



WELL DEVELOPMENT FORM

MW-1508

Well # ~~AW-1505-DA~~

Diameter (in):

2

Initial Static DTW (ft):

61.34

Total Depth (ft):

89.85

Casing Volume (g):

4.65

Date: 12/8/15

Developed By:

J. Collett

Purge Method:

Disposable Bailer / Grundfos

Total Gallons Removed:

806.25

Well Volumes Removed:

~17339

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
0913	Initial	7.12	15.1	1959	71000	61.34	Pump on Rate 1.5 GPM, Pump set at 80'
0935	27.0	7.11	15.1	1481	159	61.70	Pump set at 78'
1000	64.5	7.18	14.9	1503	91.5	61.70	Pump set at 73' Rate 2.25 GPM
1045	165.75	7.15	14.6	1499	154	61.82	Pump set at 81'
1145	300.75	7.16	14.7	1499	153.2	61.75	Pump set at 85'
1245	435.0	7.13	15.3	1524	27.0	61.85	Pump set at 85'
1305	480.0	7.16	15.3	1534	44.1	61.89	Pump set at 85'
1405	615.0	7.11	15.8	1515	85.8	61.89	Pump set at 80'
1440	693.75	7.14	15.4	1548	26.0	61.89	Pump set at 75'
1520	763.75	7.06	15.4	1516	43.5	61.89	
1525	795.0	7.06	15.4	1523	33.0	61.89	
1530	806.25	7.05	15.4	1527	23.8	61.89	Pump off
1600							

* See P-2 12-8-15 for cal info



WELL DEVELOPMENT FORM

Well # ^{P-1} ~~P-20A~~
 Diameter (in): 2
 Initial Static DTW (ft): 56.34
 Total Depth (ft): 84.25
 Casing Volume (g): 4.55

Date: 12/8/15 - 12-9-15
 Developed By: Chelsea Fleming / Dave Fallett
 Purge Method: Disposable Bailer / Grundfos
 Total Gallons Removed: 552.5
 Well Volumes Removed: -121.43

12/9/15

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
1115	Initial	7.09	12.6	1874	21000	56.34	Start Bail / Surge from Bottom
1130	5.0	7.09	12.4	1765	21000	56.70	End Bail, TD = 84.75'
0755	5.0	7.04	14.2	1860	21060	56.40	Pump set at 80.6' Rate 1.5 GPM
0825	50.0	7.06	14.3	1885	30.5	56.62	Set pump at 79.0'
0855	95.0	7.08	14.5	1901	9.44	56.59	Set pump at 78.0'
0915	110.0	7.06	14.3	1865	11.8	56.60	Set pump to 77'
0940	147.5	7.21	14.4	1850	16.8	56.60	set pump to 76'
1010	192.5	7.23	14.3	1840	4.2	56.60	set pump to 75'
1040	237.5	7.24	14.3	1846	3.7	56.60	set pump to 74'
1120	297.5	7.26	14.3	1830	3.6	56.60	set pump to 73'
1200	357.5	7.22	14.4	1888	4.9	56.60	set pump to 72'
1235	410	7.18	14.3	1890	5.1	56.60	set pump to 71'
1315	470	7.18	14.4	1880	5.3	56.60	set pump to 67'
1400	537.5	7.19	14.4	1900	5.7	56.60	
1405	545	7.16	14.4	1838	6.9	56.60	
1410	552.5	7.18	14.3	1830	4.2	56.60	pump off

* See ~~P-2~~ ~~12-8~~

see MW-8 12-9-15 for calibration



WELL DEVELOPMENT FORM

Well # P-2
 Diameter (in): 2
 Initial Static DTW (ft): 70.58
 Total Depth (ft): 97.74
 Casing Volume (g): 4.62

Date: 11/11/15
 Developed By: fs/lat
 Purge Method: Stainless Steel Disposable Bailery Grundfos
 Total Gallons Removed: 20
 Well Volumes Removed: 4.33

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
11/11/15 1155	Start	—	—	—	>1000	70.58	Begin Bail from Bottom
1226	5	—	—	—	>1000	70.90	fine s. (+ & sand) in Bail
1257	10	—	—	—	>1000	70.75	" "
1330	15	—	—	—	>1000	70.71	" "
1401	20	—	—	—	>1000	70.68	TD=97.82 End Bail



WELL DEVELOPMENT FORM

Well # P-2
 Diameter (in): 2
 Initial Static DTW (ft): 70.35
 Total Depth (ft): 97.80
 Casing Volume (g): 4.47

PH 4.01 = 4.01
7.0 = 7.0
10.01 = 10.01
1417.25 = 1417.25
10.014 = 10.514

Date: 12/8/15

Developed By: Dave Fallett / Chelsea Fleming
 Purge Method: Disposable Bailer Grundfos
 Total Gallons Removed: 411.5
 Well Volumes Removed: 92.06

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
816	Initial	6.89	16.9	2120	>1000	70.35	Pump on Grundfos Rate 1.0 GPM
0840	24	7.05	18.4	2390	81.7	70.35	Pump set at 90'
0855	39	7.11	18.3	2510	36.3	70.35	
0915	59	7.12	18.6	2480	16.8	70.35	move pump up 5 ft
0930	74	7.10	18.7	2510	>1000	70.35	
0945	89	7.07	17.9	2520	560	70.35	
1015	119	7.08	18.5	2180	154	70.40	Pump set at 80' Rate 1.5 GPM
1055	157.9	7.04	18.7	2390	>1000	70.40	move pump down 25' 83'
1125	224	7.10	18.3	2400	>1000	70.40	move pump down 8'
1230	306.5	7.10	18.3	2410	81.2	70.40	move pump to 89.75 (70 P)
1300	366.5	6.87	18.3	2220	252	70.40	
1310	381.5	7.11	18.1	2250	153	70.40	
1320	396.5	7.10	18.1	2280	118	70.40	
1325	411.5	7.11	18.1	2290	65.8	70.40	Pump off TD = 97.80'



WELL DEVELOPMENT FORM

Well # MW-8
 Diameter (in): 2
 Initial Static DTW (ft): 39.35
 Total Depth (ft): 62.27
 Casing Volume (g): 3.70

Date: 12-8/9-15
 Developed By: Chelsea Fleming / Dave Follath
 Purge Method: Disposable Bailer / Grundfos
 Total Gallons Removed: 354
 Well Volumes Removed: 45.68

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
1215	Initial	7.02	14.3	2360	71000	39.35	Begin Bail from Bottom
1230	4.0	7.04	14.3	2310	1000	39.40	End Bail TD=62.27
1405	4.0	7.09	15.9	2870	71000	39.70	install pump; start purge @ 16 rpm @ 55.55 fpm
1410	9.00	7.08	15.9	2930	71000	39.70	
1415	14.00	7.07	15.9	2980	467	39.70	
1425	24.00	7.09	16.1	2780	146	39.70	
1435	34.00	7.08	16.0	2609	96.2	39.70	surged well
1445	44.00	7.00	16.3	2780	12.01	40.70	switched to 1.5 gpm
1500	106.5	7.00	16.3	2900	720.0	34.70	surged well
1515	99.00	7.08	16.3	2980	24.8	35.70	surged well
1530	111.5	7.06	16.3	2940	1076.00	35.70	surged well
1600	156.5	7.07	16.3	2890	120.1	34.70	
1625	194	7.08	16.1	2890	34.1	35.70	well started pumping @ 1 gallon per min
1635	204	7.04	16.3	2840	2.70	34.70	1.5 gpm
1650	226.5	7.00	16.1	2880	1.89	40.45	end purge
0750	226.5	7.00	15.6	2900	2.33	40.12	start purge @ 1.5 gpm

12-8-15

12-9-15

12-9-15

See P-2 12-8-15 for calibration

12-9-15 calibration info:

pH: 7.00 = 7.06
 4.00 = 4.04
 10.00 = 10.13

Spec Cond: 1413 = 1420

turb: 20.00 = 19.88



WELL DEVELOPMENT FORM

Well # MW-8
 Diameter (in): 2
 Initial Static DTW (ft): 39.35
 Total Depth (ft): 62.27
 Casing Volume (g): 3.70

Date: 12-8-15 / 12-9-15
 Developed By: Chelsea Fleming / Dave Fillett
 Purge Method: Disposable Bailer / Grundfos
 Total Gallons Removed: 354
 Well Volumes Removed: 295.68

12-9-15

Time	Purged	pH	(°C)	(uS)	Turb.	DTW	Comments
0820	271.5	6.98	15.0	2900	2.21	40.21	1.5 gpm
0840	301.5	7.01	15.4	2890	2.14	40.21	
0900	331.5	7.04	15.3	2900	1.17	40.21	
0905	339	7.01	15.3	2860	0.97	40.21	
0910	342.5	7.02	15.3	2870	0.63	40.21	
0915	354.0	7.02	15.3	2860	0.59	40.21	prune off

See p-2 12-8-15 for cal info

CCR GROUNDWATER MONITORING SYSTEM DEMONSTRATION

**MITCHELL LANDFILL
MITCHELL POWER GENERATION PLANT
MARSHALL COUNTY, WEST VIRGINIA**

**Prepared For:
KENTUCKY POWER COMPANY
d/b/a AMERICAN ELECTRIC POWER, INC.
COLUMBUS, OHIO**

**Prepared By:
CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
CINCINNATI, OHIO**

CEC Project 110-416

MARCH 2016



Civil & Environmental Consultants, Inc.

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1.0 OBJECTIVE

This report has been prepared for Kentucky Power Company d/b/a American Electric Power, Inc. (AEP) to demonstrate that the Mitchell Landfill, a Coal Combustion Residuals (CCR) Unit by definition of the United States Environmental Protection Agency (USEPA) CCR Rule which has been published in the Federal Register (FR) on April 17, 2015 and is an extension of the current Code of Federal Rules (CFR) Title 40, Part 257 (§257), meets or exceeds the requirements for Groundwater Monitoring Systems (GMS) as defined in §257.91. Civil & Environmental Consultants, Inc. (CEC) has been contracted by AEP to provide a qualified Professional Engineer to certify compliance with the GMS requirements.

2.0 BACKGROUND INFORMATION

Kentucky Power Company (KPC), a subsidiary of AEP, owns and operates the Mitchell Power Generation Plant. This facility is located along West Virginia Route 2 near the City of Cresap, West Virginia as shown on Figure 1 – Site Location Map. The mailing address of the Mitchell Power Generation Plant is P.O. Box K, Moundsville, WV 26041-0961.

The Mitchell Power Generation Plant uses bituminous coal as the primary fuel source for its two steam-turbine electric generating units. The total electric production capacity of this plant is 1,600 megawatts. Processes and equipment that control air emissions from the coal fired units generate CCRs comprised of fly ash, bottom ash and Flue Gas Desulfurization (FGD) gypsum. CCRs that are not beneficially used, primarily fly ash, are disposed of at an off plant site CCR Unit identified as the Mitchell Landfill, which is a solid waste landfill that is owned and operated by KPC. Mitchell Landfill is classified as a Class F Industrial Landfill Facility by the West Virginia Department of Environmental Protection (WVDEP) Division of Water and Waste Management (DWWM). The landfill was designed, permitted and operates in accordance with the WV Code of State Rules, Title 33, Series 1-Solid Waste Management Rule (33CSR1) and a Solid Waste/National Pollutant Discharge Elimination System (SW/NPDES) Permit that was approved by the WVDEP on May 29, 2013 (Permit No. WV0116742). In addition, the WVDEP issued a State 401 Water Quality Certification (No. 12011) on January 10, 2013 and the United States Army Corps of Engineers (USACE) issued a Clean Water Act Section 404 permit (No. 2011-1499) on February 25, 2013. These permits provide the regulatory authority to impact aquatic resources including wetlands, streams and a pond.

The following subsections provide a summary of the Mitchell Landfill CCR Unit.

2.1 CCR UNIT LOCATION

Mitchell Landfill is located along Gatts Ridge Road (Marshall County Road 72), approximately 2 miles north of the intersection with County Road 74 (about 2 miles due east of the Mitchell Power Generation Plant). The approximate location of Mitchell Landfill is depicted on Figure 1 – Site Location Map and Figure 2 – Plant and CCR Unit Location Map. The center of Mitchell Landfill is located at the following coordinates:

- Latitude: 39 degrees 49 minutes 37 seconds North
- Longitude: 80 degrees 46 minutes 32 seconds West

2.2 DESCRIPTION OF CCR UNIT

Mitchell Landfill provides a maximum disposal capacity of about 10 million cubic yards of excess CCR produced from the Mitchell Power Generating Plant that is not beneficially reused.

The overall landfill boundary comprises about 169.6 acres with CCR being placed within a footprint of 57.6 acres (the CCR Unit disposal area is depicted on Figure 2 – Plant and CCR Unit Location Map). The landfill will be operated in 5 Phases with Phases 1 through 4 completing the maximum CCR Unit disposal footprint and Phase 5 comprising CCR placement atop the first four phases. Figure 3 – CCR Unit and Monitoring Wells, depicts the approximate boundary of the 5 Phases. Each phase of the landfill has an estimated design life that varies from about 4 to 8 years. The expected life of the landfill is 24 years, based on the current estimated average yearly CCR production rates and beneficial use quantities.

In addition to the CCR disposal footprint, the CCR Unit includes several appurtenant structures that include: 1) a perimeter haul road; 2) a leachate storage pond; 3) three stormwater ponds (identified as South, West and North Ponds); and, 4) a Maintenance Building. Figure 3 – CCR Unit and Monitoring Wells, depicts the CCR Unit boundary, the landfill disposal footprint and the appurtenant structures.

2.2.1 Engineering Systems

The landfill was designed and constructed to protect the environment in accordance with the WVDEP Class F Industrial Landfill requirements. To meet these requirements, Mitchell Landfill includes several engineering controls which consist of: 1) a groundwater interceptor drainage system; 2) a composite liner system; 3) a leachate collection system; and, 4) a surface water management system. These engineering systems are summarized below.

2.2.1.1 *Groundwater Interceptor Drainage System*

The groundwater interceptor drainage system for the landfill is a combination of pipes and aggregate drains that collect and direct groundwater from beneath the liner system to a discharge point beyond the landfill limits. This system is designed to accommodate natural groundwater volumes and the potential increased groundwater volume that may result from future hydrostatic conditions associated with future pool level increases for the Conner Run Impoundment, owned by Coal Consolidation Company and operated by Murray Energy, that is positioned in the adjacent valley west of the landfill.

2.2.1.2 *Composite Liner System*

An impermeable barrier is constructed at the base of the Mitchell Landfill CCR Unit that is protective of groundwater and complies with the applicable WVDEP performance standards for a Class F Industrial Landfill Facility. The bottom elevations of the impermeable barrier/composite liner provide the required separation from bedrock, the seasonal high water table and the uppermost significant aquifer.

The composite liner system is comprised of the following (from top to bottom):

- 30-mil PVC geomembrane;
- Geosynthetic Clay Liner (GCL);
- A minimum 6-inch thick layer of compacted subbase soil; and,
- Structural fill or isolation soil as needed to provide the minimum separation from groundwater and bedrock.

2.2.1.3 *Leachate Collection System*

Mitchell Landfill has been constructed to include a leachate collection system that conveys leachate collected above the composite liner system via gravity flow to a lift station that pumps the leachate to a storage pond (denoted as the Leachate Storage Pond) via a force main. Stormwater runoff from within active landfill areas is directed to the leachate collection layer within the landfill via vertical aggregate drains (denoted as chimney drains). The leachate collection layer conveys both stormwater from the chimney drains and leachate that seeps through the CCR placed in the landfill and transports the combined flow to the lift station. The leachate collection system is designed to maintain a leachate head on the composite liner system of one-foot or less. The locations of the lift station and Leachate Storage Pond are identified on Figure 3 - CCR Unit and Monitoring Wells.

The leachate collection system within the waste placement limits (leachate collection layer) consists of the following:

- Geocomposite Drainage Net (GDN) – covers the entire bottom of the landfill and is constructed directly above the composite liner system;
- Granular Drainage Layer – non-carbonate, open graded, aggregate material constructed to a depth of 18-inches across the bottom of the landfill within the main valley axis; and,
- Leachate Collection Pipes – perforated HDPE pipes, surrounded by non-calcareous coarse aggregate and nonwoven, needle-punched geotextile, are constructed within the Granular Drainage Layer. These leachate collection pipes convey leachate collected at the base of the landfill to the lift station via gravity drainage, which is then pumped (via a force main) to the Leachate Storage Pond.

Leachate collected and transferred to the Leachate Storage Pond is beneficially reused for dust suppression within landfill waste limits, moisture conditioning of fly ash during compaction procedures or moisture conditioning at the fly ash silo storage facility. Any leachate that is not beneficially reused is transported to the Mitchell Plant Wastewater Treatment Bottom Ash Pond Complex for treatment prior to discharge into the Ohio River.

2.2.1.4 *Surface Water Management System*

Management of surface water that is not in contact with CCR placed in the landfill is accomplished by collection and conveyance of runoff to three stormwater detention basins: 1) South Pond; 2) West Pond; and, 3) North Pond. The South and West Ponds are utilized through all phases of the landfill life and the North Pond is utilized in Phase 3 through Phase 5. The three ponds are depicted on Figure 3 – CCR Unit and Monitoring Wells.

Site runoff generated from both un-stabilized and stabilized constructed areas (i.e., construction areas, stockpiles, temporary landfill cover and permanent landfill cover) is conveyed to the ponds via drainage channels and pipes. The collection, conveyance and ponds are designed to meet the required criteria in the referenced WVDEP regulations. The stormwater conveyed to the ponds is detained and released through a non-clogging dewatering skimmer device that allows settling of suspended solids and evacuation of the stored volume of water within a seven to eight day period.

2.2.2 Construction and Operational History

2.2.2.1 *Landfill Construction*

Construction of Mitchell Landfill was initiated in 2013 and Phases 1A, 1B, 2A and 2B have been completed. The landfill construction was performed in accordance with the SW/NPDES Permit (May 29, 2013), the construction drawings, technical specifications and the Quality Assurance and Quality Control Plan. Certification Reports were prepared and submitted to WVDEP in 2014 and 2015 that provide confirmation and documentation that the construction was performed in accordance with the design and permit requirements.

Construction of Phase 3 is tentatively scheduled to begin in 2018.

2.2.2.2 *Landfill Operations*

Mitchell Landfill began operation in July 2014 and is currently receiving CCRs from Mitchell Power Generation Plant. Landfill operations, construction and monitoring are being performed in accordance with the SW/NPDES Permit.

2.2.2.3 *Groundwater Monitoring*

The initial groundwater monitoring well network at Mitchell Landfill was installed in 2011 and consisted of 12 wells. Figure 3 – CCR Unit and Monitoring Wells identifies the original monitoring well network with MW1100X well names. Background groundwater quality monitoring for the 2011 wells began in February 2012 and was completed in December 2014. Sampling and analysis procedures for the background sampling program followed the Field Sampling and Analysis Plan (FSAP), dated February 2012. Operational groundwater monitoring

is conducted semi-annually in accordance with the WVDEP SW/NPDES permit requirements. Groundwater quality results are statistically analyzed as part of each semi-annual groundwater monitoring event and included as part of the Operating Record. Five additional groundwater monitoring wells were installed in a southern area of the landfill facility in July 2015 to represent downgradient monitoring positions in the Rush Run Sandstone and Fish Creek Sandstone units. The approximate locations of the additional monitoring wells are depicted on Figure 3 – CCR Unit and Monitoring Wells and are denoted by MW1500X well names. Background sampling from these additional wells will be completed by October 2017 per 40 CFR §257.94. Additional information describing the Mitchell Landfill groundwater monitoring network is provided in Sections 3.1.1.7 and 3.1.1.8.

2.3 SUPPORTING INVESTIGATIONS AND DOCUMENTS

CEC has reviewed the following documents for evaluation of compliance with the CCR GMS:

- SW/NPDES Permit Application, Mitchell Landfill, Mitchell Plant, Cresap, West Virginia, Prepared for American Electric Power, Prepared by Civil & Environmental Consultants, Inc., CEC Project 110-416, April 12, 2012.
- SW/NPDES Permit Number WV0116742, May 29, 2013. West Virginia Department of Environmental Protection, 601 57th Street, Charleston, West Virginia 25304.
- Hydrogeologic and Geotechnical Subsurface Investigation Report, Mitchell Landfill, Marshall County, West Virginia, Prepared for American Electric Power, Prepared By Civil & Environmental Consultants, February 2012.
- Field Sampling and Analysis Plan, American Electric Power, Proposed Mitchell Landfill, Moundsville, West Virginia, Prepared for American Electric Power, 1 Riverside Drive, Columbus, Ohio, Prepared by Civil & Environmental Consultants, Inc., Cincinnati, Ohio, CEC Project 110-416, February 2012.
- Background Groundwater Monitoring Report, Mitchell Landfill, Mitchell Electric Generating Plant, Marshall County, West Virginia, Prepared for American Electric Power, Prepared By Civil & Environmental Consultants, Inc., February 2014.
- Kentucky Power Company, Mitchell Plant – Landfill, SW/NPDES Permit No. WV0116742, Semi-Annual Groundwater Sampling Event. Letter report to Scott Mandirola, Director, Division of Water and Waste Management, West Virginia Department of Environmental Protection, 601 57th Street, Charleston, West Virginia 25304, October 23, 2015.
- Mine Subsidence Analysis, Mitchell Landfill, Marshall County, West Virginia, Report to American Electric Power, 1 Riverside Plaza, Columbus, Ohio 43215, Prepared by Civil & Environmental Consultants, Inc., 4274 Glendale Milford Road, Cincinnati, Ohio 45242, CEC Project 110-416-2000, February 2012.

- Operating Record, Mitchell Landfill, Mitchell Plant, Cresap, West Virginia, Prepared for AEP, Kentucky Power, Prepared by AEP Environmental Services, Land Environment & Remediation Services, August 2014.

In addition to review of the documents above, hydrogeologic information was considered from the completion of three additional core borings and the installation of five additional monitoring wells at the Mitchell Landfill in June and July 2015 (refer to Section 2.2.2.3). CEC provided oversight services to AEP for the 2015 drilling and well installation project. The wells were installed to improve the landfill monitoring well network by providing additional monitoring locations downgradient of the limits of waste in the Rush Run Sandstone and Fish Creek Sandstone units. The 2015 core borings include B-1501, B-1502 and B-1503 installed at the locations shown on Figure 3 – CCR Unit and Monitoring Wells in the southern landfill area. Nested Rush Run Sandstone and Fish Creek Sandstone monitoring wells were installed at borings B-1501 and B-1503. The Fish Creek Sandstone is incised and not present at the B-1502 boring location; thus, only a Rush Run Sandstone monitoring well was installed at B-1502. Monitoring well boring logs and well as-built information for both the 2011 and 2015 well installation projects are provided in Appendix A. Additional information describing the current Mitchell Landfill groundwater monitoring network is provided in Section 3.1.1.7.

2.4 HYDROGEOLOGIC SETTING

A site-specific subsurface investigation was conducted in the area of the Mitchell Landfill to support the Class F Industrial Landfill Facility Application, submitted and approved by WVDEP, as well as to support the various engineering analyses and design of the landfill. The hydrogeologic and geotechnical subsurface investigation was completed to meet the requirements of 33CSR1, subsection 3.8 of Rule 33-1-3 Solid Waste Facility Permitting Requirements. The corresponding summary report is identified as the Hydrogeologic and Geotechnical Subsurface Investigation Report (HGSIR), Mitchell Landfill, dated February 2012.

The purpose of the subsurface investigation was to characterize the in-situ soil and bedrock types and properties, as well as determine the hydrogeologic features and conditions within the planned landfill limits. The investigation was comprised of site reconnaissance, soil and rock borings, test pits, monitoring well installation and development, geophysical logging, pressure packer testing, in-situ hydraulic conductivity testing and laboratory testing of selected soil and rock samples. The information developed from the field and laboratory programs associated with the subsurface investigation provided the basis for conclusions regarding the subsurface soil and bedrock profile characterizations, the hydrogeologic evaluation and geotechnical engineering properties associated with the in-situ soils/bedrock, recompacted borrow soils and CCR materials.

Subsurface boring information from the supplemental monitoring well borings B-1501, B-1502, and, B-1503 confirmed previous hydrogeologic data contained in the HGSIR as summarized in Section 3.1.1.

2.4.1 Climate

Climatic data for Mitchell Landfill is summarized as follows:

Average monthly temperature					
Jan./July	Feb./Aug.	March/Sep.	April/Oct.	May/Nov.	June/Dec.
(degrees F)	(degrees F)	(degrees F)	(degrees F)	(degrees F)	(degrees F)
26.70	28.80	38.50	50.10	59.70	68.1
72.00	70.60	64.10	52.50	41.60	31.4

Average monthly precipitation					
Jan./July	Feb./Aug.	March/Sep.	April/Oct.	May/Nov.	June/Dec.
(inches)	(inches)	(inches)	(inches)	(inches)	(inches)
2.86	2.40	3.58	3.28	3.54	3.30
3.83	3.31	2.80	2.49	2.34	2.57

Evapotranspiration					
Jan./July	Feb./Aug.	March/Sep.	April/Oct.	May/Nov.	June/Dec.
(inches)	(inches)	(inches)	(inches)	(inches)	(inches)
0.603	0.467	1.022	2.826	2.477	2.315
2.485	2.087	1.607	1.633	1.349	0.896

2.4.2 Regional and Local Geologic Setting

2.4.2.1 Regional Geology

The Mitchell Landfill site lies within the regional geologic area of West Virginia known as the Appalachian Plateau Province. This region comprises the western two-thirds of the state and is characterized by relatively flat-lying bedrock containing minable coal seams. While limestone is present within the region, the beds are generally thin and discontinuous. Most of the limestone is non-marine and there are no known karst features noted in the region. Based on the Geologic Map of West Virginia (WVGES Publication: Map 25A), the bedrock in Marshall County predominantly consists of Permian age sedimentary bedrock composed of a cyclic sequences of sandstone, siltstone, claystone, shale, limestone and coal. The literature indicates that the bedrock was deposited in a wide fluvial-deltaic plain where sediment eroding from the Appalachian Mountains traveled west to be deposited in a large shallow sea in the interior of the

continent (Martin, 1998). The bedrock units mapped within the vicinity of Mitchell Landfill are of Pennsylvanian/Permian age Dunkard, Monongahela and Conemaugh Groups.

The Mitchell Landfill site is located approximately 3.5 miles northwest of the Proctor Syncline which strikes to the northeast/southwest. No evidence of folding or faulting was observed during at the site during field investigations. Additional regional folds identified on the West Virginia GIS Technical Center website (<http://wvgis.wvu.edu/index.php>) are present southeast of the landfill site which include the New Martinsville Anticline, the Loudenville Syncline, the Washington Anticline and Nineveh Syncline all striking northeast/southwest.

According the Mine Subsidence Analysis Report (February 2012) included in the Mitchell Landfill Permit Application, the Pittsburgh coal formation rests in an elevation between approximately 420 to 460 feet above mean sea level (amsl). Ground surface elevations at Mitchell Landfill range from approximately 960 to 1,320 feet amsl; therefore, the Pittsburgh coal formation is approximately 500 to 800 feet below the ground surface.

2.4.2.2 *Local Geology*

The bedrock geology of the site consists of shale, claystone, siltstone, sandstone and occasional limestone and coal deposits of the Permian Age, Dunkard Group, Greene and Washington Formations. The deposits are typical of cyclothemic sedimentation common throughout the region. The predominant lithologies are shale (which accounts for approximately 47 percent) and sandstone plus siltstone (which accounts for 44 percent of the deposits), based on the bedrock encountered in borings drilled to at least 300 feet below ground surface (ft. bgs), or between approximate elevations of 1,228 to 930 amsl. Claystone, coal, limestone and soil make up less than 10 percent of the deposits. This is a much different lithology than that presented by Cross and Schemel (1956) and Barlow (1975) which suggests sandstone as the dominant lithology throughout the Greene Formation.

Site specific geologic cross sections were developed as part of the HGSIR for Mitchell Landfill. Two of these cross sections, Geologic Cross Sections C-C' and D-D', identified on Figure 4 – Geologic Cross Section Location Map, represent the typical hydrogeologic strata and include subsurface information from the additional monitoring well borings completed in June and July 2015. These two cross sections are depicted on Figure 5 – Geologic Cross Section D-D', which extends west to east in the southern site area and Figure 6 – Geologic Cross Section C-C', which extends south to north along the central valley. These cross sections identify that facies changes occur across the landfill site making it difficult to correlate bedrock units. However, a relatively persistent black and dark gray limestone bed and a black shale bed were documented at numerous locations. Therefore, these units are considered to be “marker beds” and are sufficient to identify specific bedrock units. Moreover, several thin coal seams are present which can be used to identify units. Overall, the position of the sandstone units with respect to each other and

the approximate elevation of the marker beds shown on Figure 5 – Geologic Cross Section D-D’ have been used to identify the bedrock units at the Mitchell Landfill site. While several sandstone units occur across the site, they are not continuous due to the incised topography, as depicted in the referenced cross sections.

Sandstone was described as gray in color, fine to medium grained and micaceous with occasional limestone inclusions. Most of the sandstone was well cemented with calcite cement and on occasion contained calcite filled fractures. The rock was hard and fresh at depth. Some zones contained interbedded sequences of sandstone and shale, or siltstone and shale.

The other predominant bedrock lithology at the site was shale. Shale unit thicknesses range from 1 to 23 feet. Small, less than ¼ inch, pyrite nodules were observed in 10 of the 22 rock cores, occurring 69 percent of the time in shale, followed by siltstone and sandstone. Pyrite occurrence was generally below an elevation of 1,180 feet amsl. Plant fossils were also observed in 15 of the 22 rock cores, occurring in shale units 81 percent of the time, the remainder being observed in siltstone.

The named sandstone units include (from bottom to top): the Hundred Sandstone; the Jollytown Sandstone; the Rush Run Sandstone; the Fish Creek Sandstone; and, the Burton Sandstone. The contacts between the sandstone units generally consist of sharp contacts to underlying dark gray and black shale with coals seams noted in the case of the Hundred and Jollytown Sandstone units. Note that the Hundred and Jollytown Sandstone units are not continuous beneath the Mitchell Landfill site. A black shale marker bed is present near the base of the Fish Creek Sandstone unit.

Based on the marker beds, bedrock appears to dip slightly to the south and southeast. Fracture and joint mapping was conducted on bedrock outcrops within and surrounding the Mitchell Landfill site. Overall, joints and fractures are oriented predominantly to the northeast between 10 and 90 degrees.

No faults were observed at or near the Mitchell Landfill site, nor are faults present according to available geologic information. As noted previously, a series of anticlines and synclines are located as near as 3.5 miles southeast of the site.

2.4.3 Uppermost Significant Aquifer

WV 33CSR1-Definitions(§33-1-2), Subsection 2.135 defines an Uppermost Aquifer to mean “the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility’s permit boundary.” Subsection 2.136 defines the Uppermost Significant Aquifer (USA) as “the first, uppermost aquifer encountered that is laterally persistent under the entire site and is free flowing

throughout the year. This defines the aquifer that flows all twelve (12) months of the year and can be encountered under any given point on the permitted site.” Based on information developed from site investigations, it has been concluded that the Rush Run Sandstone is the uppermost aquifer which meets the referenced definitions: 1) is below the landfill composite liner system; and, 2) extends laterally beyond the permitted limits of waste. Further, by definition, the Rush Run Sandstone is designated as the USA at Mitchell Landfill, as described in the referenced and approved SW/NPDES Permit issued by WVDEP. This USA designation is based on site-wide occurrence and elevation of the unit. Additional information describing the Rush Run Sandstone is provided in Section 3.1.1.

2.4.4 Surface Water and Surface Water-Groundwater Interactions

Groundwater at the site follows surface topography and bedrock bedding planes where there is a lower permeability rock type, such as a shale underlying a sandstone. Groundwater recharge is along the hilltop ridges and percolates slowly through shallow fractured bedrock into the central valley. Groundwater discharges at meager springs and seeps along the incised channels and the valley walls where bedrock subcrops are typically covered with a veneer of residual soils. Seeps within streambeds were observed during the surface water delineation and additional locations were observed during other site reconnaissance. Locations of these features were mapped using a handheld Global Position System (GPS) unit, or mapped using the site topographic map and surficial features where the GPS could not receive signals (e.g., within steep portions of the valleys). Groundwater discharging as seeps and springs, flows downslope to the unnamed tributary to Fish Creek that is at the base of the incised valley.

2.4.5 Water Users

A private water well and an abandoned hand dug well were located at the 146 Gatts Ridge Road and located within about 300 feet of Mitchell Landfill waste limits. These two wells were sealed by a WV licensed well driller on December 27, 2011 in accordance with the guidelines provided by the Marshall County Health Department. Water Well Abandonment Reports (Well Abandonment Permit No. DW-25-2011-06) were subsequently submitted to the Marshall County Health Department. Therefore, the Mitchell Landfill disposal area is not located within 1,200 feet of any public or private water well supply.

3.0 §257.91 GROUNDWATER MONITORING SYSTEM

3.1 §257.91(a) THROUGH §257.91(c) RULE DESCRIPTION

40 CFR 257.91(a) through (c) states:

(a) Performance standard. The owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

(1) Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. A determination of background quality may include sampling of wells that are not hydraulically upgradient of the CCR management area where:

(i) Hydrogeologic conditions do not allow the owner or operator of the CCR unit to determine what wells are hydraulically upgradient; or,

(ii) Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells; and,

(2) Accurately represent the quality of groundwater passing the waste boundary of the CCR unit. The downgradient monitoring system must be installed at the waste boundary that ensures detection of groundwater contamination in the uppermost aquifer. All potential contaminant pathways must be monitored.

(b) The number, spacing and depths of monitoring systems shall be determined based upon site-specific technical information that must include thorough characterization of:

(1) Aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in groundwater flow; and,

(2) Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

(c) The groundwater monitoring system must include the minimum number of monitoring wells necessary to meet the performance standards specified in paragraph (a) of this section, based on the site-specific information specified in paragraph (b) of this section. The groundwater monitoring system must contain:

(1) A minimum of one upgradient and three downgradient monitoring wells; and,

(2) Additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

3.1.1 Information Supporting Rule Compliance

3.1.1.1 *Hydrostratigraphic Units*

Water-bearing units at the Mitchell Landfill site include from deepest to shallowest; the Hundred Sandstone, Rush Run Sandstone, the Fish Creek Sandstone and the shallow bedrock combined with the Burton Sandstone. Shale and claystone beds and minor beds of limestone, are interspersed with the sandstone units and act as confining beds. The Fish Creek Sandstone and the Burton Sandstone are discontinuous, naturally incised sandstones which subcrop along the valley side slopes where they discharge as seeps and minor springs. Groundwater was not encountered in the Burton Sandstone above the Fish Creek Sandstone unit north and northwest of the limits of waste. The Burton Sandstone has been determined to be an inadequate monitoring unit because the unit is not water-bearing upgradient of the landfill and is naturally incised and absent downgradient of the landfill. The Burton Sandstone is not included in monitoring requirements in the WVDEP SW/NPDES Permit (May 29, 2013). Thus, this unit is not applicable for further discussion. The Fish Creek Sandstone extends downgradient of the Mitchell Landfill limits of waste in some areas; however, the unit is dissected along the centerline of the valley within the southern portion of the limits of waste. The Rush Run Sandstone is positioned below the base elevation of the Mitchell Landfill composite liner system and is designated as the USA as described in Section 2.4.3. The Hundred Sandstone is below the Rush Run Sandstone uppermost aquifer and is also naturally incised down valley from the landfill boundary. The Hundred Sandstone is not required to be monitored in compliance with the CCR Rules because it occurs below the designated uppermost aquifer, the Rush Run Sandstone; therefore, this unit will not be discussed further in this report. Additional information describing the Rush Run Sandstone and Fish Creek Sandstone hydrogeologic characteristics area provided below.

The Rush Run Sandstone is laterally persistent at the site but is naturally incised in a localized area down valley of the Mitchell Landfill limits of waste, where the unit subcrops along the

central valley side slopes. The Rush Run Sandstone is a fine to medium grained, gray sandstone. The top elevation of the unit ranges from approximately 1,025 feet amsl to the south and 1,048 feet amsl to the north as shown on Figure 7 – Top of Rush Run Sandstone Contours. The bottom elevation ranges from approximately 1,009 feet amsl to the south and 1,039 feet amsl to the north and dips gently to the south. Figure 8 – Rush Run Sandstone Isopach Contours, depicts the thickness of the unit which ranges from approximately 9 feet to 32 feet. The Rush Run Sandstone at the site is positioned approximately 370 to 400 feet above the downgradient Fish Creek valley bottom; thus, groundwater discharge from the unit occurs at subcrop positions along the incised terrain in the area. Seeps and springs mapped at the Mitchell Landfill site demonstrate this condition. Shale beds above the Rush Run Sandstone provide confining aquitards that separate the unit from the landfill composite liner system. Where the upper confining aquitards have been naturally incised or removed during landfill construction in the southern portion of the central valley, structural fill and geologic isolation material have been constructed which provide the required separation between groundwater and the landfill's composite liner system. Recharge to the Rush Run Sandstone unit occurs along the hilltop ridges in the area and from leakage through the shale aquitards from overlying sandstone aquifers.

The Fish Creek Sandstone, while bisected by the valley at the landfill, has a unit thickness that ranges from 9 to 47 feet. The top elevation of the Fish Creek Sandstone ranges from approximately 1,059 feet amsl to 1,112 feet amsl. The bottom elevation ranges from approximately 1,050 feet amsl to 1,072 feet amsl dipping to the south as shown on Figure 9 – Base of Fish Creek Sandstone Contours. Figure 10 – Fish Creek Sandstone Isopach Contours, depicts the thickness of the unit which ranges from approximately 9 feet to 47 feet. The contact between the Fish Creek Sandstone and underlying deposits is marked by the presence of a dark gray and sometime black, shale occurring between approximately 1,046 and 1,052 feet amsl.

3.1.1.2 Hydraulic Conductivity

Groundwater flow through the Rush Run Sandstone and Fish Creek Sandstone units is primary through secondary porosity (fractures), especially in shallow bedrock and to a lesser extent through primary porosity. Hydraulic conductivity values generally decreased with increasing depth. This pattern of decreasing hydraulic conductivity with depth has been observed in areas where unloading of bedrock by overburden removal results in stress relief fracturing of shallower units creating secondary porosity (e.g., fractures).

A mean K value developed from the pressure packer tests within each sandstone unit was calculated and summarized below:

- Rush Run – 7.48×10^{-8} centimeters per second (cm/sec)
- Fish Creek – 1.37×10^{-7} cm/sec

Recovery and rising head/falling head tests were conducted in groundwater monitoring wells. A summary of the geometric means of K for each monitored unit are summarized below:

- Rush Run – 1.07×10^{-6} cm/sec
- Fish Creek – 1.24×10^{-7} cm/sec

Shale units, which act as aquitards limiting flow between the sandstone units, were determined to have a mean K value of 1.93×10^{-7} cm/sec based on packer tests completed at the site.

3.1.1.3 *Groundwater Flow*

The following paragraphs provide a general summary of the groundwater flow corresponding to each referenced sandstone unit. Groundwater elevations measured in the Rush Run Sandstone monitoring wells generally decrease from north to south at the Mitchell Landfill site. The base of this sandstone unit is marked by low permeability shale and dips to the south-southwest. Stress relief fracturing in the shallow bedrock within the valley, in conjunction with thin colluvium, provides a preferential pathway for groundwater to discharge into the valley. Based on this information, the groundwater flow direction in the Rush Run Sandstone is likely down slope with respect to local surface topography, as well as down dip on the underlying bedrock. The groundwater flow direction is likely to mimic surface topography; therefore, flowing into the central valley and generally south as depicted on Figure 11 – Rush Run Sandstone Potentiometric Surface Map.

An inward hydraulic gradient (groundwater flow toward the landfill) in the Rush Run Sandstone and overlying bedrock strata, is created by the incised bedrock topography causing groundwater to discharge as seeps and springs along the valley side slopes. The landfill underdrain system, discussed below, has been installed to collect this inward flow and subsequently improve slope stability beneath the landfill liner. Thus, most Rush Run Sandstone monitoring positions at the periphery of the site are positioned upgradient of the landfill. A relatively narrow portion of the Rush Run Sandstone that extends down slope in the central valley is downgradient of Mitchell Landfill.

The Rush Run Sandstone is a low-yield aquifer characterized by groundwater flow primarily through open fractures and joints and secondarily through interstitial pore space in the sandstone matrix. Borings completed at the site indicate that open fractures and joints are sparsely distributed in the bedrock units encountered; thus, monitoring wells installed in the Rush Run Sandstone typically yield meager quantities of groundwater that require low-flow or passive sampling techniques.

Groundwater flow in the Fish Creek Sandstone is likely to be similar to the Rush Run Sandstone where it follows surface topography into the central valley as depicted on Figure 12 – Fish Creek

Sandstone Potentiometric Surface Map. Recharge to the Fish Creek Sandstone is from leakage through the overlying shale and clay units beneath the ridges surrounding the landfill site. A portion of the groundwater likely percolates slowly and deeper into the Rush Run Sandstone.

Groundwater discharge in the landfill area occurs at the Rush Run Sandstone and Fish Creek Sandstone subcrop position in the central valley as springs and seeps along the stream channels and the valley walls. As described in Section 2.2.1.1, Mitchell Landfill is constructed with a groundwater interceptor underdrain system designed to collect seepage along the interbedded sandstone subcrop positions located below structural fill and isolation fill materials that are constructed beneath the landfill composite liner system. The underdrain system provides an engineered, non-mechanical (gravity drained) hydraulic control that assures separation between groundwater and the composite liner system. In the central valley area near the southern limits of waste, the underdrain system collects groundwater from the Rush Run Sandstone and Fish Creek Sandstone subcrops.

Initial water levels collected from Mitchell Landfill monitoring wells may be unreliable due to the low yield nature of most of the wells and may represent inflow of water that was used for pressure testing during well drilling in November and December 2011. Other than the initial two rounds of measurements, the remaining water level data appear to be representative of seasonal variations due to recharge and discharge characteristics at the Mitchell Landfill site. However, two anomalies are noted: 1) the Fish Creek Sandstone well MW1101F where there was a steep decline of approximately 49 feet from elevation 1,106 to 1,056 feet amsl, then a rebound to a relatively stable elevation of approximately 1,094 to 1,082 feet amsl, followed by a steep increase to elevation 1,122 feet amsl in April 2015 and a gentle decline to elevation 1,097 feet amsl as of November 2015; and, 2) the Rush Run Sandstone well MW1102R exhibits a steady increase in groundwater level elevation of approximately 25 feet from June 2012 to September 2013, reaching an elevation of 1054 feet amsl, followed by a decline to elevation 1,030 feet amsl and fluctuations between 1,030 and 1,040 feet amsl since October 2014. Overall, the monitoring well data indicates relatively consistent downward gradients between each of the referenced hydrostratigraphic units at the Mitchell Landfill site. The corresponding hydrographs that present water elevations from wells monitoring the Rush Run Sandstone and Fish Creek Sandstone are presented in Appendix B.

Site specific information collected during the HGSIR completed at the Mitchell Landfill site were used to calculate groundwater flow rates within the two referenced sandstone units. The calculations require median porosity values for each sandstone unit, which were determined from the neutron porosity logs and mean hydraulic conductivity values, which were derived from field testing (pressure packer, slug tests and recovery tests).

The calculated flow rates, in feet per year (ft/yr), are summarized below:

- Rush Run – 1.11×10^{-2} feet per year (ft/yr)
- Fish Creek – 1.23×10^{-2} ft/yr

3.1.1.4 CCR Rule Definition of Uppermost Aquifer

The CCR Rule definition of the Uppermost Aquifer (UA) is found in 40 CFR §257.53 and is provided below:

Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season.

The CCR Rule definition of the UA is equivalent to the WV CSR definition (presented in Section 2.4.3). However, the WV CSR definition of the USA more specifically includes the laterally persistence characteristic, which is applicable to upland, naturally incised sandstone aquifers that occur at Mitchell Landfill. To comply with the GMS requirements in 40 CFR §257.91(a)(2), a laterally persistent UA must be monitored in order to accurately represent the quality of groundwater passing the waste boundary of the CCR unit. As further discussed in the following section (Section 3.1.1.5), the USA (Rush Run Sandstone) established for the Mitchell Landfill meets the criteria for being the UA at the site.

3.1.1.5 Identified On-site Uppermost Aquifer

Sandstone aquifers overlying the Rush Run Sandstone are naturally incised and are not laterally persistent below the Mitchell Landfill composite liner system. Therefore, the Rush Run Sandstone was identified in the HGSIR as the USA at Mitchell Landfill and meets the CCR Rule definition of the UA, as discussed above. The Rush Run Sandstone is laterally persistent beneath the Mitchell Landfill composite liner system with the exception of a small, localized area down valley of the Mitchell Landfill limits of waste, where the unit subcrops along the lower side slopes, near the central valley axis. This relatively small incised area does not preclude the availability to monitor the Rush Run Sandstone downgradient of the limits of waste. As depicted on Figure 11 – Rush Run Sandstone Potentiometric Surface Map, supplemental groundwater monitoring wells MW1501, MW1502 and MW1503, were installed in the Rush Run Sandstone downgradient of the Mitchell Landfill in 2015 to meet 40 CFR §257.91 requirements. The Rush Run Sandstone is a low-yield aquifer; thus, monitoring wells installed in the unit typically yield meager quantities of groundwater that require low-flow or passive sampling techniques.

3.1.1.6 Landfill Separation from the Uppermost Aquifer

The base of the Mitchell Landfill composite liner system ranges from 1,290 feet amsl in the northwestern limits to 1,038.5 feet amsl in the southern limits. Seasonal high water elevations in the Rush Run Sandstone correspondingly range from approximately 1,045 feet amsl in the northern and eastern areas to 1,010 feet amsl near the southern limits of waste placement. Separation between the landfill liner system and the top of the UA is provided by natural shale aquitards, or where the shales are incised by the placement of structural fill and geologic isolation material. Furthermore, the Groundwater Interceptor Drain System (refer to Section 2.2.1.1) provides a non-mechanical (gravity) drain at the Rush Run Sandstone subcrop position which serves as hydraulic discharge control in the southern central valley area. This underdrain system provides effective control of the seasonal fluctuations in potentiometric head beneath the composite liner including the UA. Natural shale aquitards, construction of isolation materials and the use of underdrains demonstrate that the base of the composite liner system is constructed greater than 1.52 meters (5 feet) above the Rush Run Sandstone at the Mitchell Landfill as depicted on Figure 13 – Isolation from Uppermost Aquifer Isopach.

3.1.1.7 CCR Groundwater Monitoring System

The Mitchell Landfill WVDEP SW/NPDES permit and CCR GMS groundwater monitoring well locations are shown on Figure 3 – CCR Unit and Monitoring Wells. The Mitchell Landfill CCR GMS includes only wells monitoring the Rush Run Sandstone (UA) and the overlying Fish Creek Sandstone, which were installed during completion of the HGSIR for the WVDEP SW/NPDES permit application and additional wells which were installed in June and July 2015 at downgradient monitoring locations, including three in the Rush Run Sandstone and two in the Fish Creek Sandstone. Table 1 – Summary of Monitoring Well and Piezometer Construction provides monitoring well construction details (2011 and 2015 well installations) and the upgradient and downgradient hydraulic positions relative to the limits of waste. A summary of the Mitchell Landfill CCR GMS, comprised of the Rush Run Sandstone and the overlying Fish Creek Sandstone monitoring wells is provided below:

Rush Run Sandstone Monitoring Wells and Depths/Elevations (measured from ground surface)

- MW1101R: 212 ft. bgs/1006.7 ft. amsl
- MW1102R: 204 ft. bgs/1022.7 ft. amsl
- MW1103R: 198 ft. bgs/1040.1 ft. amsl
- MW1104R: 212 ft. bgs/1016.7 ft. amsl
- MW1501R: 150 ft. bgs/1008.8 ft. amsl
- MW1502R: 33 ft. bgs/1012.2 ft. amsl
- MW1503R: 99 ft. bgs/1009.3 ft. amsl

Fish Creek Sandstone Monitoring Wells and Depths/Elevations (measured from ground surface)

- MW1101F: 169 ft. bgs/1050.0 ft. amsl
- MW1102F: 177 ft. bgs/1049.8 ft. amsl
- MW1103F: 179 ft. bgs/1057.4 ft. amsl
- MW1104F: 172 ft. bgs/1056.5 ft. amsl
- MW1501F: 150 ft. bgs/1052.8 ft. amsl
- MW1503F: 99 ft. bgs/1045.2 ft. amsl

Table 2 – Summary of Monitoring Well Water Levels provides seasonal water level fluctuations in the Mitchell Landfill WVDEP SW/NPDES and CCR GMS monitoring wells between October 30, 2014 and November 4, 2015. The hydraulic position of the Rush Run Sandstone and Fish Creek Sandstone monitoring wells relative to the limits of waste are provided in Figure 11 – Rush Run Sandstone Potentiometric Surface Map and Figure 12 – Fish Creek Sandstone Potentiometric Surface Map, respectively. Hydrographs of the Mitchell Landfill CCR GMS water level data are provided in Appendix B.

3.1.1.8 Background Groundwater Monitoring

At the request of AEP, CEC completed background groundwater monitoring in 2012 and 2013, which included 10 background sampling events from the 12 groundwater monitoring wells installed in 2011 for analytes required by WVDEP. Background monitoring for these wells was completed prior to acceptance of waste at the Mitchell Landfill. The objective of the background groundwater monitoring project was to develop and maintain a laboratory analytical database and perform appropriate groundwater statistical analyses to determine baseline background groundwater quality characteristics for future compliance monitoring of the landfill. Sampling and analysis procedures followed the FSAP. Background groundwater monitoring began in February 2012 and was completed in December 2013. The Mitchell Landfill construction began in November 2012 and began accepting waste in July 2014.

The Mitchell Landfill background groundwater monitoring program consisted of the following activities:

- Collection of 10 rounds of background groundwater samples from the monitoring well network prior to waste placement.
- Review and quality control evaluation of analytical data for the groundwater analytical results.

- Developed preliminary statistical evaluation of the background analytical results, including removal of data for outliers, determination of statistical trends and generation of intra-well prediction limits for the background data.

The Background Groundwater Monitoring Report (BGMR), dated February 2014, provides a summary of groundwater sampling procedures, field sampling data sheets, laboratory analytical results and statistical analyses used to evaluate background groundwater quality at the Mitchell Landfill in compliance with the WVDEP SW/NPDES permit, including the WVDEP groundwater analytical parameter list. Evaluation of the background groundwater quality data and geology of the site resulted in a recommendation for intra-well statistical analysis of future compliance groundwater monitoring data based on the variability (inter-bedding) of the rock types monitored in the monitoring wells, the discontinuous (incised) nature of the bedrock strata and the natural/spatial variation of groundwater quality at the Mitchell Landfill site. Intra-well statistical methods, which compare pre-operational, background groundwater quality data to post-operational, compliance monitoring data from individual monitoring wells, are as representative, or more representative, than that provided by upgradient wells. For the Mitchell Landfill GMS, intra-well statistical evaluation accurately represents the quality of groundwater passing the waste boundary of the CCR unit.

Additional background groundwater quality data, which will include the CCR groundwater analytes in Appendix III and IV, will be collected by October 2017 per 40 CFR §257.94 from the Mitchell GMS. Pre-operational background data are not available for the CCR analytes that are not included in the WVDEP SW/NPDES permit. However, based on the groundwater flow velocities included in Section 3.1.1.3, a potential leachate release from the southern-most limit of Phase 1 will not impact the nearest downgradient monitoring well, MW1502R (located approximately 1,000 feet south of Phase 1), prior to the completion of background monitoring of the Mitchell Landfill GMS by October 2017 per 40 CFR §257.94. Otherwise, there is the option to evaluate background data from downgradient wells using inter-well comparisons for the Rush Run Sandstone.

3.1.2 Compliance With §257.91(a) Through §257.91(c) Requirements

The Mitchell Landfill groundwater monitoring system consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples that: 1) accurately represent the quality of background groundwater that has not been affected by leakage from the Mitchell Landfill CCR unit; 2) accurately represent the quality of groundwater passing the waste boundary of the Mitchell Landfill CCR unit; and, 3) the monitoring well network consists of an appropriate number, spacing and depths of monitoring wells based on site-specific technical information (summarized in Section 3.1.1) that included thorough characterization of the saturated and unsaturated geologic units, aquifer thicknesses, groundwater flow rates, groundwater flow directions and seasonal/temporal fluctuations in groundwater flow. Thus,

the Mitchell Landfill groundwater monitoring system complies with 40 CFR 257.91(a) through 40 CFR 257.91(c) requirements.

3.2 §257.91(d) RULE DESCRIPTION

40 CFR 257.91(d) states:

(d) The owner or operator of multiple CCR units may install a multiunit groundwater monitoring system instead of separate groundwater monitoring systems for each CCR unit.

(1) The multiunit groundwater monitoring system must be equally as capable of detecting monitored constituents at the waste boundary of the CCR unit as the individual groundwater monitoring system specified in paragraphs (a) through (c) of this section for each CCR unit based on the following factors:

- (i) Number, spacing and orientation of each CCR unit;*
- (ii) Hydrogeologic setting;*
- (iii) Site history; and,*
- (iv) Engineering design of the CCR unit.*

(2) If the owner or operator elects to install a multiunit groundwater monitoring system and if the multiunit system includes at least one existing unlined CCR surface impoundment as determined by § 257.71(a) and if at any time after October 19, 2015 the owner or operator determines in any sampling event that the concentrations of one or more constituents listed in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under § 257.95(h) for the multiunit system, then all unlined CCR surface impoundments comprising the multiunit groundwater monitoring system are subject to the closure requirements under § 257.101(a) to retrofit or close.

3.2.1 Information Supporting Rule Compliance

AEP is not proposing to install a multiunit groundwater monitoring system; therefore, this rule does not apply to Mitchell Landfill.

3.3 §257.91(e) AND §257.91(f) RULE DESCRIPTION

40 CFR 257.91(e) and (f) states:

(e) Monitoring wells must be cased in a manner that maintains the integrity of the

monitoring well borehole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (i.e., the space between the borehole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

(1) The owner or operator of the CCR unit must document and include in the operating record the design, installation, development and decommissioning of any monitoring wells, piezometers and other measurement, sampling and analytical devices. The qualified professional engineer must be given access to this documentation when completing the groundwater monitoring system certification required under paragraph (f) of this section.

(2) The monitoring wells, piezometers and other measurement, sampling and analytical devices must be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program.

(f) The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. If the groundwater monitoring system includes the minimum number of monitoring wells specified in paragraph (c)(1) of this section, the certification must document the basis supporting this determination.

3.3.1 Information Supporting Rule Compliance

The Mitchell Landfill HGSIR describes the site hydrogeologic investigation, monitoring well installation field activities and the design, installation and development of the groundwater monitoring wells installed in 2011. Boring logs and as-built well diagrams for wells installed in 2011 and additional monitoring wells installed in 2015 are provided in Appendix A. Table 1 – Summary of Monitoring Well and Piezometer Construction provides monitoring well construction details (2011 and 2015 well installations) and the upgradient and downgradient hydraulic positions relative to the limits of waste. The Mitchell Landfill FSAP provides detailed sampling and analysis procedures for the collection and analysis of groundwater samples from the Mitchell Landfill GMS. Groundwater analytical parameters, sampling frequency and statistical evaluation procedures are prescribed in the WVDEP SW/NPDES Permit. The Mitchell Landfill BGMR provides sampling procedures, background groundwater monitoring data and initial statistical evaluations that apply to the Mitchell Landfill under the WVDEP SW/NPDES requirements, including the groundwater analytical parameter list. Additional background groundwater monitoring for the CCR analytes in Appendix III and IV will be completed by October 2017 per 40 CFR §257.94.

The Mitchell Landfill HGSIR and BGMR include detailed descriptions of the following investigations completed at the Mitchell Landfill, as summarized below.

Hydrogeologic and Geotechnical Subsurface Investigation Report

- Subsurface Exploration and Sampling Procedures
- Auger Drilling
- Rock Coring
- Test Pit Excavations
- Boring and Test Pit Logs
- Geophysical Logging
- Packer Testing
- Monitoring Well and Piezometer Installation
- Well Development
- Hydraulic Conductivity Testing
- Laboratory Testing
- Classification and Characterization of Subsurface Conditions
- Overburden Soil
- Bedrock
- Bedrock Outcrops
- Geologic Structure
- Hydrogeology
- Hydraulic Conductivity
- Groundwater Flow Direction
- Groundwater Flow Rate
- Surface Water Occurrence and Flow
- Conclusions

Background Groundwater Monitoring Report

- Groundwater Monitoring Network
- Monitoring Well Hydrographs
- Field and Laboratory Analytes
- Sample Collection Procedures

- Sampling Equipment
- Groundwater Purging and Sample Collection
- Documentation of Sampling Activities
- Field and Laboratory Analytical Results
- Statistical Evaluations
- Establishment of Background Data
- Outliers Removed
- Trend Analysis
- Burton Sandstone Trend Analysis
- Fish Creek Sandstone Trend Analysis
- Rush Run Sandstone Trend Analysis
- Hundred Sandstone Trend Analysis
- Intra-well Analysis

The FSAP provides detailed procedures for groundwater sampling and analysis at the Mitchell Landfill, as summarized below.

Field Sampling and Analysis Plan

- Data Quality Objectives Process
- Project Objectives and Intended Data Usage
- Field Parameters
- Laboratory Parameters
- Quality Assurance Objectives for Measurement Data
- Groundwater Sampling Procedures
- Sampling Equipment
- Equipment Calibration
- Decontamination
- Monitoring Well Inspection and Maintenance
- Water Level Monitoring
- Groundwater Sample Collection
- Sample Packaging and Transport
- Chain of Custody Procedures

- Quality Assurance/Quality Control Samples
- Laboratory Analytical Procedures
- Data Reduction, Validation and Reporting

3.3.2 Compliance With §257.91(e) And §257.91(f) Requirements

Mitchell Landfill groundwater monitoring wells were constructed and cased in a manner that maintains the integrity of the monitoring well borehole for the collection of groundwater samples, including: 1) the annular space above each well's sampling depth is sealed with bentonite to prevent contamination of samples and the groundwater; and 2) wells are constructed with slotted well screens surrounded by silica sand filter packs that reduce suspended solids and turbidity in the groundwater samples. Well design, installation, development and decommissioning of monitoring wells and piezometers and measurement, sampling and analytical devices are well documented in the HGSIR, FSAP, BGMR; and descriptions of additional monitoring wells installed in 2015 are documented in this report.

A CEC Certified Professional Geologist (CPG), under the supervision and direction of the certifying Professional Engineer, has been directly involved with the data collection, site characterization, well installation, and, background groundwater monitoring and has reviewed applicable information in the Operating Record. The information provided in Section 3.3.1 demonstrates that the Mitchell Landfill GMS complies with 40 CFR 257.91(e) and 40 CFR 257.91(f) requirements.

4.0 SUMMARY AND PROFESSIONAL ENGINEER'S CERTIFICATION

This CCR Groundwater Monitoring System Demonstration describes the Mitchell Landfill CCR unit, site geology and groundwater monitoring system in support of demonstrating compliance with 40 CFR §257.91 Groundwater Monitoring Systems. Section 3.0 of this report provides supporting information and conclusions demonstrating that the applicable Groundwater Monitoring System requirements have been met.

The following certification statement provides confirmation that this report was prepared by a qualified professional engineer and that there is sufficient information to demonstrate that the existing Mitchell Landfill and future expansion phases, meet the Groundwater Monitoring System requirements stated in 40 CFR §257.91.

Professional Engineer's Certification

By means of this certification, I certify that I have reviewed this CCR Groundwater Monitoring System Demonstration Report, Mitchell Landfill, Mitchell Power Generation Plant and the design, construction, operation and maintenance of Mitchell Landfill Groundwater Monitoring System meets the requirements of Section 40 CFR §257.91.

Anthony P. Amicon

Printed Name of Professional Engineer


Signature



19206

Registration No.

West Virginia

Registration State

06-23-2011

Date

5.0 BIBLIOGRAPHY

Background Groundwater Monitoring Report, Mitchell Landfill, Mitchell Electric Generating Plant, Marshall County, West Virginia, Prepared for American Electric Power, Prepared By Civil & Environmental Consultants, Inc., February 2014.

Field Sampling and Analysis Plan, American Electric Power, Proposed Mitchell Landfill, Moundsville, West Virginia, Prepared for American Electric Power, 1 Riverside Drive, Columbus, Ohio, Prepared by Civil & Environmental Consultants, Inc., Cincinnati, Ohio, CEC Project 110-416, February 2012.

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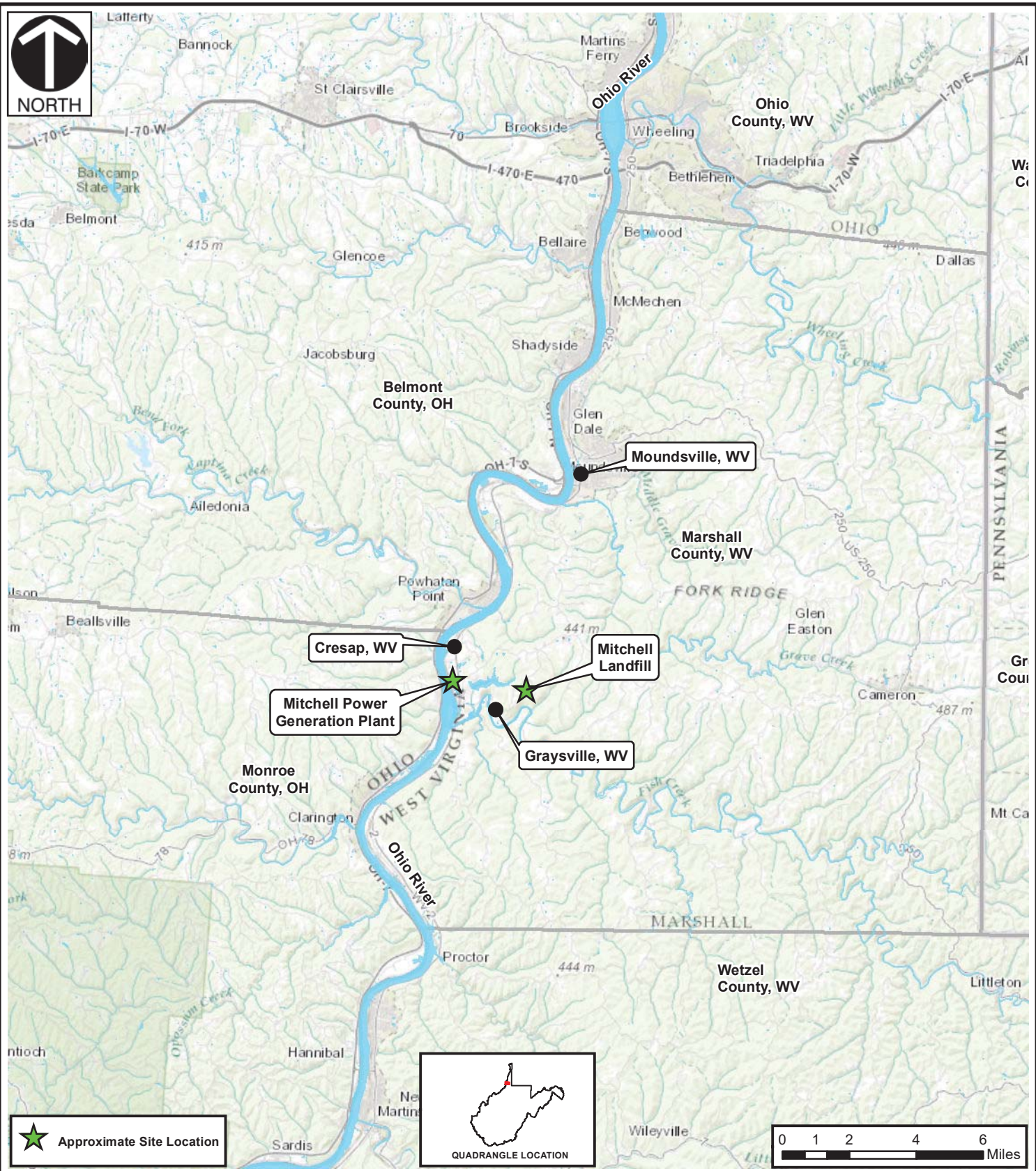
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Solid Waste/NPDES Permit Number WV0116742, May 29, 2013. West Virginia Department of Environmental Protection, 601 57th Street, Charleston, West Virginia 25304.

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WVGES Publication: Map 25A, West Virginia Geological and Economic Survey Mont Chateau Research Center 1 Mont Chateau Road Morgantown, WV 26508-8079 Phone: (304) 594-2331 Web: www.wvgs.wvnet.edu, Map: Original 1968/1969 map revised, March 2011, Map Date: May 16, 2011

FIGURES



 Approximate Site Location



SOURCE: ARCGIS ONLINE MAP SERVICE: [HTTP://GOTO.ARCGISONLINE.COM/MAPS/USA_TOPO_MAPS](http://gto.arcgis.com/maps/usa_topo_maps), LAST ACCESSED: 12/8/2015



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AMERICAN ELECTRIC POWER
 MITCHELL LANDFILL
 MITCHELL POWER GENERATION PLANT
 MARSHALL COUNTY, WEST VIRGINIA

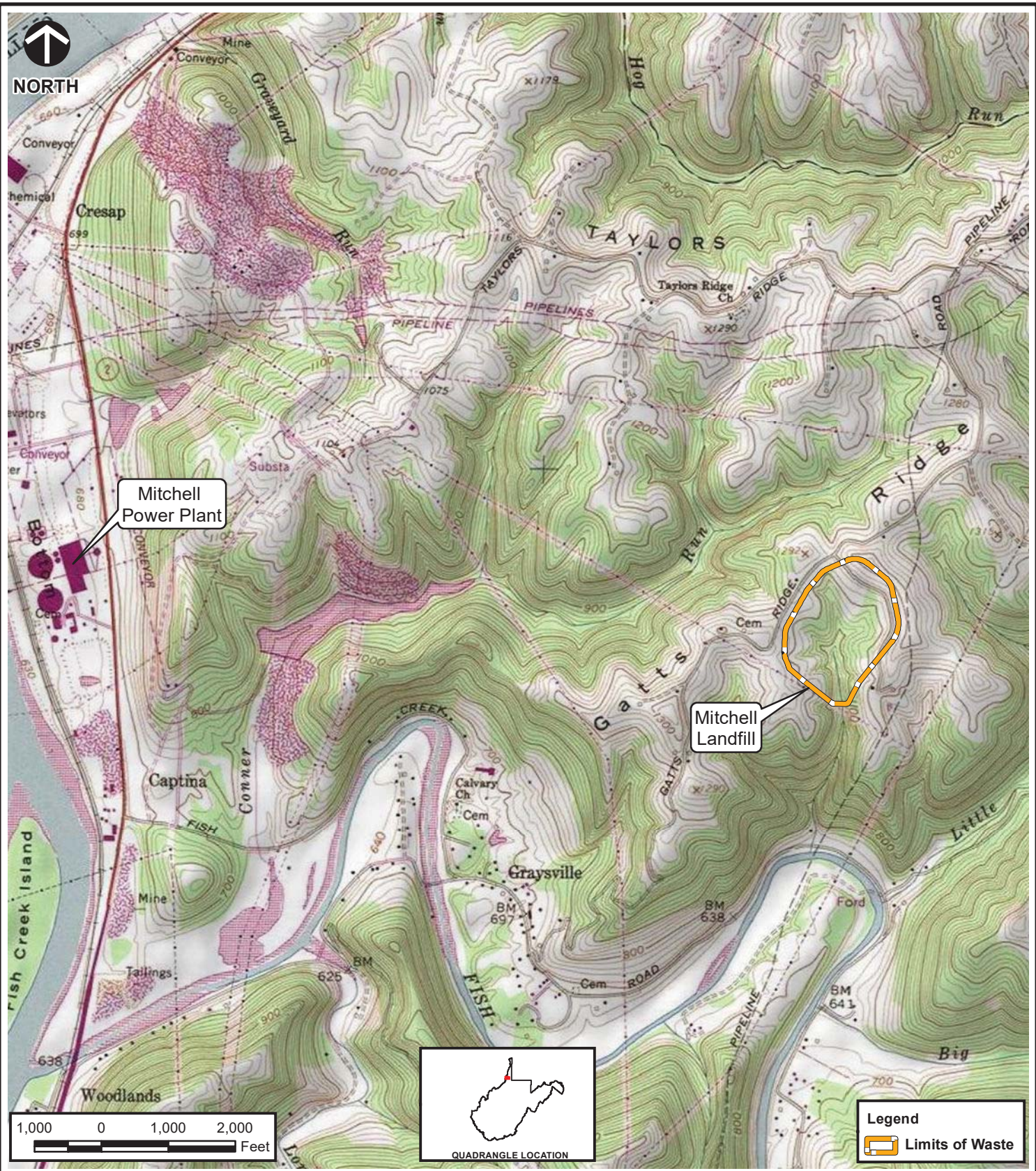
GROUNDWATER MONITORING SYSTEM DEMONSTRATION
 SITE LOCATION MAP

DRAWN BY: MAD	CHECKED BY: RAS	APPROVED BY: APA*	FIGURE NO: 1
DATE: DECEMBER 08, 2015	DWG SCALE: 1" = 4 miles	PROJECT NO: 110-416-7601	

P:\2011\110-416-GIS\Maps\Task 7601110416 Fig 1 17601.mxd - 12/8/2015 - 9:08:33 AM

Signature on File *

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SOURCE: PORTION OF THE USGS 7.5-MINUTE SERIES TOPOGRAPHIC QUADRANGLE MAP - GLEN EASTON, WV - 1978 AND POWHATAN POINT, WV - 1978.



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 MITCHELL LANDFILL
 MITCHELL POWER GENERATION PLANT
 MARSHALL COUNTY, WEST VIRGINIA**

**GROUNDWATER MONITORING SYSTEM DEMONSTRATION
 PLANT AND CCR UNIT LOCATION MAP**

DRAWN BY: MGN/DNB	CHECKED BY: RAS	APPROVED BY: APA*	FIGURE NO: 2
DATE: DECEMBER 08, 2015	DWG SCALE: 1" = 2,000'	PROJECT NO: 110-416-7601	

Signature on File *

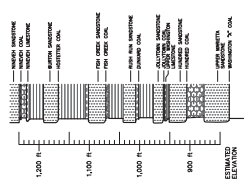
NO.	DATE	REVISION RECORD

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- LEGEND**
- FUTURE POTENTIAL (50' MESH)
 - EXISTING POTENTIAL
 - EXISTING LANDFILL
 - EXISTING CONDUITS
 - EXISTING STREAM
 - EXISTING OVERHEAD ELECTRICAL POWER LINES
 - EXISTING ELECTRICAL POLE AND TOWER
 - EXISTING VEGETATION
 - EXISTING ROADS
 - EXISTING OCCUPIED DWELLING
 - EXISTING VACANT DWELLING
 - LIMITS OF WASTE (FORMAL)
 - UNDERDRAIN POSITION AND ELEVATION
 - MONITORING WELL (COMPLETED 2011)
MM1103F
1080.34
 - MONITORING WELL (COMPLETED 2010)
MM1503F
1046.15
 - POTENTIALS BEING MONITORED

UNDERDRAIN REFERENCE DRAWINGS:

- UNDERDRAIN SYSTEM FOR CELL 14 AND 15 MONITORING SYSTEM FOR PLAN ONE, VOL. APPROX 000304, HILL AND ASSOCIATES, INC., WELLS, OHIO, SUBMITTAL DATE JULY 2014
- GROUNDWATER INTERFERATION PATTERN FREE PLAN FROM PHASE 'A' TO ENERGY DEVELOPMENT (FORM 500), HILL AND ASSOCIATES, INC., WELLS, OHIO, SUBMITTAL DATE JULY 2014
- APPROXIMATOR HILL AND ASSOCIATES, INC., WELLS, OHIO, SUBMITTAL DATE JULY 2014



BEDROCK STRATIGRAPHIC COLUMN

NOTES:

- THE WATER LEVELS PRESENTED WERE APPLICABLE TO THE LOCATION AND TIME OF MEASUREMENT. WATER LEVELS MAY FLUCTUATE THROUGHOUT THE YEAR. MONITORING OF INTERIOR DRAIN BEDROCK POINTS OF MONITORING WATER LEVELS IS REQUIRED TO DETERMINE THE POTENTIAL OF INTERIOR DRAIN BEDROCK POINTS OF MONITORING WATER LEVELS AT LOCATIONS BEING MONITORED THROUGHOUT THE YEAR.



TABLES

**Table 1 - Summary of Monitoring Well and Piezometer Construction
CCR Groundwater Monitoring System Demonstration
Mitchell Landfill**
American Electric Power - Mitchell Generating Plant

Soil Boring ID	Monitoring Well Tag Number	Date Well Installed	Coordinates ⁽¹⁾		Top of Benitole Seal Elevation (ft amsl) ⁽²⁾	Elevation Top of Benitole Seal (ft amsl)	Depth to Top of Screen (ft bgs)	Top of Screen Elevation (ft bgs)	Screen Length (ft amsl)	Depth to Bottom of Screen (ft bgs)	Measured Depth (feet)	Bottom of Screen Elevation (ft amsl)	Elevation Bottom of Screen (ft amsl)	Depth to Top of Dedicated Pump ⁽³⁾ (ft bgs)	Borehole Diameter at SquiRock (inches)	Casing Type	Casing Diameter (inches)	Monitored Stratigraphic Unit	Hydraulic Properties Relative to Waste
			Northing	Eastings															
SB-01	MW1101H	10/27/2011	484883.9	1609657.8	1218.7	1220.71	935.7	930.7	290.0	50.0	342.9	878.7	877.7	--	8.0/6.0	SCH-40 PVC	2.0	H and Interval Below	Down Gradient
	MW1101R	10/29/2011	484877.8	1609656.4	1218.7	1221.23	1033.7	1031.7	187.0	25.0	214.5	1006.7	1004.7	206.5	8.0/6.0	SCH-40 PVC	2.0	R and Interval Below	Side Gradient
	MW1101F	12/20/2011	484864.5	1609651.4	1219.0	1220.86	1066.0	1057.0	162.0	7.0	171.1	1050.0	1049.0	167.5	8.0/6.0	SCH-40 PVC	2.0	F and Interval Above	Side Gradient
	MW1101B	12/19/2011	484870.8	1609653.8	1218.8	1220.73	1131.8	1129.8	89.0	18.0	109.2	1111.8	1110.8	101.5	8.0/6.0	SCH-40 PVC	2.0	Unnamed Unit Above F	Undetermined
	MW1102R	12/14/2011	485101.7	1611103.3	1226.7	1228.36	1037.7	1030.7	196.0	8.0	204.0	1022.7	1021.7	--	8.0/6.0	SCH-40 PVC	2.0	R	Side Gradient
	MW1102F	10/25/2011	485106.1	1611101.1	1226.8	1228.67	1086.8	1079.8	30.0	17.0	180.0	1049.8	1048.8	170.0	8.0/6.0	SCH-40 PVC	2.0	F and Interval Below	Side Gradient
	MW1102B	12/15/2011	485097.4	1611096.9	1226.9	1228.84	1156.9	1154.9	17.0	89.0	90.9	1137.9	1136.9	83.0	8.0/6.0	SCH-40 PVC	2.0	Unnamed Unit Above F / Above Limestone	Undetermined
	MW1108H	9/27/2011	487005.3	1610094.0	1237.4	1239.82	937.4	930.4	307.0	40.0	347.0	890.4	889.4	--	8.0/6.0	SCH-40 PVC	2.0	H and Interval Below	Up Gradient
	MW1108R	12/16/2011	486988.5	1610097.2	1238.1	1240.01	1053.1	1047.1	191.0	7.0	200.3	1040.1	1039.1	--	8.0/6.0	SCH-40 PVC	2.0	R	Up Gradient
	MW1103F	04/19/2011	487011.2	1610102.2	1238.4	1239.19	1094.4	1087.4	30.0	179.0	181.6	1057.4	1056.4	173.5	8.0/6.0	SCH-40 PVC	2.0	F and Interval Below	Up Gradient
SB-23	MW1104R	12/22/2011	486345.1	1609471.2	1228.7	1230.66	1043.7	1041.7	187.0	25.0	213.8	1016.7	1015.7	--	8.0/6.0	SCH-40 PVC	2.0	R and Interval Below	Up Gradient
	MW1104F	12/21/2011	486352.3	1609469.3	1228.5	1230.30	1083.5	1076.5	20.0	172.0	174.1	1056.5	1055.5	--	8.0/6.0	SCH-40 PVC	2.0	F and Interval Below	Up Gradient
SB-09	PZ1101H-0	9/19/2011	485980.9	1610339.5	1141.3	1143.59	924.3	923.3	35.0	247.0	247.5	894.3	893.3	--	5.0	SCH-40 PVC	1.0	H	Abandoned
	MW1501R	8/05/2015	484663.0	1609913.5	1158.80	1161.78	1033.1	1023.4	14.6	150.0	153.5	1008.8	1007.8	--	8.0/6.0	SCH-40 PVC	4.0	R	Down Gradient
B-1501	MW1501F	8/06/2015	484662.0	1609917.5	1158.84	1161.83	1078.6	1067.4	14.6	106.0	109.7	1052.8	1051.84	--	8.0/6.0	SCH-40 PVC	4.0	F	Down Gradient
	MW1502R	8/06/2015	484648.8	1610218.1	1045.23	1047.41	1027.5	1021.83	9.6	33.0	36.0	1012.2	1011.6	--	6.0	SCH-40 PVC	4.0	R	Down Gradient
B-1503	MW1503R	8/15/2015	484596.7	1610467.6	1108.86	1111.96	1030.8	1019.5	9.6	99.0	101.9	1009.3	1007.9	--	8.0/6.0	SCH-40 PVC	4.0	R	Down Gradient
	MW1503F	8/15/2015	484591.4	1610468.5	1108.88	1111.93	1062.8	1060.4	14.6	63.0	66.3	1045.2	1044.8	--	8.0/6.0	SCH-40 PVC	4.0	F	Down Gradient

Notes:
 (1) UTM coordinates are US State Plane 1883 West Virginia North
 (2) amsl = average mean sea level; Vertical Datum is NAVD 1988; GEOID 03
 (3) Piezometer Abandoned in June 2013 due to encroaching landfill construction. One inch diameter piezometer.
 (4) Measured from the top of riser.
 (5) Dashed red border pumps installed December 2011.

Rock Type Symbol Legend:
 GL - Clay
 SH - Shale
 SH - Shale
 LS - Limestone
 SS - Sandstone

Benitole Unit Legend:
 R - Rosh Run Sandstone
 F - Fish Creek Sandstone
 B - Burton Sandstone/Shallow Beekmantown

Table 2 - Summary of Monitoring Well Water Levels
 CCR Groundwater Monitoring System Demonstration
 Mitchell Landfill
 American Electric Power - Mitchell Generating Plant

Soil Boring ID	Monitoring Well ID	Monitoring Well Tag Number	Date Well Installed	Coordinates ⁽¹⁾		Top of Riser Elevation (ft amsl)	Casing Diameter (inches)	Depth to Top of Screen (ft amsl)	Screen Length (ft amsl)	Measured Total Depth ⁽²⁾ (feet)	10/30/2014		11/11/2014		12/14/2014		1/22/2015		2/19/2015		3/19/2015		4/24/2015		5/20/2015				
				Northing	Easting						Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation
SB-01	MW1101H	0491-0003-2011	10/7/2011	4848839	1609657.8	1220.71	2	290	50	342.9	331.64	889.07	889.47	890.10	891.58	891.10	891.61	891.61	891.61	891.61	891.61	891.61	891.61	891.61	891.61	891.61	891.61	891.61	891.61
	MW1101R	0491-0006-2011	10/28/2011	4848778	1609656.4	1221.23	2	187	25	214.5	195.65	1025.58	1025.60	1025.39	1025.55	1025.55	1025.53	1025.53	1025.53	1025.53	1025.53	1025.53	1025.53	1025.53	1025.53	1025.53	1025.53	1025.53	1025.53
	MW1101F	0402-0006-2011	12/20/2011	4848645	1609651.4	1220.86	2	162	7	171.1	139.86	1081.00	1080.90	1080.55	1080.26	1080.26	1080.31	1080.31	1080.31	1080.31	1080.31	1080.31	1080.31	1080.31	1080.31	1080.31	1080.31	1080.31	1080.31
	MW1101B	0402-0005-2011	12/19/2011	4848708	1609653.8	1220.73	2	89	18	109.2	89.83	1130.90	1130.82	1130.79	1130.88	1130.88	1132.29	1132.29	1132.29	1132.29	1132.29	1132.29	1132.29	1132.29	1132.29	1132.29	1132.29	1132.29	1132.29
SB-07	MW1102R	0402-0002-2011	12/14/2011	4851017	1611103.3	1228.36	2	196	8	205.8	198.64	1029.72	1029.53	1029.19	1029.47	1029.47	1029.47	1029.47	1029.47	1029.47	1029.47	1029.47	1029.47	1029.47	1029.47	1029.47	1029.47	1029.47	1029.47
	MW1102F	0491-0004-2011	10/25/2011	4851061	1611101.1	1228.67	2	147	30	180	156.68	1071.99	1072.06	1071.75	1072.00	1072.00	1072.54	1072.54	1072.54	1072.54	1072.54	1072.54	1072.54	1072.54	1072.54	1072.54	1072.54	1072.54	1072.54
	MW1102B	0402-0003-2011	12/15/2011	4850974	1611098.9	1228.84	2	72	17	80.9	64.36	1164.48	1164.01	1163.52	1163.29	1163.29	1167.41	1167.41	1167.41	1167.41	1167.41	1167.41	1167.41	1167.41	1167.41	1167.41	1167.41	1167.41	1167.41
	MW1102H	0491-0002-2011	9/27/2011	4870053	1610094	1239.82	2	307	40	349.4	331.05	936.77	937.72	936.67	936.67	936.67	936.67	936.67	936.67	936.67	936.67	936.67	936.67	936.67	936.67	936.67	936.67	936.67	936.67
SB-18	MW1103R	0402-0004-2011	12/16/2011	4869985	1610097.2	1240.01	2	191	7	200.3	198.60	1041.41	1041.42	1041.50	1041.60	1041.60	1041.69	1041.69	1041.69	1041.69	1041.69	1041.69	1041.69	1041.69	1041.69	1041.69	1041.69	1041.69	1041.69
	MW1103F	0491-0005-2011	10/26/2011	4870112	1610102.2	1239.19	2	149	30	181.6	159.21	1079.98	1080.59	1080.82	1081.16	1081.16	1081.19	1081.19	1081.19	1081.19	1081.19	1081.19	1081.19	1081.19	1081.19	1081.19	1081.19	1081.19	1081.19
	MW1104R	0402-0008-2011	12/22/2011	4863451	1609411.2	1230.66	2	187	25	213.8	205.30	1025.36	1025.61	1025.74	1025.89	1025.89	1026.15	1026.15	1026.15	1026.15	1026.15	1026.15	1026.15	1026.15	1026.15	1026.15	1026.15	1026.15	1026.15
	MW1104F	0402-0007-2011	12/21/2011	4863523	1609468.3	1230.3	2	152	20	174.1	173.73	1056.57	1056.55	1056.57	1056.56	1056.56	1056.57	1056.57	1056.57	1056.57	1056.57	1056.57	1056.57	1056.57	1056.57	1056.57	1056.57	1056.57	1056.57
SB-09	PZ1101H ⁽³⁾	0402-0001-2011	9/19/2011	4859909	1610339.5	1143.59	1	212	35	247.5																			
	MW1501R	8/5/2015		4846630	1609913.5	1161.78	4	135.4	14.6	153.5																			
	MW1501F	8/6/2015		4846620	1609917.5	1161.83	4	91.4	14.6	109.7																			
	MW1502R	8/6/2015		4844488	1610278.1	1047.41	4	23.4	9.6	36.0																			
B-1503	MW1503R	8/15/2015		484596.7	1610467.6	1111.96	4	89.4	9.6	101.9																			
	MW1503F	8/15/2015		484591.4	1610468.5	1111.93	4	48.4	14.6	66.3																			

Bedrock Unit Legend:

- H = Hundred Sandstone
- R = Bush Run Sandstone
- F = Fish Creek Sandstone
- B = Blaine Sandstone/Chilhowie Bedrock

(1) Survey coordinates are US State Plane 1983 West Virginia North.
 (2) amsl - average mean sea level. Vertical Datum is NAVD 1988. GEOID 03.
 (3) Piezometer Abandoned in June 2015 due to encroaching landfill construction. Open inch diameter piezometer.
 (4) Measured from the top of bore.

Table 2 - Summary of Monitoring Well Water Levels
CCR Groundwater Monitoring System Demonstration
Mitchell Landfill
American Electric Power - Mitchell Generating Plant

Soil Boring ID	Monitoring Well ID	Monitoring Well Tag Number	Date Well Installed	Coordinates ⁽¹⁾		Top of Riser Elevation (ft amsl)	Casing Diameter (inches)	Depth to Top of Screen (ft amsl)	Screen Length (ft amsl)	Measured Total Depth ⁽²⁾ (feet)	6/15/2015		7/29/2015		8/26/2015		9/15/2015		10/13/2015		11/3/2015		11/4/2015				
				Northing	Easting						Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	Water Level TOC	Elevation	
SB-01	MW1101H	0491-0003-2011	10/7/2011	4848839	1609657.8	1220.71	2	290	50	342.9	325.10	885.61	326.52	894.19	325.82	894.89	325.30	895.41	331.32	889.39	331.32	889.39	331.32	889.39	331.32	889.39	
	MW1101R	0491-0006-2011	10/28/2011	4848778	1609656.4	1221.23	2	187	25	214.5	195.59	1025.64	195.67	1025.56	195.78	1025.45	195.83	1025.40	196.10	1025.13	196.10	1025.13	196.10	1025.13	196.10	1025.31	
	MW1101F	0402-0006-2011	12/20/2011	4848645	1609651.4	1220.86	2	162	7	171.1	102.07	1118.79	107.21	1113.65	109.07	1111.79	110.17	1110.69	122.83	1098.03	122.83	1098.03	122.83	1098.03	122.83	1097.52	
	MW1101B	0402-0005-2011	12/19/2011	4848708	1609653.8	1220.73	2	89	18	109.2		1131.71	89.59	89.02	1131.71	89.59	1131.14	89.82	1130.91	89.08	1131.65	89.08	1131.65	89.08	1131.65	89.08	1131.80
SB-07	MW1102R	0402-0002-2011	12/14/2011	4851017	1611103.3	1228.36	2	196	8	205.8	186.58	1041.78	194.35	1034.01	193.37	1034.99	192.80	1035.56	196.98	1031.38	196.98	1031.38	196.98	1031.38	196.98	1031.38	
	MW1102F	0491-0004-2011	10/25/2011	4851061	1611101.1	1228.67	2	147	30	180	156.53	1072.14	156.64	1072.03	156.69	1071.98	156.78	1071.89	156.62	1072.05	156.62	1072.05	156.62	1071.89	156.62	1071.89	
	MW1102B	0402-0003-2011	12/15/2011	4858974	1611096.9	1228.84	2	72	17	80.9		1140.57	61.27	1140.57	64.24	1144.60	65.23	1163.61	65.19	1163.65	65.19	1163.65	65.19	1163.65	65.19	1163.25	
	MW1102H	0491-0002-2011	9/27/2011	4870053	1610094	1239.82	2	307	40	349.4	322.95	916.87	333.80	905.02	333.58	906.24	333.19	906.63	338.42	901.40	338.42	901.40	338.42	901.40	338.42	902.05	
SB-18	MW1103R	0402-0004-2011	12/16/2011	4869985	1610097.2	1240.01	2	191	7	200.3	197.49	1042.52	199.35	1040.66	199.32	1040.69	199.14	1040.87	199.29	1040.72	199.29	1040.72	199.29	1040.72	199.29	1040.73	
	MW1103F	0491-0005-2011	10/26/2011	4870112	1610102.2	1239.19	2	149	30	181.6	157.70	1081.49	158.60	1080.59	158.19	1081.00	157.96	1081.23	160.29	1078.90	160.29	1078.90	160.29	1078.90	160.29	1080.34	
	MW1104R	0402-0008-2011	12/22/2011	4863451	1609411.2	1230.66	2	187	25	213.8	204.10	1026.56	211.04	1019.62	210.87	1019.79	210.76	1019.90	211.72	1018.94	211.72	1018.94	211.72	1018.94	211.72	1019.14	
SB-23	MW1104F	0402-0007-2011	12/21/2011	4863523	1609468.3	1230.3	2	152	20	174.1	173.62	1056.68	173.55	1056.75	173.49	1056.81	173.46	1056.84	173.48	1056.82	173.48	1056.82	173.48	1056.82	173.48	1056.88	
	PZ1101H ⁽³⁾	0402-0001-2011	9/19/2011	4859909	1610339.5	1143.59	1	212	35	247.5																	
B-100	MW1501R	8552015	8/5/2015	4846630	1609971.5	1161.78	4	155.4	14.6	153.5									152.07	1009.71	152.07	1009.68				152.14	1009.64
	MW1501F	8620015	8/6/2015	4846620	1609971.5	1161.83	4	91.4	14.6	109.7									108.47	1053.36	108.47	1053.38				108.48	1053.35
B-102	MW1502R	8620015	8/6/2015	4844488	1610278.1	1047.41	4	23.4	9.6	36.0									25.25	1022.16	25.25	1014.80				32.07	1015.34
	MW1502R	87152015	8/15/2015	484596.7	1610467.6	1111.96	4	89.4	9.6	101.9									98.06	1013.90	98.06	1013.75				98.52	1013.44
B-103	MW1503R	87152015	8/15/2015	484591.4	1610468.5	1111.93	4	48.4	14.6	66.3									65.74	1046.19	65.74	1046.18				65.78	1046.15

Bedrock Unit Legend:

- H = Hundred Sandstone
- R = Bush Run Sandstone
- F = Fish Creek Sandstone
- B = Brian Sandstone/Chama Bedrock

(1) Survey coordinates are US State Plane 1983 West Virginia North.
(2) amsl - average mean sea level. Vertical Datum is NAVD 1988. GEOID 03.
(3) Piezometer Abandoned in June 2015 due to encroaching landfill construction. Over inch diameter piezometer.
(4) Measured from the top of bore.

APPENDIX A



Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-01/ MW1101H

CLIENT American Electric Power	PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416	PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/16/11 COMPLETED 10/4/11	GROUND ELEVATION 1218.7 ft HOLE SIZE 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.	GROUND WATER LEVELS:
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Air Rotary Rock Core	AT TIME OF DRILLING Refer to notes throughout log
LOGGED BY R. Mahle / M. McCoy CHECKED BY M. McCoy	AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 484883.9, E 1609657.8	13 hours AFTER DRILLING Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1218.7		Brown LEAN CLAY (CL), trace roots, moist, medium stiff (RESIDUAL)	0.0	SS 1	47	0-2-3 (5)	1.25-2	
1217.2		Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)		SS 2	80	3-3-2 (5)	0.5-2.25	
				SS 3	87	3-5-3 (8)	1.25-2.5	
1213.8		Light brown and gray LEAN CLAY WITH SAND (CL), trace roots, few interbedded reddish-brown lean clay seams, moist, stiff (RESIDUAL)	5.0	SS 4	87	6-5-8 (13)	1.25-2.25	
1212.7				SS 5	20	3-6-5 (11)	2.5-3.75	
1210.8		Shelby Tube sample obtained from 4'-6" (Recovery = 20") Brown LEAN CLAY (CL), moist, stiff (RESIDUAL)		SS 6	87	6-7-6 (13)	1.25-2.25	
				SS 7	100	49-38-50/3"	4.5+	
1209.2		Shelby Tube sample obtained from 6'-8" (Recovery = 22") Gray, light gray and reddish-brown LEAN CLAY (CL), few thin (less than 1/8" thick) sandy silt seams, moist, stiff to hard (RESIDUAL)	10.0	SS 8	100	41-50/3"	4.5+	
				SS 9	100	43-50/1"	4.5+	
1205.2		Reddish-brown, gray and grayish-brown SHALE, completely to highly weathered, very broken, very soft, thinly laminated to laminated		SS 10	71	16-41-50/5"	4.5+	
				SS 11	100	18-50/3"	4.5+	
1202.2		Gray SHALE, highly weathered, very broken, very soft, laminated		SS 12	100	50/5"		
1200.7		Dark burgundy to gray CLAYSTONE, becomes harder with depth, calcite filled fractures from 18.5' to 18.8', slickensides at 19.3', 19.7' and 21.5', mottled below 20.2' to dark gray below 21.6', moderately weathered to highly weathered, very broken, moderately soft	20.0					
				RC 1	62 (9)			
			25.0					
		0.1' thick seam of black shale at 28.6'. Fracture with iron staining from 29' to 29.3'. Iron stained below 31.6'.	30.0					
				RC 2	71 (31)			
		Silty with vertical fracture from 32.2' to 33.9', iron stained, partially healed						
1185			35.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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BORING NUMBER SB-01/ MW1101H

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1182.1		Gray to orangish-brown SANDSTONE, noted calcite, cemented, very fine to medium grained, noted iron staining and iron stained fractures, micaceous, moderately weathered, moderately broken to slightly broken, hard, very thin bedded to medium bedded (continued)	35.0	RC 3	99 (35)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
		Orangish-brown SILTSTONE, noted iron staining, some calcite inclusions, moderately weathered, very broken at top to moderately broken, very thin bedded	40.0					
		Groundwater level reading = dry (borehole depth =38' bgs) on 9/30/2011 at 7:35 AM. Very fine to fine sandstone from 40.3' to 40.7' and 44.6' to 44.9'.	45.0					
1172.7		Sandstone from 44.3' to 45.9'. Iron stained vertical fracture from 44.6' to 45'.	50.0	RC 4	98 (50)			
1168.7		Burgundy and gray SHALE, few claystone seams, pyrite from 46' and 47' and 49.9' to 50', vertical fracture from 49.1' to 49.3', slickenside at 48', vertical fracture and iron stained at 49', moderately weathered, very broken at top, laminated	55.0					
1166.2		Gray and orange SANDSTONE, very fine to fine grained, pyrite from 50' to 50.3', vertical fractures and iron stains from 50.5' to 50.9' and from 51.8' to 52.5', slightly weathered, moderately broken, hard, very thin bedded	60.0	RC 5	62 (21)			
1157.9		Gray SHALE, few siltstone seams, iron stained fractures at 53.3', 53.9' and 54.4', slightly weathered, slightly broken, hard, laminated Very brown from 56' to 58.5' and 60.3' to 60.8'. Pyrite from 56.6' to 58.5'.	65.0					
1152.7		Burgundy to gray CLAYSTONE, few shale laminations, moderately weathered, broken, moderately soft	70.0	RC 6	80 (39)			
1151		Dark gray to light gray LIMESTONE, slightly weathered, moderately broken, hard, thick bedded						
1150.9		Black SHALE, slightly weathered, broken, soft, laminated						
1150	Gray SHALE, slightly weathered, very broken, soft, laminated							
1149.7	Gray SANDSTONE, fine to medium grained, slightly weathered, hard, very thin bedded							
1144.7	Gray SILTSTONE, calcareous, calcite veins, occasional shale laminations, slightly weathered, moderately broken, medium hard to hard, very thin bedded	75.0						

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, calcareous, siltstone interbeds, very brown from 76' to 79.5', calcite lined vertical fracture from 77.6' to 78', slightly weathered, moderately broken, hard, laminated (continued)	75.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			80.0	RC 7	87 (32)			
1133.3		Black and gray LIMESTONE, black shale interbeds at 87.7', 88.3' and 88.8', iron stained horizontal fractures at 86.5', 86.8' and 88.1', slightly weathered, medium bedded, hard, broken to moderately broken	85.0					
		Water at 88.7'.						
1129.7		Gray SHALE, few blocky claystone seams, calcareous, iron stained vertical fractures at 89.5', 90.1', 90.7', and 91.2' to 91.7', slightly weathered to fresh, broken, moderately hard, laminated	90.0	RC 8	66 (8)			
1124.4		Burgundy CLAYSTONE, few shale seams, iron stained fractures, fresh, slightly broken, hard	95.0					
			100.0	RC 9	100 (64)			
1115.4		Gray SANDSTONE, very fine to fine grained, calcareous, iron stained, fresh, slightly broken, hard, very thin bedded	105.0					
1112.3		Gray SHALE, few siltstone seams, calcareous infills, fresh, moderately broken, very broken from 106.4' to 107.4' and from 109.4' to 109.7', moderately hard, thinly laminated to laminated	110.0					
1107.7		Burgundy to gray CLAYSTONE, fresh, moderately broken, moderately hard	115.0	RC 10	80 (41)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Burgundy to gray CLAYSTONE, fresh, moderately broken, moderately hard (continued)	115.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1102.3		Gray SANDSTONE, iron stained vertical fractures from 116.4' to 117.4', fresh, moderately broken, hard, very thin bedded						
1099.7		Gray and burgundy SHALE, few claystone seams, iron stained vertical fracture from 119.5' to 120', fresh, slightly to moderately broken, hard, laminated	120.0	RC 11	64 (25)			
1094.5		Gray SILTSTONE, few claystone seams, fresh, moderately broken, moderately hard, thin bedded	125.0					
1092.2		Gray and burgundy SHALE, few claystone seams, transitioning to claystone with depth, occasional thin siltstone interbeds, fresh, moderately broken, moderately hard, thinly laminated to laminated	130.0	RC 12	90 (66)			
			135.0					
1083.2		Gray and burgundy CLAYSTONE, occasional thin siltstone and shale interbeds, iron stained fracture at 140.1', fresh, very broken, moderately hard	140.0					
1078.6		Gray SILTSTONE, fresh, moderately broken, hard, thin bedded to medium bedded Limestone interbeds from 142.5' to 142.8'		RC 13	70 (38)			
1074.2		Gray LIMESTONE, fresh, moderately broken, hard, thick bedded	145.0	RC 14				
1071.7		Gray SILTSTONE, slightly micaceous, few limestone inclusions from 147' to 147.4', interbedded shale from 151.3' to 152.4', fresh, moderately broken, moderately hard to hard, thin bedded	150.0					
1066.3			155.0	RC 15	82 (61)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, interbedded siltstone from 155.4' to 155.8', slightly reddish-gray from 155.4' to 156.7' with claystone seams, interbedded slightly micaceous siltstone seams less than 1/8" thick from 157' to 160.5, fresh, moderately broken, moderately hard, thinly laminated to laminated (continued)	155.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			160.0					
1058.2	XXXXXX	Gray SILTSTONE, few limestone inclusions, fresh, moderately broken to broken, hard, medium bedded		RC 16	100 (84)			
1057.4	.....	Gray SANDSTONE, very fine to medium grained, limestone inclusions, interbedded siltstone seams throughout less than 1/16" thick, interbedded shale and siltstone layers from 163.6' to 164', fresh, moderately broken to slightly broken, hard, thin bedded to medium bedded	165.0				
1050.2	XXXXXX	Gray SILTSTONE, slightly micaceous, few interbedded shale seams throughout less than 1/8" thick, fresh, moderately broken, hard, very thin bedded	170.0					
1049.7	.....	Gray becoming reddish-gray and dark gray SHALE, few claystone seams, interbedded siltstone seams throughout less than 1/8" thick, pyrite specks observed at 170.3', iron staining from 171' to 171.1', fresh, moderately broken, moderately hard, thinly laminated to laminated	175.0	RC 17	90 (58)		
1044.9	.....	Gray becoming dark gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded becoming thick bedded	180.0				
1042.2	.....	Dark gray SHALE, fresh, moderately broken to broken, hard, laminated					
1041.2	.....	Gray to slightly reddish-gray SHALE, few claystone and siltstone seams, calcareous, few limestone inclusions, fresh, broken, hard, laminated	185.0				
1037.9	XXXXXX	Gray SILTSTONE, slightly micaceous, calcareous, few limestone inclusions, few shale seams throughout less than 1/8" thick, fresh, broken, hard, very thin bedded to thin bedded	190.0	RC 18	98 (84)			
1034.4	.....	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, few interbedded siltstone seams less than 1/16" thick, fresh, moderately broken to slightly broken, hard, very thin bedded to thin bedded	195.0				
1031.8	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded		RC 19	100 (76)			

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded (continued)	195.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			200.0	RC 20	100 (74)			
			205.0					
			210.0					
1007.7		Gray becoming reddish-gray CLAYSTONE, few shale seams, limestone inclusions, fresh, moderately broken, moderately hard to hard	215.0	RC 21	88 (60)			
1001.7		Reddish-brown CLAYSTONE, gray seam from 220.1' to 220.4', 0.5" thick dark gray lens at 221.7', fresh, moderately broken, hard	220.0					
996.9		Gray SILTSTONE, slightly micaceous, few limestone inclusions, interbedded shale seams less than 1/16" thick from 221.8' to 222.2', fresh, moderately broken, hard, very thin bedded	225.0	RC 22	87 (71)			
995.2		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded						
991.7		Gray and reddish-brown CLAYSTONE, blocky, fresh, moderately broken, hard						
989.4		Gray SILTSTONE, slightly micaceous, interbedded shale seams less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded to thin bedded	230.0	RC 23	77 (56)			
984.7			235.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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BORING NUMBER SB-01/ MW1101H

CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout less than 1/8" thick, fresh, slightly broken, very hard, very thin bedded (<i>continued</i>)	235.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
981.7	XXXXXX	Gray SHALE, few siltstone seams, slightly micaceous, interbedded shale lenses throughout less than 1/8" thick, interbedded sandstone layer, reddish-brown seams from 237.8' to 237.9', from 238.7' to 238.8', from 239' to 239.3', and from 241.3' to 241.4', pyrite at 238.1', fresh, moderately broken, hard, thinly laminated to laminated	240.0	RC 24	88 (50)			
976.8	XXXXXX	Gray and reddish-brown SHALE, few interbedded slightly micaceous siltstone seams throughout less than 1/16" thick, fresh, slightly broken, hard, thinly laminated to laminated	245.0					
971.7	XXXXXX	Reddish-brown becoming gray SHALE, few claystone seams, fresh, broken, moderately hard to hard, thinly laminated to laminated	250.0					
968	XXXXXX	Black COAL, fresh, broken, moderately hard, thinly laminated						
967.4	XXXXXX	Gray SILTSTONE, slightly micaceous, calcareous, interbedded shale seams throughout less than 1/8" thick, limestone inclusions throughout, fresh, slightly broken, hard, very thin bedded	255.0	RC 25	84 (59)			
961.7	XXXXXX	Gray SILTSTONE, slightly micaceous, calcareous, limestone inclusions, interbedded shale seams throughout less than 1/8" thick, gray and reddish-brown and gray claystone seams from 264.4' to 267' and 270.1' to 276', fresh, moderately broken to slightly broken, hard to very hard, medium bedded	260.0	RC 26	92 (77)			
	XXXXXX		265.0					
	XXXXXX		270.0	RC 27	78 (42)			
	XXXXXX		275.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
315.0								
901.7		Reddish-gray becoming gray SHALE, few claystone seams, interbedded siltstone from 318.4' to 320.6', percentage of siltstone increasing with depth, 1/8" thick dark gray seams at 318.8', fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	320.0					<p>2-Inch Slotted Screen</p> <p>Filter Sand</p>
898.1		Gray SILTSTONE, few interbedded sandstone seams, slightly micaceous, interbedded calcareous limestone throughout, fresh, slightly broken, very hard, very thin bedded to thin bedded		RC 32	100 (87)			
894.4		Gray SHALE, interbedded siltstone seams less than 0.5" thick throughout, fresh, moderately broken, hard, thinly laminated to laminated	325.0					
892		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions from 329.8' to 330', fresh, broken, very hard, very thin bedded	330.0					
888.7		Gray SILTSTONE, slightly micaceous interbedded shale seams less than 1/16" thick from 330' to 331.5', interbedded sandstone from 331.5' to 332.9', fresh, moderately broken, hard, very thin bedded		RC 33	85 (46)			
885.8		Gray SHALE, few limestone inclusions, pyrite specks observed at 336.7', fresh, moderately broken, hard, thinly laminated to laminated	335.0					
880.5		Black COAL, fresh, broken, moderately hard, thinly laminated						
880.2		Dark gray SHALE, many limestone inclusions, calcareous from 338.5' to 341.6' and 342.3' to 347' with the exception of a dark gray lens from 343.3' to 343.5', noted increased percentage of limestone inclusions from 343.5' to 347', fresh, moderately broken, hard to very hard, thinly laminated to laminated	340.0					
		Geophysical logging and packer testing were performed upon completion. The following groundwater level readings were taken for geophysical logging after filling borehole with water (note: borehole would not fill completely): Before logging, 10/4/2011 4:43 PM 52.03' bgs After first tooling, 10/4/2011 5:41 PM 62.85' bgs At completion, 10/4/2011 7:15 PM 95.19' bgs	345.0	RC 34	93 (63)			
871.7		Bottom of hole at 347.0 feet.						
		Approximate 0.5' bench cut for access. Cut soil described as 0.2' of topsoil over 0.3' of brown lean clay with sand (CL).						
		The following groundwater level reading was taken after drilling: 10/5/2011 8:44 AM at 96.4' bgs (borehole depth = 347' bgs) prior to well installation						
		Well MW1101H installed following geophysical logging and packer testing.						



Civil & Environmental Consultants, Inc.
4274 Glendale Milford Road
Cincinnati, Ohio 45242

BORING NUMBER SB-01/ MW1101R

CLIENT American Electric Power	PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416	PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/16/11 COMPLETED 10/4/11	GROUND ELEVATION 1218.7 ft HOLE SIZE 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.	GROUND WATER LEVELS:
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Air Rotary Rock Core	AT TIME OF DRILLING Refer to notes throughout log
LOGGED BY R. Mahle / M. McCoy CHECKED BY M. McCoy	AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 484877.8, E 1609656.4	13 hours AFTER DRILLING Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1218.7		Brown LEAN CLAY (CL), trace roots, moist, medium stiff (RESIDUAL)	0.0	SS 1	47	0-2-3 (5)	1.25-2	
1217.2		Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)		SS 2	80	3-3-2 (5)	0.5-2.25	
				SS 3	87	3-5-3 (8)	1.25-2.5	
1213.8		Light brown and gray LEAN CLAY WITH SAND (CL), trace roots, few interbedded reddish-brown lean clay seams, moist, stiff (RESIDUAL)	5.0	SS 4	87	6-5-8 (13)	1.25-2.25	
1212.7				SS 5	20	3-6-5 (11)	2.5-3.75	
1210.8		Shelby Tube sample obtained from 4'-6" (Recovery = 20") Brown LEAN CLAY (CL), moist, stiff (RESIDUAL)		SS 6	87	6-7-6 (13)	1.25-2.25	
		Shelby Tube sample obtained from 6'-8" (Recovery = 22") Gray, light gray and reddish-brown LEAN CLAY (CL), few thin (less than 1/8" thick) sandy silt seams, moist, stiff to hard (RESIDUAL)	10.0	SS 7	100	49-38-50/3"	4.5+	
1209.2				SS 8	100	41-50/3"	4.5+	
		Reddish-brown, gray and grayish-brown SHALE, completely to highly weathered, very broken, very soft, thinly laminated to laminated		SS 9	100	43-50/1"	4.5+	
1205.2		Reddish-brown CLAYSTONE, highly weathered, very broken, very soft	15.0	SS 10	71	16-41-50/5"	4.5+	
				SS 11	100	18-50/3"	4.5+	
1202.2		Gray SHALE, highly weathered, very broken, very soft, laminated		SS 12	100	50/5"		
1200.7		Dark burgundy to gray CLAYSTONE, becomes harder with depth, calcite filled fractures from 18.5' to 18.8', slickensides at 19.3', 19.7' and 21.5', mottled below 20.2' to dark gray below 21.6', moderately weathered to highly weathered, very broken, moderately soft	20.0					
				RC 1	62 (9)			
		0.1' thick seam of black shale at 28.6'. Fracture with iron staining from 29' to 29.3'. Iron stained below 31.6'.	30.0					
		Silty with vertical fracture from 32.2' to 33.9', iron stained, partially healed		RC 2	71 (31)			
1185			35.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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BORING NUMBER SB-01/ MW1101R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1182.1		Gray to orangish-brown SANDSTONE, noted calcite, cemented, very fine to medium grained, noted iron staining and iron stained fractures, micaceous, moderately weathered, moderately broken to slightly broken, hard, very thin bedded to medium bedded (continued)	35.0	RC 3	99 (35)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
		Orangish-brown SILTSTONE, noted iron staining, some calcite inclusions, moderately weathered, very broken at top to moderately broken, very thin bedded	40.0					
		Groundwater level reading = dry (borehole depth =38' bgs) on 9/30/2011 at 7:35 AM. Very fine to fine sandstone from 40.3' to 40.7' and 44.6' to 44.9'.	45.0					
1172.7		Sandstone from 44.3' to 45.9'. Iron stained vertical fracture from 44.6' to 45'.	50.0	RC 4	98 (50)			
1168.7		Burgundy and gray SHALE, few claystone seams, pyrite from 46' and 47' and 49.9' to 50', vertical fracture from 49.1' to 49.3', slickenside at 48', vertical fracture and iron stained at 49', moderately weathered, very broken at top, laminated	55.0					
1166.2		Gray and orange SANDSTONE, very fine to fine grained, pyrite from 50' to 50.3', vertical fractures and iron stains from 50.5' to 50.9' and from 51.8' to 52.5', slightly weathered, moderately broken, hard very thin bedded	60.0	RC 5	62 (21)			
1157.9		Gray SHALE, few siltstone seams, iron stained fractures at 53.3', 53.9' and 54.4', slightly weathered, slightly broken, hard, laminated Very brown from 56' to 58.5' and 60.3' to 60.8'. Pyrite from 56.6' to 58.5'.	65.0					
1152.7		Burgundy to gray CLAYSTONE, few shale laminations, moderately weathered, broken, moderately soft	70.0	RC 6	80 (39)			
1151		Dark gray to light gray LIMESTONE, slightly weathered, moderately broken, hard, thick bedded						
1150.9		Black SHALE, slightly weathered, broken, soft, laminated						
1150	Gray SHALE, slightly weathered, very broken, soft, laminated							
1149.7	Gray SANDSTONE, fine to medium grained, slightly weathered, hard, very thin bedded							
1144.7	Gray SILTSTONE, calcareous, calcite veins, occasional shale laminations, slightly weathered, moderately broken, medium hard to hard, very thin bedded	75.0						

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, calcareous, siltstone interbeds, very brown from 76' to 79.5', calcite lined vertical fracture from 77.6' to 78', slightly weathered, moderately broken, hard, laminated (continued)	75.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			80.0	RC 7	87 (32)			
1133.3		Black and gray LIMESTONE, black shale interbeds at 87.7', 88.3' and 88.8', iron stained horizontal fractures at 86.5', 86.8' and 88.1', slightly weathered, medium bedded, hard, broken to moderately broken	85.0					
		Water at 88.7'.						
1129.7		Gray SHALE, few blocky claystone seams, calcareous, iron stained vertical fractures at 89.5', 90.1', 90.7', and 91.2' to 91.7', slightly weathered to fresh, broken, moderately hard, laminated	90.0	RC 8	66 (8)			
1124.4		Burgundy CLAYSTONE, few shale seams, iron stained fractures, fresh, slightly broken, hard	95.0					
			100.0	RC 9	100 (64)			
1115.4		Gray SANDSTONE, very fine to fine grained, calcareous, iron stained, fresh, slightly broken, hard, very thin bedded	105.0					
1112.3		Gray SHALE, few siltstone seams, calcareous infills, fresh, moderately broken, very broken from 106.4' to 107.4' and from 109.4' to 109.7', moderately hard, thinly laminated to laminated	110.0					
1107.7		Burgundy to gray CLAYSTONE, fresh, moderately hard, moderately broken	115.0	RC 10	80 (41)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Burgundy to gray CLAYSTONE, fresh, moderately hard, moderately broken <i>(continued)</i>	115.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1102.3		Gray SANDSTONE, iron stained vertical fractures from 116.4' to 117.4', fresh, moderately broken, hard, very thin bedded						
1099.7		Gray and burgundy SHALE, few claystone seams, iron stained vertical fracture from 119.5' to 120', fresh, slightly to moderately broken, hard, laminated	120.0	RC 11	64 (25)			
1094.5		Gray SILTSTONE, few claystone seams, fresh, moderately broken, moderately hard, thin bedded	125.0					
1092.2		Gray and burgundy SHALE, few claystone seams, transitioning to claystone with depth, occasional thin siltstone interbeds, fresh, moderately broken, moderately hard, thinly laminated to laminated	130.0	RC 12	90 (66)			
			135.0					
1083.2		Gray and burgundy CLAYSTONE, occasional thin siltstone and shale interbeds, iron stained fracture at 140.1', fresh, very broken, moderately hard	140.0					
1078.6		Gray SILTSTONE, fresh, moderately broken, hard, thin bedded to medium bedded Limestone interbeds from 142.5' to 142.8'		RC 13	70 (38)			
1074.2		Gray LIMESTONE, fresh, moderately broken, hard, thick bedded	145.0	RC 14				
1071.7		Gray SILTSTONE, slightly micaceous, few limestone inclusions from 147' to 147.4', interbedded shale from 151.3' to 152.4', fresh, moderately broken, moderately hard to hard, thin bedded	150.0					
1066.3			155.0	RC 15	82 (61)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, interbedded siltstone from 155.4' to 155.8', slightly reddish-gray from 155.4' to 156.7' with claystone seams, interbedded slightly micaceous siltstone seams less than 1/8" thick from 157' to 160.5, fresh, moderately broken, moderately hard, thinly laminated to laminated (continued)	155.0					<p>2-Inch Solid PVC Riser Sealed with Bentonite Grout</p> <p>Hole Plug (Bentonite Chips)</p> <p>Filter Sand</p>
1058.2		Gray SILTSTONE, few limestone inclusions, fresh, moderately broken to broken, hard, medium bedded	160.0	RC 16	100 (84)			
1057.4		Gray SANDSTONE, very fine to medium grained, limestone inclusions, interbedded siltstone seams throughout less than 1/16" thick, interbedded shale and siltstone layers from 163.6' to 164', fresh, moderately broken to slightly broken, hard, thin bedded to medium bedded	165.0					
1050.2		Gray SILTSTONE, slightly micaceous, few interbedded shale seams throughout less than 1/8" thick, fresh, moderately broken, hard, very thin bedded	170.0	RC 17	90 (58)			
1049.7		Gray becoming reddish-gray and dark gray SHALE, few claystone seams, interbedded siltstone seams throughout less than 1/8" thick, pyrite specks observed at 170.3', iron staining from 171' to 171.1', fresh, moderately broken, moderately hard, thinly laminated to laminated	175.0					
1044.9		Gray becoming dark gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded becoming thick bedded	180.0					
1042.2		Dark gray SHALE, fresh, moderately broken to broken, hard, laminated	185.0	RC 18	98 (84)			
1041.2		Gray to slightly reddish-gray SHALE, few claystone and siltstone seams, calcareous, few limestone inclusions, fresh, broken, hard, laminated	185.0					
1037.9		Gray SILTSTONE, slightly micaceous, calcareous, few limestone inclusions, few shale seams throughout less than 1/8" thick, fresh, broken, hard, very thin bedded to thin bedded	190.0	RC 19	100 (76)			
1034.4		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, few interbedded siltstone seams less than 1/16" thick, fresh, moderately broken to slightly broken, hard, very thin bedded to thin bedded	195.0					
1031.8		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded						

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BORING NUMBER SB-01/ MW1101R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded (continued)	195.0					<p>2-Inch Slotted Screen</p> <p>Filter Sand</p>
			200.0	RC 20	100 (74)			
			205.0					
			210.0					
1007.7		Gray becoming reddish-gray CLAYSTONE, few shale seams, limestone inclusions, fresh, moderately broken, moderately hard to hard	215.0	RC 21	88 (60)			
1001.7		Reddish-brown CLAYSTONE, gray seam from 220.1' to 220.4', 0.5" thick dark gray lens at 221.7', fresh, moderately broken, hard	220.0					
996.9		Gray SILTSTONE, slightly micaceous, few limestone inclusions, interbedded shale seams less than 1/16" thick from 221.8' to 222.2', fresh, moderately broken, hard, very thin bedded	225.0	RC 22	87 (71)			
995.2		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded						
991.7		Gray and reddish-brown CLAYSTONE, blocky, fresh, moderately broken, hard						
989.4		Gray SILTSTONE, slightly micaceous, interbedded shale seams less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded to thin bedded	230.0	RC 23	77 (56)			
984.7			235.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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BORING NUMBER SB-01/ MW1101R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout less than 1/8" thick, fresh, slightly broken, very hard, very thin bedded <i>(continued)</i>	235.0					
981.7	XXXXXX	Gray SHALE, few siltstone seams, slightly micaceous, interbedded shale lenses throughout less than 1/8" thick, interbedded sandstone layer, reddish-brown seams from 237.8' to 237.9', from 238.7' to 238.8', from 239' to 239.3', and from 241.3' to 241.4', pyrite at 238.1', fresh, moderately broken, hard, thinly laminated to laminated	240.0					
976.8	XXXXXX	Gray and reddish-brown SHALE, few interbedded slightly micaceous siltstone seams throughout less than 1/16" thick, fresh, slightly broken, hard, thinly laminated to laminated	245.0	RC 24	88 (50)			
971.7	XXXXXX	Reddish-brown becoming gray SHALE, few claystone seams, fresh, broken, moderately hard to hard, thinly laminated to laminated	250.0					
968	XXXXXX	Black COAL, fresh, broken, moderately hard, thinly laminated						
967.4	XXXXXX	Gray SILTSTONE, slightly micaceous, calcareous, interbedded shale seams throughout less than 1/8" thick, limestone inclusions throughout, fresh, slightly broken, hard, very thin bedded	255.0	RC 25	84 (59)			
961.7	XXXXXX	Gray SILTSTONE, slightly micaceous, calcareous, limestone inclusions, interbedded shale seams throughout less than 1/8" thick, gray and reddish-brown and gray claystone seams from 264.4' to 267' and 270.1' to 276', fresh, moderately broken to slightly broken, hard to very hard, medium bedded	260.0					
	XXXXXX		265.0	RC 26	92 (77)			
	XXXXXX		270.0					
	XXXXXX		275.0	RC 27	78 (42)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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BORING NUMBER SB-01/ MW1101R

CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			315.0					
901.7		Reddish-gray becoming gray SHALE, few claystone seams, interbedded siltstone from 318.4' to 320.6', percentage of siltstone increasing with depth, 1/8" thick dark gray seams at 318.8', fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	320.0					
898.1		Gray SILTSTONE, few interbedded sandstone seams, slightly micaceous, interbedded calcareous limestone throughout, fresh, slightly broken, very hard, very thin bedded to thin bedded		RC 32	100 (87)			
894.4		Gray SHALE, interbedded siltstone seams less than 0.5" thick throughout, fresh, moderately broken, hard, thinly laminated to laminated	325.0					
892		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions from 329.8' to 330', fresh, broken, very hard, very thin bedded	330.0					
888.7		Gray SILTSTONE, slightly micaceous interbedded shale seams less than 1/16" thick from 330' to 331.5', interbedded sandstone from 331.5' to 332.9', fresh, moderately broken, hard, very thin bedded		RC 33	85 (46)			
885.8		Gray SHALE, few limestone inclusions, pyrite specks observed at 336.7', fresh, moderately broken, hard, thinly laminated to laminated	335.0					
880.5		Black COAL, fresh, broken, moderately hard, thinly laminated						
880.2		Dark gray SHALE, many limestone inclusions, calcareous from 338.5' to 341.6' and 342.3' to 347' with the exception of a dark gray lens from 343.3' to 343.5', noted increased percentage of limestone inclusions from 343.5' to 347', fresh, moderately broken, hard to very hard, thinly laminated to laminated	340.0					
		Geophysical logging and packer testing were performed upon completion. The following groundwater level readings were taken for geophysical logging after filling borehole with water (note: borehole would not fill completely): Before logging, 10/4/2011 4:43 PM 52.03' bgs After first tooling, 10/4/2011 5:41 PM 62.85' bgs At completion, 10/4/2011 7:15 PM 95.19' bgs	345.0	RC 34	93 (63)			
871.7		Bottom of hole at 347.0 feet. Approximate 0.5' bench cut for access. Cut soil described as 0.2' of topsoil over 0.3' of brown lean clay with sand (CL). The following groundwater level reading was taken after drilling: 10/5/2011 8:44 AM at 96.4' bgs (borehole depth = 347' bgs) prior to well installation Well MW1101R installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-01. The ground elevation for MW1101R = 1218.7 ft.						



Civil & Environmental Consultants, Inc.
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 Cincinnati, Ohio 45242

BORING NUMBER SB-01/ MW1101F

CLIENT American Electric Power	PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416	PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/16/11 COMPLETED 10/4/11	GROUND ELEVATION 1218.7 ft HOLE SIZE 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.	GROUND WATER LEVELS:
DRILLING METHOD 4.25" I.D. HSA: Auto Hammer & Air Rotary Rock Core	AT TIME OF DRILLING Refer to notes throughout log
LOGGED BY R. Mahle / M. McCoy CHECKED BY M. McCoy	AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 484864.5, E 1609651.4	13 hours AFTER DRILLING Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1218.7		Brown LEAN CLAY (CL), trace roots, moist, medium stiff (RESIDUAL)	0.0	SS 1	47	0-2-3 (5)	1.25-2	
1217.2		Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)		SS 2	80	3-3-2 (5)	0.5-2.25	
				SS 3	87	3-5-3 (8)	1.25-2.5	
1213.8		Light brown and gray LEAN CLAY WITH SAND (CL), trace roots, few interbedded reddish-brown lean clay seams, moist, stiff (RESIDUAL)	5.0	SS 4	87	6-5-8 (13)	1.25-2.25	
1212.7				SS 5	20	3-6-5 (11)	2.5-3.75	
1210.8		Shelby Tube sample obtained from 4'-6" (Recovery = 20%) Brown LEAN CLAY (CL), moist, stiff (RESIDUAL)		SS 6	87	6-7-6 (13)	1.25-2.25	
				SS 7	100	49-38-50/3"	4.5+	
1209.2		Shelby Tube sample obtained from 6'-8" (Recovery = 22%) Gray, light gray and reddish-brown LEAN CLAY (CL), few thin (less than 1/8" thick) sandy silt seams, moist, stiff to hard (RESIDUAL)	10.0	SS 8	100	41-50/3"	4.5+	
				SS 9	100	43-50/1"	4.5+	
1205.2		Reddish-brown, gray and grayish-brown SHALE, completely to highly weathered, very broken, very soft, thinly laminated to laminated		SS 10	71	16-41-50/5"	4.5+	
		Reddish-brown CLAYSTONE, highly weathered, very broken, very soft	15.0	SS 11	100	18-50/3"	4.5+	
1202.2		Gray SHALE, highly weathered, very broken, very soft, laminated		SS 12	100	50/5"		
1200.7		Dark burgundy to gray CLAYSTONE, becomes harder with depth, calcite filled fractures from 18.5' to 18.8', slickensides at 19.3', 19.7' and 21.5', mottled below 20.2' to dark gray below 21.6', moderately weathered to highly weathered, very broken, moderately soft	20.0	RC 1	62 (9)			
		0.1' thick seam of black shale at 28.6'. Fracture with iron staining from 29' to 29.3'. Iron stained below 31.6'.	30.0					
		Silty with vertical fracture from 32.2' to 33.9', iron stained, partially healed						RC 2	71 (31)
1185			35.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1182.1		Gray to orangish-brown SANDSTONE, noted calcite, cemented, very fine to medium grained, noted iron staining and iron stained fractures, micaceous, moderately weathered, moderately broken to slightly broken, hard, very thin bedded to medium bedded (continued)	35.0	RC 3	99 (35)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
		Orangish-brown SILTSTONE, noted iron staining, some calcite inclusions, moderately weathered, very broken at top to moderately broken, very thin bedded	40.0					
		Groundwater level reading = dry (borehole depth =38' bgs) on 9/30/2011 at 7:35 AM. Very fine to fine sandstone from 40.3' to 40.7' and 44.6' to 44.9'.	45.0					
1172.7		Sandstone from 44.3' to 45.9'. Iron stained vertical fracture from 44.6' to 45'.	50.0	RC 4	98 (50)			
1168.7		Burgundy and gray SHALE, few claystone seams, pyrite from 46' and 47' and 49.9' to 50', vertical fracture from 49.1' to 49.3', slickenside at 48', vertical fracture and iron stained at 49', moderately weathered, very broken at top, laminated	55.0					
1166.2		Gray and orange SANDSTONE, very fine to fine grained, pyrite from 50' to 50.3', vertical fractures and iron stains from 50.5' to 50.9' and from 51.8' to 52.5', slightly weathered, moderately broken, hard very thin bedded	60.0	RC 5	62 (21)			
1157.9		Gray SHALE, few siltstone seams, iron stained fractures at 53.3', 53.9' and 54.4', slightly weathered, slightly broken, hard, laminated Very brown from 56' to 58.5' and 60.3' to 60.8'. Pyrite from 56.6' to 58.5'.	65.0					
1152.7		Burgundy to gray CLAYSTONE, few shale laminations, moderately weathered, broken, moderately soft	70.0	RC 6	80 (39)			
1151		Dark gray to light gray LIMESTONE, slightly weathered, moderately broken, hard, thick bedded						
1150.9		Black SHALE, slightly weathered, broken, soft, laminated						
1150	Gray SHALE, slightly weathered, very broken, soft, laminated							
1149.7	Gray SANDSTONE, fine to medium grained, slightly weathered, hard, very thin bedded							
1144.7	Gray SILTSTONE, calcareous, calcite veins, occasional shale laminations, slightly weathered, moderately broken, medium hard to hard, very thin bedded	75.0						

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PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, calcareous, siltstone interbeds, very brown from 76' to 79.5', calcite lined vertical fracture from 77.6' to 78', slightly weathered, moderately broken, hard, laminated (continued)	75.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			80.0	RC 7	87 (32)			
1133.3		Black and gray LIMESTONE, black shale interbeds at 87.7', 88.3' and 88.8', iron stained horizontal fractures at 86.5', 86.8' and 88.1', slightly weathered, medium bedded, hard, broken to moderately broken	85.0					
		Water at 88.7'.						
1129.7		Gray SHALE, few blocky claystone seams, calcareous, iron stained vertical fractures at 89.5', 90.1', 90.7', and 91.2' to 91.7', slightly weathered to fresh, broken, moderately hard, laminated	90.0	RC 8	66 (8)			
1124.4		Burgundy CLAYSTONE, few shale seams, iron stained fractures, fresh, slightly broken, hard	95.0					
			100.0	RC 9	100 (64)			
1115.4		Gray SANDSTONE, very fine to fine grained, calcareous, iron stained, fresh, slightly broken, hard, very thin bedded	105.0					
1112.3		Gray SHALE, few siltstone seams, calcareous infills, fresh, moderately broken, very broken from 106.4' to 107.4' and from 109.4' to 109.7', moderately hard, thinly laminated to laminated	110.0					
1107.7		Burgundy to gray CLAYSTONE, fresh, moderately hard, moderately broken	115.0	RC 10	80 (41)			

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CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Burgundy to gray CLAYSTONE, fresh, moderately hard, moderately broken <i>(continued)</i>	115.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1102.3		Gray SANDSTONE, iron stained vertical fractures from 116.4' to 117.4', fresh, moderately broken, hard, very thin bedded						
1099.7		Gray and burgundy SHALE, few claystone seams, iron stained vertical fracture from 119.5' to 120', fresh, slightly to moderately broken, hard, laminated	120.0	RC 11	64 (25)			
1094.5		Gray SILTSTONE, few claystone seams, fresh, moderately broken, moderately hard, thin bedded	125.0					
1092.2		Gray and burgundy SHALE, few claystone seams, transitioning to claystone with depth, occasional thin siltstone interbeds, fresh, moderately broken, moderately hard, thinly laminated to laminated	130.0	RC 12	90 (66)			
			135.0					
1083.2		Gray and burgundy CLAYSTONE, occasional thin siltstone and shale interbeds, iron stained fracture at 140.1', fresh, very broken, moderately hard	140.0					
1078.6		Gray SILTSTONE, fresh, moderately broken, hard, thin bedded to medium bedded Limestone interbeds from 142.5' to 142.8'		RC 13	70 (38)			
1074.2		Gray LIMESTONE, fresh, moderately broken, hard, thick bedded	145.0	RC 14				
1071.7		Gray SILTSTONE, slightly micaceous, few limestone inclusions from 147' to 147.4', interbedded shale from 151.3' to 152.4', fresh, moderately broken, moderately hard to hard, thin bedded	150.0					
1066.3			155.0	RC 15	82 (61)			

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, interbedded siltstone from 155.4' to 155.8'; slightly reddish-gray from 155.4' to 156.7' with claystone seams, interbedded slightly micaceous siltstone seams less than 1/8" thick from 157' to 160.5, fresh, moderately broken, moderately hard, thinly laminated to laminated (continued)	155.0					
1058.2	XXXX	Gray SILTSTONE, few limestone inclusions, fresh, moderately broken to broken, hard, medium bedded	160.0					
1057.4	XXXX	Gray SANDSTONE, very fine to medium grained, limestone inclusions, interbedded siltstone seams throughout less than 1/16" thick, interbedded shale and siltstone layers from 163.6' to 164', fresh, moderately broken to slightly broken, hard, thin bedded to medium bedded	165.0	RC 16	100 (84)			
1050.2	XXXX	Gray SILTSTONE, slightly micaceous, few interbedded shale seams throughout less than 1/8" thick, fresh, moderately broken, hard, very thin bedded	170.0					
1049.7	XXXX	Gray becoming reddish-gray and dark gray SHALE, few claystone seams, interbedded siltstone seams throughout less than 1/8" thick, pyrite specks observed at 170.3', iron staining from 171' to 171.1', fresh, moderately broken, moderately hard, thinly laminated to laminated	175.0	RC 17	90 (58)			
1044.9	XXXX	Gray becoming dark gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded becoming thick bedded	180.0					
1042.2	XXXX	Dark gray SHALE, fresh, moderately broken to broken, hard, laminated	185.0					
1041.2	XXXX	Gray to slightly reddish-gray SHALE, few claystone and siltstone seams, calcareous, few limestone inclusions, fresh, broken, hard, laminated	190.0					
1037.9	XXXX	Gray SILTSTONE, slightly micaceous, calcareous, few limestone inclusions, few shale seams throughout less than 1/8" thick, fresh, broken, hard, very thin bedded to thin bedded	195.0	RC 18	98 (84)			
1034.4	XXXX	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, few interbedded siltstone seams less than 1/16" thick, fresh, moderately broken to slightly broken, hard, very thin bedded to thin bedded						
1031.8	XXXX	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded		RC 19	100 (76)			

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, dark gray fine to coarse grained seams less than 1/8" thick from 197' to 207', fresh, moderately broken to slightly broken, very hard, very thin bedded to thick bedded (continued)	195.0					
			200.0					
			205.0					
			210.0					
1007.7		Gray becoming reddish-gray CLAYSTONE, few shale seams, limestone inclusions, fresh, moderately broken, moderately hard to hard	215.0	RC 21	88 (60)			
1001.7		Reddish-brown CLAYSTONE, gray seam from 220.1' to 220.4', 0.5" thick dark gray lens at 221.7', fresh, moderately broken, hard	220.0					
996.9		Gray SILTSTONE, slightly micaceous, few limestone inclusions, interbedded shale seams less than 1/16" thick from 221.8' to 222.2', fresh, moderately broken, hard, very thin bedded	225.0	RC 22	87 (71)			
995.2		Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded						
991.7		Gray and reddish-brown CLAYSTONE, blocky, fresh, moderately broken, hard						
989.4		Gray SILTSTONE, slightly micaceous, interbedded shale seams less than 1/8" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded to thin bedded	230.0					
				RC 23	77 (56)			
984.7			235.0					

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout less than 1/8" thick, fresh, slightly broken, very hard, very thin bedded <i>(continued)</i>	235.0					
981.7	XXXXXX	Gray SHALE, few siltstone seams, slightly micaceous, interbedded shale lenses throughout less than 1/8" thick, interbedded sandstone layer, reddish-brown seams from 237.8' to 237.9', from 238.7' to 238.8', from 239' to 239.3', and from 241.3' to 241.4', pyrite at 238.1', fresh, moderately broken, hard, thinly laminated to laminated	240.0					
976.8	XXXXXX	Gray and reddish-brown SHALE, few interbedded slightly micaceous siltstone seams throughout less than 1/16" thick, fresh, slightly broken, hard, thinly laminated to laminated	245.0	RC 24	88 (50)			
971.7	XXXXXX	Reddish-brown becoming gray SHALE, few claystone seams, fresh, broken, moderately hard to hard, thinly laminated to laminated	250.0					
968	XXXXXX	Black COAL, fresh, broken, moderately hard, thinly laminated						
967.4	XXXXXX	Gray SILTSTONE, slightly micaceous, calcareous, interbedded shale seams throughout less than 1/8" thick, limestone inclusions throughout, fresh, slightly broken, hard, very thin bedded	255.0	RC 25	84 (59)			
961.7	XXXXXX	Gray SILTSTONE, slightly micaceous, calcareous, limestone inclusions, interbedded shale seams throughout less than 1/8" thick, gray and reddish-brown and gray claystone seams from 264.4' to 267' and 270.1' to 276', fresh, moderately broken to slightly broken, hard to very hard, medium bedded	260.0					
	XXXXXX		265.0	RC 26	92 (77)			
	XXXXXX		270.0					
	XXXXXX			RC 27	78 (42)			
	XXXXXX		275.0					

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CLIENT American Electric Power	PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416	PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/7/11 COMPLETED 10/12/11	GROUND ELEVATION 1226.8 ft HOLE SIZE 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.	GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core	AT TIME OF DRILLING Refer to notes throughout log
LOGGED BY M. McCoy CHECKED BY A. Amicon	AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 485101.7, E 1611103.3	AFTER DRILLING Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1226.8		Brown and dark brown LEAN CLAY (CL), trace roots, moist, soft to medium stiff (RESIDUAL) Noted hard fine grained sandstone fragments in shoe of SS-1 and SS-2.	0.0	SS 1	67	3-3-3 (6)	1	
				SS 2	27	2-3-2 (5)		
				SS 3	27	3-2-2 (4)		
1222.5		Brown LEAN CLAY (CL), few shale fragments, noted iron staining, moist, medium stiff (RESIDUAL)	5.0	SS 4	67	1-2-4 (6)	1	
1220.5		Light brownish-gray SILTSTONE, completely weathered, very broken, very soft, very thin bedded, slightly micaceous		SS 5	80	4-19-29 (48)	2.5	
1219.4		Reddish-brown CLAYSTONE, highly weathered, very broken, very soft, interbedded shale		SS 6	53	12-16-18 (34)	1.5	
1218.1		Reddish-brown CLAYSTONE, highly weathered, very broken, very soft, blocky, fracture fills, few shale seams		SS 7	73	15-22-25 (47)	1.5	
1216.5		Light olive gray CLAYSTONE, moderately weathered, very broken, moderately soft, friable, noted hard drilling at 12'	10.0	SS 8	100	50/4"	3.5-4	
1215.3		Gray SHALE, moderately weathered, very broken, moderately hard, laminated		SS 9	60	50/2"		
1210.8		Brown and orange SILTSTONE, iron stained, moderately weathered, very broken, hard, very thin bedded						
1208.2		Gray to burgundy CLAYSTONE, iron stained, slickenside at 19.3', vertical fracture at 19.4', vertical fracture and iron stained at 20.2', moderately weathered, broken, very broken from 19.4' to 20.4', moderately soft	20.0	RC 1	28 (6)			
1198.8		Brown SANDSTONE, fine grained, iron stained, with iron stained fractures, moderately weathered, moderately broken, hard, medium bedded	30.0					
1195.8		Bluish-gray SHALE, some iron stains, moderately weathered, moderately broken, moderately hard, thinly laminated to laminated	35.0	RC 2	35 (5)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1192		Gray SHALE, some iron stains, moderately weathered, moderately broken, very broken from 40.2' to 40.6', hard, laminated (continued)	35.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1186.2 1186		Black COAL, moderately weathered, slightly broken, hard, laminated Black to gray SHALE, few claystone seams, moderately weathered, moderately hard to soft, very broken from 40.8' to 41.2', moderately broken below 41.2', laminated	40.0	RC 3	41 (16)			
1178.2 1177.6		Gray SILTSTONE, slightly weathered, moderately broken, hard, very thin bedded Gray and orange SANDSTONE, micaceous, fine grained, iron staining with fractures from 50.4' to 52', moderately weathered, moderately broken to very broken zones, moderately hard, medium bedded	50.0					
1175.2		Gray SHALE, few claystone and siltstone seams, calcareous, burgundy mottling below 54.2', moderately weathered, moderately broken, moderately hard, laminated	55.0	RC 4	83 (57)			
1169.6		Gray SHALE, few siltstone seams, burgundy mottling, calcite veins, pyrite, moderately weathered, slightly broken, moderately hard, laminated	60.0					
1168.2		Gray SILTSTONE, iron stained below 60.5' with fractures, slightly weathered, slightly broken to moderately broken, hard, very thin bedded to thin bedded	65.0	RC 5	32 (11)			
1162.2		Gray and burgundy SHALE, few claystone seams, slightly weathered, moderately to very broken, moderately hard, laminated	70.0					
1156.6		Gray SILTSTONE, limestone inclusions at 70.3' and 71.1', slightly weathered, slightly to moderately broken, hard, medium bedded	75.0	RC 6	71 (39)			
1153.5								

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1150.7		Gray SANDSTONE, few interbedded siltstone seams, micaceous, fine grained, slightly weathered, slightly broken, hard, very thin bedded (continued)	75.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
		Gray SANDSTONE, micaceous, very fine to fine grained, slightly weathered, moderately broken, hard, very thin bedded						
		Shaley interbeds from 82' to 82.5' and from 84.5' to 85.5'.	80.0	RC 7	100 (76)			
		Very broken from 88.4' to 89.1'.	85.0					
1137.7		Gray SHALE, slightly fissile, slightly weathered, moderately broken, medium hard, laminated	90.0	RC 8	97 (53)			
1132.4		Gray and dark gray LIMESTONE, slightly weathered, broken, moderately broken from 94.4' to 95', hard, thick bedded	95.0					
1128.3		Dark red SHALE, few claystone seams, calcite veins, noted iron staining, fractures with iron stains at 100.3', 101.3', 102.5' and 102.9', slightly weathered, moderately broken, moderately hard, laminated	100.0	RC 9	70 (38)			
		Water at 102'.	105.0					
		Very broken from 107' to 109'. Mottled brown and gray from 109' to 111.2'.	110.0					
		RQD length not measured for RC-10. Sample recovered from barrel after tripping rods.						
1115.6	Gray SANDSTONE, micaceous, fine to medium grained, fresh, slightly broken, hard, very thin bedded to thin bedded		RC 10	95				
1113.6	Gray SHALE, few interbedded siltstone seams, broken to very broken, laminated							
			115.0					

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, few interbedded siltstone seams, broken to very broken, laminated <i>(continued)</i>	115.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1109.8		Gray and red SHALE, few claystone seams, calcareous, fissile, occasional siltstone interbeds between 0.1' and 0.3' thick, fresh, very broken to moderately broken, soft, thinly laminated to laminated Some iron mottling between 121' and 125'.	120.0	RC 11	87 (51)			
			125.0					
1099.8		Gray SANDSTONE, micaceous, very fine to medium grained, well cemented, some calcite inclusions, few thin shale partings 0.1' thick, fresh, slightly broken, hard, very thin bedded to thin bedded Very broken zone from 130.4' to 131.8'.	130.0	RC 12	90 (59)			
			135.0					
1090.3		Gray SANDSTONE, micaceous, fine to medium grained, well cemented, fresh, slightly to moderately broken, hard, very thin bedded to thin bedded Trace pyrite at 145.5'.	140.0	RC 13	100 (65)			
			145.0					
1079.8		Gray SANDSTONE, micaceous, fine to medium grained, thin shale partings, well cemented, few calcite filled fractures, micaceous partings, calcite veins from 162' to 162.7', fresh, moderately broken, very broken from 157' to 167', slightly broken to moderately broken near bottom, hard, very thin bedded to thin bedded	150.0	RC 14	100 (66)			
			155.0					

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CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, fine to medium grained, thin shale partings, well cemented, few calcite filled fractures, micaceous partings, calcite veins from 162' to 162.7', fresh, moderately broken, very broken from 157' to 167', slightly broken to moderately broken near bottom, hard, very thin bedded (continued)	155.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			160.0	RC 15	100 (62)			
			165.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			170.0	RC 16	100 (78)			
1052.6		Gray SHALE, fresh, slightly broken, very broken from 177' to 178', hard, thinly laminated to laminated	175.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1048.8	XXXXXX	Gray SILTSTONE, few interbedded sandstone seams, micaceous, fresh, moderately broken, hard, very thin bedded						
1047.5		Gray SHALE, silty, siltstone interbeds at 186', fresh, moderately broken, hard, laminated	180.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
		Blue, green and black and very broken from 187' to 188'.	185.0	RC 17	91 (23)			
1038.8	XXXXXX	Gray SILTSTONE, few interbedded sandstone seams, calcareous at 190.5', fresh, very broken, hard, very thin bedded	190.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1036.3		Black and gray SHALE, grades to siltstone, fresh, moderately broken, hard, thinly laminated		RC 18	100 (58)			
1033.8	XXXXXX	Gray SILTSTONE, calcite veins, limestone interbeds, fresh, slightly broken, hard, very thin bedded	195.0					Hole Plug (Bentonite Chips)

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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Civil & Environmental Consultants, Inc.
 4274 Glendale Milford Road
 Cincinnati, Ohio 45242

BORING NUMBER SB-07/ MW1102R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SILTSTONE, calcite veins, limestone interbeds, fresh, slightly broken, hard, very thin bedded (<i>continued</i>)	195.0					<p>2-Inch Slotted Screen</p> <p>Filter Sand</p>
1029.8	XXXXXX	Gray SILTSTONE, interbedded shale and limestone, limestone at 197.6', from 198.3' to 198.5', 199.8', 201.4', 202', 203' and 204', fresh, moderately to very broken, hard, very thin bedded to thin bedded	200.0	RC 19	100 (60)			
1022.7	|||||	Gray SHALE, few claystone seams, calcareous, black zones 0.2' thick, some iron staining, fresh, moderately broken, hard, laminated Very hard near 207'. Very broken from 207' to 212'. Fissile beds below 208.5'	205.0					
			210.0	RC 20	87 (50)			
1014.8	XXXXXX	Gray SILTSTONE, micaceous, trace calcite, fresh, moderately broken, hard, very thin bedded	215.0					
1010.4	|||||	Dark gray SHALE, very few claystone seams, fissile, few limestone inclusions, fresh, broken, moderately hard, thinly laminated to laminated Black from 222' to 224'. Burgundy and gray claystone from 227' to 228.7', very broken.	220.0	RC 21	100 (34)			
			225.0					
998.1	XXXXXX	Gray SILTSTONE, calcareous, calcite veins, fresh, moderately broken, hard, very thin bedded	230.0					
995.4	|||||	Gray SHALE, fissile, fresh, moderately broken, hard, thinly laminated to laminated		RC 22	100 (67)			
994.3	.....	Light gray SANDSTONE, micaceous, fine to medium grained, fine grained from 238' to 241.7', well cemented, fresh, moderately broken, very broken from 237' to 241.7', hard, very thin bedded to	235.0				

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 2/1/12

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BORING NUMBER SB-07/ MW1102R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		thin bedded Light gray SANDSTONE, micaceous, fine to medium grained, fine grained from 238' to 241.7', well cemented, fresh, moderately broken, very broken from 237' to 241.7', hard, very thin bedded to thin bedded (continued)	235.0					
985.1		Gray and dark red SHALE, few claystone seams, fissile, iron stained from 244.3' to 247' and at 252.1', fresh, moderately broken to very broken, moderately hard, thinly laminated to laminated	240.0	RC 23	100 (19)			
		Burgundy, calcareous and silty between 247' and 248.7' with claystone and siltstone seams.	245.0					
		Thin limestone beds from 251.5' to 253'.	250.0	RC 24	74 (38)			
973.5		Gray SANDSTONE, very fine to fine grained, well cemented, few interbedded siltstone seams, fresh, moderately broken, hard, very thin bedded	255.0					
971.1		Burgundy and gray SHALE, fissile, iron stained bands throughout, fresh, very broken, moderately hard, thinly laminated to laminated						
		May have rock in borehole from Runs 24 and 25.	260.0	RC 25	81 (11)			
963.8		Black SHALE, few coal seams, fresh, very broken, moderately hard to hard, thinly laminated to laminated	265.0					
961.7		Dark gray SILTSTONE, few interbedded shale and sandstone seams, micaceous, fresh, moderately broken, hard, very thin bedded						
960		Dark gray SHALE, few interbedded siltstone seams, micaceous, fresh, moderately broken, moderately hard, laminated	270.0	RC 26	95 (45)			
953.4		Gray SILTSTONE, fresh, moderately broken, hard, thick bedded	275.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			275.0					
	XXXXXX	Gray SILTSTONE, fresh, moderately broken, hard, thick bedded <i>(continued)</i>						
950.5	XXXXXX	Burgundy and gray CLAYSTONE, fresh, moderately broken, hard						
949.8	XXXXXX	Gray SHALE, few burgundy claystone seams, moderately broken, moderately hard, laminated						
	XXXXXX	Slickensides at 279' and 280.5'	280.0	RC 27	100 (66)			
	XXXXXX		285.0					
941.8	XXXXXX	Gray to reddish-brown CLAYSTONE, few shale seams, calcareous, well-cemented, trace pyrite less than 1 mm thick, fresh, moderately broken, hard						
938.8	XXXXXX	Gray SILTSTONE, calcareous, micaceous, fresh, slightly broken becoming moderately broken, hard, thick bedded	290.0	RC 28	98 (81)			
	XXXXXX		295.0					
930.8	XXXXXX	Gray LIMESTONE, few interbedded siltstone seams, shaley at top, fresh, moderately broken, hard, thin bedded to medium bedded						
	XXXXXX		300.0	RC 29	90 (39)			
926.8	XXXXXX	Gray SHALE, few interbedded siltstone seams, calcareous, fresh, slightly broken, very hard, thinly laminated to laminated						
925.3	XXXXXX	Gray LIMESTONE, micaceous, some thin shale interbeds increasing with depth, fresh, slightly broken, very hard, medium bedded						
	XXXXXX		305.0					
921.8	XXXXXX	Gray SANDSTONE, micaceous, fine grained, many shale partings increasing with depth, fresh, very broken, hard, very thin bedded to thin bedded						
919.4	XXXXXX	Gray LIMESTONE, calcareous, shaley at bottom with interbedded siltstone seams, fresh, moderately broken, very hard, medium bedded	310.0	RC 30	100 (54)			
	XXXXXX	Black at 310.2'						
	XXXXXX		315.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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BORING NUMBER SB-07/ MW1102R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
911.8		<p>Gray SHALE, few interbedded siltstone seams, calcareous, occasional limestone interbeds, trace pyrite less than 1 mm thick, fresh, moderately broken, hard, thinly laminated to laminated</p> <p>4 feet of Run 31 fell into hole, unable to retrieve.</p> <p>Few reddish-brown and gray claystone seams beginning at 321'.</p> <p>Dark red and very broken from 325' to 328'.</p>	<p>315.0</p> <p>320.0</p> <p>325.0</p>	<p>RC 31</p> <p>RC 32</p>	<p>60 (35)</p> <p>100 (27)</p>			
898.8		<p>Bottom of hole at 328.0 feet.</p> <p>Soil sampling completed on 9/7/2011. Boring offset on 10/10/2011 for rock coring. Augered to 18' to begin rock core sampling.</p> <p>The following groundwater level readings were taken during drilling: 9/7/2011 3:30 PM, Dry (borehole depth = 12.2') 10/11/2011 7:45 AM at approximately 38' bgs 10/12/2011 7:50 AM at approximately 39' bgs 10/13/2011 7:20 AM at approximately 35' bgs</p> <p>Geophysical logging and packer testing were performed upon completion.</p> <p>Well MW1102R installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-07. The ground elevation for MW1102R = 1226.7 ft.</p>						



Civil & Environmental Consultants, Inc.
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BORING NUMBER SB-07/ MW1102F

CLIENT American Electric Power	PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416	PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/7/11 COMPLETED 10/12/11	GROUND ELEVATION 1226.8 ft HOLE SIZE 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.	GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core	AT TIME OF DRILLING Refer to notes throughout log
LOGGED BY M. McCoy CHECKED BY A. Amicon	AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 485106.1, E 1611110.1	AFTER DRILLING Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1226.8		Brown and dark brown LEAN CLAY (CL), trace roots, moist, soft to medium stiff (RESIDUAL) Noted hard fine grained sandstone fragments in shoe of SS-1 and SS-2.	0.0	SS 1	67	3-3-3 (6)	1	
				SS 2	27	2-3-2 (5)		
				SS 3	27	3-2-2 (4)		
1222.5		Brown LEAN CLAY (CL), few shale fragments, noted iron staining, moist, medium stiff (RESIDUAL)	5.0	SS 4	67	1-2-4 (6)	1	
1220.5		Light brownish-gray SILTSTONE, completely weathered, very broken, very soft, very thin bedded, slightly micaceous		SS 5	80	4-19-29 (48)	2.5	
1219.4		Reddish-brown CLAYSTONE, highly weathered, very broken, very soft, interbedded shale		SS 6	53	12-16-18 (34)	1.5	
1218.1		Reddish-brown CLAYSTONE, highly weathered, very broken, very soft, blocky, fracture fills, few shale seams		SS 7	73	15-22-25 (47)	1.5	
1216.5		Light olive gray CLAYSTONE, moderately weathered, very broken, moderately soft, friable, noted hard drilling at 12'	10.0	SS 8	100	50/4"	3.5-4	
1215.3		Gray SHALE, moderately weathered, very broken, moderately hard, laminated		SS 9	60	50/2"		
1210.8		Brown and orange SILTSTONE, iron stained, moderately weathered, very broken, hard, very thin bedded						
1208.2		Gray to burgundy CLAYSTONE, iron stained, slickenside at 19.3', vertical fracture at 19.4', vertical fracture and iron stained at 20.2', moderately weathered, broken, very broken from 19.4' to 20.4', moderately soft	20.0	RC 1	28 (6)			
1198.8		Brown SANDSTONE, fine grained, iron stained, with iron stained fractures, moderately weathered, moderately broken, hard, medium bedded	30.0					
1195.8		Bluish-gray SHALE, some iron stains, moderately weathered, moderately broken, moderately hard, thinly laminated to laminated	35.0	RC 2	35 (5)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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BORING NUMBER SB-07/ MW1102F

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1192		Gray SHALE, some iron stains, moderately weathered, moderately broken, very broken from 40.2' to 40.6', hard, laminated (continued)	35.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1186.2 1186		Black COAL, moderately weathered, slightly broken, hard, laminated Black to gray SHALE, few claystone seams, moderately weathered, moderately hard to soft, very broken from 40.8' to 41.2', moderately broken below 41.2', laminated	40.0	RC 3	41 (16)			
1178.2 1177.6		Gray SILTSTONE, slightly weathered, moderately broken, hard, very thin bedded Gray and orange SANDSTONE, micaceous, fine grained, iron staining with fractures from 50.4' to 52', moderately weathered, moderately broken to very broken zones, moderately hard, medium bedded	50.0					
1175.2		Gray SHALE, few claystone and siltstone seams, calcareous, burgundy mottling below 54.2', moderately weathered, moderately broken, moderately hard, laminated	55.0	RC 4	83 (57)			
1169.6		Gray SHALE, few siltstone seams, burgundy mottling, calcite veins, pyrite, moderately weathered, slightly broken, moderately hard, laminated	60.0					
1168.2		Gray SILTSTONE, iron stained below 60.5' with fractures, slightly weathered, slightly broken to moderately broken, hard, very thin bedded to thin bedded	65.0	RC 5	32 (11)			
1162.2		Gray and burgundy SHALE, few claystone seams, slightly weathered, moderately to very broken, moderately hard, laminated	70.0					
1156.6		Gray SILTSTONE, limestone inclusions at 70.3' and 71.1', slightly weathered, slightly to moderately broken, hard, medium bedded	75.0	RC 6	71 (39)			
1153.5								

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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BORING NUMBER SB-07/ MW1102F

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1150.7	[Dotted pattern]	Gray SANDSTONE, few interbedded siltstone seams, micaceous, fine grained, slightly weathered, slightly broken, hard, very thin bedded <i>(continued)</i> Gray SANDSTONE, micaceous, very fine to fine grained, slightly weathered, moderately broken, hard, very thin bedded	75.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
		Shaley interbeds from 82' to 82.5' and from 84.5' to 85.5'. Very broken from 88.4' to 89.1'.	80.0	RC 7	100 (76)			
1137.7	[Horizontal line pattern]	Gray SHALE, slightly fissile, slightly weathered, moderately broken, medium hard, laminated	90.0	RC 8	97 (53)			
1132.4	[Block pattern]	Gray and dark gray LIMESTONE, slightly weathered, broken, moderately broken from 94.4' to 95', hard, thick bedded	95.0					
1128.3	[Vertical line pattern]	Dark red SHALE, few claystone seams, calcite veins, noted iron staining, fractures with iron stains at 100.3', 101.3', 102.5' and 102.9', slightly weathered, moderately broken, moderately hard, laminated Water at 102'. Very broken from 107' to 109'. Mottled brown and gray from 109' to 111.2'. RQD length not measured for RC-10. Sample recovered from barrel after tripping rods.	100.0	RC 9	70 (38)			
1115.6	[Dotted pattern]	Gray SANDSTONE, micaceous, fine to medium grained, fresh, slightly broken, hard, very thin bedded to thin bedded	105.0	RC 10	95			
1113.6	[Horizontal line pattern]	Gray SHALE, few interbedded siltstone seams, broken to very broken, laminated	110.0					
			115.0					

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, few interbedded siltstone seams, broken to very broken, laminated (<i>continued</i>)	115.0					<p>2-Inch Solid PVC Riser Sealed with Bentonite Grout</p> <p>Hole Plug (Bentonite Chips)</p> <p>Filter Sand</p>
1109.8		Gray and red SHALE, few claystone seams, calcareous, fissile, occasional siltstone interbeds between 0.1' and 0.3' thick, fresh, very broken to moderately broken, soft, thinly laminated to laminated	120.0					
		Some iron mottling between 121' and 125'.	125.0	RC 11	87 (51)			
1099.8		Gray SANDSTONE, micaceous, very fine to medium grained, well cemented, some calcite inclusions, few thin shale partings 0.1' thick, fresh, slightly broken, hard, very thin bedded to thin bedded	130.0					
		Very broken zone from 130.4' to 131.8'.	135.0	RC 12	90 (59)			
1090.3		Gray SANDSTONE, micaceous, fine to medium grained, well cemented, fresh, slightly to moderately broken, hard, very thin bedded to thin bedded	140.0					
		Trace pyrite at 145.5'.	145.0	RC 13	100 (65)			
1079.8		Gray SANDSTONE, micaceous, fine to medium grained, thin shale partings, well cemented, few calcite filled fractures, micaceous partings, calcite veins from 162' to 162.7', fresh, moderately broken, very broken from 157' to 167', slightly broken to moderately broken near bottom, hard, very thin bedded to thin bedded	150.0					
			155.0	RC 14	100 (66)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, fine to medium grained, thin shale partings, well cemented, few calcite filled fractures, micaceous partings, calcite veins from 162' to 162.7', fresh, moderately broken, very broken from 157' to 167', slightly broken to moderately broken near bottom, hard, very thin bedded (continued)	155.0					<p>2-Inch Slotted Screen</p> <p>Filter Sand</p> <p>Hole Plug (Bentonite Chips)</p>
			160.0	RC 15	100 (62)			
			165.0					
			170.0	RC 16	100 (78)			
1052.6		Gray SHALE, fresh, slightly broken, very broken from 177' to 178', hard, thinly laminated to laminated	175.0					
1048.8	XXXXXX	Gray SILTSTONE, few interbedded sandstone seams, micaceous, fresh, moderately broken, hard, very thin bedded						
1047.5	XXXXXX	Gray SHALE, silty, siltstone interbeds at 186', fresh, moderately broken, hard, laminated	180.0	RC 17	91 (23)			
		Blue, green and black and very broken from 187' to 188'.	185.0					
1038.8	XXXXXX	Gray SILTSTONE, few interbedded sandstone seams, calcareous at 190.5', fresh, very broken, hard, very thin bedded	190.0					
1036.3	XXXXXX	Black and gray SHALE, grades to siltstone, fresh, moderately broken, hard, thinly laminated		RC 18	100 (58)			
1033.8	XXXXXX	Gray SILTSTONE, calcite veins, limestone interbeds, fresh, slightly broken, hard, very thin bedded	195.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SILTSTONE, calcite veins, limestone interbeds, fresh, slightly broken, hard, very thin bedded (<i>continued</i>)	195.0					Hole Plug (Bentonite Chips)
1029.8		Gray SILTSTONE, interbedded shale and limestone, limestone at 197.6', from 198.3' to 198.5', 199.8', 201.4', 202', 203' and 204', fresh, moderately to very broken, hard, very thin bedded to thin bedded	200.0	RC 19	100 (60)			
1022.7		Gray SHALE, few claystone seams, calcareous, black zones 0.2' thick, some iron staining, fresh, moderately broken, hard, laminated Very hard near 207'. Very broken from 207' to 212'. Fissile beds below 208.5'	205.0 210.0					
1014.8		Gray SILTSTONE, micaceous, trace calcite, fresh, moderately broken, hard, very thin bedded	215.0	RC 20	87 (50)			
1010.4		Dark gray SHALE, very few claystone seams, fissile, few limestone inclusions, fresh, broken, moderately hard, thinly laminated to laminated Black from 222' to 224'. Burgundy and gray claystone from 227' to 228.7', very broken.	220.0 225.0	RC 21	100 (34)			
998.1		Gray SILTSTONE, calcareous, calcite veins, fresh, moderately broken, hard, very thin bedded	230.0					
995.4		Gray SHALE, fissile, fresh, moderately broken, hard, thinly laminated to laminated		RC 22	100 (67)			
994.3		Light gray SANDSTONE, micaceous, fine to medium grained, fine grained from 238' to 241.7', well cemented, fresh, moderately broken, very broken from 237' to 241.7', hard, very thin bedded to	235.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		thin bedded Light gray SANDSTONE, micaceous, fine to medium grained, fine grained from 238' to 241.7', well cemented, fresh, moderately broken, very broken from 237' to 241.7', hard, very thin bedded to thin bedded (continued)	235.0					<p>Hole Plug (Bentonite Chips)</p>
			240.0					
985.1		Gray and dark red SHALE, few claystone seams, fissile, iron stained from 244.3' to 247' and at 252.1', fresh, moderately broken to very broken, moderately hard, thinly laminated to laminated	245.0	RC 23	100 (19)			
		Burgundy, calcareous and silty between 247' and 248.7' with claystone and siltstone seams.	250.0					
		Thin limestone beds from 251.5' to 253'.		RC 24	74 (38)			
973.5		Gray SANDSTONE, very fine to fine grained, well cemented, few interbedded siltstone seams, fresh, moderately broken, hard, very thin bedded	255.0					
971.1		Burgundy and gray SHALE, fissile, iron stained bands throughout, fresh, very broken, moderately hard, thinly laminated to laminated May have rock in borehole from Runs 24 and 25.	260.0					
				RC 25	81 (11)			
963.8		Black SHALE, few coal seams, fresh, very broken, moderately hard to hard, thinly laminated to laminated	265.0					
961.7		Dark gray SILTSTONE, few interbedded shale and sandstone seams, micaceous, fresh, moderately broken, hard, very thin bedded						
960		Dark gray SHALE, few interbedded siltstone seams, micaceous, fresh, moderately broken, moderately hard, laminated	270.0	RC 26	95 (45)			
953.4		Gray SILTSTONE, fresh, moderately broken, hard, thick bedded	275.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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Civil & Environmental Consultants, Inc.
 4274 Glendale Milford Road
 Cincinnati, Ohio 45242

BORING NUMBER SB-07/ MW1102F

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			275.0					
	xxxxx	Gray SILTSTONE, fresh, moderately broken, hard, thick bedded <i>(continued)</i>						
950.5	|||||	Burgundy and gray CLAYSTONE, fresh, moderately broken, hard						
949.8	|||||	Gray SHALE, few burgundy claystone seams, moderately broken, moderately hard, laminated						
	|||||	Slickensides at 279' and 280.5'	280.0	RC 27	100 (66)			
	|||||		285.0					
941.8	|||||	Gray to reddish-brown CLAYSTONE, few shale seams, calcareous, well-cemented, trace pyrite less than 1 mm thick, fresh, moderately broken, hard						
938.8	xxxxx	Gray SILTSTONE, calcareous, micaceous, fresh, slightly broken becoming moderately broken, hard, thick bedded						
	xxxxx		290.0	RC 28	98 (81)			
	xxxxx		295.0					
930.8	|||||	Gray LIMESTONE, few interbedded siltstone seams, shaley at top, fresh, moderately broken, hard, thin bedded to medium bedded						
	|||||		300.0	RC 29	90 (39)			
926.8	|||||	Gray SHALE, few interbedded siltstone seams, calcareous, fresh, slightly broken, very hard, thinly laminated to laminated						
925.3	|||||	Gray LIMESTONE, micaceous, some thin shale interbeds increasing with depth, fresh, slightly broken, very hard, medium bedded						
	|||||		305.0					
921.8	|||||	Gray SANDSTONE, micaceous, fine grained, many shale partings increasing with depth, fresh, very broken, hard, very thin bedded to thin bedded						
919.4	|||||	Gray LIMESTONE, calcareous, shaley at bottom with interbedded siltstone seams, fresh, moderately broken, very hard, medium bedded						
	|||||	Black at 310.2'	310.0	RC 30	100 (54)			
	|||||		315.0					

Hole Plug (Bentonite Chips)

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12



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ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
911.8		<p>Gray SHALE, few interbedded siltstone seams, calcareous, occasional limestone interbeds, trace pyrite less than 1 mm thick, fresh, moderately broken, hard, thinly laminated to laminated</p> <p>4 feet of Run 31 fell into hole, unable to retrieve.</p> <p>Few reddish-brown and gray claystone seams beginning at 321'.</p> <p>Dark red and very broken from 325' to 328'.</p>	<p>315.0</p> <p>320.0</p> <p>325.0</p>	<p>RC 31</p> <p>RC 32</p>	<p>60 (35)</p> <p>100 (27)</p>			<p>Hole Plug (Bentonite Chips)</p>
898.8		<p>Bottom of hole at 328.0 feet.</p> <p>Soil sampling completed on 9/7/2011. Boring offset on 10/10/2011 for rock coring. Augered to 18' to begin rock core sampling.</p> <p>The following groundwater level readings were taken during drilling: 9/7/2011 3:30 PM, Dry (borehole depth = 12.2') 10/11/2011 7:45 AM at approximately 38' bgs 10/12/2011 7:50 AM at approximately 39' bgs 10/13/2011 7:20 AM at approximately 35' bgs</p> <p>Geophysical logging and packer testing were performed upon completion.</p> <p>Well MW1102F installed following geophysical logging and packer testing.</p>						



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BORING NUMBER SB-18/ MW1103H

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CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/6/11 **COMPLETED** 9/23/11
GROUND ELEVATION 1237.4 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core (NX) **AT TIME OF DRILLING** Refer to notes at bottom of log
LOGGED BY M. McCoy / R. Mahle **CHECKED BY** A. Amicon **AT END OF DRILLING** Refer to notes at bottom of log
LOCATION N 487005.3, E 1610094.0 **AFTER DRILLING** Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM	
1237.4		Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)	0.0	SS 1	93	3-4-5 (9)	2		
				SS 2	73	2-2-3 (5)	2		
1234.4		Light olive gray and reddish-brown to olive brown LEAN CLAY (CL), few shale fragments, slightly fissile to fissile, moist, medium stiff to very stiff (RESIDUAL)	5.0	SS 3	60	3-3-4 (7)	1		
				SS 4	53	5-10-11 (21)	1.5		
				SS 5	47	12-10-14 (24)	1.5		
1229.9		Reddish-brown CLAYSTONE, completely to highly weathered, very broken, very soft, few limestone seams, blocky, few gray blocky siltstone partings	10.0	SS 6	60	11-12-26 (38)	1-2.25		
				SS 7	80	8-11-33 (44)	3-3.5		
				SS 8	100	50/5"	1		
1225.9		Light gray to brown SHALE, highly weathered, very broken, very soft, laminated, very fissile	15.0	SS 9	60	31-22-25 (47)	1		
				SS 10	100	14-50/5"	1		
1222.6			Light gray SILTSTONE, highly weathered, very broken, very soft, very thin bedded	15.0	SS 11	93	25-34-36 (70)		
1221.9					SS 12	100	50/5"		
1219.9		Reddish-brown to light brown SHALE, highly weathered, very broken, very soft, laminated, fissile	20.0	RC 1	72 (65)				
1212.6		Reddish-brown CLAYSTONE, few interbedded shale seams, highly weathered to moderately weathered, slightly broken, very soft to moderately soft	25.0	RC 2	80 (43)				
1209.4		Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated	30.0						
			35.0						

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated (continued)	35.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1199.4		Gray and reddish brown CLAYSTONE, few discontinuous slightly micaceous siltstone seams, few limestone inclusions, moderately weathered, moderately broken, moderately soft	40.0					
1197.7		Gray SILTSTONE, slightly micaceous, few discontinuous shale and sandstone seams, noted pyritic specs at 31.6', increasing in grain size with depth, iron stained fractures from 39.7' to 41.4', moderately weathered, moderately broken, moderately hard, very thin bedded	45.0	RC 3	97 (76)			
1192.1		Gray SANDSTONE, moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, brownish-gray from 46.4' to 47', vertical iron stained fracturing from 46.6' to 47'	50.0					
1190.4		Gray to brownish-gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, vertical iron stained fracture from 47' to 47.3', moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded	55.0	RC 4	79 (46)			
1189.6		Gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, vertical iron stained fracture from 46.6' to 47'	60.0					
1185.4		Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams throughout, few limestone inclusions, sandstone lens from 49.2' to 50.1', moderately weathered, moderately broken, moderately soft to moderately hard, very thin bedded to thin bedded	65.0					
1180.4		Gray SHALE, discontinuous and slightly micaceous siltstone seams throughout, reddish-brown from 52.5' to 53.2' with claystone seams and limestone inclusions, pyritic specs observed, highly to moderately weathered, moderately broken, moderately soft, thinly laminated to laminated	70.0					
1178.9		Gray SILTSTONE, slightly micaceous, interbedded sandstone seams throughout, few limestone inclusions, pyritic specs observed, moderately weathered, moderately broken, moderately hard, very thin bedded	75.0	RC 5	93 (29)			
1174.6		Gray SANDSTONE, micaceous, very fine to medium grained, slightly weathered, moderately broken, moderately hard, very thin bedded						
1170.4		Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone throughout, pyritic specs observed, moderately to slightly weathered, moderately broken, moderately soft, thinly laminated to laminated						
1165.3		Gray SHALE, discontinuous slightly micaceous siltstone seams throughout, few limestone inbeds, pyritic specs observed throughout, reddish brown claystone seams from 67.9' to 68.2', 68.4' to 68.7', 69.3' to 70.1', and 71.3' to 71.6', moderately weathered, moderately broken, moderately soft, thinly laminated to laminated						
1164.3		Light gray LIMESTONE, calcareous, few shale inclusions, slightly weathered, moderately broken, hard, thick bedded		RC 6	93 (64)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, very fine to medium grained, micaceous interbedded limestone, slightly weathered, slightly broken to broken, hard, very thin bedded to thin bedded <i>(continued)</i>	75.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1157.9	XXXXXX	Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded	80.0	RC 7	100 (7)			
1150.4	XXXXXX	Gray SILTSTONE, slightly micaceous, few interbedded shale seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded	85.0					
1149.5	XXXXXX	Gray SHALE, slightly to moderately weathered, broken, moderately soft, laminated to thinly laminated	90.0					
		Reddish-gray discoloration from 92.2' to 92.4'. Pyritic specks observed at 93.7'.		RC 8	100 (30)			
1143.6	XXXXXX	Gray to dark gray LIMESTONE, calcareous, slightly weathered, moderately broken, hard, medium bedded	95.0					
1140.4	XXXXXX	Gray SHALE, with calcareous limestone inclusions, slightly weathered, moderately broken, moderately soft, laminated	100.0					
		Gray and reddish-gray from 101.6' to 107' with few claystone seams.		RC 9	100 (56)			
1130.4	XXXXXX	Gray SILTSTONE, moderately to slightly micaceous, fresh, moderately broken, moderately hard, very thin bedded	105.0					
1128.2	XXXXXX	Gray SANDSTONE, micaceous, very fine to medium grained, interbedded calcareous limestone, fresh, moderately broken, hard, very thin bedded	110.0	RC 10	88 (68)			
			115.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1122.1		Gray SHALE, few interbedded siltstone seams, fresh, moderately broken, moderately soft, thinly laminated to laminated	115.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1117.1		Reddish-brown and gray CLAYSTONE, few interbedded shale seams, fresh, moderately broken, moderately soft	120.0	RC 11	74 (33)			
1111.6		Gray SILTSTONE, interbedded limestone, fresh, slightly broken, moderately hard, very thin bedded	125.0					
1110.4		Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than 1/8" thick, limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded	130.0	RC 12	100 (83)			
			135.0					
1100.4		Gray SILTSTONE, slightly micaceous, discontinuous sandstone seams less than 1/10" thick, sporadic limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded	140.0	RC 13	100 (50)			
1093.9		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded throughout with siltstone seams which decrease in frequency with depth and are less than 1/10" thick, fresh, moderately broken, moderately hard to hard, very thin bedded to thin bedded	145.0					
1090.4		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded	150.0	RC 14	100 (90)			
			155.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded (continued)	155.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
			160.0	RC 15	100 (100)			
			165.0					
			170.0	RC 16	100 (68)			
			175.0					
1061.2		Gray SHALE, 0.5" coal seam at 176.5', hairline coal fractures at 176.3' and 178.4', fresh, broken, moderately hard, thinly laminated to laminated						
1060.4		Gray and dark gray SHALE, few claystone seams, fresh, moderately broken, moderately soft, laminated to thinly laminated	180.0					
1056.1		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout, noted calcareous limestone inclusions throughout, fresh, moderately broken, hard, very thin bedded		RC 17	87 (59)			
1054.1	x x x x	Gray SILTSTONE, interbedded with sandstone and shale seams less than 1/16" thick, fresh, moderately broken, hard, very thin bedded	185.0					
1053.4	x x x x	Black SHALE, few limestone inclusions, gray shale from 184' to 184.2' and 186.7' to 186.9', fresh, moderately broken, moderately soft, thinly laminated to laminated						
1050.4		Dark gray SHALE, calcareous with limestone inclusions, fresh, slightly broken, hard, laminated						
1048.5	x x x x	Gray SILTSTONE, slightly micaceous, few limestone inclusions, sandstone layer from 191.7' to 192', fresh, moderately broken, moderately hard to hard, very thin bedded	190.0	RC 18	100 (56)			
1044.4		Gray SANDSTONE, very fine to medium grained, micaceous, few interbedded siltstone seams throughout, fresh, moderately broken, hard, very thin bedded	195.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
195.0								
1041.9	XXXXXX XXXXXX XXXXXX	Gray SILTSTONE, slightly micaceous, limestone inclusions, few interbedded sandstone seams throughout, fresh, moderately broken to broken, hard, very thin bedded						2-Inch Solid PVC Riser Sealed with Bentonite Grout
1039.4	|||||	Gray SHALE, fresh, moderately broken, moderately soft to moderately hard, thinly laminated to laminated	200.0	RC 19	100 (86)			
1033.1	XXXXXX XXXXXX XXXXXX	Gray SILTSTONE, slightly micaceous, few discontinuous sandstone and shale lenses less than 1/10" thick, fresh, moderately broken, hard, very thin bedded	205.0					
1029.8	|||||	Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone seams less than 1/8" in thickness, slightly micaceous siltstone layer from 210.7' to 211.2', fresh, broken, moderately soft, thinly laminated to laminated Few pyritic specks observed from 212' to 214'.	210.0	RC 20	95 (56)			
			215.0					
1021.7	|||||	Gray and reddish-gray to reddish-brown SHALE, fresh, broken, moderately hard, thinly laminated to laminated						
1019.1	|||||	Gray becoming reddish-brown and gray SHALE, few claystone seams, calcareous, limestone inclusions throughout, fresh, moderately broken, hard, laminated	220.0	RC 21	75 (60)			
			225.0					
1010.4	XXXXXX XXXXXX	Gray SILTSTONE, fresh, broken, moderately hard, very thin bedded						
1009.6	|||||	Gray SANDSTONE, micaceous, very fine to fine grained, interbedded siltstone layers throughout, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded	230.0					
1006.7	XXXXXX XXXXXX XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than about 1/8" thick, fresh, broken, moderately hard, very thin bedded		RC 22	93 (59)			
1004.6								
			235.0					

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ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated (continued)	275.0					
			280.0					
954.9	XXXXXX	Gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded		RC 27	99 (74)			
			285.0					
952.2	.....	Gray SANDSTONE, micaceous, very fine to medium grained, fresh, slightly broken, very hard, thin bedded					
950.4	XXXXXX	Gray SILTSTONE, few limestone inclusions, slightly micaceous, interbedded sandstone seams 1/16" thick from 291.4' to 297', fresh, slightly broken, hard to very hard, very thin bedded						
			290.0	RC 28	97 (76)			
			295.0					
940.4	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded with shale, pyritic specks observed at 298.2' and 298.5', fresh, broken, hard, very thin bedded						
938.8	XXXXXX	Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, pyritic specks observed at 298.7', fresh, slightly broken, hard to very hard, very thin bedded	300.0					
937.9	.....						
936	XXXXXX	Gray SANDSTONE, micaceous, very fine to fine grained, few interbedded siltstone seams less than 1/16" thick, fresh, slightly broken, very hard, thin bedded		RC 29	96 (79)			
		Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, fresh, slightly broken, hard to very hard, very thin bedded	305.0					
930.4	XXXXXX	Gray SILTSTONE, slightly micaceous, few limestone inclusions, few interbedded sandstone seams less than 1/16" in thickness from 307.6' to 307.8', fresh, broken, hard, very thin bedded						
929.6	.....		Gray SANDSTONE, very fine to medium grained, interbedded siltstone seams throughout less than 1/4" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded	310.0			
925.7	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded		RC 30	55 (11)			
			315.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			315.0					
	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded (<i>continued</i>)						
920.4		Gray SANDSTONE, slightly micaceous, few interbedded sandstone seams less than 1/16" thick, fresh, broken, hard, very thin bedded						
919.6								
918.5	XXXXXX	Gray SANDSTONE, micaceous, very fine to medium coarse grained, few limestone inclusions, interbedded siltstone seams less than 1/8" thick, fresh, moderately broken, very hard, thin bedded	320.0					
	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded throughout with shale seams less than 1/8" thick, fresh, moderately broken, hard to very hard, very thin bedded		RC 31	98 (77)			
914.4		Gray SHALE, dark gray shale zone from 325.8' to 326', fresh, moderately broken, hard becoming moderately hard, thinly laminated to laminated	325.0					
910.4		Gray to dark gray SHALE, interbedded siltstone throughout, few limestone inclusions, fresh, moderately broken, hard, laminated	330.0					
				RC 32	100 (55)			
			335.0					
900.4		Gray SHALE, interbedded siltstone and sandstone seams throughout, interbedded hard siltstone layers with micaceous sandstone inclusions from 337.4' to 338.1' and 339' to 339.2', fresh, broken, moderately hard to hard, laminated	340.0					
897.4		Gray SANDSTONE, interbedded siltstone seams throughout less than 1/16" thick, micaceous, very fine to medium grained, interbedded limestone, fresh, moderately broken, hard, very thin bedded						
896.2					RC 33	100 (50)		
		Gray SHALE, black shale lens 3/4" thick at 344.5', fresh, moderately hard, broken, thinly laminated to laminated						
892.8		Gray and dark gray LIMESTONE, calcareous, fresh, moderately broken, very hard, thick bedded	345.0					
890.4		Gray and dark gray SHALE, calcareous, limestone seam 3/4" thick at 347.8', fresh, broken, moderately hard, laminated						
888.5		Gray LIMESTONE, calcareous, shale inclusions throughout, fresh, moderately broken, very hard, thick bedded	350.0					
885.7		Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated		RC 34	96 (50)			
883.6								
883.1		Gray LIMESTONE, calcareous, shale inclusions throughout,	355.0					

2-Inch Slotted Screen

Filter Sand

Hole Plug (Bentonite Chips)

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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Civil & Environmental Consultants, Inc.
 4274 Glendale Milford Road
 Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103H

CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
880.4		<p>fresh, moderately broken, very hard, medium bedded Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated <i>(continued)</i></p> <p>Bottom of hole at 357.0 feet.</p> <p>Soil sampling completed on 9/6/11. Boring offset on 9/20/11 for rock coring. Augered to 17.5' to begin rock core sampling.</p> <p>The following groundwater level readings were taken during drilling: 9/21/2011 7:45 AM at 91.2' bgs (borehole depth = 107' bgs) 9/22/2011 8:25 AM at 223.1' bgs (borehole depth = 227' bgs) 9/23/2011 7:45 AM at 333.1' bgs (borehole depth = 347' bgs)</p> <p>Geophysical logging and packer testing were performed upon completion.</p> <p>Well MW1103H installed following geophysical logging and packer testing.</p>	355.0					



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BORING NUMBER SB-18/ MW1103R

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CLIENT American Electric Power	PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416	PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/6/11 COMPLETED 9/23/11	GROUND ELEVATION 1237.4 ft HOLE SIZE 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.	GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core (NX)	AT TIME OF DRILLING Refer to notes at bottom of log
LOGGED BY M. McCoy / R. Mahle CHECKED BY A. Amicon	AT END OF DRILLING Refer to notes at bottom of log
LOCATION N 486998.5, E 1610097.2	AFTER DRILLING Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1237.4		Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)	0.0	SS 1	93	3-4-5 (9)	2	
				SS 2	73	2-2-3 (5)	2	
1234.4		Light olive gray and reddish-brown to olive brown LEAN CLAY (CL), few shale fragments, slightly fissile to fissile, moist, medium stiff to very stiff (RESIDUAL)	5.0	SS 3	60	3-3-4 (7)	1	
				SS 4	53	5-10-11 (21)	1.5	
1229.9		Reddish-brown CLAYSTONE, completely to highly weathered, very broken, very soft, few limestone seams, blocky, few gray blocky siltstone partings	10.0	SS 5	47	12-10-14 (24)	1.5	
				SS 6	60	11-12-26 (38)	1-2.25	
1225.9		Light gray to brown SHALE, highly weathered, very broken, very soft, laminated, very fissile	15.0	SS 7	80	8-11-33 (44)	3-3.5	
				SS 8	100	50/5"	1	
1222.6		Light gray SILTSTONE, highly weathered, very broken, very soft, very thin bedded	15.0	SS 9	60	31-22-25 (47)	1	
1221.9				SS 10	100	14-50/5"	1	
1219.9		Reddish-brown to light brown SHALE, highly weathered, very broken, very soft, laminated, fissile	20.0	SS 11	93	25-34-36 (70)		
				SS 12	100	50/5"		
1219.9	Reddish-brown CLAYSTONE, few interbedded shale seams, highly weathered to moderately weathered, slightly broken, very soft to moderately soft	20.0	RC 1	72 (65)				
1212.6		Gray SHALE, few interbedded slightly micaceous siltstone seams, reddish brown and gray from 27.3' to 28' with claystone seams, moderately weathered, slightly broken, moderately soft, laminated	25.0					
1209.4	Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated		30.0	RC 2	80 (43)			
			35.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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BORING NUMBER SB-18/ MW1103R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated (continued)	35.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1199.4		Gray and reddish brown CLAYSTONE, few discontinuous slightly micaceous siltstone seams, few limestone inclusions, moderately weathered, moderately broken, moderately soft	40.0					
1197.7		Gray SILTSTONE, slightly micaceous, few discontinuous shale and sandstone seams, noted pyritic specs at 31.6', increasing in grain size with depth, iron stained fractures from 39.7' to 41.4', moderately weathered, moderately broken, moderately hard, very thin bedded	45.0	RC 3	97 (76)			
1192.1		Gray SANDSTONE, moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, brownish-gray from 46.4' to 47', vertical iron stained fracturing from 46.6' to 47'	50.0					
1190.4		Gray to brownish-gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, vertical iron stained fracture from 47' to 47.3', moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded	55.0	RC 4	79 (46)			
1189.6		Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams throughout, few limestone inclusions, sandstone lens from 49.2' to 50.1', moderately weathered, moderately broken, moderately soft to moderately hard, very thin bedded to thin bedded	60.0					
1185.4		Gray SHALE, discontinuous and slightly micaceous siltstone seams throughout, reddish-brown from 52.5' to 53.2' with claystone seams and limestone inclusions, pyritic specs observed, highly to moderately weathered, moderately broken, moderately soft, thinly laminated to laminated	65.0					
1180.4		Gray SILTSTONE, slightly micaceous, interbedded sandstone seams throughout, few limestone inclusions, pyritic specs observed, moderately weathered, moderately broken, moderately hard, very thin bedded	70.0	RC 5	93 (29)			
1178.9		Gray SANDSTONE, micaceous, very fine to medium grained, slightly weathered, moderately broken, moderately hard, very thin bedded	75.0					
1174.6		Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone throughout, pyritic specs observed, moderately to slightly weathered, moderately broken, moderately soft, thinly laminated to laminated						
1170.4		Gray SHALE, discontinuous slightly micaceous siltstone seams throughout, few limestone inbeds, pyritic specs observed throughout, reddish brown claystone seams from 67.9' to 68.2', 68.4' to 68.7', 69.3' to 70.1', and 71.3' to 71.6', moderately weathered, moderately broken, moderately soft, thinly laminated to laminated						
1165.3		Light gray LIMESTONE, calcareous, few shale inclusions, slightly weathered, moderately broken, hard, thick bedded		RC 6	93 (64)			
1164.3								

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, very fine to medium grained, micaceous interbedded limestone, slightly weathered, slightly broken to broken, hard, very thin bedded to thin bedded <i>(continued)</i>	75.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1157.9	XXXXXX	Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded	80.0	RC 7	100 (7)			
1150.4	XXXXXX	Gray SILTSTONE, slightly micaceous, few interbedded shale seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded	85.0					
1149.5	XXXXXX	Gray SHALE, slightly to moderately weathered, broken, moderately soft, laminated to thinly laminated	90.0					
		Reddish-gray discoloration from 92.2' to 92.4'. Pyritic specks observed at 93.7'.		RC 8	100 (30)			
1143.6	XXXXXX	Gray to dark gray LIMESTONE, calcareous, slightly weathered, moderately broken, hard, medium bedded	95.0					
1140.4	XXXXXX	Gray SHALE, with calcareous limestone inclusions, slightly weathered, moderately broken, moderately soft, laminated	100.0					
		Gray and reddish-gray from 101.6' to 107' with few claystone seams.		RC 9	100 (56)			
1130.4	XXXXXX	Gray SILTSTONE, moderately to slightly micaceous, fresh, moderately broken, moderately hard, very thin bedded	105.0					
1128.2	XXXXXX	Gray SANDSTONE, micaceous, very fine to medium grained, interbedded calcareous limestone, fresh, moderately broken, hard, very thin bedded	110.0	RC 10	88 (68)			
			115.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1122.1		Gray SHALE, few interbedded siltstone seams, fresh, moderately broken, moderately soft, thinly laminated to laminated	115.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1117.1		Reddish-brown and gray CLAYSTONE, few interbedded shale seams, fresh, moderately broken, moderately soft	120.0	RC 11	74 (33)			
1111.6		Gray SILTSTONE, interbedded limestone, fresh, slightly broken, moderately hard, very thin bedded	125.0					
1110.4		Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than 1/8" thick, limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded	130.0	RC 12	100 (83)			
1100.4		Gray SILTSTONE, slightly micaceous, discontinuous sandstone seams less than 1/10" thick, sporadic limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded	135.0					
1100.4			140.0	RC 13	100 (50)			
1093.9		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded throughout with siltstone seams which decrease in frequency with depth and are less than 1/10" thick, fresh, moderately broken, moderately hard to hard, very thin bedded to thin bedded	145.0					
1090.4		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded	150.0	RC 14	100 (90)			
			155.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded (continued)	155.0					
			160.0	RC 15	100 (100)			
			165.0					
			170.0	RC 16	100 (68)			
			175.0					
1061.2		Gray SHALE, 0.5" coal seam at 176.5', hairline coal fractures at 176.3' and 178.4', fresh, broken, moderately hard, thinly laminated to laminated	180.0					
1060.4		Gray and dark gray SHALE, few claystone seams, fresh, moderately broken, moderately soft, laminated to thinly laminated						
1056.1		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout, noted calcareous limestone inclusions throughout, fresh, moderately broken, hard, very thin bedded		RC 17	87 (59)			
1054.1								
1053.4		Gray SILTSTONE, interbedded with sandstone and shale seams less than 1/16" thick, fresh, moderately broken, hard, very thin bedded	185.0					
		Black SHALE, few limestone inclusions, gray shale from 184' to 184.2' and 186.7' to 186.9', fresh, moderately broken, moderately soft, thinly laminated to laminated						
1050.4		Dark gray SHALE, calcareous with limestone inclusions, fresh, slightly broken, hard, laminated						
1048.5		Gray SILTSTONE, slightly micaceous, few limestone inclusions, sandstone layer from 191.7' to 192', fresh, moderately broken, moderately hard to hard, very thin bedded	190.0	RC 18	100 (56)			
1044.4		Gray SANDSTONE, very fine to medium grained, micaceous, few interbedded siltstone seams throughout, fresh, moderately broken, hard, very thin bedded	195.0					

2-Inch Solid PVC Riser Sealed with Bentonite Grout

Hole Plug (Bentonite Chips)

Filter Sand

2-Inch Slotted Screen

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 2/1/12

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CLIENT American Electric Power

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CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
195.0								
1041.9	XXXXXX XXXXXX XXXXXX XXXXXX	Gray SILTSTONE, slightly micaceous, limestone inclusions, few interbedded sandstone seams throughout, fresh, moderately broken to broken, hard, very thin bedded						<p>Filter Sand</p>
1039.4	|||||	Gray SHALE, fresh, moderately broken, moderately soft to moderately hard, thinly laminated to laminated	200.0	RC 19	100 (86)			
1033.1	XXXXXX XXXXXX XXXXXX XXXXXX	Gray SILTSTONE, slightly micaceous, few discontinuous sandstone and shale lenses less than 1/10" thick, fresh, moderately broken, hard, very thin bedded	205.0					
1029.8	|||||	Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone seams less than 1/8" in thickness, slightly micaceous siltstone layer from 210.7' to 211.2', fresh, broken, moderately soft, thinly laminated to laminated Few pyritic specks observed from 212' to 214'.	210.0	RC 20	95 (56)			
1021.7	|||||	Gray and reddish-gray to reddish-brown SHALE, fresh, broken, moderately hard, thinly laminated to laminated	215.0					
1019.1	|||||	Gray becoming reddish-brown and gray SHALE, few claystone seams, calcareous, limestone inclusions throughout, fresh, moderately broken, hard, laminated	220.0	RC 21	75 (60)			
1010.4	XXXXXX XXXXXX	Gray SILTSTONE, fresh, broken, moderately hard, very thin bedded	225.0					
1009.6	XXXXXX XXXXXX	Gray SANDSTONE, micaceous, very fine to fine grained, interbedded siltstone layers throughout, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded	230.0					
1006.7	XXXXXX XXXXXX XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than about 1/8" thick, fresh, broken, moderately hard, very thin bedded		RC 22	93 (59)			
1004.6	XXXXXX XXXXXX		235.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 2/1/12

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1002.1	[Vertical line with horizontal dashes]	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, interbedded siltstone seams throughout which decrease in frequency with depth, fresh, moderately broken, hard, very thin bedded (<i>continued</i>)	235.0	RC 23	85 (48)			
1000.4		Gray SHALE, fresh, broken, moderately hard, thinly laminated to laminated	240.0					
		Gray SHALE, few claystone seams, gray and light reddish-gray from 240.8' to 243.2', fresh, broken, moderately broken from 240.8' to 247', moderately hard, thinly laminated to laminated	245.0					
989.1	[Vertical line with 'x' marks]	Gray SILTSTONE, slightly micaceous, interbedded sandstone seams generally less than 1/8" thick, fresh, very thin bedded	250.0	RC 24	92 (36)			
983.1	[Vertical line with horizontal dashes]	Gray and reddish-brown SHALE, few claystone seams, thinly laminated to laminated, few interbedded siltstone seams from 254.3' to 254.9', fresh, moderately broken to broken, moderately hard	255.0					
979.3	[Vertical line with 'x' marks]	Coal seam at 258'.						
977.9	[Vertical line with 'x' marks]	Gray SILTSTONE, slightly micaceous, fresh, moderately broken, hard, very thin bedded	260.0	RC 25	87 (62)			
		Gray SHALE, calcareous, interbedded slightly micaceous siltstone throughout, few limestone inclusions throughout, very hard shale from 263.6' to 267' with limestone, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	265.0					
970.4	[Vertical line with horizontal dashes]	Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated	270.0	RC 26	93 (56)			
			275.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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			275.0					
		Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated (continued)	280.0					
954.9	XXXXXX	Gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded	285.0	RC 27	99 (74)			
952.2	.....	Gray SANDSTONE, micaceous, very fine to medium grained, fresh, slightly broken, very hard, thin bedded						
950.4	XXXXXX	Gray SILTSTONE, few limestone inclusions, slightly micaceous, interbedded sandstone seams 1/16" thick from 291.4' to 297', fresh, slightly broken, hard to very hard, very thin bedded	290.0					
			295.0	RC 28	97 (76)			
940.4	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded with shale, pyritic specks observed at 298.2' and 298.5', fresh, broken, hard, very thin bedded						
938.8	XXXXXX	Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, pyritic specks observed at 298.7', fresh, slightly broken, hard to very hard, very thin bedded	300.0					
937.9	.....						
936	XXXXXX	Gray SANDSTONE, micaceous, very fine to fine grained, few interbedded siltstone seams less than 1/16" thick, fresh, slightly broken, very hard, thin bedded		RC 29	96 (79)			
		Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, fresh, slightly broken, hard to very hard, very thin bedded	305.0					
930.4	XXXXXX	Gray SILTSTONE, slightly micaceous, few limestone inclusions, few interbedded sandstone seams less than 1/16" in thickness from 307.6' to 307.8', fresh, broken, hard, very thin bedded						
929.6	.....		Gray SANDSTONE, very fine to medium grained, interbedded siltstone seams throughout less than 1/4" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded	310.0				
925.7	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded		RC 30	55 (11)			
			315.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			315.0					
	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded (<i>continued</i>)						
920.4		Gray SANDSTONE, slightly micaceous, few interbedded sandstone seams less than 1/16" thick, fresh, broken, hard, very thin bedded						
919.6								
918.5	XXXXXX	Gray SANDSTONE, micaceous, very fine to medium coarse grained, few limestone inclusions, interbedded siltstone seams less than 1/8" thick, fresh, moderately broken, very hard, thin bedded	320.0					
	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded throughout with shale seams less than 1/8" thick, fresh, moderately broken, hard to very hard, very thin bedded		RC 31	98 (77)			
914.4		Gray SHALE, dark gray shale zone from 325.8' to 326', fresh, moderately broken, hard becoming moderately hard, thinly laminated to laminated	325.0					
910.4		Gray to dark gray SHALE, interbedded siltstone throughout, few limestone inclusions, fresh, moderately broken, hard, laminated	330.0					
			335.0	RC 32	100 (55)			
900.4		Gray SHALE, interbedded siltstone and sandstone seams throughout, interbedded hard siltstone layers with micaceous sandstone inclusions from 337.4' to 338.1' and 339' to 339.2', fresh, broken, moderately hard to hard, laminated	340.0					
897.4		Gray SANDSTONE, interbedded siltstone seams throughout less than 1/16" thick, micaceous, very fine to medium grained, interbedded limestone, fresh, moderately broken, hard, very thin bedded						
896.2					RC 33	100 (50)		
		Gray SHALE, black shale lens 3/4" thick at 344.5', fresh, moderately hard, broken, thinly laminated to laminated						
892.8		Gray and dark gray LIMESTONE, calcareous, fresh, moderately broken, very hard, thick bedded	345.0					
890.4		Gray and dark gray SHALE, calcareous, limestone seam 3/4" thick at 347.8', fresh, broken, moderately hard, laminated						
888.5		Gray LIMESTONE, calcareous, shale inclusions throughout, fresh, moderately broken, very hard, thick bedded	350.0					
885.7		Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated		RC 34	96 (50)			
883.6		Gray LIMESTONE, calcareous, shale inclusions throughout,						
883.1				355.0				

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
880.4		<p>fresh, moderately broken, very hard, medium bedded Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated (<i>continued</i>)</p> <p>Bottom of hole at 357.0 feet.</p> <p>Soil sampling completed on 9/6/11. Boring offset on 9/20/11 for rock coring. Augered to 17.5' to begin rock core sampling.</p> <p>The following groundwater level readings were taken during drilling: 9/21/2011 7:45 AM at 91.2' bgs (borehole depth = 107' bgs) 9/22/2011 8:25 AM at 223.1' bgs (borehole depth = 227' bgs) 9/23/2011 7:45 AM at 333.1' bgs (borehole depth = 347' bgs)</p> <p>Geophysical logging and packer testing were performed upon completion.</p> <p>Well MW1103R installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-18. The ground elevation for MW1103R = 1238.1 ft.</p>	355.0					



Civil & Environmental Consultants, Inc.
 4274 Glendale Milford Road
 Cincinnati, Ohio 45242

BORING NUMBER SB-18/ MW1103F

CLIENT American Electric Power
PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/6/11 **COMPLETED** 9/23/11
GROUND ELEVATION 1237.4 ft **HOLE SIZE** 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.
GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core (NX) **AT TIME OF DRILLING** Refer to notes at bottom of log
LOGGED BY M. McCoy / R. Mahle **CHECKED BY** A. Amicon **AT END OF DRILLING** Refer to notes at bottom of log
LOCATION N 487011.2, E 1610102.2 **AFTER DRILLING** Well installed

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM	
1237.4		Brown LEAN CLAY WITH SAND (CL), trace roots, noted iron oxide concretions, moist, medium stiff to stiff (RESIDUAL)	0.0	SS 1	93	3-4-5 (9)	2		
				SS 2	73	2-2-3 (5)	2		
1234.4		Light olive gray and reddish-brown to olive brown LEAN CLAY (CL), few shale fragments, slightly fissile to fissile, moist, medium stiff to very stiff (RESIDUAL)	5.0	SS 3	60	3-3-4 (7)	1		
				SS 4	53	5-10-11 (21)	1.5		
				SS 5	47	12-10-14 (24)	1.5		
1229.9		Reddish-brown CLAYSTONE, completely to highly weathered, very broken, very soft, few limestone seams, blocky, few gray blocky siltstone partings	10.0	SS 6	60	11-12-26 (38)	1-2.25		
				SS 7	80	8-11-33 (44)	3-3.5		
				SS 8	100	50/5"	1		
1225.9		Light gray to brown SHALE, highly weathered, very broken, very soft, laminated, very fissile	15.0	SS 9	60	31-22-25 (47)	1		
				SS 10	100	14-50/5"	1		
1222.6			Light gray SILTSTONE, highly weathered, very broken, very soft, very thin bedded	15.0	SS 11	93	25-34-36 (70)		
1221.9					SS 12	100	50/5"		
1219.9		Reddish-brown to light brown SHALE, highly weathered, very broken, very soft, laminated, fissile	20.0	RC 1	72 (65)				
				RC 2	80 (43)				
1212.6		Gray SHALE, few interbedded slightly micaceous siltstone seams, reddish brown and gray from 27.3' to 28' with claystone seams, moderately weathered, slightly broken, moderately soft, laminated	25.0						
1209.4									
		Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated	30.0						
			35.0						

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SHALE, many interbedded sandstone seams, few discontinuous slightly micaceous siltstone seams throughout, few limestone inclusions, highly to moderately weathered, moderately broken, moderately soft, laminated (continued)	35.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1199.4		Gray and reddish brown CLAYSTONE, few discontinuous slightly micaceous siltstone seams, few limestone inclusions, moderately weathered, moderately broken, moderately soft	40.0					
1197.7		Gray SILTSTONE, slightly micaceous, few discontinuous shale and sandstone seams, noted pyritic specs at 31.6', increasing in grain size with depth, iron stained fractures from 39.7' to 41.4', moderately weathered, moderately broken, moderately hard, very thin bedded	45.0	RC 3	97 (76)			
1192.1		Gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, brownish-gray from 46.4' to 47', vertical iron stained fracturing from 46.6' to 47', moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded	50.0					
1190.4		Gray to brownish-gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, few discontinuous siltstone seams, vertical iron stained fracture from 47' to 47.3', moderately weathered, moderately broken, moderately hard, very thin bedded to thin bedded	55.0	RC 4	79 (46)			
1189.6		Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams throughout, few limestone inclusions, sandstone lens from 49.2' to 50.1', moderately weathered, moderately broken, moderately soft to moderately hard, very thin bedded to thin bedded	60.0					
1185.4		Gray SHALE, discontinuous and slightly micaceous siltstone seams throughout, reddish-brown from 52.5' to 53.2' with claystone seams and limestone inclusions, pyritic specs observed, highly to moderately weathered, moderately broken, moderately soft, thinly laminated to laminated	65.0					
1180.4		Gray SILTSTONE, slightly micaceous, interbedded sandstone seams throughout, few limestone inclusions, pyritic specs observed, moderately weathered, moderately broken, moderately hard, very thin bedded	70.0	RC 5	93 (29)			
1178.9		Gray SANDSTONE, micaceous, very fine to medium grained, slightly weathered, moderately broken, moderately hard, very thin bedded	75.0					
1174.6		Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone throughout, pyritic specs observed, moderately to slightly weathered, moderately broken, moderately soft, thinly laminated to laminated						
1170.4		Gray SHALE, discontinuous slightly micaceous siltstone seams throughout, few limestone inbeds, pyritic specs observed throughout, reddish brown claystone seams from 67.9' to 68.2', 68.4' to 68.7', 69.3' to 70.1', and 71.3' to 71.6', moderately weathered, moderately broken, moderately soft, thinly laminated to laminated						
1165.3		Light gray LIMESTONE, calcareous, few shale inclusions, slightly weathered, moderately broken, hard, thick bedded		RC 6	93 (64)			
1164.3								

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, very fine to medium grained, micaceous interbedded limestone, slightly weathered, slightly broken to broken, hard, very thin bedded to thin bedded <i>(continued)</i>	75.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1157.9	XXXXXX	Gray SILTSTONE, slightly micaceous, few interbedded sandstone seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded	80.0	RC 7	100 (7)			
1150.4	XXXXXX	Gray SILTSTONE, slightly micaceous, few interbedded shale seams, interbedded limestone, slightly weathered, moderately broken, moderately hard, very thin bedded	85.0					
1149.5	XXXXXX	Gray SHALE, slightly to moderately weathered, broken, moderately soft, laminated to thinly laminated	90.0					
		Reddish-gray discoloration from 92.2' to 92.4'. Pyritic specks observed at 93.7'.		RC 8	100 (30)			
1143.6	XXXXXX	Gray to dark gray LIMESTONE, calcareous, slightly weathered, moderately broken, hard, medium bedded	95.0					
1140.4	XXXXXX	Gray SHALE, with calcareous limestone inclusions, slightly weathered, moderately broken, moderately soft, laminated	100.0					
		Gray and reddish-gray from 101.6' to 107' with few claystone seams.		RC 9	100 (56)			
1130.4	XXXXXX	Gray SILTSTONE, moderately to slightly micaceous, fresh, moderately broken, moderately hard, very thin bedded	105.0					
1128.2	XXXXXX	Gray SANDSTONE, micaceous, very fine to medium grained, interbedded calcareous limestone, fresh, moderately broken, hard, very thin bedded	110.0	RC 10	88 (68)			
			115.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1122.1		Gray SHALE, few interbedded siltstone seams, fresh, moderately broken, moderately soft, thinly laminated to laminated	115.0					<p>2-Inch Solid PVC Riser Sealed with Bentonite Grout</p> <p>Hole Plug (Bentonite Chips)</p> <p>Filter Sand</p>
1117.1		Reddish-brown and gray CLAYSTONE, few interbedded shale seams, fresh, moderately broken, moderately soft	120.0	RC 11	74 (33)			
1111.6		Gray SILTSTONE, interbedded limestone, fresh, slightly broken, moderately hard, very thin bedded	125.0					
1110.4		Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than 1/8" thick, limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded	130.0	RC 12	100 (83)			
1100.4		Gray SILTSTONE, slightly micaceous, discontinuous sandstone seams less than 1/10" thick, sporadic limestone inclusions throughout, fresh, moderately broken, moderately hard, very thin bedded	135.0					
1100.4			140.0	RC 13	100 (50)			
1093.9		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded throughout with siltstone seams which decrease in frequency with depth and are less than 1/10" thick, fresh, moderately broken, moderately hard to hard, very thin bedded to thin bedded	145.0					
1090.4		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded	150.0	RC 14	100 (90)			
			155.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded with siltstone lenses less than 1/16" thick from 147' to 152.3', siltstone seam approximately 1/16" thick at 159.5', discontinuous siltstone lenses from 174.5' to 176.2', fresh, slightly broken, hard, thick bedded (continued)	155.0					<p>2-Inch Slotted Screen</p> <p>Filter Sand</p>
			160.0	RC 15	100 (100)			
			165.0					
			170.0	RC 16	100 (68)			
			175.0					
1061.2		Gray SHALE, 0.5" coal seam at 176.5', hairline coal fractures at 176.3' and 178.4', fresh, broken, moderately hard, thinly laminated to laminated	180.0					
1060.4		Gray and dark gray SHALE, few claystone seams, fresh, moderately broken, moderately soft, laminated to thinly laminated						
1056.1		Gray SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams throughout, noted calcareous limestone inclusions throughout, fresh, moderately broken, hard, very thin bedded		RC 17	87 (59)			
1054.1	x x x x	Gray SILTSTONE, interbedded with sandstone and shale seams less than 1/16" thick, fresh, moderately broken, hard, very thin bedded	185.0					
1053.4	x x x x	Black SHALE, few limestone inclusions, gray shale from 184' to 184.2' and 186.7' to 186.9', fresh, moderately broken, moderately soft, thinly laminated to laminated						
1050.4		Dark gray SHALE, calcareous with limestone inclusions, fresh, slightly broken, hard, laminated						
1048.5	x x x x	Gray SILTSTONE, slightly micaceous, few limestone inclusions, sandstone layer from 191.7' to 192', fresh, moderately broken, moderately hard to hard, very thin bedded	190.0	RC 18	100 (56)			
1044.4		Gray SANDSTONE, very fine to medium grained, micaceous, few interbedded siltstone seams throughout, fresh, moderately broken, hard, very thin bedded	195.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			195.0					
1041.9	XXXXXX XXXXXX XXXXXX XXXXXX	Gray SILTSTONE, slightly micaceous, limestone inclusions, few interbedded sandstone seams throughout, fresh, moderately broken to broken, hard, very thin bedded						
1039.4	|||||	Gray SHALE, fresh, moderately broken, moderately soft to moderately hard, thinly laminated to laminated	200.0	RC 19	100 (86)			
1033.1	XXXXXX XXXXXX XXXXXX XXXXXX	Gray SILTSTONE, slightly micaceous, few discontinuous sandstone and shale lenses less than 1/10" thick, fresh, moderately broken, hard, very thin bedded	205.0					
1029.8	|||||	Gray SHALE, few limestone inclusions, interbedded slightly micaceous siltstone seams less than 1/8" in thickness, slightly micaceous siltstone layer from 210.7' to 211.2', fresh, broken, moderately soft, thinly laminated to laminated Few pyritic specks observed from 212' to 214'.	210.0	RC 20	95 (56)			
			215.0					
1021.7	|||||	Gray and reddish-gray to reddish-brown SHALE, fresh, broken, moderately hard, thinly laminated to laminated						
1019.1	|||||	Gray becoming reddish-brown and gray SHALE, few claystone seams, calcareous, limestone inclusions throughout, fresh, moderately broken, hard, laminated	220.0	RC 21	75 (60)			
			225.0					
1010.4	XXXXXX XXXXXX	Gray SILTSTONE, fresh, broken, moderately hard, very thin bedded						
1009.6	XXXXXX XXXXXX	Gray SANDSTONE, micaceous, very fine to fine grained, interbedded siltstone layers throughout, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded	230.0					
1006.7	XXXXXX XXXXXX XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded throughout with sandstone seams less than about 1/8" thick, fresh, broken, moderately hard, very thin bedded		RC 22	93 (59)			
1004.6	XXXXXX XXXXXX							
			235.0					

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CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1002.1	[Vertical line with horizontal dashes]	Gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, interbedded siltstone seams throughout which decrease in frequency with depth, fresh, moderately broken, hard, very thin bedded (<i>continued</i>)	235.0	RC 23	85 (48)			
1000.4		Gray SHALE, fresh, broken, moderately hard, thinly laminated to laminated Gray SHALE, few claystone seams, gray and light reddish-gray from 240.8' to 243.2', fresh, broken, moderately broken from 240.8' to 247', moderately hard, thinly laminated to laminated	240.0					
989.1	[Vertical line with 'x' marks]	Gray SILTSTONE, slightly micaceous, interbedded sandstone seams generally less than 1/8" thick, fresh, very thin bedded	250.0	RC 24	92 (36)			
983.1	[Vertical line with horizontal dashes]	Gray and reddish-brown SHALE, few claystone seams, thinly laminated to laminated, few interbedded siltstone seams from 254.3' to 254.9', fresh, moderately broken to broken, moderately hard	255.0					
979.3	[Vertical line with 'x' marks]	Coal seam at 258'. Gray SILTSTONE, slightly micaceous, fresh, moderately broken, hard, very thin bedded	260.0	RC 25	87 (62)			
977.9	[Vertical line with horizontal dashes]	Gray SHALE, calcareous, interbedded slightly micaceous siltstone throughout, few limestone inclusions throughout, very hard shale from 263.6' to 267' with limestone, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	265.0					
970.4	[Vertical line with horizontal dashes]	Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated	270.0	RC 26	93 (56)			
			275.0					

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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			275.0					
		Gray becoming gray and reddish-brown SHALE, many interbedded claystone seams, very calcareous throughout with limestone inclusions, pyritic specks observed at 275.7', predominantly reddish-brown claystone from 280.5' to 282.5', fresh, moderately broken, hard to very hard, thinly laminated to laminated (continued)	280.0					
954.9	XXXXXX	Gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, fresh, slightly broken, very hard, very thin bedded	285.0	RC 27	99 (74)			
952.2	.....	Gray SANDSTONE, micaceous, very fine to medium grained, fresh, slightly broken, very hard, thin bedded						
950.4	XXXXXX	Gray SILTSTONE, few limestone inclusions, slightly micaceous, interbedded sandstone seams 1/16" thick from 291.4' to 297', fresh, slightly broken, hard to very hard, very thin bedded	290.0					
			295.0	RC 28	97 (76)			
940.4	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded with shale, pyritic specks observed at 298.2' and 298.5', fresh, broken, hard, very thin bedded						
938.8	XXXXXX	Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, pyritic specks observed at 298.7', fresh, slightly broken, hard to very hard, very thin bedded	300.0					
937.9	.....						
936	XXXXXX	Gray SANDSTONE, micaceous, very fine to fine grained, few interbedded siltstone seams less than 1/16" thick, fresh, slightly broken, very hard, thin bedded		RC 29	96 (79)			
		Gray SILTSTONE, few limestone inclusions throughout, slightly micaceous, fresh, slightly broken, hard to very hard, very thin bedded	305.0					
930.4	XXXXXX	Gray SILTSTONE, slightly micaceous, few limestone inclusions, few interbedded sandstone seams less than 1/16" in thickness from 307.6' to 307.8', fresh, broken, hard, very thin bedded						
929.6	.....		Gray SANDSTONE, very fine to medium grained, interbedded siltstone seams throughout less than 1/4" thick, few limestone inclusions, fresh, moderately broken, hard, very thin bedded	310.0				
925.7	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded		RC 30	55 (11)			
			315.0					

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			315.0					
	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded sandstone and shale seams throughout less than 1/16" thick, fresh, broken, hard, very thin bedded (<i>continued</i>)						
920.4		Gray SANDSTONE, slightly micaceous, few interbedded sandstone seams less than 1/16" thick, fresh, broken, hard, very thin bedded						
919.6								
918.5	XXXXXX	Gray SANDSTONE, micaceous, very fine to medium coarse grained, few limestone inclusions, interbedded siltstone seams less than 1/8" thick, fresh, moderately broken, very hard, thin bedded	320.0					
	XXXXXX	Gray SILTSTONE, slightly micaceous, interbedded throughout with shale seams less than 1/8" thick, fresh, moderately broken, hard to very hard, very thin bedded		RC 31	98 (77)			
914.4		Gray SHALE, dark gray shale zone from 325.8' to 326', fresh, moderately broken, hard becoming moderately hard, thinly laminated to laminated	325.0					
910.4		Gray to dark gray SHALE, interbedded siltstone throughout, few limestone inclusions, fresh, moderately broken, hard, laminated	330.0					
			335.0					
				RC 32	100 (55)			
900.4		Gray SHALE, interbedded siltstone and sandstone seams throughout, interbedded hard siltstone layers with micaceous sandstone inclusions from 337.4' to 338.1' and 339' to 339.2', fresh, broken, moderately hard to hard, laminated	340.0					
897.4		Gray SANDSTONE, interbedded siltstone seams throughout less than 1/16" thick, micaceous, very fine to medium grained, interbedded limestone, fresh, moderately broken, hard, very thin bedded						
896.2								
		Gray SHALE, black shale lens 3/4" thick at 344.5', fresh, moderately hard, broken, thinly laminated to laminated		RC 33	100 (50)			
892.8		Gray and dark gray LIMESTONE, calcareous, fresh, moderately broken, very hard, thick bedded	345.0					
890.4		Gray and dark gray SHALE, calcareous, limestone seam 3/4" thick at 347.8', fresh, broken, moderately hard, laminated						
888.5		Gray LIMESTONE, calcareous, shale inclusions throughout, fresh, moderately broken, very hard, thick bedded	350.0					
885.7		Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated		RC 34	96 (50)			
883.6		Gray LIMESTONE, calcareous, shale inclusions throughout,						
883.1				355.0				

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
880.4		<p>fresh, moderately broken, very hard, medium bedded Gray and dark gray SHALE, calcareous, interbedded limestone seams throughout less than 1/8" thick, few limestone inclusions, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated (<i>continued</i>)</p> <p>Bottom of hole at 357.0 feet.</p> <p>Soil sampling completed on 9/6/11. Boring offset on 9/20/11 for rock coring. Augered to 17.5' to begin rock core sampling.</p> <p>The following groundwater level readings were taken during drilling: 9/21/2011 7:45 AM at 91.2' bgs (borehole depth = 107' bgs) 9/22/2011 8:25 AM at 223.1' bgs (borehole depth = 227' bgs) 9/23/2011 7:45 AM at 333.1' bgs (borehole depth = 347' bgs)</p> <p>Geophysical logging and packer testing were performed upon completion.</p> <p>Well MW1103F installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-18. The ground elevation for MW1103F = 1236.4 ft.</p>	355.0					



Civil & Environmental Consultants, Inc.
 4274 Glendale Milford Road
 Cincinnati, Ohio 45242

BORING NUMBER SB-23/ MW1104R

CLIENT American Electric Power
CEC PROJECT NUMBER 110-416
DATE STARTED 10/31/11 **COMPLETED** 11/2/11
DRILLING CONTRACTOR Frontz Drilling, Inc.
DRILLING METHOD Air Rotary Rock Core
LOGGED BY R. Mahle **CHECKED BY** M. McCoy
LOCATION N 486345.1, E 1609471.2

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
GROUND ELEVATION 1228.5 ft **HOLE SIZE** 0.5 ft
GROUND WATER LEVELS:
AT TIME OF DRILLING Refer to notes at bottom of log
AT END OF DRILLING Refer to notes at bottom of log
AFTER DRILLING Well installed

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1228.5		No soil sampling performed at boring location. Augered to 19' to begin rock coring.	0.0					<p>2.0' Stickup Concrete Seal 2-Inch Solid PVC Riser Sealed with Bentonite Grout</p>
1209.5		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, few limestone iclusions throughout, interbedded siltstone seams less than 1/16' thick from 19' to 23.2', moderate olive brown staining from 19.5' to 20.3', 23.3' to 24', 25.5' to 26' and 27.8' to 29' with few iron stains throughout, moderately weathered, moderately broken, hard, very fine bedded	20.0	RC 1	100 (79)			
1196.3		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, 1/8" thick iron stained fractures at 38.6' and 39', moderately weathered, slightly broken, moderately hard to hard, very thin bedded	35.0	RC 2	70 (54)			

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BORING NUMBER SB-23/ MW1104R

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CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, 1/8" thick iron stained fractures at 38.6' and 39', moderately weathered, slightly broken, moderately hard to hard, very thin bedded (<i>continued</i>)	35.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1189.5		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions and siltstone seams (less than 1/8" thick) throughout, slightly weathered, moderately broken, hard, very fine bedded	40.0					
1186.1		Medium bluish-gray SHALE, few interbedded slightly micaceous siltstone seams (less than 1/8" thick) from 42.4' to 43.8', grayish-red staining from 44' to 47.3' and 48.2' to 48.5', vertical fracture from 45.8' to 46.3', moderately weathered, moderately broken, moderately soft, thinly laminated to laminated Pyritic specks observed from 47.5' to 47.8'. Grayish-red claystone layer from 48.5' to 49.3'.	45.0	RC 3	100 (79)			
1179.2		Medium bluish-gray to grayish-red purple SILTSTONE, slightly micaceous, few interbedded shale seams (less than 1/8" thick) throughout, moderately weathered, moderately broken, moderately soft, very thin bedded	50.0	RC 4	63 (46)			
1178.2								
1177.1								
		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, few interbedded sandstone seams (less than 1/8" thick) throughout, slightly weathered, moderately broken, very thin bedded Grayish-blue SANDSTONE, micaceous, very fine to medium grained, interbedded limestone throughout, slightly weathered, slightly broken, hard, very thin bedded Broken from 59' to 59.3'.	55.0					
1169.2		Medium bluish-gray SILTSTONE, interbedded shale and sandstone seams (less than 1/8" thick) throughout, pyritic specks observed throughout, slightly weathered, moderately broken, moderately hard, very thin bedded	60.0					
1166.7		Medium bluish-gray and grayish-red SHALE, few claystone lenses, pyritic specks from 61.8' to 62.1', slightly weathered, moderately broken, moderately hard, thinly laminated	65.0	RC 5	96 (75)			
1161.8		Dark gray SHALE, calcareous interbedded limestone throughout, limestone layers from 66.7' to 67.1' and from 68.6' to 69', slightly weathered, moderately broken, moderately hard to hard, thinly laminated to thin bedded, thin bedded from 69' to 69.4'						
1159.1		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams from 69.4' to 69.7', few limestone inclusions, slightly weathered, moderately broken, hard, very thin bedded	70.0					
1157.1		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 74.6' to 79', limestone layer from 76.1' to 76.3', slightly weathered, moderately broken, moderately hard, very thin bedded	75.0	RC 6	98 (55)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

(Continued Next Page)



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BORING NUMBER SB-23/ MW1104R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			75.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 74.6' to 79', limestone layer from 76.1' to 76.3', slightly weathered, moderately broken, moderately hard, very thin bedded (continued)						
1149.5		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded shale seams (less than 0.5" thick) throughout, slightly weathered, moderately broken, moderately hard, very thin bedded	80.0					
			85.0	RC 7	88 (60)			
1141.7		Medium dark gray SHALE, slightly calcareous, limestone layer from 88.8' to 89', slightly weathered, moderately broken, moderately hard to hard, thinly laminated						
1139.5		Olive gray LIMESTONE, calcareous, brownish-gray layer with interbedded calcareous siltstone (slightly micaceous) from 90.3' to 90.8', slightly weathered, moderately broken, very hard, thin bedded	90.0					
1137.3		Dark gray to brownish-gray SILTSTONE, slightly micaceous, calcareous, interbedded limestone, few interbedded shale seams (less than 1/16" thick) from 92.8' to 99', slightly weathered, moderately broken, hard, thin bedded	95.0	RC 8	45 (20)			
1129.5		Brownish-gray SILTSTONE, slightly micaceous, calcareous, interbedded limestone throughout, medium bluish-gray from 100.7' to 103.9', slightly weathered, moderately broken, hard, very thin bedded	100.0					
1124.6		Medium bluish-gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, few siltstone seams (less than 1/8" thick), fresh, moderately broken, hard, very thin bedded	105.0	RC 9	87 (72)			
		Percentage of siltstone increasing with depth from 109' to 111.4'.	110.0					
1117.1		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, few discontinuous sandstone seams (less than 1/16" thick) from 111.4' to 114', few interbedded shale seams from 114' to 114.8', fresh, moderately broken, moderately hard to hard, very thin bedded	115.0	RC 10	90 (65)			

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PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1113.7		Medium bluish-gray SHALE, dark reddish-brown lens from 115.8' to 115.9', few interbedded siltstone lenses (less than 1/8" thick) from 114.8' to 115.8', fresh, moderately broken, moderately hard, thinly laminated to laminated (<i>continued</i>)	115.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1112.2		Dark reddish-brown CLAYSTONE, fresh, moderately broken to broken, moderately hard						
1108.8		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 119.7' to 126', fresh, moderately broken, hard, very thin bedded	120.0	RC 11	89 (50)			
		Interbedded shale seams (less than 1/10" thick) from 126' to 129'.	125.0					
1099.5		Medium bluish-gray SILTSTONE, slightly micaceous, fresh, slightly broken, moderately hard to hard, very thin bedded	130.0	RC 12	75 (64)			
		Few interbedded shale seams (less than 1/16" thick) from 137.8' to 139'.	135.0					
1089.5		Olive gray becoming grayish-brown, medium bluish-gray and dark reddish-brown SHALE, few interbedded siltstone seams (less than 1/10" thick), few claystone seams, slightly micaceous, fresh, moderately broken, moderately hard, thinly laminated	140.0	RC 13	88 (67)			
		Dark reddish-brown from 144.7' to 147.3' with claystone seams.	145.0					
1079.5		Medium bluish-gray SILTSTONE, slightly micaceous, few interbedded (less than 1/8" thick) sandstone seams, sandstone lens from 149.8' to 150.1', interbedded shale seams (less than 1/16" thick) with grayish-brown staining from 150.3' to 150.8', fresh, moderately broken, hard to very hard, very thin bedded	150.0	RC 14	96 (72)			
1077.7		Medium bluish-gray SANDSTONE, micaceous, very fine to medium grained, fresh, moderately broken, very hard, very thin bedded						
1074.1			155.0					

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PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1" thick) throughout, fresh, moderately broken, hard to very hard, very thin bedded (continued)	155.0					<p>2-Inch Solid PVC Riser Sealed with Bentonite Grout</p> <p>Hole Plug (Bentonite Chips)</p> <p>Filter Sand</p>
1069.5		Medium bluish-gray SILTSTONE, slightly micaceous, calcareous, few interbedded sandstone seams (less than 0.5" thick) throughout, few interbedded shale seams (less than 1/8" thick) throughout, interbedded limestone throughout, fresh, moderately broken, hard, very thin bedded	160.0	RC 15	95 (69)			
		Broken from 169' to 169.5'.	165.0					
1059		Medium gray SANDSTONE, micaceous, very fine to medium grained, interbedded limestone throughout, fresh, moderately broken, very hard, very thin bedded	170.0					
1057.1		Medium gray SILTSTONE, slightly micaceous, calcareous, few interbedded (less than 1/16" thick) shale seams and limestone throughout, fresh, moderately broken, hard, very thin bedded		RC 16	98 (68)			
1056		Medium bluish-gray SHALE, calcareous, moderate brown from 173.4' to 174.1', interbedded sandstone from 174.1' to 176.5', interbedded limestone throughout, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	175.0					
1052		Dark gray SILTSTONE, limestone lens from 176.5' to 176.6', limestone inclusions throughout, 1/8" grayish-black shale seams at 177.9' and 178', fresh, moderately broken, very hard, very thin bedded						
1050		Light gray SANDSTONE, micaceous, very fine to medium grained, few siltstone seams (less than 1/16" thick) and broken from 179' to 181.2', fresh, moderately broken, very hard, thin bedded	180.0					
1047.3		Grayish-black SHALE, fresh, moderately broken, moderately hard, thinly laminated						
1044.9		Medium bluish-gray SANDSTONE, micaceous, very fine to fine grained, calcareous limestone inclusions from 175.5' to 178.6', fresh, moderately broken, hard to very hard, very thin bedded to thin bedded	185.0	RC 17	98 (76)			
1039.5		Medium light gray SANDSTONE, micaceous, very fine to medium grained, medium dark gray less than 1/16" thick fine to medium grained seams throughout, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded	190.0					
			195.0	RC 18	97 (62)			

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BORING NUMBER SB-23/ MW1104R

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			195.0					
1032.7		Medium bluish-gray SILTSTONE, slightly micaceous, few interbedded shale seams less than 1/4" thick throughout, few calcareous limestone inclusions, fresh, moderately broken, hard, very thin bedded						<p>2-Inch Slotted Screen</p> <p>Filter Sand</p>
1029.5		Medium bluish-gray SHALE, some brownish-gray staining from about 201.5' to 202.5', few limestone inclusions, interbedded siltstone seams (less than 1/8" thick) from 199' to 201.3', fresh, moderately broken, hard, thinly laminated	200.0					
1025.3		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, few interbedded (less than 1/16" thick) very fine to fine grained sandstone seams, fresh, moderately broken, hard, very thin bedded	205.0	RC 19	96 (36)			
1023.8		Medium gray SANDSTONE, micaceous, very fine to medium grained, interbedded limestone, interbedded siltstone lenses from 207.4' to 207.9', fresh, moderately broken, very hard, very thin bedded						
1020.1		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, fresh, moderately broken, hard, very thin bedded	210.0					
1019.5		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded shale seams (increasing in percentage with depth) throughout, few sandstone seams (less than 1/4" thick) from 210.2' to 210.4', fresh, moderately broken, hard, very thin bedded						
1015.7		Medium bluish-gray SHALE, few interbedded siltstone seams (less than 1/8" thick) from 212.8' to 214.8', grayish-blue staining from 214.8' to 216.3', fresh, moderately broken, moderately hard to hard, thinly laminated	215.0	RC 20	95 (47)			
1012.1		Medium gray becoming dark reddish-brown SHALE, calcareous, interbedded limestone throughout, becoming dark reddish-brown starting at 217.3' with interbedded claystone, fresh, moderately broken, very hard, laminated						
1009.5		Dark reddish-brown to grayish-red CLAYSTONE, few interbedded shale lenses, calcareous and becoming less calcareous with depth, fresh, moderately broken, very hard	220.0					
			225.0	RC 21	83 (61)			
1002.7		Medium bluish-gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded						
999.5		Bottom of hole at 229.0 feet.						
		<p>The following groundwater level readings were taken during drilling: 11/1/2011 8:30 AM at 56.7' bgs (borehole depth = 59' bgs) 11/2/2011 9:36 AM at 173.3' bgs (borehole depth = 199' bgs) Well MW1104R installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-23. The ground elevation for MW1104R = 1228.7 ft.</p>						



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BORING NUMBER SB-23/ MW1104F

CLIENT American Electric Power
CEC PROJECT NUMBER 110-416
DATE STARTED 10/31/11 **COMPLETED** 11/2/11
DRILLING CONTRACTOR Frontz Drilling, Inc.
DRILLING METHOD Air Rotary Rock Core
LOGGED BY R. Mahle **CHECKED BY** M. McCoy
LOCATION N 486352.3, E 1609469.3

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
GROUND ELEVATION 1228.5 ft **HOLE SIZE** 0.5 ft
GROUND WATER LEVELS:
AT TIME OF DRILLING Refer to notes at bottom of log
AT END OF DRILLING Refer to notes at bottom of log
AFTER DRILLING Well installed

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1228.5		No soil sampling performed at boring location. Augered to 19' to begin rock coring.	0.0					<p>1.8' Stickup Concrete Seal 2-Inch Solid PVC Riser Sealed with Bentonite Grout</p>
1209.5		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, few limestone iclusions throughout, interbedded siltstone seams less than 1/16' thick from 19' to 23.2', moderate olive brown staining from 19.5' to 20.3', 23.3' to 24', 25.5' to 26' and 27.8' to 29' with few iron stains throughout, moderately weathered, moderately broken, hard, very fine bedded	20.0	RC 1	100 (79)			
1196.3		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, 1/8" thick iron stained fractures at 38.6' and 39', moderately weathered, slightly broken, moderately hard to hard, very thin bedded	35.0	RC 2	70 (54)			

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BORING NUMBER SB-23/ MW1104F

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, 1/8" thick iron stained fractures at 38.6' and 39', moderately weathered, slightly broken, moderately hard to hard, very thin bedded (<i>continued</i>)	35.0					2-Inch Solid PVC Riser Sealed with Bentonite Grout
1189.5		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions and siltstone seams (less than 1/8" thick) throughout, slightly weathered, moderately broken, hard, very thin bedded	40.0					
1186.1		Medium bluish-gray SHALE, few interbedded slightly micaceous siltstone seams (less than 1/8" thick) from 42.4' to 43.8', grayish-red staining from 44' to 47.3' and 48.2' to 48.5', vertical fracture from 45.8' to 46.3', moderately weathered, moderately broken, moderately soft, thinly laminated to laminated Pyritic specks observed from 47.5' to 47.8'. Grayish-red claystone layer from 48.5' to 49.3'.	45.0	RC 3	100 (79)			
1179.2		Medium bluish-gray to grayish-red purple SILTSTONE, slightly micaceous, few interbedded shale seams (less than 1/8" thick) throughout, moderately weathered, moderately broken, moderately soft, very thin bedded	50.0	RC 4	63 (46)			
1178.2								
1177.1								
		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions throughout, few interbedded sandstone seams (less than 1/8" thick) throughout, slightly weathered, moderately broken, very thin bedded Grayish-blue SANDSTONE, micaceous, very fine to medium grained, interbedded limestone throughout, slightly weathered, slightly broken, hard, very thin bedded Broken from 59' to 59.3'.	55.0					
1169.2		Medium bluish-gray SILTSTONE, interbedded shale and sandstone seams (less than 1/8" thick) throughout, pyritic specks observed throughout, slightly weathered, moderately broken, moderately hard, very thin bedded	60.0					
1166.7		Medium bluish-gray and grayish-red SHALE, few claystone lenses, pyritic specks from 61.8' to 62.1', slightly weathered, moderately broken, moderately hard, thinly laminated	65.0	RC 5	96 (75)			
1161.8		Dark gray SHALE, calcareous interbedded limestone throughout, limestone layers from 66.7' to 67.1' and from 68.6' to 69', slightly weathered, moderately broken, moderately hard to hard, thinly laminated to thin bedded, thin bedded from 69' to 69.4'						
1159.1		Grayish-blue SANDSTONE, micaceous, very fine to medium grained, interbedded siltstone seams from 69.4' to 69.7', few limestone inclusions, slightly weathered, moderately broken, hard, very thin bedded	70.0					
1157.1		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 74.6' to 79', limestone layer from 76.1' to 76.3', slightly weathered, moderately broken, moderately hard, very thin bedded	75.0	RC 6	98 (55)			

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BORING NUMBER SB-23/ MW1104F

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			75.0					
	XXXXXX	Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 74.6' to 79', limestone layer from 76.1' to 76.3', slightly weathered, moderately broken, moderately hard, very thin bedded (continued)						
1149.5	XXXXXX	Medium bluish-gray SILTSTONE, slightly micaceous, interbedded shale seams (less than 0.5" thick) throughout, slightly weathered, moderately broken, moderately hard, very thin bedded	80.0					
			85.0	RC 7	88 (60)			2-Inch Solid PVC Riser Sealed with Bentonite Grout
1141.7	|||||	Medium dark gray SHALE, slightly calcareous, limestone layer from 88.8' to 89', slightly weathered, moderately broken, moderately hard to hard, thinly laminated						
1139.5	|||||	Olive gray LIMESTONE, calcareous, brownish-gray layer with interbedded calcareous siltstone (slightly micaceous) from 90.3' to 90.8', slightly weathered, moderately broken, very hard, thin bedded	90.0					
1137.3	XXXXXX	Dark gray to brownish-gray SILTSTONE, slightly micaceous, calcareous, interbedded limestone, few interbedded shale seams (less than 1/16" thick) from 92.8' to 99', slightly weathered, moderately broken, hard, thin bedded	95.0	RC 8	45 (20)			
1129.5	XXXXXX	Brownish-gray SILTSTONE, slightly micaceous, calcareous, interbedded limestone throughout, medium bluish-gray from 100.7' to 103.9', slightly weathered, moderately broken, hard, very thin bedded	100.0					
1124.6	XXXXXX	Medium bluish-gray SANDSTONE, micaceous, very fine to medium grained, few limestone inclusions, few siltstone seams (less than 1/8" thick), fresh, moderately broken, hard, very thin bedded	105.0	RC 9	87 (72)			
		Percentage of siltstone increasing with depth from 109' to 111.4'.	110.0					
1117.1	XXXXXX	Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, few discontinuous sandstone seams (less than 1/16" thick) from 111.4' to 114', few interbedded shale seams from 114' to 114.8', fresh, moderately broken, moderately hard to hard, very thin bedded	115.0	RC 10	90 (65)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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BORING NUMBER SB-23/ MW1104F

CLIENT American Electric Power **PROJECT NAME** Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416 **PROJECT LOCATION** Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1113.7	[Diagonal hatching pattern]	Medium bluish-gray SHALE, dark reddish-brown lens from 115.8' to 115.9', few interbedded siltstone lenses (less than 1/8" thick) from 114.8' to 115.8', fresh, moderately broken, moderately hard, thinly laminated to laminated (<i>continued</i>)	115.0					<p>2-Inch Solid PVC Riser Sealed with Bentonite Grout</p> <p>Hole Plug (Bentonite Chips)</p> <p>Filter Sand</p>
1112.2		Dark reddish-brown CLAYSTONE, fresh, moderately broken to broken, moderately hard						
1108.8	[Cross-hatching pattern]	Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1/8" thick) from 119.7' to 126', fresh, moderately broken, hard, very thin bedded	120.0	RC 11	89 (50)			
		Interbedded shale seams (less than 1/10" thick) from 126' to 129'.	125.0					
1099.5	[Cross-hatching pattern]	Medium bluish-gray SILTSTONE, slightly micaceous, fresh, slightly broken, moderately hard to hard, very thin bedded	130.0	RC 12	75 (64)			
		Few interbedded shale seams (less than 1/16" thick) from 137.8' to 139'.	135.0					
1089.5	[Horizontal line pattern]	Olive gray becoming grayish-brown, medium bluish-gray and dark reddish-brown SHALE, few interbedded siltstone seams (less than 1/10" thick), few claystone seams, slightly micaceous, fresh, moderately broken, moderately hard, thinly laminated	140.0	RC 13	88 (67)			
		Dark reddish-brown from 144.7' to 147.3' with claystone seams.	145.0					
1079.5	[Cross-hatching pattern]	Medium bluish-gray SILTSTONE, slightly micaceous, few interbedded (less than 1/8" thick) sandstone seams, sandstone lens from 149.8' to 150.1', interbedded shale seams (less than 1/16" thick) with grayish-brown staining from 150.3' to 150.8', fresh, moderately broken, hard to very hard, very thin bedded	150.0					
1077.7		Medium bluish-gray SANDSTONE, micaceous, very fine to medium grained, fresh, moderately broken, very hard, very thin bedded						
1074.1	[Cross-hatching pattern]		155.0	RC 14	96 (72)			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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Civil & Environmental Consultants, Inc.
 4274 Glendale Milford Road
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BORING NUMBER SB-23/ MW1104F

CLIENT American Electric Power

PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant

CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded sandstone seams (less than 1" thick) throughout, fresh, moderately broken, hard to very hard, very thin bedded (continued)	155.0					<p>2-Inch Slotted Screen</p> <p>Filter Sand</p>
1069.5		Medium bluish-gray SILTSTONE, slightly micaceous, calcareous, few interbedded sandstone seams (less than 0.5" thick) throughout, few interbedded shale seams (less than 1/8" thick) throughout, interbedded limestone throughout, fresh, moderately broken, hard, very thin bedded	160.0	RC 15	95 (69)			
		Broken from 169' to 169.5'.	165.0					
1059		Medium gray SANDSTONE, micaceous, very fine to medium grained, interbedded limestone throughout, fresh, moderately broken, very hard, very thin bedded	170.0					
1057.1		Medium gray SILTSTONE, slightly micaceous, calcareous, few interbedded (less than 1/16" thick) shale seams and limestone throughout, fresh, moderately broken, hard, very thin bedded		RC 16	98 (68)			
1056		Medium bluish-gray SHALE, calcareous, moderate brown from 173.4' to 174.1', interbedded sandstone from 174.1' to 176.5', interbedded limestone throughout, fresh, moderately broken, moderately hard to hard, thinly laminated to laminated	175.0					
1052		Dark gray SILTSTONE, limestone lens from 176.5' to 176.6', limestone inclusions throughout, 1/8" grayish-black shale seams at 177.9' and 178', fresh, moderately broken, very hard, very thin bedded						
1050		Light gray SANDSTONE, micaceous, very fine to medium grained, few siltstone seams (less than 1/16" thick) and broken from 179' to 181.2', fresh, moderately broken, very hard, thin bedded	180.0					
1047.3		Grayish-black SHALE, fresh, moderately broken, moderately hard, thinly laminated		RC 17	98 (76)			
1044.9		Medium bluish-gray SANDSTONE, micaceous, very fine to fine grained, calcareous limestone inclusions from 175.5' to 178.6', fresh, moderately broken, hard to very hard, very thin bedded to thin bedded	185.0					
1039.5		Medium light gray SANDSTONE, micaceous, very fine to medium grained, medium dark gray less than 1/16" thick fine to medium grained seams throughout, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded	190.0	RC 18	97 (62)			
			195.0					

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CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			195.0					
1032.7		Medium bluish-gray SILTSTONE, slightly micaceous, few interbedded shale seams less than 1/4" thick throughout, few calcareous limestone inclusions, fresh, moderately broken, hard, very thin bedded						
1029.5		Medium bluish-gray SHALE, some brownish-gray staining from about 201.5' to 202.5', few limestone inclusions, interbedded siltstone seams (less than 1/8" thick) from 199' to 201.3', fresh, moderately broken, hard, thinly laminated	200.0					
1025.3		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, few interbedded (less than 1/16" thick) very fine to fine grained sandstone seams, fresh, moderately broken, hard, very thin bedded	205.0	RC 19	96 (36)			
1023.8		Medium gray SANDSTONE, micaceous, very fine to medium grained, interbedded limestone, interbedded siltstone lenses from 207.4' to 207.9', fresh, moderately broken, very hard, very thin bedded						
1020.1		Medium bluish-gray SILTSTONE, slightly micaceous, few limestone inclusions, fresh, moderately broken, hard, very thin bedded	210.0					
1019.5		Medium bluish-gray SILTSTONE, slightly micaceous, interbedded shale seams (increasing in percentage with depth) throughout, few sandstone seams (less than 1/4" thick) from 210.2' to 210.4', fresh, moderately broken, hard, very thin bedded						
1015.7		Medium bluish-gray SHALE, few interbedded siltstone seams (less than 1/8" thick) from 212.8' to 214.8', grayish-blue staining from 214.8' to 216.3', fresh, moderately broken, moderately hard to hard, thinly laminated	215.0	RC 20	95 (47)			
1012.1		Medium gray becoming dark reddish-brown SHALE, calcareous, interbedded limestone throughout, becoming dark reddish-brown starting at 217.3' with interbedded claystone, fresh, moderately broken, very hard, laminated						
1009.5		Dark reddish-brown to grayish-red CLAYSTONE, few interbedded shale lenses, calcareous and becoming less calcareous with depth, fresh, moderately broken, very hard	220.0					
			225.0	RC 21	83 (61)			
1002.7		Medium bluish-gray SANDSTONE, micaceous, very fine to fine grained, few limestone inclusions, fresh, moderately broken, very hard, very thin bedded						
999.5		Bottom of hole at 229.0 feet.						
		<p>The following groundwater level readings were taken during drilling: 11/1/2011 8:30 AM at 56.7' bgs (borehole depth = 59' bgs) 11/2/2011 9:36 AM at 173.3' bgs (borehole depth = 199' bgs) Well MW1104F installed after completion in an offset boring. The above-noted ground elevation corresponds to the ground elevation at which soil and rock sampling was initiated at SB-23. The ground elevation for MW1104F = 1228.5 ft.</p>						



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BORING NUMBER SB-09/ PZ1101H

CLIENT American Electric Power	PROJECT NAME Mitchell Landfill, Mitchell Electric Generating Plant
CEC PROJECT NUMBER 110-416	PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia
DATE STARTED 9/13/11 COMPLETED 9/19/11	GROUND ELEVATION 1141.3 ft HOLE SIZE 0.5 ft
DRILLING CONTRACTOR Frontz Drilling, Inc.	GROUND WATER LEVELS:
DRILLING METHOD HSA: Auto Hammer & Air Rotary Rock Core	AT TIME OF DRILLING Refer to notes at bottom of log
LOGGED BY B. Bashore CHECKED BY M. McCoy	AT END OF DRILLING 254.1 ft / Elev 887.2 ft
LOCATION N 485990.9, E 1610339.5	17.75 hours AFTER DRILLING 240.7 ft / Elev 900.6 ft

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
1141.3		TOPSOIL	0.0					2.3' Stickup
1141.2		Brown LEAN CLAY WITH SAND (CL), few shale fragments, trace roots, moist, medium stiff (RESIDUAL)		SS 1	67	3-3-3 (6)	1.2-1.8	Concrete Seal
1139.8		Reddish-brown to brown FAT CLAY (CH), noted iron oxide concretions, moist, very stiff (RESIDUAL)		SS 2	67	5-7-11 (18)	3.1-4.4	
1138.3		Shelby Tube sample obtained from 1'-3' (Recovery = 20")		SS 3	53	16-27-25 (52)	0.3-0.5	
1136.8		Grayish-brown SANDY LEAN CLAY (CL), few shale fragments, hard, moist (RESIDUAL)	5.0	SS 4	47	13-31-40 (71)	0.1	
		Grayish-brown to reddish-brown and brown SHALE, completely becoming highly weathered, very broken, very soft, laminated		SS 5	86	42-50/1"	1.5	
				SS 6	93	17-50/3"	1.9	
			10.0	SS 7	60	33-31-36 (67)	0.1	
				SS 8	80	50/3"	4.5+	
				SS 9	0	50/1"	1.2	
1127.8		Gray to dark gray SANDSTONE, few calcite inclusions, trace shale laminations, fine to medium grained, micaceous, few iron stained fractures, moderately weathered, slightly broken, hard to very hard, thick bedded	15.0	RC 1	95 (94)			1-Inch Solid PVC Riser Sealed with Bentonite Grout
1121		Dark gray SHALE, rough to smooth texture, vertical fractures with iron staining from 20.3' to 22', moderately weathered, very broken, moderately hard, laminated	20.0					
1119.3		Maroon CLAYSTONE, rough to smooth texture, highly weathered, very broken, soft to moderately hard		RC 2	28 (5)			
		Assuming highly weathered maroon claystone from 22.6' - 29.8' (No Recovery)	25.0					
1111.5		Dark gray SHALE, some limestone inclusions, some calcite inclusions, smooth to rough texture, moderately weathered, broken, soft, thinly laminated to laminated	30.0					
1106.9			35.0	RC	96			

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CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12



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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Dark gray SILTSTONE, some calcite inclusions, few limestone inclusions, rough to smooth texture, micaceous, moderately weathered, moderately broken, moderately hard to hard, very thin bedded (continued)	35.0	3	(88)			<p>1-Inch Solid PVC Riser Sealed with Bentonite Grout</p>
1101.5		Dark gray SILTSTONE, some sandstone seams and shale laminations, trace calcite inclusions, rough to smooth texture, micaceous, slightly weathered, broken, moderately hard to hard, very thin bedded	40.0					
1097.2		Dark gray SANDSTONE, some siltstone seams, fine to medium grained, micaceous, slightly weathered, moderately broken, hard, medium bedded	45.0	RC 4	99 (93)			
1095.4		Dark gray SILTSTONE, some sandstone seams, few calcite inclusions, rough to smooth texture, micaceous, slightly weathered, broken, moderately hard to hard, very thin bedded						
1092.8		Gray SANDSTONE, some siltstone seams, very fine to medium grained, micaceous, slightly weathered, moderately to slightly broken, hard to very hard, very thin bedded	50.0					
			55.0	RC 5	100 (100)			
1081.5		Gray SANDSTONE, trace calcite inclusions, fine to medium grained, micaceous, slightly weathered, moderately broken, hard, very thin bedded to medium bedded	60.0					
			65.0	RC 6	96 (93)			
1070.4		note: sandstone interbedded w/ shale and intensely fractured from 70.9' - 71.6'	70.0					
1069.7								
		Gray SANDSTONE, few shale laminations, fine to medium grained, micaceous, slightly weathered, slightly broken, hard, thin bedded to thick bedded	75.0	RC	93			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			75.0					
1065		Dark gray SHALE, smooth to rough texture, slightly weathered, broken, soft to moderately hard, thinly laminated to laminated		7	(74)			1-Inch Solid PVC Riser Sealed with Bentonite Grout
1061.5		Dark gray SHALE, some calcite inclusions, few limestone inclusions, smooth to rough texture, slightly weathered, broken, moderately hard to soft, thinly laminated to laminated	80.0					
1056.8		Dark gray to black SHALE, few claystone seams, some plant fossils, some calcite inclusions, rough texture, fresh, moderately broken, soft to moderately hard, thinly laminated to laminated	85.0	RC 8	97 (72)			
1054.3		Gray SANDSTONE, few shale inclusions, very fine to medium grained, micaceous, fresh, moderately broken, hard, very thin bedded						
1051.5		Dark gray to black SHALE, few calcite inclusions, smooth texture, fresh, broken, soft to hard, thinly laminated to laminated Completely black from 90.9' - 91.4', shale becomes interbedded with limestone at 91.4'.	90.0					
1047.3		Dark gray to gray SANDSTONE, some shale laminations, some limestone inclusions, fine to medium grained, micaceous, fresh, slightly weathered, hard, thick bedded	95.0	RC 9	77 (58)			
1041.5		Gray SANDSTONE, few coal inclusions, fine to medium grained, micaceous, fresh, slightly broken, hard, medium bedded to thick bedded	100.0					
			105.0	RC 10	100 (99)			
1031.5		Gray SANDSTONE, fine to medium grained, micaceous, fresh, slightly weathered, hard, medium bedded to thick bedded	110.0					
			115.0	RC	99			

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CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
		Gray SANDSTONE, fine to medium grained, micaceous, fresh, slightly weathered, hard, medium bedded to thick bedded <i>(continued)</i>	115.0	11	(99)			1-Inch Solid PVC Riser Sealed with Bentonite Grout
			120.0					
			125.0	RC 12	87 (71)			
1015.4		Dark gray to red-brown CLAYSTONE, waxy texture, fresh, broken, moderately hard to soft	130.0					
		Highly weathered vertical fracture at 132.8'.						
1007.8		Dark gray SHALE, interbedded siltstone seams throughout, some calcite inclusions, smooth to rough texture, fresh, moderately broken, soft to moderately hard, laminated	135.0	RC 13	95 (81)			
1003.8		Gray SANDSTONE, trace shale laminations, fine to medium grained, micaceous, fresh, moderately broken, hard, thin bedded to medium bedded	140.0					
996.7		Dark gray SHALE, smooth texture, fresh, broken, moderately hard to soft, thinly laminated to laminated	145.0	RC 14	86 (85)			
991.5		Dark gray to maroon SHALE, few claystone seams, some plant fossils, trace calcite inclusions, smooth to waxy texture, fresh, broken, soft to moderately hard, thinly laminated to laminated	150.0					
			155.0	RC	75			

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CEC PROJECT NUMBER 110-416

PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
985.6		Dark gray to maroon SHALE, few claystone seams, some plant fossils, trace calcite inclusions, smooth to waxy texture, fresh, broken, soft to moderately hard, thinly laminated to laminated (continued) note: siltstone layer from 155.7' - 156.7'	155.0	15	(41)			1-Inch Solid PVC Riser Sealed with Bentonite Grout
981.5		Dark gray to brown SHALE, some plant fossils, platy w/ horizontal bedding, smooth to rough texture, fresh, broken, soft to moderately hard, thinly laminated to laminated	160.0					
			165.0	RC 16	87 (73)			
975		Dark gray to brown SHALE, some plant fossils, smooth to rough texture, fresh, broken, moderately hard, thinly laminated to laminated	170.0					
971.5		Dark gray SHALE, some plant fossils, platy, smooth texture, fresh, broken, moderately hard to soft, thinly laminated to laminated	175.0	RC 17	90 (79)			
968.1		Dark gray to maroon SILTSTONE, few claystone seams throughout, trace calcite inclusions, slightly micaceous, rough texture, fresh, broken, soft, very thin bedded	180.0					
961.5		Dark gray to maroon SHALE, siltstone and claystone seams throughout, some plant fossils, smooth to rough texture, fresh, broken, moderately hard to soft, laminated	185.0	RC 18	78 (65)			
951.5		Dark gray to maroon CLAYSTONE, few shale and siltstone seams, trace plant fossils, platy, smooth to rough texture, fresh, broken, moderately hard to soft	190.0					
948.1		Dark gray SILTSTONE, few sandstone seams, trace calcite inclusions, gritty texture, micaceous, fresh, slightly broken, hard, thick bedded	195.0	RC	95			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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		Dark gray SILTSTONE, few sandstone seams, trace calcite inclusions, gritty texture, micaceous, fresh, slightly broken, hard, thick bedded <i>(continued)</i>	195.0	19	(91)			<p>Hole Plug (Bentonite Chips)</p> <p>Filter Sand</p> <p>1-Inch Slotted Screen</p>
943		Dark gray SHALE, some limestone inclusions, trace plant fossils, trace sandstone and siltstone seams, rough to smooth texture, fresh, broken, moderately hard to hard, laminated	200.0					
			205.0	RC 20	98 (95)			
935.3		Dark gray SANDSTONE, interbedded shale laminations increasing in percentage with depth, few siltstone seams, trace calcite inclusions, micaceous, very fine to medium grained, fresh, broken, moderately hard to hard, very thin bedded	210.0					
929.9		Gray SANDSTONE, some shale laminations, fine to medium grained, micaceous, fresh, moderately broken, hard, thin bedded to medium bedded note: sandstone interbedded w/ shale from 213.5' - 214.8'	215.0	RC 21	98 (97)			
			220.0					
918.5		Dark gray SHALE, some limestone inclusions, trace calcite inclusions, smooth to rough texture, fresh, broken, moderately hard to soft, thinly laminated to laminated	225.0	RC 22	94 (89)			
911.5		Dark gray to maroon SHALE, few claystone seams, trace calcite inclusions, platy, smooth texture, fresh, broken, moderately hard to soft, thinly laminated to laminated	230.0					
			235.0	RC	86			

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12

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PROJECT LOCATION Gatts Ridge Road, Cresap, West Virginia

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN (tsf)	WELL DIAGRAM
			235.0					
905.5		Dark gray SANDSTONE, interbedded shale laminations and siltstone seams, trace limestone inclusions, micaceous, fresh, broken, moderately hard to hard, very thin bedded		23	(68)			<p>Filter Sand</p> <p>Hole Plug (Bentonite Chips)</p>
901.5		Gray SANDSTONE, some shale laminations, fine to medium grained, micaceous, fresh, broken, hard, very thin bedded to thin bedded	240.0					
896.5		Dark gray SHALE, some interbedded sandstone, platy, smooth to gritty texture, fresh, very broken, moderately hard, thinly laminated to laminated	245.0	RC 24	94 (82)			
894.1		Gray SANDSTONE, few shale inclusions, fine to medium grained, micaceous, fresh, moderately broken, hard, very thin bedded						
893.5		Dark gray SHALE, some plant fossils, platy, smooth texture, fresh, broken, moderately hard, thinly laminated	250.0					
887.3		Black COAL, fresh, broken, laminated						
886.8		Dark gray SHALE, some plant fossils, platy, smooth texture, fresh, broken, moderately hard, thinly laminated to laminated	255.0	RC 25	57 (35)			
885.4		Brown to dark gray LIMESTONE, few coal inclusions, high reaction to HCl, fresh, slightly broken, very hard, thick bedded						
881.5		Bottom of hole at 259.8 feet.						
		<p>The following groundwater level readings were taken during drilling:</p> <ul style="list-style-type: none"> 9/13/2011 6:00 PM at 129.4' bgs (borehole depth = 129.8' bgs) 9/14/2011 8:00 AM at 109.3' bgs (borehole depth = 129.8' bgs) 9/15/2011 8:15 AM at 114.2' bgs (borehole depth = 149.8' bgs) 9/16/2011 8:00 AM at 211.7' bgs (borehole depth = 230' bgs) 9/19/2011 11:00 AM at 131.3' bgs (borehole depth = 230' bgs) 9/19/2011 2:40 PM at 254.1' bgs (borehole depth = 259.8' bgs) <p>The following groundwater level readings were taken after drilling:</p> <ul style="list-style-type: none"> 9/20/2011 8:30 AM at 240.7' bgs (borehole depth = 259.8' bgs) <p>Piezometer PZ1101H installed upon completion.</p>						

CEC CUSTOM LOG WITH WELL 110-416 MITCHELL LANDFILL.GPJ GOOD TEMPLATE.GDT 1/30/12