

APPENDIX A – Closed Landfill Surface Water Chemical Data

Surface Water Samples Closed Landfills

Landfill	Location	Year	Date	Field Temp	DO	TDS	Ammonia	Nitrite-Nitrate	Chloride	Sulfate	COD	Phosphorus	Conductivity	Cyanide	Bicarb	Alkalinity	Carb	pH	Turbidity	Mercury	Calcium	Iron	Magnesium	Potassium	Sodium	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Silver	Strontium	Thallium	Vanadium	Zinc			
Standards	MCL					500		10	250	250				0.2				6.5-8.5	0.0020						250		0.006	0.01	2	0.004		0.005	0.1		0.05		0.1		0.002				5.00				
SMCL																																															
Action Level																																															
Carmical & Miami	#1	2001	9/20/2001			392	<1	2.27	68.2	47.3	<30	-	770	-	217	-	8.51	24.6	<0.0005	-	-	-	-	-	39.2	-	<0.004	<0.005	0.09	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05				
	#1	2002	7/16/2002			304	<1	0.213	80	36.7	<30	-	662	-	138	-	8.72	29	<0.0005	-	-	-	-	-	43.2	-	<0.004	<0.005	0.067	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05				
	#1	2003	10/8/2003			452	<1	3.28	56	61.8	<30	-	786	-	287	-	8.41	6.2	<0.0005	-	-	-	-	-	29.7	-	<0.004	<0.0025	0.077	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05				
	#1	2004	9/10/2004			515	<1	1.86	85.5	73.3	<30	-	889	-	241	-	8.35	8.65	<0.0005	-	-	-	-	-	53.2	-	<0.004	<0.0025	0.098	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05				
	#1	2005	9/22/2005			364	0.058	2.97	54.2	46.4	<30	-	663	-	193	-	7.86	23.8	<0.0005	-	-	-	-	-	33	-	<0.004	<0.003	0.081	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.001	-	<0.05				
	#1	2006	9/15/2006			263	0.138	1.79	39.5	39	<30	-	538	-	168	-	7.84	23.8	<0.002	-	-	-	-	-	22.7	-	<0.004	<0.003	0.07	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.001	-	<0.05				
	#1	2007	10/9/2007			566	<0.05	1.54	102	77	<50	-	880	-	266	-	8.28	11.9	<0.200	-	-	-	-	-	65.1	-	<0.001	<0.005	0.101	-	<0.0004	<0.002	-	<0.005	0.001	-	<0.0061	<0.005	-	-	<0.001	-	0.012				
	#1	2008	10/30/2008			583	0.043	3.65	92.6	68.7	<15.9	-	893	-	240	-	8.63	3.85	<0.000894	-	-	-	-	-	68.1	-	0.000499	0.00084	0.0925	-	<0.00043	<0.00024	-	0.00278	0.0003	-	0.00162	0.000711	-	-	<0.000017	-	0.011				
	#1	2009	11/5/2009			390	0.095	2.2	56.3	46.4	14.4	-	698	-	250	-	8.36	15	<0.000894	-	-	-	-	-	33.2	-	0.000175	0.000967	0.0822	-	<0.00043	<0.00024	-	0.00223	0.0008	-	0.00133	<0.00069	-	-	<0.000017	-	0.005				
	#1	2010	9/16/2010			562	0.309	1.52	126	78.9	<50.0	0.334	-	996	-	245	260	<20.0	8.73	17	<0.0002	83.3	0.428	34.1	83.5	-	0.000314	0.00181	0.103	<0.0002	<0.0002	<0.000633	0.003	0.0007	0.0527	<0.005	<0.002	<0.0001	-	<0.0002	0.0017	-	<0.0002	0.0017	0.007		
	#1	2011	9/15/2011			494	0.068	1.65	92.3	61.9	<50	0.242	-	824	-	227	230	<20	8.54	6.3	<0.0002	72.0	0.332	30.3	5.15	89.5	-	<0.0004	<0.0004	0.0981	<0.0004	<0.0004	0.000642	0.00293	0.0008	0.0465	<0.005	<0.004	<0.0002	-	<0.0004	<0.008	<0.014				
	#1	2012	9/13/2012			956	0.124	1.03	63.2	51	<50.0	0.413	-	624	-	179	184	<10.0	8.39	13	<0.0002	59.1	0.596	24.4	5.29	36.1	-	<0.0005	<0.004	0.0798	<0.0004	<0.0004	0.000556	0.00267	0.0008	0.0811	<0.004	<0.004	<0.0002	-	<0.0004	<0.01	<0.009				
	#1	2014	9/10/2014	24.4		456	<0.200	1.38	78.3	51	15.8	0.298	743	<0.01	230	245	15.5	8.71	7.3	<0.0002	72.2	0.576	28.4	4.68	51.4	0.445	<0.002	<0.005	0.0918	<0.001	0.0985	<0.001	<0.002	<0.001	0.0592	0.00295	<0.005	<0.001	0.591	<0.002	<0.005	<0.020					
	#1	2016	9/15/2016	24.5	8.30	440	<0.02	ND	66	42	12	0.29	660	<0.002	210	210	ND	8.3	14	<0.005	62	0.46	23	4.8	42	0.66	<0.03	<0.01	<0.1	<0.0004	<0.1	<0.005	<0.025	<0.025	<0.015	<0.05	<0.05	<0.03	<0.01	0.45	<0.005	<0.05					
	#1	2018	10/1/2018			375	<0.2	3.31	42.2	32.1	10.1	0.29	617	<0.01	217	222	<5.0	8.3	27	<0.002	67.8	1.13	24.8	5.77	24.7	1.14	<0.002	<0.005	0.0795	<0.001	<0.1	<0.001	<0.002	<0.001	0.00368	0.0013	0.046	0.00272	<0.005	<0.001	0.648	<0.001	<0.005	<0.02			
	#1	2020	10/13/2020	20.3		435	<0.2	2.51	84.7	56.2	<10.0	0.385	869	<0.01	236	244	7.43	8.4	10.6	<0.002	69	0.412	29	5.57	57.6	0.338	<0.002	<0.005	0.0857	<0.001	0.112	<0.001	<0.002	<0.001	0.00201	0.00286	<0.005	<0.001	0.675	<0.001	<0.005	<0.02					
	#1	2022	10/19/2022	10.2		468	<0.2	2.48	86	55.9	12.3	0.174	852	<0.01	238	268	30.5	8.5	2.7	<0.0002	72.9	0.129	30.9	5.11	55	0.0833	<0.002	<0.005	0.0808	<0.001	0.101	<0.001	<0.005	<0.001	0.0184	0.00203	<0.005	<0.001	0.687	<0.001	<0.005	<0.02					
	#2	2001	9/20/2001			407	<1	2.48	67.4	57.3	<30	-	771	-	221	-	8.47	32	<0.0005	-	-	-	-	-	40	-	<0.004	<0.005	0.09	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05				
	#2	2002	7/16/2002			319	<1	0.203	78.4	35.8	47.4	-	667	-	127	-	8.48	34.4	<0.0005	-	-	-	-	-	43.8	-	<0.004	<0.005	0.069	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05				
	#2	2003	10/8/2003			454	<1	3.29	56.6	63.8	<30	-	793	-	300	-	8.42	6.7	<0.0005	-	-	-	-	-	29.7	-	<0.004	<0.0025	0.079	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05				
	#2	2004	9/10/2004			517	<1	1.9	89	63.6	<30	-	888	-	243	-	8.27	9.31	<0.0002	-	-	-	-	53.1	-	<0.004	<0.0025	0.097	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05					
	#2	2005	9/22/2005			369	<0.05	2.96	53.5	46.4	<30	-	667	-	193	-	8.12	15.8	<0.0002	-	-	-	-	33.7	-	<0.004	<0.003	0.08	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.001	-	<0.05					
	#2	2006	9/15/2006			286	0.07	1.78	39.5	36.5	<30	-	542	-	170	-	7.86	29.3	<0.0002	-	-	-	-	23.1	-	<0.004	<0.003	0.074	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.001	-	<0.05					
	#2	2007	10/9/2007			427	<1	2.39	67.4	55.3	<30	-	771	-	234	-	8.45	50.1	<0.0005	-	-	-	-	38.9	-	<0.004	<0.005	0.094	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05					
	#3	2002	7/16/2002			323	<1	0.201	77	34.5	38.5	-	662	-	140	-	8.78	29.8	<0.0005	-	-	-	-	42.5	-	<0.004	<0.005	0.063	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05					
#3	2003	10/8/2003			455	<1	3.44	56	63.4	<30	-	792	-	300	-	8.42	7.28	<0.0005	-	-	-	-	29.6	-	<0.004	<0.0025	0.078	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	-	<0.0015	-	<0.05						
#3	2004	9/10/2004			507	<1	1.89	90.8	60.2	<30	-	888	-	236	-	8.31	11.1	<0.0002	-	-	-	-	53.9																								

Surface Water Samples Closed Landfills

Landfill	Location	Year	Date	Field Temp	DO	TDS	Ammonia	Nitrite-Nitrate	Chloride	Sulfate	COD	Phosphorus	Conductivity	Cyanide	Bicarb	Alkalinity	Carb	pH	Turbidity	Mercury	Calcium	Iron	Magnesium	Potassium	Sodium	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Nickel	Selenium	Silver	Strontium	Thallium	Vanadium	Zinc	MCL		
																																													SMCL	500	<1
Standards	SMCL	500	<1	<0.05	53.1	29.1	<30	-	543	-	-	151	-	8.18	3.8	<0.0002	-	-	-	35.3	-	<0.004	<0.003	0.068	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.02	<0.005	-	<0.001	-	<0.05						
Action Level	500	<1	<0.05	50.9	40.2	<30	-	616	-	-	194	-	8.10	5.81	<0.0005	-	-	-	27.1	-	<0.004	<0.0025	0.079	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.02	<0.005	-	<0.0015	-	<0.05							
Newtown	#1	2001	9/21/2001			260	<1	<0.05	40.4	36.4	<30	-	546	-	-	180	-	8.20	4.25	<0.0005	-	-	-	-	-	<0.004	<0.005	0.056	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.0015	-	<0.05					
	#1	2002	6/18/2002			312	<1	<0.05	41.3	24.7	<30	-	555	-	-	186	-	8.15	3	<0.0005	-	-	-	-	-	-	<0.004	<0.005	0.08	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.002	-	<0.001				
	#1	2003	9/24/2003			328	<1	<0.05	50.9	40.2	<30	-	616	-	-	194	-	8.10	5.81	<0.0005	-	-	-	-	-	-	<0.004	<0.0025	0.069	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.0015	-	<0.05				
	#1	2004	8/24/2004			278	<1	<0.05	51.7	29.6	<30	-	542	-	-	148	-	8.17	2.82	<0.0002	-	-	-	-	-	-	<0.004	<0.0025	0.078	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.0015	-	<0.05				
	#1	2005	8/11/2005			258	<0.05	<0.05	55.5	32.3	<30	-	528	-	-	141	-	8.12	2.92	<0.0002	-	-	-	-	-	-	<0.004	<0.003	0.068	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.001	-	<0.05				
	#1	2006	8/31/2006			307	<0.05	<0.05	50.9	34.8	<30	-	510	-	-	138	-	8.11	2.92	<0.0002	-	-	-	-	-	-	<0.004	<0.003	0.08	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.001	-	<0.05				
	#1	2007	9/18/2007			327	<0.3	<0.02	64	33.6	<50	-	536	-	-	150	-	8.04	6.84	<0.0002	-	-	-	-	-	-	<0.004	<0.003	0.08	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.01	-	<0.05				
	#1	2008	10/30/2008			390	0.035	<0.00885	53	30.3	18	-	544	-	-	158	-	8.49	3.01	0.000089	-	-	-	-	-	-	0.000238	0.000733	0.0901	-	-	<0.000443	<0.00024	-	0.000563	0.000156	-	0.000897	<0.00069	-	<0.000017	-	0.003				
	#1	2009	11/5/2009			249	0.057	0.0398	61.3	35.8	<10.9	-	515	-	-	158	-	8.51	3.2	0.000089	-	-	-	-	-	-	0.000106	<0.00072	0.0768	-	-	<0.000443	<0.00024	-	0.000636	<0.00069	-	0.000566	<0.00069	-	<0.000017	-	0.001				
	#1	2010	9/9/2010			367	0.124	<0.02	66.3	29.9	113	<0.1	524	-	-	135	136	<20.0	8.53	2.4	-	-	39.3	0.112	19	4.17	42.9	-	<0.0002	<0.002	0.0627	<0.0002	-	<0.0002	<0.002	0.0158	<0.003	<0.002	<0.0001	<0.0002	0.0158	<0.003	<0.002	<0.0001	<0.0002	<0.004	<0.005
	#1	2011	10/13/2011			351	<0.05	<0.02	62.1	31.3	<50.0	<0.1	526	-	-	168	170	<20.0	8.09	4	<0.0002	0.0641	-	-	18.5	4.13	38.0	-	<0.0002	<0.002	0.0627	<0.0002	-	<0.0002	<0.004	0.000253	<0.001	<0.0002	0.0158	<0.0045	<0.002	<0.0001	<0.0002	<0.001	<0.0002	<0.004	<0.005
	#2	2001	9/21/2001			234	<1	<0.05	40.4	35	<30	-	545	-	-	163	-	8.25	4.81	<0.0005	-	-	-	-	-	-	<0.004	<0.005	0.062	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.0015	-	<0.05				
	#2	2002	6/18/2002			308	<1	<0.05	40.5	26	<30	-	556	-	-	184	-	8.10	21.6	<0.0005	-	-	-	-	-	-	<0.004	<0.005	0.081	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.002	-	<0.05				
	#2	2003	9/24/2003			291	<1	<0.05	50.6	44.2	<30	-	613	-	-	188	-	8.17	4.23	<0.0005	-	-	-	-	-	-	<0.004	<0.0025	0.066	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.0015	-	<0.05				
	#2	2004	8/24/2004			285	<1	<0.05	53.1	29.1	<30	-	543	-	-	151	-	8.18	3.8	<0.0002	-	-	-	-	-	-	<0.004	<0.0025	0.075	-	-	0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.0015	-	<0.05				
	#2	2005	8/11/2005			269	<0.05	<0.05	54.4	33.2	<30	-	527	-	-	142	-	8.17	3.32	<0.0002	-	-	-	-	-	-	<0.004	<0.003	0.084	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.0015	-	<0.05				
	#2	2006	8/31/2006			298	<0.05	<0.05	52.3	36.5	<30	-	510	-	-	140	-	8.22	5.68	<0.0002	-	-	-	-	-	-	<0.004	<0.003	0.081	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.001	-	<0.05				
	#2	2007	9/18/2007			302	<0.3	<0.02	62	28.6	<50	-	535	-	-	154	-	8.23	6.53	<0.0002	-	-	-	-	-	-	<0.004	<0.003	0.081	-	-	<0.0002	<0.02	-	<0.05	<0.005	-	<0.02	<0.005	-	<0.01	-	<0.05				
	#2	2008	10/30/2008			442	0.127	<0.00885	51.8	31.6	<15.9	-	534	-	-	168	-	8.45	4.2	0.000089	-	-	-	-	-	-	0.000179	0.000973	0.089	-	-	<0.000443	<0.00024	-	0.000574	0.000156	-	0.000744	<0.00069	-	<0.000017	-	0.003				
	#2	2009	11/5/2009			283	0.135	0.0315	61.1	35.7	<10.9	-	539	-	-	150	-	8.53	3.4	0.000089	-	-	-	-	-	-	0.000113	0.00124	0.0853	-	-	<0.000443	<0.00024	-	0.000697	0.000156	-	0.000637	<0.00069	-	<0.000017	-	0.001				
	#2	2010	9/9/2010			297	0.125	<0.02	67.2	30.3	<50.0	<0.1	520	-	-	134	134	<20.0	8.53	3.4	-	-	41.6	0.109	19.7	4.32	45.1	-	<0.0002	<0.002	0.0659	<0.0002	-	<0.0002	<0.002	0.000218	<0.001	<0.0002	0.0192	<0.003	<0.002	<0.0001	<0.0002	<0.004	<0.005		
	#2	2011	10/13/2011			341	<0.05	<0.02	58.3	27.2	<50.0	<0.1	520	-	-	165	166	<20.0	8.18	6.2	<0.0002	0.063	<0.0002	-	-	17.5	3.96	36.2	-	<0.0002	<0.002	0.063	<0.0002	-	<0.0002	0.000279	<0.001	<0.0002	0.0192	<0.004	<0.002	<0.0001	<0.0002	<0.001	<0.0002	<0.004	<0.005
	#2	2013	10/15/2013	18.4		240	<0.200	<0.100	46.9	23.8	15.5	<0.100	510	<0.01	<0.01	150	<50.0	8.44	5.82	<0.0002	42.9	0.245	18.7	3.61	32.6	0.148	<0.002	<0.005	0.029	<0.001	0.135	<0.001	<0.002	<0.001	<0.002	<0.001	<0.002	0.0228	<0.002	<0.005	<0.001	0.158	<0.002	<0.005	<0.02		
	#2	2015	10/20/2015			272	<0.200	<0.100	50.1	27.7	10.2	<0.1	521	<0.01	<0.01	189	189	<50.0	7.53	4.72	<0.0002	45.8	0.144	19.4	3.47	32.8	0.0516	<0.002	<0.005	0.029	<0.001	0.117	<0.001	<0.002	<0.001	<0.002	0.0168	<0.002	<0.005	<0.001	0.179	<0.002	<0.005	<0.02			
	#2	2017	10/18/2017			268	<0.200	<0.050	46.4	25.7	17.6	<0.100	500	<0.0100	<0.0100	153	158	<50.0	8.20	9.29	<0.0002	40.1	0.149	18.2	3.48	28.3	0.075	<0.002	<0.005	0.0604	<0.001	<0.2															

APPENDIX B – SAMPLING AND INSPECTION METHODS

SURFACE WATER SAMPLING

Surface water sampling was conducted by obtaining single location grab samples in streams, rivers, or ponds around each of the landfills where possible. Efforts are made to collect the samples during low flow times where groundwater contributions are considered to be greater. This monitoring was performed to serve as an indicator of water quality above and below each landfill.

Samples were collected in polyethylene wide-mouth jars ranging in size from 60 ml to 500 ml. Samples were preserved with sulfuric acid, nitric acid, or sodium hydroxide as required and delivered to the lab for analysis. Water temperature is recorded using a Taylor thermometer. These readings are taken at several spots at each sample location and a median reading is reported. Samples were analyzed by Eurofins Cleveland and Eurofins Cedar Falls. Chain-of-custody protocols were followed. Methods used to analyze the samples are below:

Method	Method Description	Preservative	Bottle	Protocol
9056A 28D	Chloride & Sulfate			SW846
SM 2510B	Specific Conductance	None	500 ml	SM
SM 2540C	Solids, Total Dissolved			SM
SM 2320B	Alkalinity	None	60 ml	SM
180.1	Turbidity	None	250 ml	MCAWW
9040C	pH			SW846
6020B	Metals			SW846
7470A	Mercury	Nitric Acid	500 ml	SW846
6010D	Boron			SW846
SM 4500 P E	Total Phosphorus as P			SM
410.4 LL	COD	Sulfuric Acid	500 ml	MCAWW
350.1	Ammonia			MCAWW
353.2	Nitrate Nitrite as N			MCAWW
SM 4500 CN I	Cyanide, Weak Acid Dissociable	Sodium Hydroxide	250 ml	SM

Protocol References:

MCAWW = "Methods For Chemical Analysis Of Water And Wastes"

SM = "Standard Methods For The Examination Of Water And Wastewater"

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods"

BIOLOGICAL SAMPLING

Biological organisms can provide an indication of water quality based on their typical habitat requirements. For example, Psephenidae (Water-Penny) cannot tolerate pollution, high sedimentation, and high amounts of algae or fungi, so their presence is an indicator of good water quality. Other organisms such as isopods (sow bugs) inhabit unpolluted shallows. Amphipods (salamanders), plecopterans (stoneflies), ephemeropterans (mayflies), some odonatans (dragonflies and damselflies), trichopterans (caddis flies) and some gastropods (lymnea) need an abundance of dissolved oxygen (DO) to survive. Dipterans (flies, mosquitoes, and midges) are able to live in low DO environments and are much more tolerant of pollution. Some of these organisms can live in only low current streams; in unpolluted clear waters; occur in debris (masses of leaves and algae); occur under stones; occur in vegetation; occur in mud; found in decaying vegetation; or occur only in ponds. Some organisms have specific physical features such as respiratory tubes (Dipteran larva), which enable those organisms to survive in low DO environments or in highly polluted waters. These ecological characteristics can provide an indication of a clean versus a polluted environment.

Biological water samples were collected at each of the same locations as the water samples taken for chemical analysis. Biological samples were collected using an aquatic kick net with 1000-micron mesh. A kick sampling technique was used to loosen organisms from riffle areas of streams and then the area was swept with the net. Pond areas were swept with the net after making an attempt to stir-up bottom areas near the shoreline. In some locations, rocks and other debris were also picked for organisms. Biological organisms were identified and counted in the field. If organisms could not be identified, samples were placed in 4 oz. Nalgene wide-mouth jars and preserved in 70% isopropyl alcohol. The jars were appropriately labeled and samples taken back to the Health District Office for further identification. If needed, organisms were identified with the aid of a magnifying glass and a Swift Instruments variable magnification (1X-4X) binocular microscope.

GAS SAMPLING

Waste materials in landfills generally decompose under anaerobic conditions resulting in the production of methane gas. Methane is only explosive between certain concentrations. The Lower Explosive Limit (LEL) of methane is 5%. Concentrations below this level are too lean to burn. The Upper Explosive Limit (UEL) of methane is 15%. Concentrations above this level are too rich to burn. Monitoring for methane is often reported as a percentage of the LEL. For example 50% LEL corresponds to 2.5% methane (0.5 X the LEL of 5).

Landfills of the past were not necessarily constructed in a manner that would contain these gases. Therefore, many of the older landfills generate methane gas and, because of design or lack of design, allow the gas being generated to migrate outside of the landfill limits and into the soils and other pathways surrounding the site. As a result, explosive gases have been known to migrate into nearby structures and reach explosive concentrations, thereby posing possible danger to the occupants of the structures.

Gas sampling is conducted in the field by using a punch-bar method and then monitoring the punch hole of 2.5 to 3 feet for the presence of methane (as LEL), carbon monoxide (CO), oxygen (O₂), and hydrogen sulfide (H₂S) with a gas monitor (Honeywell PHD6 gas detector). The gas meter is calibrated according to the manufacturer's recommendations. The results provide a measure of gas production and possible gas migration in the areas on and around the closed landfills.

Because of the type of gas monitor used, CO levels are subject to interference from other components of landfill gas such as Hydrogen, Hydrogen Sulfide, and VOC's. Exposure to these other gases could result in the monitor falsely reporting concentrations of CO. For this reason, CO results reported are used only as an indicator. If repeated high concentrations were reported in the same area these concentrations would need to be confirmed by laboratory analysis.

The purpose of the monitoring performed by the WM staff this past year was to gather information as to the need for further concerns about gas migration towards occupied structures within 1000 feet of the limits of the landfill. The landfills monitored by WM staff are landfills which have not been required to develop explosive gas monitoring plans (EGMP) as detailed in OAC 3745-27-12. These rules require contingency procedures if 25% of the LEL (1.25% methane) is found in a structure. WM staff use this same trigger during their monitoring. If the concentration of methane at a given punch bar location is 25% LEL or greater, then an additional punch bar location is monitored. The additional location is in a direction away from the assumed limits of waste and towards any occupied structures. This process is continued until a concentration of less than 25% is encountered. If the monitoring results indicated a need, then an explosive gas plan may be required of the current property owner to ensure controls would prevent gas migration and potential explosive conditions in structures both on- and off-site.

Punch bar gas monitoring is performed based on the theory that gas will rise to the top of the underground surface and be trapped by the cover materials which are less permeable than the waste mass. Since the present-day underground geology is unknown at many of these landfills, it is possible that the gas may be trapped at depths deeper than the target punch bar depth of 2.5 – 3.0 feet. For example gas could have a horizontal “least resistance” pathway through sand and gravel or be impeded from rising to the surface by an impermeable layer of waste/soil within the waste mass. For this reason, it cannot be assumed that because gas was not detected in our monitoring that the landfill is not producing methane, or that this methane is not migrating offsite.

There are a few closed landfills located in the county which were required to develop a EGMP but have since been released from this requirement by the OEPA after demonstrating *“there is no significant likelihood of explosive gas formation and migration sufficient to require contingency procedures”* per OAC 3745-27-12(O). These landfills are evaluated during HCPH’s visual inspections to determine if any activities have occurred at the property which could affect gas production or migration. If these activities are suspected additional punch bar monitoring may be completed by HCPH.

VISUAL INSPECTIONS

Owners of solid waste landfills that ceased acceptance of solid waste prior to post closure care rule implementation do not have any specific requirements to monitor and maintain the sites. Therefore inspectors have limited regulations to guide inspections of these sites. Current inspections include visually looking for issues that could cause a public health nuisance such as exposed waste, leachate outbreaks, erosion, open dumping etc. Explosive gas monitoring structures and/or surface water sampling locations may also be checked during these inspections.

APPENDIX C – SAMPLING AND INSPECTION SCHEDULE

SURFACE WATER SAMPLING - Landfills where surface water sampling is performed are divided into two groups. Groups are then sampled alternating years.

EXPLOSIVE GAS MONITORING - Landfills where gas monitoring is performed by HCPH are monitored each year.

LANDFILL INSPECTIONS - Landfills that are visually inspected are scheduled every 1 - 3 years.

2023 THROUGH 2026 SAMPLING AND INSPECTION SCHEDULE

S = Surface Water sampling
G = Gas sampling

V = Visual inspection and/or Walking of streams
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Landfill	2023	2024	2025	2026
Alexander Sand and Gravel				
Allgeier C&DD	V			V
Amberley Village			V	
Anderson Township	V	V	V	V
Arlington Heights		V		V
Aston Oaks		V		V
Bass Island	V		V	
Bernard C&DD		V		
Bevis Towing C&DD		V		
Blue Ash				
Caravella	V			V
Carmical	V	V	S	V
Cheviot	V	G	V	G
Church Street	V			V
Cincinnati Milacron		V		V
Clarke			V	
Crosby Twp Civic		V		V
Debolt	V	G	V	G
E Miami River Engineer's	V	V	V	V
Elmwood Place				
Evans	V	V	S	V
Evendale	V		V	
Fernald				
Geiler C&DD	V			V
Glendale	V	G	V	S,G
Glenway Crossing	V		V	
Golf Manor				
Greenhills	V	V	S	V
Hamilton County Parks				
Harrison Ave		V		
Harrison C&DD				
Harrison	V	V	V	V
Little Dry Run		V		V
Lockland Incinerator	V	S,G	V	S,G
Lockland Shepherd	V	S		S
Loveland Harper	V	V	S	V
Mariemont		V		V
Miamitown			S	S
Miamiview Rd Ash	V		V	
New Baltimore	V	V	V	V
Old Burkhard Gravel Pit				
Old Galbraith Rd	V		V	
Old Newtown	V	S,G	V	S,G
Paul Willis	V	V	V	V
Reading Incinerator	V	V	V	V
Schweitzer	V	S		S
St. Bernard	V	V	V	V
St. Bernard - Oak St	V	V	V	V
Steelman C&DD		V		
Terrace Park	V		V	
Valley Junction				
Wayne C&DD			V	
Wolfer C&DD	V			V
Wurzelbacher				
Wyoming	V	S,G	V	G