USING MINESOIL AND OVERBURDEN ANALYSES TO LOCATE A HIGHWAY IN WEST VIRGINIA[1]

Jennifer R. Jones, John C. Sencindiver, and Jeffrey G. Skousen[2]

Abstract. Appalachian Corridor H will pass through Beaver Creek watershed in Tucker County, West Virginia. Some of this area has been affected by surface mining of Upper Freeport Coal. The resulting mined lands are currently producing acid mine drainage, and have the potential to produce more if disturbed. In order to document soil development and to predict impacts of disturbance on water quality, a study was initiated to evaluate properties of the minesoils that may be affected by highway construction. Six sampling sites were located on both minesoils and native soils, and both will be disturbed during road construction. Soil profiles were described and horizons were sampled for laboratory analysis. Analyses of pH; total carbon and sulfur; and acid-base accounting were completed for the soils. The pH values ranged from 3.2 to 5.0. Total sulfur was generally low, ranging from 0.01% to 0.64%. Several rock cores drilled along two proposed routes by a private firm were sampled and analyzed by acid-base accounting procedures. The cores indicated generally acidic rock units in this region and the potential of producing additional acidity if unweathered rocks and minesoils are exposed to the atmosphere. The minesoil and core data have been used to assist the West Virginia Division of Highways in locating the corridor through the mined areas.

Additional Key Words: acid-base accounting, acid mine drainage, soil development, reclamation.

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[2] Jennifer R. Jones is a graduate research assistant and John C. Sencindiver and Jeffrey G. Skousen are professors in the Division of Plant and Soil Sciences, West Virginia University, P.O. Box 6108, Morgantown, WV 26506-6108.

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Introduction

A Portion of the proposed Appalachian Corridor H will pass through the Beaver Creek watershed in Tucker County, WV. Beaver Creek flows adjacent to Rt. 93 and enters the Blackwater River near the town of Davis. Construction of the new highway will redisturb areas that were previously mined for Upper Freeport coal, as well as undisturbed materials that have formed over the Upper Freeport coal.

The Upper Freeport coal is the upper strata of the Allegheny group of the Pennsylvanian System (West Virginia University, 1995). Upon exposure to air and water, the shales that are found both under and over the Upper Freeport coal, as well as the coal itself, are expected to produce acid mine drainage (West Virginia University, 1995). Minesoils in the area are currently producing some acid mine drainage. Redisturbance of these minesoils and undisturbed materials could potentially increase the acid mine drainage problems of the area.

Two different proposed routes have been recommended for one section of Corridor H along Beaver Creek (Figure 1). One proposed route will redisturb more of the mined and reclaimed lands than the other route. The second proposed route will be located adjacent to and use part of the existing Rt. 93 in road construction. This will help decrease the amount of material that will be disturbed.

The objectives of this study were to evaluate each of the proposed routes of Corridor H through the mined and reclaimed lands, and to provide the West Virginia Division of Highways with an assessment of the impacts of building the highway through these areas. Furthermore, data generated in this study could be used to determine the preventative measures necessary to protect the area from a detrimental increase in acid mine drainage, and the amendments needed to reclaim disturbed sites.

Methods and Materials

The research area is comprised of undisturbed materials and three major disturbed areas along ridgetops resulting from mining the Upper Freeport Coal in the 1960's. These are located on the southeastern side of Rt. 93, approximately 5 km northeast of Davis, West Virginia (Figure 1).

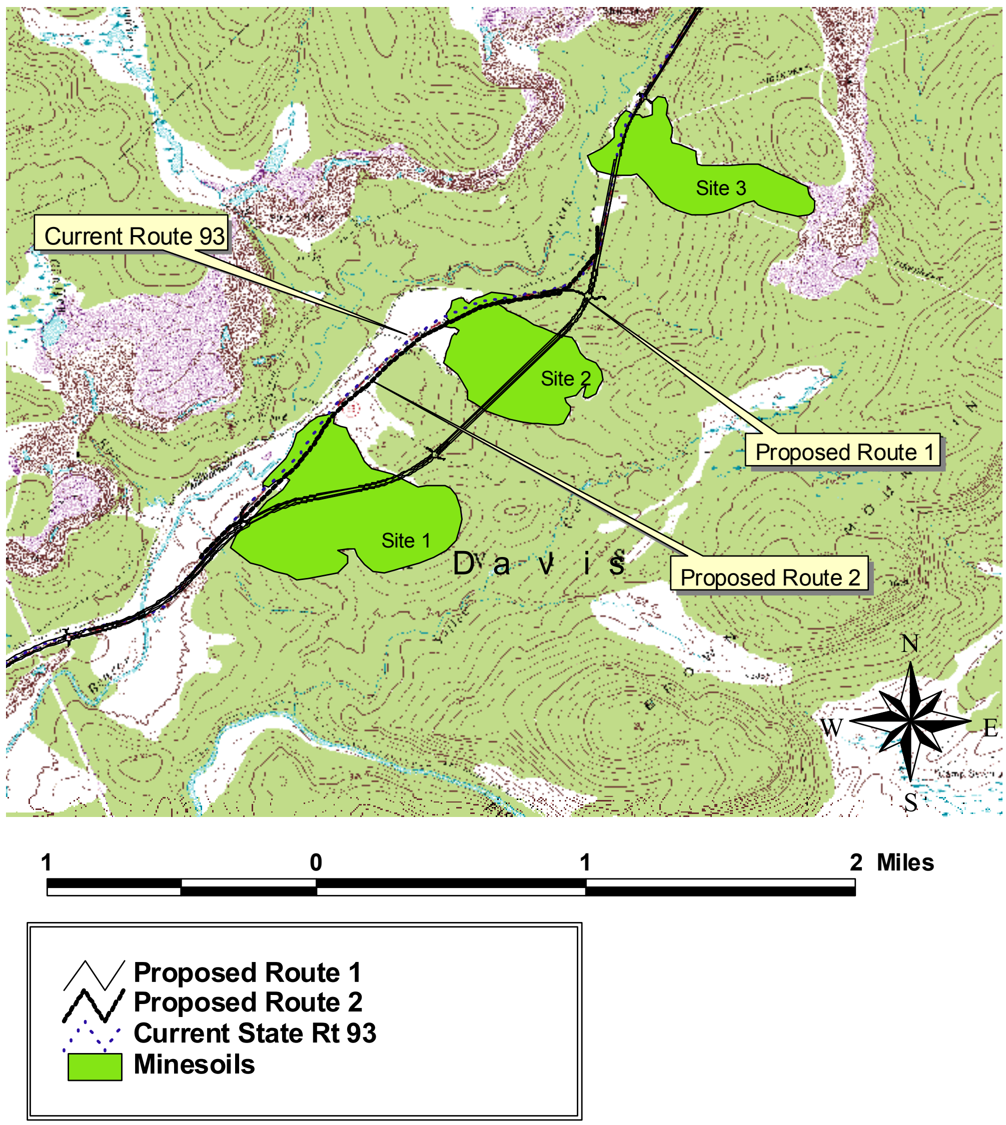

Figure 1. Proposed corridor H routes and location of minesoil sites 1, 2, and 3 (Davis Quadrangle WV-MD Topographic Map)

On each of the three disturbed areas, two soil pits (for a total of six) were described and sampled. The most southwestern spoil pile within the research area was identified as Site 1. The most northeastern spoil pile was identified as Site 3, with Site 2 located in between sites 1 and 3.

The minesoil sampling sites were located along what will be known as route #1. Six undisturbed sampling sites were selected adjacent to the mined areas. These were spread among the disturbed sites with undisturbed site 1 being the most southwestern site and site 6 being the most northeastern.

Each of the soil pits were excavated to at least 100 cm and described according to standard soil survey techniques (Soil Survey Division Staff, 1993). Bulk samples were taken from each described horizon for laboratory analyses. The samples were taken to laboratories in the Division of Plant and Soil Sciences at West Virginia University where they were prepared for analyses by air drying and sieving to less than 2 mm.

Each soil sample was analyzed for pH, neutralization potential (NP), total carbon, and total sulfur. The pH of each soil was measured using a 1:1 (soil:water) method (method 81c, Soil Survey Staff, 1996). Total carbon and sulfur were determined using a LECO CNS 2000 analyzer. Total sulfur and NP were used to determine the acid-base account (ABA) as outlined in Skousen et al. (1997).

The ABA consists of three important values: the maximum potential acidity (MPA), the neutralization potential (NP), and the net neutralization potential (NNP). The MPA is the maximum amount of sulfuric acid that can be produced from the oxidation of sulfur in the coal and overburden and is determined by multiplying the total sulfur by 31.25. The value of 31.25 is used because it represents the amount of $CaCO_3$ in tons that it would take to neutralize 1000 tons of material that contains 1% pyritic sulfur (Skousen et al., 2001; Sobek et al., 2000). The NP is a measure of the amount of neutralizing materials within the soil, coal, and overburden. Both values are expressed in tons of $CaCO_3$/ 1000 tons of material. The third value in the ABA is the NNP. This is determined by subtracting the MPA from the NP. Negative NNP values indicate potentially acid producing materials, where positive numbers indicate potentially acid-neutralizing materials (Skousen et al., 1987; 2001). When the NNP values are below – 5 tons $CaCO_3$/1000 tons, materials are expected to produce significant amounts of acidic drainage and the more negative the number, the higher the potential. The ABA procedure can also help to identify alkaline materials. In order for layers to be considered alkaline and to be used for neutralization of surrounding acidic layers, they must have a NNP value of >15 tons $CaCO_3$/1000 tons (Skousen et al., 1987). Materials with NNP values between >-5 and <15 tons $CaCO_3$/1000 tons material are not identified as either acid-producing or acid-neutralizing. Small amounts of acid can be produced from materials within this group that have low pH values. Insignificant amounts of alkalinity may be produced from materials with high pH values that fall within this group.

Rock cores were drilled and sampled for acid-base accounting by a private consulting firm. Eleven cores have been chosen for discussion in this paper. All of the cores from route 2 have been included and five of the cores from route 1 have been included. Four of the cores were located on the minesoil sites 1 and 2 along the first proposed route. These four cores were selected for discussion in this paper due to their location and proximity to the minesoil sampling sites. Cores R-1-3 and R-1-5 were located on site 1; cores R-1-9 and R-1-10 were located on site 2. There were no cores sampled for ABA on site 3. Five of the cores were located on the minesoils along the second proposed route. Cores R-2-13 and R-2-14 were located on site 1; cores R-2-16, R-2-17, and R-2-18 were located on site 2. Again, there were no cores located on minesoil site 3. There were also two cores located on undisturbed material; these were cores R-1-1 and R-2-15. As the numbers indicate, R-1-1 was located along the first route, while R-2-15 was located along the second route. These cores reached to deeper depths than the soil data and extend to the actual road construction grade. The core data were used to complement minesoil and undisturbed soil data in order to evaluate proposed highway placement.

Results and Discussion

Profile Descriptions

All soils sampled for this project showed some degree of pedogenesis. Two of the minesoils had O (organic) horizons at the surface with A horizons below the O horizons, and Bw (weakly developed B) horizons under the A horizons. In other words, the profiles had O-A-B-C horizonization. The other four minesoils had A horizons at the surface. Three of these profiles had Bw horizons under the A's, showing A-B-C horizonization. Site 3 Pit 1 did not have a Bw horizon, but did have an AC transition below the A horizon, showing O-AC-C horizonization. The major O horizons ranged from 1 to 3 cm in thickness and the major A horizons ranged from 5 to 9 cm in thickness. The solum ranged from 9 to 99 cm in thickness. The solum included all O, A, AC, and Bw horizons. All of the minesoils were located on sideslopes with slopes ranging from 7% to 28% (Table 1). Field descriptions were used to classify the soils (Soil Survey Staff, 1998). Four were classified as Inceptisols and two were classified as Entisols (Table 2).

Table 1. Landforms, slope, and aspect of sampling sites.

	Sample ID	Landform	Slope (%)	Aspect
Minesoils	Site 1 Pit 1	Sideslope	28	SW
	Site 1 Pit 2	Sideslope	24	W
	Site 2 Pit 1	Sideslope	9	W
	Site 2 Pit 2	Sideslope	5	N NW
	Site 3 Pit 1	Sideslope	7	W
	Site 3 Pit 2	Sideslope	11	SW
Undisturbed Soils	Site 1	Terrace	2	---------
	Site 2	Sideslope	6	N
	Site 3	Sideslope	9	W
	Site 4	Toeslope	4	NW
	Site 5	Toeslope	4	NW
	Site 6	Footslope	36	N

Table 2. Classification of minesoils and undisturbed soils. *

	Sample ID	Soil Order	Taxonomic Name
Minesoils	Site 1 Pit 1	Inceptisol	loamy-skeletal, mixed, acid, mesic, Typic Dystrudepts
	Site 1 Pit 2	Inceptisol	loamy-skeletal, mixed, acid, mesic, Typic Dystrudepts
	Site 2 Pit 1	Entisol	loam-skeletal, mixed, acid, mesic, Typic Udorthents
	Site 2 Pit 2	Inceptisol	loamy-skeletal,mixed, acid, mesic, Aquic Dystrudepts
	Site 3 Pit 1	Entisol	clayey, mixed, acid, mesic, Aquic Udorthents
	Site 3 Pit 2	Inceptisol	clayey, mixed, acid, mesic, Aquic Dystrudepts
Undisturbed Soils	Site 1	Ultisol	fine, mixed, acid, mesic, Typic Fragiaquults
	Site 2	Inceptisol	fine-loamy, mixed, acid, mesic, Aquic Dystrudepts
	Site 3	Inceptisol	fine-loamy, mixed, acid, mesic, Aquic Dystrudepts
	Site 4	Inceptisol	fine-loamy, mixed, acid, mesic, Typic Endoaquepts
	Site 5	Inceptisol	coarse-loamy, mixed, acid, mesic, Aquic Fragiudepts
	Site 6	Inceptisol	coarse-loamy, mixed, acid, mesic, Typic Dystrudepts

*Classifications are based on field descriptions and are subject to change.

Three of the undisturbed soils had A horizons at the surface, and B horizons in the subsoil. However, undisturbed sites 4, 5, and 6 all had O horizons at the surface. Site 4 had an E horizon under the O followed by a B horizon. Site 5 had an A/E transition under the O followed by B horizons. Site 6 had an A horizon under the O with E and B horizons described under the A. The major O horizons ranged from 4 to 10 cm thick and the major A horizons ranged from 4 to 23 cm thick. The solum ranged from 75 to 100+ cm in thickness. In these soils, the solum included all O, A, B, and transition horizons.

The undisturbed soils had thicker O and A horizons as well as thicker sola. They also exhibited stronger structure and a larger variance in texture than the undisturbed soils. This was expected because the development of the undisturbed soils was not interrupted and they have had much longer time periods to develop than the minesoils. Two of the undisturbed soils were found on sideslopes, one on a footslope, two on toeslopes, and one on a terrace. The slopes of these soils ranged from 2 to 36% (Table 1). Four of the five undisturbed soils were classified as Inceptisols, and one was classified as an Ultisol (Table 2).

Chemical Data

For purposes of presenting and analyzing data, all subordinate horizons and transition horizons beginning with A (such as AC) have been combined for each individual soil profile and are shown as horizon A. All subordinate B horizons and B transitions (Bw and BC horizons) have been combined and are shown as the B horizon for each soil. Likewise, all subordinate and transition C horizons were combined and analyzed as one C horizon. The O horizons were not analyzed in the laboratory.

Total Carbon . The A horizons in the minesoils had a total carbon content that ranged from 2.5 to 7.7% (Table 3). The B horizons had total carbon values between 1.3 to 6.4%, and the C horizons ranged from 1.4 to 25.5%. Site 1 Pit 2 and Site 3 Pit 1 had generally higher carbon content than the other soils. This can be attributed to the presence of carbolithic material (high carbon rock and coal fragments) within the profile. A noticeably high total carbon of 25% was found in the C horizon of Site 2 Pit 2. When the profile was described, the C horizon was a very dark gray to black color, indicating a horizon of concentrated carbolithic material. It was unlike any other horizon described within the profiles of this project.

The undisturbed soils yielded total carbon that ranged from 7.0 to 16.7% in the A horizons, from 1.1 to 1.2% in the E horizons, from 0.5 to 5.6% in the B horizons, and from 0.1 to 4.7% in the C horizons (Table 3). The source of the relative high carbon values in some of the B and C horizons of these soils is not known at this time. However, all of these horizons with higher carbon values did have dark colors including 2.5Y 3/1, 10YR 4/3, and 10YR 4/2.

Carbon values generally decreased with depth within the profile, which is expected in undisturbed soils, and values were higher in the A horizons of the undisturbed soils than the A horizons of the minesoils. This is due to the difference in vegetation. The undisturbed soils supported more vegetative cover than the minesoils. The vegetation on the minesoils was primarily pine trees, while the undisturbed soils supported grasses, forbs, and hardwood trees. The presence of the grasses on the undisturbed soils is another reason for higher carbon values.

Table 3. Total percent carbon with depth of minesoils and undisturbed soils.

Upper Freeport Minesoils				**Undisturbed Soils**			
Sample ID	**Major Horizon**	**Lower Depth**	**Carbon**	**Sample ID**	**Major Horizon**	**Lower Depth**	**Carbon**
		cm	**%**			**cm**	**%**
Site1 Pit1	A	10	2.5	Und Site 1	A	23	7.5
	B	35	1.3		B	79	0.7
	C	190+	1.4		C	110+	0.5
Site1 Pit2	A	8	6.9	Und Site2	A	8	8.4
	B	99	6.4		B	82	2.4
	C	250+	5.7		C	100+	4.1
Site2 Pit1	A	5	5.6	Und Site 3	A	9	16.7
	B	12	3.4		B	81	5.6
	C	141+	5.5		C	105+	4.7
Site2 Pit2	A	5	3.8	Und Site 4	E	33	1.2
	B	49	3.5		B	83	0.5
	C	120+	25.5	Und Site 5	A	9	3.5
Site3 Pit1	A	9	7.7		B	100+	2.1
	C	170+	6.5	Und Site 6	A	27	7.0
Site3 Pit2	A	11	4.5		E	43	1.1
	B	34	2.6		B	75	1.1
	C	118+	2.6		C	120+	0.1

pH. All of the minesoils were acidic, with pH values below 5 (Table 4). The A horizons had pH values that ranged from 3.4 to 4.6. The B horizons ranged from 3.2 to 4.9, while the C horizons ranged from 3.3 to 4.8. Due to the nature of the Upper Freeport coal, we expected to find generally low pH values. This expectation was supported by Johnson and Skousen (1995) who found similar pH values in Upper Freeport minesoils ranging from 3.5 to 5.2.

The undisturbed soils, as expected, also were acidic, with all values below 5 (Table 5). The A horizons had pH values that ranged from 3.5 to 5.0; the E horizons ranged from 4.1 to 4.2; the B horizons ranged from 4.0 to 4.6; while the C horizons ranged from 4.2 to 4.6.

Total Sulfur. The total sulfur in the minesoils did not vary widely and showed the same basic trend as the carbon data (Table 4). It ranged from 0.02 to 0.17% in the A horizons, from 0.02 to

0.15 % in the B horizons, and from 0.02 to 0.64% in the C horizons. The highest sulfur content was found in the C horizon of Site 2 Pit 2 because of the presence of the carbolithic material at this site. Site 1 Pit 2 also had some carbolithic material described. Sulfur values of horizons at this site were generally higher than horizons from other sites, but lower than those of the Site 2 Pit 2 horizon.

The total sulfur of the undisturbed soils was similar in all horizons (Table 5), ranging from 0.01 to 0.05%. The undisturbed soils had generally lower sulfur values than the minesoils because of the lack of carbolithic material within the soils.

Minesoil Acid-Base Account

The MPA of the minesoils ranged from 0.63 tons $CaCO_3$/1000 tons to 20.00 tons $CaCO_3$/1000 tons of material (Table 4). The NP was found to range between 1.54 and 11.57 tons $CaCO_3$/1000 tons. The NNP value ranged from –18.46 to 10.94 tons $CaCO_3$/1000 tons. There were only two horizons with negative NNP numbers: the B horizon of Site 1 Pit 2 and the C horizon of Site 2 Pit 2. The B horizon of Site 1 Pit 2 had an NNP value of –0.68 and this layer and a low pH. Site 2 Pit 2 C horizons had an NNP value of –18.46. Due to the high sulfur content and very low pH value, it is clear this layer has the potential to produce significant acid mine drainage if disturbed and exposed to the atmosphere.

The majority of the major horizons were found to have positive NNP values, but all were below 11 tons $CaCO_3$/1000 tons. The pH of these soils was quite low suggesting that they have the potential to produce small amounts of acid mine drainage. There were no alkaline layers or acid-neutralizing materials identified among the minesoils. Undisturbed Soils Acid-Base Account

The MPA in the undisturbed soils was found to be lower than the values found in the minesoils (Table 5), ranging from 0.31 to 1.88 tons $CaCO_3$/1000 tons material. The NP was found to be between 1.29 and 11.86 tons $CaCO_3$/1000 tons material. These values were similar to the NP values of the minesoils. The NNP values were found to be between –0.59 and 10.61 tons $CaCO_3$/1000 tons material. Two horizons were found to have negative NNP values, however, these were not negative enough to be considered acid-producing. Even though most of the horizons did have positive NNP values, none of these were high enough to be considered acid-neutralizing. Like the minesoils, the undisturbed soils possess no neutralizing materials.

Table 4. Acid-base account of Upper Freeport minesoils.

Soil	Horizon	Lower Depth	pH	Total Sulfur	MPA	NP	NNP
		cm		%	Tons $CaCO_3$ eq/1000 tons	Tons $CaCO_3$ eq/1000 tons	Tons $CaCO_3$ eq/1000 tons
Site1 Pit1	A	10	4.3	0.02	0.63	9.95	9.32
	B	35	4.9	0.02	0.63	11.57	10.94
	C	190+	4.2	0.02	0.63	6.94	6.31
Site1 Pit2	A	8	3.4	0.17	5.31	6.48	1.17
	B	99	3.3	0.15	4.69	4.01	-0.68
	C	250+	3.2	0.13	4.06	6.71	2.65
Site2 Pit1	A	5	3.9	0.05	1.56	5.09	3.53
	B	12	4.0	0.03	0.94	5.56	4.62
	C	141+	4.3	0.05	1.56	6.85	5.29
Site2 Pit2	A	5	3.8	0.07	2.19	6.48	4.29
	B	49	3.9	0.09	2.81	4.01	1.20
	C	120+	3.0	0.64	20.00	1.54	-18.46
Site3 Pit1	A	9	4.5	0.07	2.19	9.03	6.84
	C	170+	4.0	0.07	2.19	9.41	7.22
Site3 Pit2	A	11	4.2	0.05	1.56	9.26	7.70
	B	34	4.6	0.04	1.25	6.48	5.23
	C	118+	4.7	0.03	0.94	3.09	2.15

*MPA = Maximum Potential Acidity NP= Neutralization Potential NNP= Net Neutralization Potential

Table 5. Acid-base account of undisturbed soils.

Sample	Horizon	Lower Depth	pH	Total Sulfur	MPA	NP	NNP
		cm		%	Tons CaCO3 eq/1000 tons	Tons CaCO3 eq/1000 tons	Tons CaCO3 eq/1000 tons
Site 1	A	23	5.0	0.04	1.25	11.86	10.61
	B	79	4.4	0.02	0.63	4.30	3.67
	C	110+	4.2	0.02	0.63	2.58	1.95
Site 2	A	8	4.1	0.05	1.56	1.29	-0.27
	B	82	4.5	0.03	0.94	3.72	2.78
	C	100+	4.6	0.05	1.56	4.38	2.82
Site 3	A	9	3.7	0.06	1.88	1.29	-0.59
	B	81	4.1	0.05	1.56	4.64	3.08
	C	105+	4.4	0.05	1.61	3.48	1.87
Site 4	E	33	4.2	0.02	0.63	3.35	2.73
	B	83	4.6	0.01	0.31	4.32	4.00
Site 5	A	9	3.8	0.02	0.63	2.58	1.96
	B	100+	4.3	0.02	0.63	4.74	4.12
Site 6	A	27	3.5	0.05	1.56	3.61	2.05
	E	43	4.1	0.01	0.31	2.06	1.75
	B	75	4.0	0.01	0.31	2.84	2.52
	C	120+	4.2	0.01	0.31	2.06	1.75

*MPA = Maximum Potential Acidity NP= Neutralization Potential NNP = Net Neutralization Potential

Core Acid-Base Account

The ABA data for the core samples (Table 6) provide additional insight into the potential for acid production from the areas to be disturbed by the highway. The pH values from the cores along the first route indicate that the samples were generally acidic, ranging from 2.53 to 5.81. The MPA values from the initial route core samples ranged from <0.30 to 332.5 tons $CaCO_3$/ 1000 tons, with sulfur values ranging from <0.01 to 10.64%. The NP values of the samples ranged from –0.79 to 8.13 tons Ca CO_3/1000 tons. The NNP values ranged from –332.91 to 3.53 tons $CaCO_3$/1000 tons material. All but nine of the layers had a negative NNP value. Nine of the layers with negative NNP values were identified as significant acid producers with NNP values less than –5 tons/1000 tons. None of the layers with positive NNP values were identified as acid-neutralizing, since the values were below 15 tons of $CaCO_3$/1000 tons material. These values indicate that there are no acid-neutralizing materials within the core samples from route 1, and the minesoils within the research area are potentially acid producers.

The pH of the cores along the second route ranged from 3.76 to 7.84 (Table 7). Only two of the layers had pH values above 7, therefore these cores also were generally acidic. The MPA values ranged from <0.30 to 162.81 tons $CaCO_3$/1000 tons of material, with sulfur values ranging from <0.01 to 5.21%. The NP values ranged from –2.85 to 98.32 tons $CaCO_3$/1000 tons material. The NNP values of the second route cores ranged from –160.81 to 92.38 tons $CaCO_3$/1000 tons material. Six layers had negative NNP values, of which four were found to be acid-producing. Only one of the layers was found to be acid-neutralizing, which is not nearly enough to prevent acid problems along this route.

The core samples from route 1 contained more acid-producing layers than the core samples from route 2. Additionally, the lowest and highest NNP values from the second route were higher than those from the first route. Also, there was one neutralizing layer and at least two layers with pH values above 7 in the second route. Neither of theses cases was found in any of the layers from the first route. This suggests that acid production associated from disturbance of material along the second route may not be as detrimental as those associated with the first route.

Table 6. Acid-base account of route 1 core samples.

Core #	Depth	PH	Total Sulfur	MPA*	NP*	NNP*
	m		%	Tons $CaCO_3$ eq/1000 tons	Tons $CaCO_3$ eq/1000 tons	Tons $CaCO_3$ eq/1000 tons
R-1-1**	3.05	5.46	0.02	0.63	3.67	3.04
	5.94	2.53	10.64	332.50	-0.41	-332.91
	6.71	5.38	0.21	6.56	3.32	-3.24
R1-2	3.05	3.25	0.54	16.88	-0.79	-17.67
	6.10	3.44	0.93	29.06	-0.61	-29.67
	9.14	3.84	0.12	3.75	0.89	-2.86
R-1-3	3.05	4.51	0.08	2.50	1.84	-0.66
	6.10	4.58	0.17	5.31	2.44	-2.87
R-1-4	2.44	4.54	0.21	6.56	1.83	-4.73
	5.49	3.95	0.02	0.63	0.59	-0.04
	8.53	3.96	0.24	7.50	-0.39	-7.89
	11.58	4.52	0.04	1.25	1.00	-0.25
	13.11	4.57	0.03	0.94	-0.45	-1.39
	16.15	4.65	0.13	4.06	0.75	-3.31
R-1-5	3.96	4.65	0.02	0.64	0.26	-0.38
	5.49	4.64	0.05	1.56	0.91	-0.65
	8.53	4.76	0.01	0.31	0.81	0.50
R-1-6	2.29	4.66	0.02	0.63	0.53	-0.10
	5.33	4.74	0.05	1.56	1.80	0.24
	8.38	4.95	0.06	1.88	1.49	-0.39
	11.43	4.91	0.03	0.94	1.42	0.48
	14.48	4.92	0.02	0.64	1.03	0.39
R-1-7	3.05	4.41	<0.01	<0.30	1.22	1.07
	6.10	4.74	0.07	2.19	0.38	-1.81
	9.14	4.74	0.07	2.19	0.71	-1.48
R-1-8	3.05	4.76	0.14	4.38	1.41	-2.97
	6.10	3.38	1.91	59.69	-0.34	-60.03
	9.14	4.33	0.06	1.88	1.00	-0.88
	12.19	5.09	0.03	0.94	1.81	0.87
R-1-9	2.13	4.97	0.15	4.69	0.69	-4.00
	5.18	5.05	0.16	5.00	3.63	-1.37
	8.23	5.50	0.64	20.00	6.28	-13.72
	11.28	5.81	0.52	16.25	8.13	-8.12
R-1-10	2.74	3.27	0.37	11.56	0.18	-11.38
	5.79	4.50	0.21	6.56	4.00	-2.56
R-1-11	2.74	5.34	0.14	4.38	1.96	-2.42
	5.79	4.88	0.10	3.13	2.26	-0.87
	8.84	4.02	0.42	13.13	2.24	-10.89
	15.24	4.86	0.21	6.56	1.88	-4.68
	18.29	5.00	0.02	0.63	4.16	3.53
R-1-12	2.50	4.73	0.13	4.06	-0.25	-4.31
	5.55	4.81	0.02	0.63	1.11	0.48

*MPA = Maximum Potential Acidity NP= Neutralization Potential NNP Net Neutralization Potential.
** Undisturbed Cores; all other cores on mined lands.

Table 7. Acid-base account of route 2 core samples.

Core #	Depth	pH	Total Sulfur	MPA*	NP*	NNP*
	m		%	Tons $CaCO_3$ eq/1000 tons	Tons $CaCO_3$ eq/1000 tons	Tons $CaCO_3$ eq/1000 tons
R-2-13	3.05	4.87	0.05	1.56	0.80	-0.76
	6.10	4.78	0.09	2.81	1.21	-1.60
	9.14	5.13	<0.01	<0.30	4.39	4.24
	12.19	7.78	2.11	65.94	4.73	-61.21
R-2-14	3.05	4.90	<0.01	<0.30	2.93	2.78
	6.10	4.63	0.96	30.00	4.01	-25.99
R-2-15**	1.52	4.85	<0.01	<0.30	2.02	1.87
	5.79	3.76	5.21	162.81	2.00	-160.81
	6.10	4.97	<0.01	<0.30	1.77	1.62
R-2-16	3.05	6.34	<0.01	<0.30	4.55	4.40
	5.49	5.07	<0.01	<0.30	2.50	2.35
R-2-17	3.05	5.16	<0.01	<0.30	3.42	3.77
	6.10	5.25	<0.01	<0.30	2.76	2.61
	9.14	5.09	0.01	0.31	2.04	1.73
	11.89	7.84	0.19	5.94	98.32	92.38
R-2-18	3.05	4.55	0.18	5.63	-2.85	-8.48
	8.63	6.46	0.11	3.43	10.10	6.67
	9.14	6.03	0.03	0.94	4.83	3.89
	12.19	5.02	0.07	2.19	10.04	7.85

*MPA = Maximum Potential Acidity NP= Neutralization Potential NNP Net Neutralization Potential.
** Undisturbed Cores; all other cores on mined lands.

Conclusions

The minesoils in this study are very young soils, but they are showing some signs indicative of pedogenesis such as horizonization, solum thickness, and structure within the profiles. Five of our six profiles had Bw horizons developed, an indicator of minesoil genesis. The undisturbed soils were older, better developed soils that showed an increased number of horizons, thicker horizons, and various textures and structures.

All sampled minesoil horizons and undisturbed horizons were found to be acidic. The ABA data from the minesoil samples and core samples indicated the potential of the minesoils to continue to be acid-producing upon redisturbance. The data also show the potential for presently undisturbed materials to produce acid when they are exposed to the atmosphere during road construction. Exposure of potentially acid-producing materials that are currently buried will certainly cause future problems upon disturbance. While some of the horizons have the potential to produce acid, that potential would be much greater from horizons disturbed below the current weathering zone. The core samples were drilled to depths much deeper than the depths excavated for the soil profiles. Therefore their ABA data are more representative of what could happen when the road is constructed. These samples show a slightly higher possibility of future acid production than did the minesoil samples mainly because many of the layers in the cores were not as weathered as the minesoil horizons.

Both proposed routes of the road show the potential for acid production, however positioning the highway along the second route would have advantages. The second route will take advantage of the existing road in the area during construction. Therefore, building along the second route would disturb less total material, and more importantly less of the spoil material. This could possibly decrease the amount of acid production that would result from the highway construction. In both cases, preventing harm to the Beaver Creek Watershed would require acid-neutralization by limestone application since very little neutralizing material is available on either route. Acid-base account data indicate that building Corridor H along the second route would require less total limestone than the first route.

Using ABA findings and the potential of acid increases within the area, it was determined that construction of Appalachian Corridor H would be more feasible and less detrimental to the total environment and the Beaver Creek Watershed if the second proposed route were followed. The West Virginia Division of Highways has agreed to position Corridor H along the second proposed route.

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