<50	<100	<1.0	<34	<32	<34	<30	<30	<3.0	<4.0
trans-1,3-Dichloropropene	ppbv				<21	<48	<95	<1.0	<32	<31	<32	<30	<30	<3.0	<4.0
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	ppbv				124	135	132	64	121	122	139	100	110	86	140
1,4-Dioxane	ppbv				<250	<560	<1100	<10	<380	<360	<380	340	550	140	<40
Ethanol	ppbv				19500	19000	18600	6500	<580	<410	<440	11000	20000	7600	3700
Ethyl Acetate	ppbv				876	941	<1200	610	<420	<400	<420	620	1000	540	580
Ethylbenzene	**ppbv**	**14700**	**18700**	**45000**	**8760**	**9680**	**7680**	**4700**	**7810**	**7610**	**9610**	**4100**	**9000**	**2400**	**2300**
4-Ethyltoluene	ppbv				321	<620	<1200	430	<420	403	517	570	490	20	73
Heptane	ppbv				1460	1590	1370	620	1210	1140	1390	1500	1600	620	530
Hexachlorobutadiene	ppbv				<380	<840	<1700	<1.0	<570	<540	<570	<30	<30	<3.0	<4.0
Hexane	ppbv				1580	1820	1690	860	2500	2030	2600	1600	2300	840	970
2-Hexanone (Methyl Butyl Ketone)	ppbv				<250	<560	<1100	<1.0	<380	<360	<380	<30	<30	<6.0	<4.0
Isopropanol (2 propanol)	ppbv				4220	4290	4330	2100	<570	<540	<570	1800	5300	2100	1100
Methyl tert-Butyl Ether (MTBE)	ppbv				<25	<56	<110	<1.0	<38	<36	<38	<30	<30	3.7	<4.0
Methylene Chloride (Dichloromethane)	**ppbv**				**157**	**<200**	**<400**	**60**	**<580**	**<320**	**<450**	**470**	**<300**	**50**	**57**
4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	ppbv				<400	<900	<1800	<1.0	<610	<580	<610	<30	490	250	190
Naphthalene	ppbv							390				140	220	<3.0	<4.0
Propene	ppbv				7040	7360	7220	<40	4740	4510	5400	9400	10000	14000	7400

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Flare Inlet Gas Samples,
TO-15 Data Summary

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		Run 1	Run 2	Run 3	Run 1	Run 2	Run 3		Run 1	Run 2	Run 3				
ANALYTE															
Styrene	ppbv				190	296	184	140	104	95	121	160	160	15	33
1,1,2,2-Tetrachloroethane	**ppbv**				**<25**	**<56**	**<110**	**<1.0**	**<38**	**<36**	**<38**	**<30**	**<30**	**<3.0**	**<4.0**
Tetrachloroethylene	**ppbv**				**135**	**146**	**122**	**79**	**93**	**92**	**110**	**1000**	**740**	**42**	**39**
Tetrahydrofuran	ppbv				1410	1700	1600	630	<76	<72	<76	940	1200	600	590
Toluene	**ppbv**	**104000**	**109000**	**237000**	**41800**	**54300**	**45500**	**13000**	**35400**	**27300**	**35300**	**6000**	**24000**	**13000**	**8600**
1,2,4-Trichlorobenzene	ppbv				<250	<560	<1100	17	<380	<360	<380	<30	<30	<3.0	<4.0
1,1,1-Trichloroethane	ppbv				<38	<84	<170	<1.0	<57	<54	<57	<30	<30	<3.0	<4.0
1,1,2-Trichloroethane	ppbv				<19	<42	<84	<1.0	<29	<27	<29	<30	<30	<3.0	<4.0
Trichloroethylene	**ppbv**				**91**	**98**	**170**	**43**	**70**	**78**	**89**	**120**	**120**	**35**	**38**
Trichlorofluoromethane (Freon 11)	ppbv				<25	<56	<110	3.5	<38	<36	<38	<120	<120	<12	<16
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	ppbv				<19	<42	<84	3	<29	<27	<29	<120	<120	<12	<16
1,2,4-Trimethylbenzene	ppbv		3020	7780	921	1100	924	750	998	981	1270	1500	1000	7.4	140
1,3,5-Trimethylbenzene	ppbv				455	532	463	580	525	515	650	720	560	11	90
Vinyl Acetate	ppbv				<25	130	<110	<20	<38	<36	<38	<600	<600	<60	<80
Vinyl Chloride	ppbv	3670	3040	5250	1330	1380	1290	550	878	891	1070	830	960	590	700
m&p-Xylene	ppbv	31000	41100	88800	15300	17500	13500	7700	13400	13100	16600	4600	15000	3100	3300
o-Xylene	ppbv	5710	8550	20000	3340	3830	2960	2000	3240	3160	4030	4100	4200	700	1000