ATTACHMENT II-F

GROUNDWATER HYDROLOGY

GROUNDWATER HYDROLOGY (880-X-8E-.06(1))

Description of Groundwater Hydrology

Groundwater availability is determined by the inherent water-bearing characteristics of aquifers which are controlled by geologic factors such as type, permeability, and structure of strata which make up the aquifers. In the Warrior Coal Basin, groundwater occurs along well defined fractures, joints and bedding planes of the alternating sequences of the sandstones and shales within the Pottsville Formation. Recharge of aquifers is primarily by the infiltration of rainfall which percolates downward through openings along joints, fractures and bedding planes. According to historical published data, the Pottsville Formation is the predominate aquifer of north Alabama. Groundwater occurs in conditions where the underlying stratum prevents downward percolation of water and forms a "perched" water table along the alternating sequences of clays, sandstones, shales and coal seams. These perched zones are susceptible to climatic conditions such as seasonal precipitation variations and frequency of rainfall which can cause an increase in aquifer storage and groundwater pressure. In general permeability decreases with depth and as stated in "Regional Analysis of the Black Creek-Cobb Coalbed Methane Target Interval, Black Warrior Alabama, U.S.G.S. Bulletin 145" structural geology is a primary control on the hydrologic system. The production of water for water wells in the formation decreases with depth and these wells are typically developed in the weathered near-surface part of the Pottsville at an average depth of 150 feet. Due to decreasing permeability of the Pottsville, little additional water production is obtained below a depth of approximately 400 feet.

Ground water production is variable by local conditions in the Pottsville Formation and wells developed in this formation generally do not produce excessive groundwater as compared to the limestone aquifers of the Appalachian Plateaus and Interior Low Plateaus of Alabama. According to "Ground Water Atlas of the United States, U.S.G.S. Report HA 730-G", the sandstone beds of the Pottsville Formation yield small volumes of water, but the Pottsville supplies water to a large number of domestic wells because it caps thousands of square miles of upland plateaus. Water in the sandstone is obtained primarily from fractures. Recharge is primarily by the infiltration of rainfall which percolates downward through the soil and weathered rock horizon into the formation and is generally stored in and transmitted through openings along joints, fractures and bedding planes.

The overburden within the permit area is atypical of the Pottsville Formation as described with alternating layers of sandstones, shales, clays and coal seams. Information from this site shows that very little water is present in the strata above the coal seam and no distinct stratigraphic zones were encountered that consistently produce water were encountered during data collection. Groundwater movement near the Masseyline mine is believed to be in the direction of dip that is primarily to the northwest, based on the data obtained from drill holes. No springs and/or seeps were noted on the proposed permit area.

Lithologic Description of Water Bearing Zone(s)

Minimal groundwater was encountered during drilling of the Monitoring Wells/ Overburden Sample points. Water was noted on several drill logs by CDM Mining & Equipment, LLC and several intervals produced enough water to expel wet cuttings during the drilling of the monitoring wells at the proposed site. As the casings were being installed water could be heard

draining into the hole. (See drawings MW-1/OB-1, MW-2/OB-2, MW-3/OB-3 and MW-4/OB-4 for details of these overburden/groundwater monitoring wells and corresponding site data and wellhead protection appliances installed at each well.) On October 20, 2010, the first groundwater samples were taken after giving all monitoring wells time to stabilize. On this date the monitoring wells showed the following depths:

MONITORING WELL ID	DEPTH TO WATER	WATER ELEVATION (MSL)
MW-1	4.09'	486.74'
MW-2	41.82'	601.43'
MW-3	89.95'	595.16'
MW-4	85.45'	564.84'

For a more detailed description of the lithology of the Pottsville water bearing zones see the attached Lithologic fence diagrams (cross-sections) in Part II-E, drawings Geologic Section A-A', Geologic Section B-B', Geologic Section C-C', Geologic Section D-D' and Geologic Section E-E'.

Aquifer Test(s):

Aquifer test(s) have not been required at this time.

Well Inventory:

A well inventory is now pending for residences within one-half mine of the proposed mining site/boundary. Preliminary investigations revealed that there are one-hundred and sixty-six (166) occupied residences within the half-mile radius of the Masseyline Mine. The Birmingham Water Works provides the primary water source to all residences within the surrounding area of the proposed mine. (See Well Inventory and Hydro-Geo Map).

Groundwater Baseline Quality:

See attached Groundwater Baseline Analysis.

Geologic Structures that Impact Groundwater Movement

No major faults exist within the proposed mining area. The upturned limb of the Warrior Coal Field Monocline has resulted in variations of the dip of the strata to the northwest rather than the normal southwest trends of the Warrior Field. For maps and cross-sections to support the geology/lithology of this site, see the attached Structural Contour Map (Hydro-Geo Map) and Fence Diagrams, Geologic Section A-A', Geologic Section B-B', Geological Section C-C', Geological Section D-D' and Geologic Section E-E' (cross-sections) in Part II-E.

Groundwater Description Support Data:

All maps Fence Diagrams (cross-sections) are certified under Attachment II-H, Certification Statement.

Groundwater Sampling and Analytical Methods:

Groundwater samples were taken by TASK Engineering Management Inc. from the installed monitoring wells at the proposed mine site by the following methods:

1) Prior to starting the groundwater sampling sequence, the groundwater level was measured using the top of the casing as a reference point. This level and/or depth to the water surface was then measured using a "Solinst Water Level Meter 101" which will electronically read the existing water level and measure to an accuracy of 1/100' and to a depth of 300'. Ground surface elevations are determined by aerial photographs and digital terrain models and final water elevations are determined by correction (subtraction) of the stickup interval value measured for each individual well to adjust to actual surface elevation (MSL) and final determination of the water elevation (MSL).

2) Once water elevation is determined, the monitoring well is bailed using a three (3) inch diameter, three (3) foot length PVC well bailer to purge at least ten (10) bailer volumes (where the water quantities are available in the well). The well will then be allowed to recover for a minimum of one (1) hour.

3) After purging and recovery, the monitoring well is sampled using a "Solinst Stainless Steel Point Source Bailer-Model 429" which allows samples of groundwater from specific depths using a system of top and bottom ball valves. Samples are taken approximately ten (10) feet above the coal seam as determined from drill logs and developed geologic columns.

Note: Samples are taken approximately ten (10) feet above the lowest coal seam because most coal seams within the Pottsville Formation are generally fairly good aquifers due to the cleat systems found in coal and representative samples can be taken by this method.

4) Monitoring well samples are decanted from the bailer into new, clean plastic sample bottles immediately after removing the bailer from the well. Depth to water surface, pH and Conductivity are measured in the field. After all field measurements are completed, the time, date, mine identification and monitoring well identification are recorded on the sample bottle and on a chain of custody form to maintain documentation and sample integrity. Samples are then deposited in a field cooler with ice to refrigerate to near 4°C for delivery to the TASK Engineering Management Inc. offices for further chemical testing.

5) The bailer is washed with distilled water and dried after each sample sequence to avoid contamination.

All groundwater samples were taken by the hand-dip (grab) method as defined by the 17th Edition of Standard Methods for the Examination of Water and Wastewater. See following for description and documentation of methodology of analyses:

1) Analysis of pH was a direct reading and performed in accordance with the standard operating procedures of the Hach Company's sensION1 Portable pH meter.

2) Analysis of Conductivity, SpC, was a direct reading and performed in accordance with the standard operating procedures of the Hach Company's DR3 Spectrophotometer which is equipped with a conductivity meter.

3) Analysis of Total Iron, Fe, was utilizing a Hach DR/890 Colorimeter and performed in accordance with the Hach DR/820-DR/850-DR/890 Datalogging Colorimeter Handbook, "FerroVer Method", pp.227 through 233 (USEPA approved).

4) Analysis of Total Manganese, Mn, was performed in accordance with the Hach DR/820-DR/850-DR/890 Datalogging Colorimeter Handbook, "Periodate Oxidation Method", pp.253 through 261 (USEPA approved).

5) Analysis of Sulfate, SO_4, was performed in accordance with the Hach DR/820-DR/850-DR/890 Datalogging Colorimeter Handbook, "SulfaVer 4 Method", pp.539 through 545 (USEPA approved).

6) Analysis of Acidity was performed by digital titration in accordance with the Hach Water Analysis Handbook , "Methyl Orange Method" pp.2-3 through 2-5.

7) Analysis of Alkalinity was performed by digital titration in accordance with the Hach Water Analysis Handbook, "Titration Method" pp.2-9 through 2-12.

NOTE: Any chemical analyses parameters outside the ability of TASK Engineering Management Inc. will be sent to ESC LAB SCIENCES for processing. Samples not analyzed by TASK Engineering Management Inc. will be so noted by correspondence to the Regulatory Authority.

Results of Groundwater Sampling and Analytical Data for Each Sample

See attached Groundwater Water Baseline Tables. All groundwater samples were analyzed for pH, Total Iron, Total Manganese, Conductivity, Sulfates, Acidity, Alkalinity, Water Depth and Water Elevation.

GROUNDWATER BASELINE ANALYSIS

SAMPLE I.D.: MW-1
MONITORING SOURCE: WELL
MONITORING ELEVATION: 490.83 FT. MSL

DATE	H20 DEPTH FT.	pH s.u.	SpC u-mhos/cm	Fe Mg/l	Mn Mg/l	SO4 Mg/l	ACID Mg/l	ALKA Mg/l
10/20/10	4.09	5.74	95	1.54	0.5	7	3	23
11/22/10	4.11	5.03	72	1.26	0.6	8	9	31
12/21/10	4.25	5.23	60	1.77	0.4	6	12	42
01/26/11	3.77	5.49	83	2.03	0.7	10	6	19
02/23/11	3.21	5.77	105	1.71	0.4	8	7	29
03/25/11	3.18	5.34	90	1.66	0.3	9	10	30
04/24/11	2.95	5.42	86	1.41	0.6	7	5	19
05/25/11	3.46	5.52	102	1.20	0.5	9	7	34
06/27/11	2.83	5.80	103	1.60	0.3	8	11	39
07/27/11	2.77	5.72	71	1.16	0.5	6	8	27
08/25/11	2.86	5.66	53	1.09	0.3	4	4	29
09/29/11	2.44	5.69	49	1.02	0.3	3	4	36
10/26/10	2.90	5.74	45	0.94	0.1	2	7	26
11/28/11	2.63	5.52	51	0.92	0.4	5	6	28
12/28/11	2.51	5.61	52	1.12	0.3	6	10	32

GROUNDWATER BASELINE ANALYSIS

SAMPLE I.D.: MW-2
MONITORING SOURCE: WELL
MONITORING ELEVATION: 643.25 FT. MSL

DATE	H20 DEPTH FT.	pH s.u.	SpC u-mhos/cm	Fe Mg/l	Mn Mg/l	SO4 Mg/l	ACID Mg/l	ALKA Mg/l
10/20/10	41.82	6.01	318	2.57	0.7	123	21	19
11/22/10	41.65	6.21	304	2.60	0.6	109	23	21
12/21/10	41.93	6.20	260	2.90	0.8	115	19	15
01/26/11	41.30	6.42	225	3.01	0.6	120	27	29
02/23/11	40.66	6.46	219	3.11	0.5	106	10	36
03/25/11	40.71	6.63	191	3.15	0.7	96	14	30
04/24/11	39.86	6.54	199	3.12	0.9	88	15	21
05/25/11	40.31	6.71	186	3.22	0.8	89	17	31
06/27/11	38.79	6.42	209	3.17	0.7	104	16	34
07/27/11	36.24	6.62	196	3.20	0.6	90	12	29
08/25/11	37.30	6.69	202	3.36	0.7	94	17	26
09/29/11	35.27	6.59	226	3.32	0.4	102	19	34
10/26/10	34.50	6.73	183	3.44	0.7	82	21	39
11/28/11	32.60	6.41	219	3.39	0.9	117	22	26
12/28/11	30.98	6.61	192	3.47	0.8	98	16	29

GROUNDWATER BASELINE ANALYSIS

SAMPLE I.D.: MW-3
MONITORING SOURCE: WELL
MONITORING ELEVATION: 685.11 FT. MSL

DATE	H20 DEPTH FT.	pH s.u.	SpC u-mhos/cm	Fe Mg/l	Mn Mg/l	SO4 Mg/l	ACID Mg/l	ALKA Mg/l
10/20/10	89.95	6.09	213	1.81	0.6	7	12	26
11/22/10	89.20	6.21	175	1.62	0.4	8	15	31
12/21/10	89.79	6.29	165	1.44	0.5	6	10	30
01/26/11	89.34	6.37	142	1.27	0.4	5	11	34
02/23/11	89.62	6.44	145	0.90	0.2	3	14	30
03/25/11	89.10	6.61	137	0.75	0.3	3	15	26
04/24/11	89.33	6.69	141	0.66	0.4	5	19	24
05/25/11	89.67	6.76	139	0.71	0.6	6	9	21
06/27/11	87.22	6.82	127	0.69	0.5	5	12	26
07/27/11	86.19	6.91	131	0.65	0.4	5	13	29
08/25/11	86.45	6.23	159	0.81	0.3	6	16	32
09/29/11	84.78	6.95	136	0.85	0.4	5	15	21
10/26/10	82.58	7.05	135	0.61	0.5	6	20	19
11/28/11	81.88	7.02	129	0.55	0.6	7	22	15
12/28/11	81.06	6.98	136	0.71	0.5	5	21	17

GROUNDWATER BASELINE ANALYSIS

SAMPLE I.D.: MW-4
MONITORING SOURCE: WELL
MONITORING ELEVATION: 650.29 FT. MSL

DATE	H20 DEPTH FT.	pH s.u.	SpC u-mhos/cm	Fe Mg/l	Mn Mg/l	SO4 Mg/l	ACID Mg/l	ALKA Mg/l
10/20/10	85.45	6.10	87	2.90	6.1	15	19	36
11/22/10	84.90	6.22	106	3.12	5.2	26	22	42
12/21/10	85.10	6.49	113	3.29	4.1	19	26	44
01/26/11	84.77	6.36	90	2.97	1.2	12	18	39
02/23/11	84.60	6.60	52	1.49	0.9	8	21	42
03/25/11	84.23	6.21	100	2.79	1.2	9	19	35
04/24/11	84.26	6.50	88	1.98	0.9	7	20	46
05/25/11	84.75	6.42	75	1.80	0.7	10	19	39
06/27/11	83.90	6.56	79	1.72	1.1	9	17	35
07/27/11	82.97	6.78	50	2.14	1.8	7	14	29
08/25/11	83.39	6.72	82	1.95	0.9	5	16	30
09/29/11	82.46	6.60	70	1.75	1.2	10	12	29
10/26/10	81.60	6.54	62	1.66	0.8	6	15	33
11/28/11	79.66	6.90	120	1.70	1.3	9	19	26
12/28/11	78.33	6.71	89	1.86	2.3	19	18	21

SEASONAL GROUNDWATER DATA

SAMPLE I.D.: MW-1
MONITORING EL.: 590.83 FT. MSL

SEASON	H20 DEPTH	pH s.u.	SpC u-mhos/cm	Fe Mg/l	Mn Mg/l	SO4 Mg/l	ACID Mg/l	ALKA Mg/l
SUMMER	2.69	5.69	57.67	1.09	0.37	4.33	5.33	30.67
FALL	3.42	5.39	62.50	1.26	0.38	5.67	7.83	30.33
WINTER	3.39	5.50	92.67	1.80	0.47	9.00	7.67	26.00
SPRING	3.08	5.55	97.00	1.40	0.47	8.00	7.67	30.67
AVERAGE	3.14	5.53	77.76	1.39	0.42	6.75	7.13	29.42

SEASONAL GROUNDWATER DATA

SAMPLE I.D.: MW-2
MONITORING EL.: 643.25 FT. MSL

SEASON	H20 DEPTH	pH s.u.	SpC u-mhos/cm	Fe Mg/l	Mn Mg/l	SO4 Mg/l	ACID Mg/l	ALKA Mg/l
SUMMER	36.27	6.63	208.00	3.29	0.57	95.33	16.00	29.67
FALL	37.25	6.29	246.00	3.06	0.75	107.33	20.33	24.83
WINTER	40.89	6.49	211.67	3.09	0.60	107.33	17.00	31.67
SPRING	39.65	6.54	198.00	3.17	0.80	93.67	16.00	28.67
AVERAGE	38.52	6.49	215.92	3.15	0.68	100.92	17.33	28.71

SEASONAL GROUNDWATER DATA

SAMPLE I.D.: MW-3
MONITORING EL.: 685.11 FT. MSL

SEASON	H20 DEPTH	pH s.u.	SpC u-mhos/cm	Fe Mg/l	Mn Mg/l	SO4 Mg/l	ACID Mg/l	ALKA Mg/l
SUMMER	85.81	6.56	142.00	0.77	0.37	5.33	14.67	27.33
FALL	85.74	6.43	158.83	1.12	0.52	6.50	16.67	23.00
WINTER	89.35	6.46	141.33	0.97	0.30	3.67	13.33	30.00
SPRING	88.74	6.75	135.67	0.69	0.50	5.33	13.33	23.67
AVERAGE	87.41	6.55	144.46	0.89	0.42	5.21	14.50	26.00

SEASONAL GROUNDWATER DATA

SAMPLE I.D.: MW-4
MONITORING EL.: 650.29 FT. MSL

SEASON	H20 DEPTH	pH s.u.	SpC u-mhos/cm	Fe Mg/l	Mn Mg/l	SO4 Mg/l	ACID Mg/l	ALKA Mg/l
SUMMER	82.94	6.69	67.33	1.95	1.30	7.33	14.00	29.33
FALL	82.51	6.41	96.17	2.42	3.30	15.67	19.83	33.67
WINTER	84.53	6.36	80.67	2.42	1.10	9.67	19.33	38.67
SPRING	84.30	6.49	80.67	1.83	0.90	8.67	18.67	40.00
AVERAGE	83.57	6.49	81.21	2.15	1.65	10.33	17.96	35.42