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February 10, 2014

Ms. Jaclynne Drummond
Compliance Hydrogeologist
North Carolina Department of Environment and Natural Resources
Solid Waste Section
1646 Mail Service Center
Raleigh, North Carolina 27699-1646

Subject: Initial Monitored Natural Attenuation Corrective Action Evaluation
Jackson County Closed Municipal Solid Waste Landfill, North Carolina
Permit # 50-02

Dear Ms. Drummond,

Altamont Environmental, Inc. (Altamont), on behalf of Jackson County, is submitting this Initial Monitored Natural Attenuation Corrective Action Evaluation for the Jackson County Closed Municipal Solid Waste Landfill with permit number 50-02.

The Jackson County Solid Waste Department maintains a closed Municipal Solid Waste Landfill (MSWLF) located approximately 0.75 miles west of Dillsboro, North Carolina, on the northeast side of Old Dillsboro Road (Old U.S. Highway 74). The water quality monitoring at the landfill is governed by the North Carolina Department of Environment and Natural Resources (DENR), Division of Waste Management (DWM), Solid Waste Section (SWS), under Permit No. 50-02 issued to Jackson County. The landfill permit requires semiannual monitoring of groundwater quality by sampling seven monitoring wells (Figure 1).

Over time, groundwater quality monitoring indicated persistent low-level exceedances of constituents in groundwater samples. In response to the continued exceedances of analyzed constituents, the following activities have occurred:

- September 7, 2010—An Assessment of Corrective Measures (ACM) report was submitted to the DENR DWM SWS. The ACM stated that volatile organic compounds (VOCs) and metals have been historically detected in excess of the North Carolina groundwater quality standards. Individual metals are not persistently detected over time and, historically, elevated turbidity levels in the samples may have affected the results. Therefore, the ACM suggested that the objective of the remedy focus on VOCs. The ACM evaluated several potential remedies.
- November 12, 2010—Based on the ACM report, the SWS requested a remedy to restore groundwater quality and effectively reduce contamination.
- May 13, 2011—Following advertisement and solicitation for public comment on the assessment of corrective measures, a Corrective Action Permit Modification application was submitted. The Corrective Action Permit Modification application indicated that the selected remedy was leachate removal and monitoring of natural attenuation parameters.
- June 2, 2011—The SWS approved the selected remedy. The SWS requested the preparation of a Corrective Action Plan (CAP).

- June 30, 2011—A CAP was submitted to the SWS (Altamont 2011). Based upon the property currently owned by Jackson County, relative to monitoring locations, the CAP established a compliance and review boundary for the closed landfill by referencing the North Carolina Administrative Code (NCAC), Title 15A, Subchapter 2L.0107. The CAP offered a remedy to restore groundwater quality and effectively reduce contamination for VOC constituents in excess of groundwater quality standards outside the compliance boundary. The CAP offered implementation of the remedy in a three-phase approach over a 5-year time span. Implementation utilized wells associated with the existing landfill gas extraction system. Dedicated pumps were installed into each of the landfill gas extraction wells and leachate is disposed of in the Tuckaseegee Water & Sewer Authority collection system. In addition to leachate extraction, groundwater natural attenuation parameters are monitored and natural attenuation processes are evaluated.
- September 1, 2011—The CAP was approved by the SWS. After 5 years, the corrective actions discussed in the CAP shall be evaluated and reviewed. If VOC concentrations are not reduced, contingency plans may be required.
- June 30, 2012—The first phase of CAP implementation was completed. The leachate extraction pumps were acquired.
- September 1, 2012—The second phase of CAP implementation was completed. The leachate extraction pumps were installed in 10 Landfill Gas (LFG) extraction wells (Figure 2) and leachate extraction was initiated.
- September 6, 2013—The third and final phase of CAP implementation was completed. The temporary collection tank (from which the leachate was pumped and hauled for disposal) discharge was permanently connected to the Tuckaseigee Water & Sewer Authority.

Figure 1 shows the locations of all seven groundwater monitoring wells and all of the installed landfill gas extraction wells.

The June 30, 2011 CAP established a compliance and review boundary for the closed landfill by referencing the North Carolina Administrative Code (NCAC), Title 15A, Subchapter 2L.0107 based upon the property currently owned by Jackson County, relative to monitoring locations. Historically, several volatile organic compounds have been detected in samples collected from monitoring wells located outside the compliance boundary (MW-02, MW-04, MW-06, and MW-07).

The CAP offered a remedy to restore groundwater quality and effectively reduce contamination for VOC constituents in excess of groundwater quality standards outside the compliance boundary. The selected and approved remedy is leachate removal and monitored natural attenuation (MNA). Leachate is extracted from the existing landfill gas extraction wells and is discharged into the Tuckaseigee Water and Sewer Authority's sanitary sewer collection system. Natural attenuation is monitored by performing groundwater sample collection from the monitoring wells and analysis for a natural attenuation parameter suite every six months, during fall and spring each year. The first natural attenuation results were obtained during the fall 2011 sampling event following the CAP approval. Tables 1 and 2 provide summary of MNA and field parameters and establish a baseline to further evaluate the effectiveness of MNA.

Since the first semiannual sampling event in 2010, two VOCs, benzene and 1,4-dichlorobenzene, have been detected in excess of the 2L standard outside of the compliance boundary and remain the contaminants of concern. Both benzene and 1,4-dichlorobenzene can be degraded under aerobic conditions. Since April 2011, benzene was detected above its 2L Standard outside of the compliance boundary in samples collected from monitoring wells MW-06 and MW-07 and it remains the primary contaminant of concern in these wells. Table 3 presents summary of detected VOCs above 2L standards.

Altamont will continue to analyze for MNA parameters during routine groundwater monitoring sample collection events. The interpretation of the MNA performance parameter data and technical evaluation of

MNA as a remedy at the site following leachate extraction, will be presented in a comprehensive MNA Corrective Action Evaluation report to be submitted five years following the approval of the CAP by the SWS. For a complete dataset refer to laboratory reports in the semiannual monitoring report submittals.

Thank you for your time and consideration on this project. Please feel free to call or respond with any questions or comments related to this project.

Sincerely,

ALTAMONT ENVIRONMENTAL, INC.

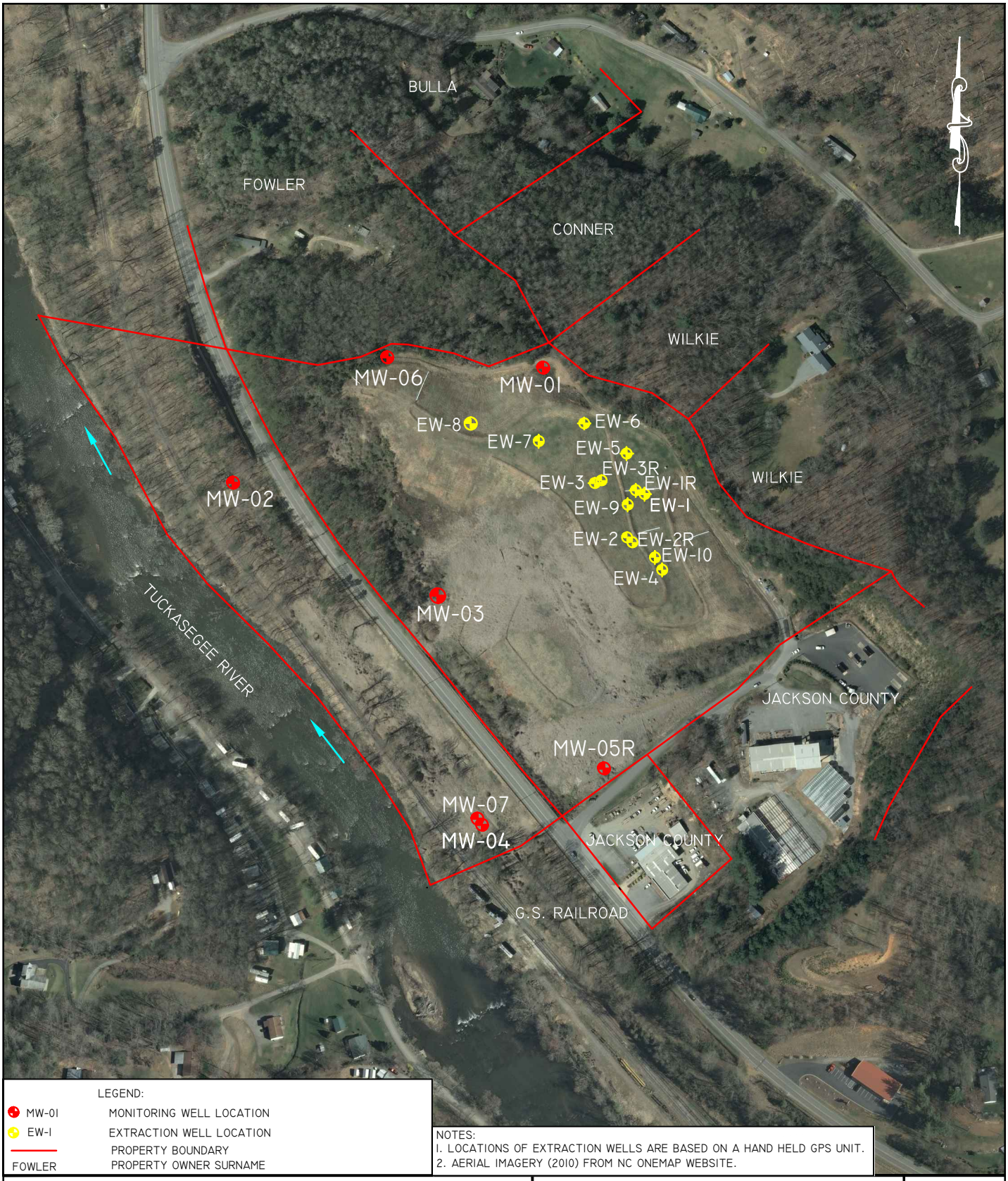
Robert Hastings, P.G.

Enclosures: Figure 1 – Monitoring Well Location

Table 1 – Summary of Field Parameters

Table 2 – Summary of Monitored Natural Attenuation Parameters

Table 3 – Summary of Historical Groundwater Analytical Data (Detected Compounds Above 2L Standard)



LEGEND:

MW-01	MONITORING WELL LOCATION
EW-1	EXTRACTION WELL LOCATION
	PROPERTY BOUNDARY
FOWLER	PROPERTY OWNER SURNAME

NOTES:
1. LOCATIONS OF EXTRACTION WELLS ARE BASED ON A HAND HELD GPS UNIT.
2. AERIAL IMAGERY (2010) FROM NC ONEMAP WEBSITE.

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MONITORING WELL LOCATION

JACKSON COUNTY CLOSED MUNICIPAL
SOLID WASTE LANDFILL
PERMIT #50-02
JACKSON COUNTY, NORTH CAROLINA

FIGURE 1

DRAWN BY: MARTA A. VANDUSSEN
PROJECT MANAGER: CHRIS GILBERT
CLIENT: JACKSON COUNTY
DATE: 12/17/2013

SCALE (FEET)
150' 0 150' 300'
1" = 300'

P:\JACKSON COUNTY\DILLSBORO GW\FIGURES\CAD\2013\FALL\FIGURE 2-SAMPLE LOCATION MAP.DWG

Table 1
Summary of Field Parameters
Jackson County Closed Municipal Solid Waste Landfill, Jackson County, North Carolina

	Parameter Name	Dissolved Oxygen	Oxygen Reduction Potential	pH	Specific Conductivity	Temperature	Turbidity	Depth to Water	Total Well Depth	Top of Casing Elevation
	CAS Number	SW356	SW336	SW320	SW323	SW325	SW330	SW318	SW411	SW328
	SWS ID	356	336	320	323	325	330	318	411	328
	Units	mg/L	mV	SU	µS/cm	°C (Celcius)	NTU	feet	feet	feet
WELL ID	COLLECT DATE									
MW-01	04/03/2007	1.35	146	**5.58**	155.4	16.1	0.00	101.56	112.8	2,171.42
	10/09/2007	0.85	129.5	**5.38**	125	16.4	17.4	102.70	112.8	2,171.42
	04/16/2008	1.19	58.7	**5.44**	231	16.08	30.14	104.89	112.8	2,171.42
	10/09/2008	0.84	-78.3	**5.92**	154	16.9	1.22	105.41	110.0	2,171.42
	04/08/2009	1.21	28.1	**5.59**	0.236	17.51	1.47	106.41	110.0	2,171.42
	10/06/2009	2.43	145.1	**5.37**	107	17.78	0.00	103.73	110.5	2,171.42
	04/13/2010	2.26	30.6	**5.66**	109	16.15	7.32	98.10	110.5	2,171.42
	10/26/2010	0.39	-41.2	**5.61**	135	16.60	7.01	98.31	110.5	2,171.42
	04/13/2011	0.44	-16.8	**5.71**	232	15.62	0.00	101.48	110.5	2,171.42
	10/26/2011	1.33	-31.5	**5.57**	181	15.81	0.00	102.16	110.5	2,171.42
	04/11/2012	1.19	-111.1	**5.80**	136	15.13	22.22	102.89	110.5	2,171.42
	10/23/2012	0.27	45.2	**5.43**	175	16.36	10.63	101.03	110.5	2,171.42
	04/11/2013	0.31	2.6	**6.03**	197	16.24	2.27	100.70	110.5	2,171.42
MW-02	04/03/2007	6.44	142	**6.12**	167.8	16.0	5.98	25.95	62.75	2,015.38
	10/09/2007	1.66	197.9	**5.59**	121	15.0	19.91	27.41	62.75	2,015.38
	04/15/2008	3.74	164.1	**5.79**	213	14.23	15.23	26.57	62.75	2,015.38
	10/07/2008	6.21	225.8	**5.83**	148	16.2	16.2	27.14	60.0	2,015.38
	04/08/2009	56.8	301.1	**5.97**	0.158	12.77	0.93	26.45	60.0	2,015.38
	10/22/2009	4.38	221.7	**5.96**	115	15.10	0.00	25.30	63.0	2,015.38
	04/13/2010	11.91	181.8	**5.78**	83	16.20	18.90	23.97	63.0	2,015.38
	10/27/2010	5.05	220.9	**5.71**	111	15.61	1.05	27.22	63.0	2,015.38
	04/13/2011	2.69	20.9	**5.89**	180	17.09	0.00	25.87	63.0	2,015.38
	10/27/2011	4.96	158.7	**5.44**	229	15.16	0.00	34.10	63.0	2,015.38
	04/12/2012	4.30	-85.5	**6.28**	156	15.72	7.60	26.48	63.0	2,015.38
	10/24/2012	3.74	165.6	**5.63**	136	18.14	0.00	28.80	63.0	2,015.38
	04/10/2013	6.11	171.9	**6.03**	118	18.76	0.00	28.29	63.0	2,015.38

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	CAS Number	SW356	SW336	SW320	SW323	SW325	SW330	SW318	SW411	SW328
	SWS ID	356	336	320	323	325	330	318	411	328
	Units	mg/L	mV	SU	µS/cm	°C (Celcius)	NTU	feet	feet	feet
WELL ID	COLLECT DATE									
MW-03	04/03/2007	1.63	166	**5.58**	377	17.4	0.00	50.50	62.5	2,045.53
	10/09/2007	1.14	134.7	**5.63**	307	16.2	17.69	54.84	62.5	2,045.53
	04/16/2008	0.90	171.7	**5.58**	445	15.31	0.39	50.84	62.5	2,045.53
	10/08/2008	0.89	160.6	**6.01**	327	15.6	0.77	55.69	63.5	2,045.53
	04/07/2009	1.15	211.6	**5.45**	0.320	13.85	0.00	50.11	63.5	2,045.53
	10/06/2009	0.83	189.1	**5.38**	256	16.73	0.00	51.78	65.5	2,045.53
	04/13/2010	3.64	195.8	**5.35**	150	16.16	10.18	48.2	65.5	2,045.53
	10/26/2010	0.31	156.9	**5.65**	255	16.25	2.26	52.68	65.5	2,045.53
	04/13/2011	0.47	45.9	**5.39**	330	15.88	0.00	48.02	65.5	2,045.53
	10/26/2011	0.49	157.9	**4.52**	388	16.06	0.00	53.67	65.5	2,045.53
	04/11/2012	0.99	-109.3	**5.58**	235	14.85	29.52	47.42	65.5	2,045.53
	10/24/2012	0.50	160.1	**5.22**	287	16.09	13.94	52.90	65.5	2,045.53
	04/10/2013	0.55	153.4	**5.75**	209	15.60	0.00	44.27	65.5	2,045.53
MW-04	04/03/2007	2.54	201	**5.47**	602	16.3	21.53	28.49	42.97	1,980.77
	10/09/2007	1.68	259.4	**5.34**	456	15.7	81.32	30.35	42.97	1,980.77
	04/15/2008	3.07	482.3	**5.36**	719	15.11	16.59	28.51	42.97	1,980.77
	10/07/2008	9.48	573.7	**5.33**	481	15.4	0.42	30.54	40.0	1,980.77
	04/08/2009	0.39	528.2	**5.29**	0.540	14.35	0.53	28.45	40.0	1,980.77
	10/07/2009	0.93	300.4	**5.30**	370	15.28	0.00	27.65	43.0	1,980.77
	04/13/2010	2.02	183.6	**5.65**	253	15.49	10.09	26.82	43.0	1,980.77
	10/27/2010	0.40	544.6	**5.56**	425	15.22	7.42	28.81	43.0	1,980.77
	04/13/2011	0.68	52.4	**5.86**	648	14.56	0.00	26.70	43.0	1,980.77
	10/27/2011	2.99	532.3	**5.39**	744	14.87	0.00	29.25	43.0	1,980.77
	04/12/2012	1.09	6.8	**5.66**	585	13.62	0.00	26.61	43.0	1,980.77
	10/24/2012	0.21	502.0	**5.27**	540	15.00	0.00	28.25	43.0	1,980.77
	04/10/2013	1.40	186.2	**5.56**	378	14.95	0.00	26.47	43.0	1,980.77

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	CAS Number	SW356	SW336	SW320	SW323	SW325	SW330	SW318	SW411	SW328
	SWS ID	356	336	320	323	325	330	318	411	328
	Units	mg/L	mV	SU	µS/cm	°C (Celcius)	NTU	feet	feet	feet
WELL ID	COLLECT DATE									
MW-05	04/03/2007	3.98	71	5.98	616	15.5	391.4	50.63	60.12	2,028.97
	10/09/2007	3.88	65.7	6.17	618	16.6	620.5	51.62	60.12	2,028.97
	04/16/2008	2.55	38.0	6.28	1085	16.19	149.9	51.50	60.12	2,028.97
	10/10/2008	3.8	43.6	7.19	673	18	4.06	52.4	60.12	2,028.97
	04/07/2009	2.46	26.5	6.09	0.745	14.02	3.3	52.08	60.12	2,028.97
	10/07/2009	3.26	23.5	6.37	558	16.84	6.90	50.12	60.0	2,028.97
	04/13/2010	10.96	-58.7	6.76	468	17.72	30.59	45.58	60.0	2,028.97
	10/26/2010	2.53	-44	6.41	529	17.08	18.14	47.76	60.0	2,028.97
	04/13/2011	2.84	-16.11	6.46	853	16.28	0.00	48.22	60.0	2,028.97
	10/26/2011	Well Casing Bent; No sample collected								
MW-05R	04/12/2012	3.50	-130.9	6.89	854	17.92	850.8	48.81	54.0	2,030.95
	10/24/2012	3.11	18.2	**5.72**	599	18.27	531.60	50.86	54.0	2,030.95
	04/11/2013	2.42	-70.7	6.85	785	16.73	37.82	49.18	56.6	2,030.95
MW-06	04/03/2007	1.78	152	**5.44**	105.7	15.7	136.3	89.25	94.0	2,139.57
	10/09/2007	0.90	60.4	**5.39**	92	16.46	297.4	90.07	94.0	2,139.57
	04/15/2008	1.28	138.1	**5.45**	161	18.30	56.85	92.23	94.0	2,139.57
	10/09/2008	2.27	141.6	**5.77**	109	19.1	24.2	92.39	96.08	2,139.57
	04/07/2009	0.86	72.9	**5.60**	0.182	14.10	5.96	93.35	96.08	2,139.57
	10/06/2009	1.38	-37.0	**6.01**	396	17.17	144.9	88.51	94.0	2,139.57
	04/13/2010	1.82	-61.8	**6.03**	110	15.14	25.70	78.77	94.0	2,139.57
	10/26/2010	0.39	-10.5	**5.19**	91	15.74	6.20	83.33	94.0	2,139.57
	04/13/2011	1.39	-30.9	**6.23**	257	14.94	2.81	87.83	94.0	2,139.57
	10/26/2011	1.46	-72.6	**5.40**	219	14.97	0.00	88.23	94.0	2,139.57
	04/11/2012	2.19	-108.4	**6.03**	204	14.29	52.28	87.61	94.0	2,139.57
	10/23/2012	0.37	10.3	**5.33**	114	15.99	1.81	86.42	94.0	2,139.57
	04/11/2013	0.39	93.4	**5.40**	76	15.65	6.34	83.89	94.0	2,139.57

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	CAS Number	SW356	SW336	SW320	SW323	SW325	SW330	SW318	SW411	SW328
	SWS ID	356	336	320	323	325	330	318	411	328
	Units	mg/L	mV	SU	µS/cm	°C (Celcius)	NTU	feet	feet	feet
WELL ID	COLLECT DATE									
MW-07	04/13/2011	0.71	5.1	**6.22**	791	15.38	12.41	31.92	95.0	1,981.29
	10/27/2011	1.53	-51.0	**6.01**	760	15.01	0.01	32.89	95.0	1,981.29
	04/12/2012	0.72	-164.0	**6.41**	604	14.44	4.74	32.29	95.0	1,981.29
	10/24/2012	0.43	81.6	**5.72**	519	15.17	8.20	33.17	95.0	1,981.29
	04/10/2013	0.21	101.9	**6.09**	496	15.62	4.30	31.85	95.0	1,981.29

Notes:

1. The field sampling logs with historic parameters were submitted to DENR SWS in semi-annual submittals.
2. "CAS NUMBER" is a unique number assigned by the Chemical Abstracts Service (CAS) to all identified parameters.
3. "SWS ID" is the Solid Waste Section Identification Number.
4. "Units" are as indicated.
5. mg/L indicates miligram per liter.
6. Standard Units (SU) for pH.
7. Nephelometric turbidity units (NTU) for turbidity.
8. µS/cm indicates microsiemens per centimeter.

Table 2
Summary of Monitored Natural Attenuation Parameters
Jackson County Closed Municipal Solid Waste Landfill, Jackson County, North Carolina

	Parameter Name	Ethane	Ethene	Methane	Alkalinity, Total as CaCO3	BOD, 5 day	Chemical Oxygen Demand	Chloride	Cyanide	Iron, Ferrous	Nitrogen, Nitrate	Nitrogen, Nitrite	Nitrogen	Sulfate	Sulfide	Total Organic Carbon	Carbon Dioxide	Hydrogen
	CAS Number	74-84-0	74-85-1	74-82-8	SW337	SW316	SW317	16887-00-6 or SW301	57-12-5	SW334	SW419	SW304	SW419	14808-79-8	18496-25-8	7440-44-0 or E-10195	124-38-9	SW338
	SWS ID	331	332	456	337	316	317	301	58	334	419	304	419	315	187	357	459	338
	Units	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	nM
WELL ID	COLLECT DATE																	
MW-1	10/26/2011	5 U	5 U	2,060	94,000	NA	NA	5,000 U	5.1 J	5,800	200 U	NA	NA	5,000 U	100 U	12,100	NA	NA
	04/11/2012	6.2 U	6.2 U	5,360	85,800	8,300	NA	5,000 U	5 U	2,800	200 U	NA	NA	5,000 U	100 U	4,600	250	42
	10/23/2012	0.86 U	0.79 U	3,130	99,500	2,000 U	25,000 U	1,200	5 U	16,400	32 J	NA	NA	2,300 J	100 U	1,000 U	160	5.4
	04/11/2013	0.86 U	0.79 U	1,550	112,000	2,800	25,000 U	1,000 U	5 U	20,000	20 U	20 U	20 U	3,000 J	100 U	7,500	150	1.8
MW-2	10/27/2011	5 U	5 U	5 U	38,100	NA	NA	28,500	6.1	500 U	200 U	NA	NA	6,300 J	100 U	3,700	NA	NA
	04/12/2012	6.2 U	6.2 U	2.5 J	24,500	2,000 U	NA	26,200	5 U	500 U	250	NA	NA	6,600	100 U	1,700	27	3.9
	10/24/2012	0.86 U	0.79 U	11.5	29,800	2,000 U	25,000 U	20,000	5 U	500 U	290 J	NA	NA	8,100 J	100 U	4,000	45	0.89
	04/10/2013	0.86 U	0.79 U	3.3 U	25,800	2,000 U	25,000 U	18,200	5.6 J	500 U	170 J	20 U	170 J	7,800 J	100 U	2,100	34	0.71
MW-3	10/26/2011	5 U	5 U	56.8	104,000	NA	NA	46,700	5 U	500 U	410 J	NA	NA	5,000 U	100 U	15,000	NA	NA
	4/11/2012	6.2 U	6.2 U	21.8	68,900	2,000 U	NA	37,000	5 U	500 U	3,200	NA	NA	5,000 U	100 U	5,500	190	170
	10/23/2012	0.86 U	0.79 U	6.5 J	87,500	2,000 U	25,000 U	50,600	5 U	500 U	560 J	NA	NA	2700 J	100 U	11,800	150	0.74
	04/10/2013	0.86 U	0.79 U	4 J	56,600	2,000 U	25,000 U	30,900	5.3 J	500 U	6000 J	39 J	6000 J	2100 J	100 U	6,300	140	0.38 J
MW-4	10/27/2011	5 U	5 U	1,410	93,200	NA	NA	92,600	5 U	500 U	2,500 J	NA	NA	71,100 J	100 U	172,000	NA	NA
	04/12/2012	6.2 U	6.2 U	544	70,400	2,000 U	NA	71,700	5 U	500 U	7,700	NA	NA	10,000 U	100 U	6,500	240	62
	10/24/2012	0.86 U	0.79 U	889	95,200	2,000 U	25,000 U	83,400	5 U	500 U	4,000 J	NA	NA	105,000 J	100 U	14,400	230	19
	04/10/2013	0.86 U	0.79 U	9.1	68,700	2,000 U	25,000 U	46,200	5 U	500 U	14,600	100 U	14,600	62,500 J	100 U	8,600	250	20
MW-5	10/26/2011	NOT SAMPLED																
MW-5R	04/12/2012	6.2 U	6.2 U	850	313,000	69,000	NA	82,300	5 U	1,200	200 U	NA	NA	5,000 U	100 U	30,600	170	NA
	10/24/2012	0.86 U	0.79 U	3.3 U	308,000	4,900	68,000	76,000	5 U	500 U	20 U	NA	NA	2,700 J	100 U	27,200	160	NA
	04/11/2013	0.86 U	0.79 U	4,870	411,000	13,200	26,000	50,800	5 U	500 U	20 U	24 J	20 U	3,400 J	100 U	24,300	110	NA
MW-6	10/26/2011	5 U	5 U	1,170	83,000	NA	NA	5,000 U	6.4 J	10,300	200 U	NA	NA	5,000 U	100 U	13,200	NA	NA
	04/11/2012	6.2 U	6.2 U	313	125,000	2,000 U	NA	5,000 U	5 U	13,200	200 U	NA	NA	5,000 U	100 U	4,600	220	31
	10/23/2012	0.86 U	0.79 U	21.1	57,600	2,000 U	25,000 U	1,000 U	5 U	3,600	20 U	NA	NA	2,000 U	100 U	1,100	120	0.34 J
	04/11/2013	0.86 U	0.79 U	314	41,500	2,000 U	25,000 U	1,000 U	5 U	1,400	20 U	20 U	20 U	2,100 J	100 U	9,600	240	12
MW-7	10/27/2011	5 U	5 U	1,360	250,000	NA	NA	45,400	5 U	2,700	200 U	NA	NA	42,800 J	100 U	13,200	NA	NA
	4/12/2012	6.2 U	6.2 U	1,090	204,000	2,000 U	NA	51,400	5 U	500 U	200 U	NA	NA	24,600	100 U	5,900	150	4.1
	10/24/2012	0.86 U	1.0 J	1,200	214,000	2,000 U	25,000 U	48,600	5 U	1,800	20 U	NA	NA	27,200 J	100 U	12,500	120	16
	04/10/2013	0.86 U	0.79 U	1,470	230,000	2,000 U	25,000 U	19,700	5.4 J	600	20 U	20 U	20 U	30,800 J	100 U	15,600	300	0.54 J

Table 2
Summary of Monitored Natural Attenuation Parameters
Jackson County Closed Municipal Solid Waste Landfill, Jackson County, North Carolina

		Volatile Fatty Acids									
	Parameter Name	Lactic Acid	Acetic Acid	Propionic Acid	Butyric Acid	Pyruvic Acid	Formic Acid	i-Pentanoic Acid	Pentanoic Acid	i-Hexanoic Acid	Hexanoic Acid
	CAS Number	SW415	SW416	SW417	SW418	SW414	NE	503-74-2	109-52-4	NE	142-62-1
	SWS ID	415	416	417	418	414	NE	488	487	NE	485
	Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
WELL ID	COLLECT DATE										
MW-1	10/26/2011	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	04/11/2012	**0.062 J**	**0.022 J**	**0.014 J**	0.004 U	0.033 U	**0.058 J**	0.044 U	0.012 U	0.006 U	0.006 U
	10/23/2012	0.032 U	0.021 U	0.004 U	0.007 U	0.004 U	**0.044 J**	0.012 U	0.01 U	0.013 U	0.039 U
	04/11/2013	2.3 U	1.8 U	1 U	0.87 U	2 U	NA	NA	NA	NA	NA
MW-2	10/27/2011	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	04/12/2012	**0.15**	**0.12**	0.007 U	0.004 U	0.033 U	**0.047 J**	0.044 U	0.012 U	0.006 U	0.006 U
	10/24/2012	0.032 U	**0.081**	0.004 U	0.007 U	0.004 U	0.01 U	0.012 U	0.01 U	0.013 U	0.039 U
	04/10/2013	2.3 U	1.8 U	1 U	0.87 U	2 U	NA	NA	NA	NA	NA
MW-3	10/26/2011	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4/11/2012	**0.081 J**	**0.056 J**	0.007 U	0.004 U	0.033 U	**0.068 J**	0.044 U	0.012 U	0.006 U	**0.073**
	10/23/2012	**0.22**	0.021 U	0.004 U	0.007 U	0.004 U	0.01 U	0.012 U	0.01 U	0.013 U	0.039 U
	04/10/2013	2.3 U	1.8 U	1 U	0.87 U	2 U	NA	NA	NA	NA	NA
MW-4	10/27/2011	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	04/12/2012	**0.11**	**0.031 J**	**0.012 J**	0.004 U	0.033 U	**0.063 J**	0.044 U	0.012 U	0.006 U	0.006 U
	10/24/2012	0.032 U	0.021 U	0.004 U	0.007 U	0.004 U	0.01 U	0.012 U	0.01 U	0.013 U	**0.082 J**
	04/10/2013	2.3 U	1.8 U	1 U	0.87 U	2 U	NA	NA	NA	NA	NA
MW-5	10/26/2011										
MW-5R	04/12/2012	**0.14**	**0.031 J**	0.007 U	0.004 U	0.033 U	**0.086 J**	0.044 U	0.012 U	0.006 U	**0.081**
	10/24/2012	**0.11**	**0.027 J**	0.004 U	0.007 U	0.004 U	**0.032 J**	0.012 U	0.01 U	0.013 U	0.039 U
	04/11/2013	2.3 U	1.8 U	1 U	0.87 U	2 U	NA	NA	NA	NA	NA
MW-6	10/26/2011	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	04/11/2012	**0.096 J**	**0.019 J**	0.007 U	0.004 U	0.033 U	**0.049 J**	0.044 U	0.012 U	0.006 U	0.006 U
	10/23/2012	0.032 U	0.021 U	0.004 U	0.007 U	0.004 U	**0.021 J**	0.012 U	0.01 U	0.013 U	0.039 U
	04/11/2013	2.3 U	1.8 U	1 U	0.87 U	2 U	NA	NA	NA	NA	NA
MW-7	10/27/2011	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	4/12/2012	**0.14**	**0.032 J**	0.007 U	0.004 U	0.033 U	**0.048 J**	0.044 U	0.012 U	0.006 U	0.006 U
	10/24/2012	**0.033 J**	0.021 U	0.004 U	0.007 U	0.004 U	0.01 U	0.012 U	0.01 U	0.013 U	0.039 U
	04/10/2013	2.3 U	1.8 U	1 U	0.87 U	2 U	NA	NA	NA	NA	NA

Notes:

1. The report of analysis with all historic monitored natural attenuation parameters were submitted to DENR SWS in semi-annual submittals.
2. **Bold** indicates detection.
3. NA indicates not analyzed.
4. µg/L indicates microgram per liter, mg/L indicates miligram per liter.

Table 3
Summary of Historical Groundwater Analytical Data (Detected VOCs Above 2L Standard)
Jackson County Closed Municipal Solid Waste Landfill, Jackson County, North Carolina

Monitoring Well Identification and Location	Sample Collection Date	Volatile Organic Compound					
		1,1-Dichloroethane µg/L	1,4-Dichlorobenzene µg/L	Benzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Vinyl chloride µg/L
	NC 2L Standard	6	6	1.0	0.70	3	0.03
MW-01 (Inside Compliance Boundary)	04/22/1999	31	3.5	7.9	3.7	4.3	2.1
	10/21/1999	32	ND	8.9	ND	ND	ND
	04/17/2000	25	ND	6	ND	ND	ND
	10/09/2000	28	ND	9.8	ND	ND	ND
	04/17/2001	20	6.6	8.9	ND	ND	ND
	10/09/2001	21	9.7	9.9	ND	ND	ND
	04/10/2002	22	11	12	ND	ND	ND
	10/09/2002	20	18	14	ND	5.5	ND
	04/17/2003	12	ND	8.3	ND	ND	ND
	10/20-21/2003	13	8.6	9.6	ND	ND	ND
	04/27/2004	10	10	7.3	1.8 J	ND	1.7 J
	10/18-19/2004	9.1	11	7.5	ND	ND	ND
	04/19/2005	10	15	8.1	ND	ND	ND
	10-12/2005	9.5	13	7.6	ND	ND	ND
	04/13/2006	6.1	14	8	ND	ND	ND
	10/10-11/2006	5.4	13	6.7	ND	ND	ND
	04/03/2007	7.8	15	6.2	1.6	1.6	0.58 U
	10/09/2007	9.8	17.8	6.8	1.6	1.7	0.62 U
	04/16/2008	9.0	0.33 U	5.9	0.46 U	0.95 J	0.67 J
	10/09/2008	7.9	7.6	5.5	0.70 J	1.2	0.62 U
	04/08/2009	6.5	5.6	5.8	0.49 J	1.2	0.62 U
	10/06/2009	7.4	5.3	5.0	0.48 J	1.0	0.62 U
	04/13/2010	6.6	11.0	5.2	0.69 J	1.3	0.62 U
	10/26/2010	5.0	8.5	3.5	0.46 U	1.1	0.62 U
	04/13/2011	5.0	0.33 U	2.7	0.46 U	0.97 J	0.62 U
	10/26/2011	7.7	9.8	2.1	0.78 J	1.0 J	0.62 U
	04/11/2012	6.1	10.9	2.8	0.78 J	1.1	0.62 U
	10/23/2012	5.0	10	1.7	0.68 J	0.94 J	0.62 U
	04/11/2013	4.8 J	8.0	1.7	0.77 J	0.75 J	0.78 J

Table 3
Summary of Historical Groundwater Analytical Data (Detected VOCs Above 2L Standard)
Jackson County Closed Municipal Solid Waste Landfill, Jackson County, North Carolina

Monitoring Well Identification and Location	Sample Collection Date	Volatile Organic Compound					
		1,1-Dichloroethane µg/L	1,4-Dichlorobenzene µg/L	Benzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Vinyl chloride µg/L
	NC 2L Standard	6	6	1.0	0.70	3	0.03
MW-02 (Outside Compliance Boundary)	04/22/1999	3.7	ND	ND	ND	1.1	ND
	10/21/1999	ND	ND	ND	ND	ND	ND
	04/17/2000	ND	ND	ND	ND	ND	ND
	10/09/2000	6.5	ND	ND	ND	ND	ND
	04/17/2001	ND	ND	ND	ND	ND	ND
	10/09/2001	5.8	ND	ND	ND	ND	ND
	04/10/2002	ND	ND	ND	ND	ND	ND
	10/09/2002	6.7	ND	ND	ND	ND	ND
	04/17/2003	ND	ND	ND	ND	ND	ND
	10/20-21/2003	ND	ND	ND	ND	ND	ND
	04/27/2004	2.6	ND	ND	ND	ND	ND
	10/18-19/2004	ND	ND	ND	ND	ND	ND
	04/19/2005	ND	ND	ND	ND	ND	ND
	10-12/2005	ND	ND	ND	ND	ND	ND
	04/13/2006	ND	ND	ND	ND	ND	ND
	10/10-11/2006	ND	ND	ND	ND	ND	ND
	04/03/2007	1.1	0.68 J	0.31 U	0.16 U	0.26 U	0.58 U
	10/09/2007	3.3 J	1.8	0.42 J	0.46 U	0.47 U	0.62 U
	04/15/2008	1.1 J	0.33 U	0.25 U	0.46 U	0.47 U	0.62 U
	10/07/2008	1.3 J	0.58 J	0.25 U	0.46 U	0.47 U	0.62 U
	04/08/2009	0.67 J	0.33 U	0.25 U	0.46 U	0.47 U	0.62 U
	10/22/2009	0.57 J	0.33 U	0.25 U	0.46 U	0.47 U	0.62 U
	04/13/2010	0.43 J	0.33 U	0.25 U	0.46 U	0.62 J	0.62 U
	10/27/2010	0.64 J	0.33 U	0.25 U	0.46 U	0.47 U	0.62 U
	04/13/2011	0.32 U	0.33 U	0.25 U	0.46 U	0.47 U	0.62 U
	10/27/2011	1.2 J	0.33 U	0.25 U	0.46 U	0.47 U	0.62 U
	04/12/2012	0.45 J	0.33 U	0.25 U	0.46 U	0.47 U	0.62 U
	10/24/2012	0.49 J	0.33 U	0.25 U	0.46 U	0.47 U	0.62 U
	04/10/2013	0.13 U	0.19 U	0.15 U	0.17 U	0.15 U	0.32 U

Table 3
Summary of Historical Groundwater Analytical Data (Detected VOCs Above 2L Standard)
Jackson County Closed Municipal Solid Waste Landfill, Jackson County, North Carolina

Monitoring Well Identification and Location	Sample Collection Date	Volatile Organic Compound					
		1,1-Dichloroethane µg/L	1,4-Dichlorobenzene µg/L	Benzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Vinyl chloride µg/L
	NC 2L Standard	6	6	1.0	0.70	3	0.03
MW-03 (Inside Compliance Boundary)	04/22/1999	7.0	4.8	4.8	1.0	1.3	1.2
	10/21/1999	ND	ND	ND	ND	ND	ND
	04/17/2000	ND	5.1	ND	ND	ND	ND
	10/09/2000	8.2	10.0	6.1	ND	ND	ND
	04/17/2001	5.4	7.2	ND	ND	ND	ND
	10/09/2001	6.5	11.0	ND	ND	ND	ND
	04/10/2002	6.0	8.7	ND	ND	ND	ND
	10/09/2002	10.0	ND	ND	ND	ND	ND
	04/17/2003	ND	8.3	ND	ND	ND	ND
	10/20-21/2003	5.8	17.0	ND	ND	ND	ND
	04/27/2004	5.4	14.0	3.6 J	ND	ND	ND
	10/18-19/2004	6.5	18.0	ND	ND	ND	ND
	04/19/2005	ND	14.0	ND	ND	ND	ND
	10-12/2005	6.3	19.0	ND	ND	ND	ND
	04/13/2006	ND	12.0	ND	ND	ND	ND
	10/10-11/2006	ND	ND	ND	ND	ND	ND
	04/03/2007	2.6	11	2.0	0.23 J	0.27 J	0.58 U
	10/09/2007	5.9	18.4	1.7	0.46 U	0.47 U	0.62 U
	04/16/2008	1.1 J	0.33 U	1.1	0.46 U	0.47 U	0.62 U
	10/08/2008	2.7 J	12.6	1.3	0.46 U	0.47 U	0.62 U
	04/07/2009	1.0 J	4.9	0.79 J	0.46 U	0.47 U	0.62 U
	10/06/2009	1.7 J	8.3	1.7	0.46 U	0.47 U	0.62 U
	04/13/2010	0.47 J	3.5	1.3	0.46 U	0.52 J	0.62 U
	10/26/2010	2.7 J	9.5	1.3	0.46 U	0.47 U	0.62 U
	04/13/2011	0.32 U	0.33 U	0.43 J	0.46 U	0.47 U	0.62 U
	10/26/2011	2.9 J	11.2	1.2	0.46 U	0.47 U	0.62 U
	04/11/2012	0.44 J	2.5	0.58 J	0.46 U	0.47 U	0.62 U
	10/23/2012	1.8	8.6	1.3	0.46 U	0.47 U	0.62 U
	04/10/2013	0.13 U	1.8	0.15 U	0.17 U	0.15 U	0.32 U

Table 3
Summary of Historical Groundwater Analytical Data (Detected VOCs Above 2L Standard)
Jackson County Closed Municipal Solid Waste Landfill, Jackson County, North Carolina

Monitoring Well Identification and Location	Sample Collection Date	Volatile Organic Compound					
		1,1-Dichloroethane µg/L	1,4-Dichlorobenzene µg/L	Benzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Vinyl chloride µg/L
	NC 2L Standard	6	6	1.0	0.70	3	0.03
MW-04 (Outside Compliance Boundary)	04/22/1999	4	7.9	2.8	3.9	3.5	2
	10/21/1999	ND	6.7	ND	ND	ND	ND
	04/17/2000	ND	6.2	ND	ND	ND	ND
	10/09/2000	ND	5.7	ND	ND	ND	ND
	04/17/2001	ND	6.2	ND	ND	ND	ND
	10/09/2001	ND	7.8	ND	ND	ND	ND
	04/10/2002	ND	7.2	ND	ND	ND	ND
	10/09/2002	ND	ND	ND	ND	ND	ND
	04/17/2003	ND	ND	ND	ND	ND	ND
	10/20-21/2003	ND	6.3	ND	ND	ND	ND
	04/27/2004	ND	7.5	ND	ND	ND	ND
	10/18-19/2004	ND	6.6	ND	ND	ND	ND
	04/19/2005	ND	ND	ND	ND	ND	ND
	10-12/2005	ND	8.9	ND	ND	ND	ND
	04/13/2006	ND	7.8	ND	ND	ND	ND
	10/10-11/2006	ND	ND	ND	ND	ND	ND
	04/03/2007	0.50 J	8.4	1.3	0.38 J	0.38 J	0.58 U
	10/09/2007	3.1 J	11.3	1.8	0.46 U	0.47 U	0.97 J
	04/15/2008	0.57 J	0.33 U	1.2	0.46 U	0.47 U	0.76 J
	10/07/2008	0.52 J	9.3	1.5	0.46 U	0.47 U	0.97 J
	04/08/2009	0.44 J	7.1	1.2	0.46 U	0.47 U	0.78 J
	10/07/2009	0.37 J	5.6	1.1	0.46 U	0.47 U	0.90 J
	04/13/2010	0.32 U	2.9	0.55 J	0.46 U	0.47 J	0.62 U
	10/27/2010	0.32 U	4.8	1.1	0.46 U	0.47 U	0.62 U
	04/13/2011	0.32 U	0.33 U	0.59 J	0.46 U	0.47 U	0.62 U
	10/27/2011	0.32 U	6.8	0.89 J	0.46 U	0.47 U	0.89 J
	04/12/2012	0.32 U	4.0	0.64 J	0.46 U	0.47 U	0.69 J
	10/24/2012	0.32 U	5.8	0.93 J	0.46 U	0.47 U	1.1
	04/10/2013	0.13 U	2.4	0.43 J	0.17 U	0.15 U	0.52 J

Table 3
Summary of Historical Groundwater Analytical Data (Detected VOCs Above 2L Standard)
Jackson County Closed Municipal Solid Waste Landfill, Jackson County, North Carolina

Monitoring Well Identification and Location	Sample Collection Date	Volatile Organic Compound					
		1,1-Dichloroethane µg/L	1,4-Dichlorobenzene µg/L	Benzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Vinyl chloride µg/L
	NC 2L Standard	6	6	1.0	0.70	3	0.03
MW-05 (Inside Compliance Boundary)	04/22/1999	3	14	3.4	ND	ND	2.2
	10/21/1999	ND	14	ND	ND	ND	ND
	04/17/2000	ND	13	ND	ND	ND	ND
	10/09/2000	ND	12	ND	ND	ND	ND
	04/17/2001	ND	15	ND	ND	ND	ND
	10/09/2001	ND	13	ND	ND	ND	ND
	04/10/2002	ND	ND	ND	ND	ND	ND
	10/09/2002	ND	ND	ND	ND	ND	ND
	04/17/2003	ND	13	ND	ND	ND	ND
	10/20-21/2003	ND	11	ND	ND	ND	ND
	04/27/2004	ND	16	2.3 J	ND	ND	2.4 J
	10/18-19/2004	ND	15	ND	ND	ND	ND
	04/19/2005	NOT SAMPLED					
	10-12/2005	NOT SAMPLED					
	04/13/2006	NOT SAMPLED					
	10/10-11/2006	NOT SAMPLED					
	04/03/2007	0.49 J	17	1.9	0.16 U	0.26 U	0.58 U
	10/09/2007	0.32 U	18.8	1.6	0.46 U	0.47 U	1.4
	04/16/2008	0.35 J	0.33 U	0.56 J	0.46 U	0.47 U	0.93 J
	10/10/2008	0.32 U	16.2	1.2	0.46 U	0.47 U	0.78 J
	04/07/2009	0.32 J	15.9	1.0	0.46 U	0.47 U	0.99 J
	10/07/2009	0.32 U	13.1	1.2	0.46 U	0.47 U	0.93 J
	04/13/2010	0.32 U	12.1	2.0	0.46 U	0.55 J	1.5
	10/26/2010	0.32 U	13.9	1.8	0.46 U	0.47 U	1.6
	04/13/2011	0.32 U	0.33 U	1.5	0.46 U	0.47 U	1.1
MW-05R	04/12/2012	0.32 U	2.5	1.3	0.46 U	0.47 U	0.82 J
	10/24/2012	0.32 U	3.5	1.3	0.46 U	0.47 U	0.62 J
	04/11/2013	0.13 U	3.7	1.5	0.17 U	0.15 U	0.32 U

Table 3
Summary of Historical Groundwater Analytical Data (Detected VOCs Above 2L Standard)
Jackson County Closed Municipal Solid Waste Landfill, Jackson County, North Carolina

Monitoring Well Identification and Location	Sample Collection Date	Volatile Organic Compound					
		1,1-Dichloroethane µg/L	1,4-Dichlorobenzene µg/L	Benzene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L	Vinyl chloride µg/L
	NC 2L Standard	6	6	1.0	0.70	3	0.03
MW-06 (Outside Compliance Boundary)	04/27/2004	**13**	**14**	**6.3**	**1.8**	ND	ND
	10/18-19/2004	**12**	**9.5**	**5.7**	ND	ND	ND
	04/19/2005	**10**	**11**	**6.4**	ND	ND	ND
	10-12/2005	**7.9**	**11**	ND	ND	ND	ND
	04/13/2006	**7.3**	**14**	**6.3**	ND	ND	ND
	10/10-11/2006	**7.9**	ND	**5.5**	ND	ND	ND
	04/03/2007	**9.7**	**13**	**4.7**	**1.3**	1.5	0.58 U
	10/09/2007	**11.3**	**11.2**	**3.3**	**1.5**	1.5	0.62 U
	04/15/2008	**11.8**	0.33 U	**1.9**	0.46 U	0.47 U	0.62 U
	10/09/2008	**12.4**	2.1	**1.8**	0.46 U	0.86 J	0.62 U
	04/07/2009	**13.0**	3.2	**1.4**	**0.81 J**	1.4	0.62 U
	10/06/2009	2.7 J	1.3	0.56 J	0.46 U	0.47 U	0.62 U
	04/13/2010	1.1 J	3.9	**1.7**	0.46 U	0.47 U	0.62 U
	10/26/2010	5.4	**7.9**	**4.3**	0.46 U	1.2	0.62 U
	04/13/2011	0.85 J	4.6	**1.8**	0.46 U	0.47 U	0.62 U
	10/26/2011	3.8 J	**6.0**	**2.3**	0.46 U	0.47 U	**0.91 J**
	04/11/2012	**6.7**	4.3	**2.5**	0.46 U	0.47 U	0.62 U
	10/23/2012	5.3	**7.0**	**2.8**	0.46 U	0.76 J	0.62 U
	04/11/2013	**6.1**	5.8	**1.9**	0.17 U	0.78 J	0.32 U
MW-07 (Outside Compliance Boundary)	08/11/2010	0.87 J	0.51 J	0.76 J	0.46 U	1.0	0.62 U
	04/13/2011	0.54 J	3.7	**1.1**	0.46 U	0.47 U	0.62 U
	10/27/2011	0.71 J	5.0	**1.1**	0.46 U	0.47 U	**0.65 J**
	04/12/2012	0.54 J	5.7	**1.4**	0.46 U	0.47 U	**0.82 J**
	10/24/2012	0.57 J	4.9	**1.4**	0.46 U	0.47 U	**0.68 J**
	04/10/2013	0.47 J	**6.4**	**1.7**	0.17 U	0.15 U	**0.89 J**

Notes

1. The VOCs shown on this table have historically been detected more frequently and at higher concentrations than other VOCs analyzed during the semiannual monitoring events. See specific semiannual monitoring reports for the complete datasets.
2. NC 2L Standard - Groundwater quality standard promulgated under Title 15 North Carolina Administrative Code Subchapter 2L (Department of Environment and Natural Resources). Last amended April 1, 2013.
3. µg/L - micrograms per liter.
4. ND - not detected.
5. **Bold** and grayed values indicate concentrations above associated North Carolina groundwater standards.
6. Some detections contained "J" or estimated values. See respective analytical reports for value.