APPENDIX C: Target Development for Acid Mine Drainage Parameters of Concern

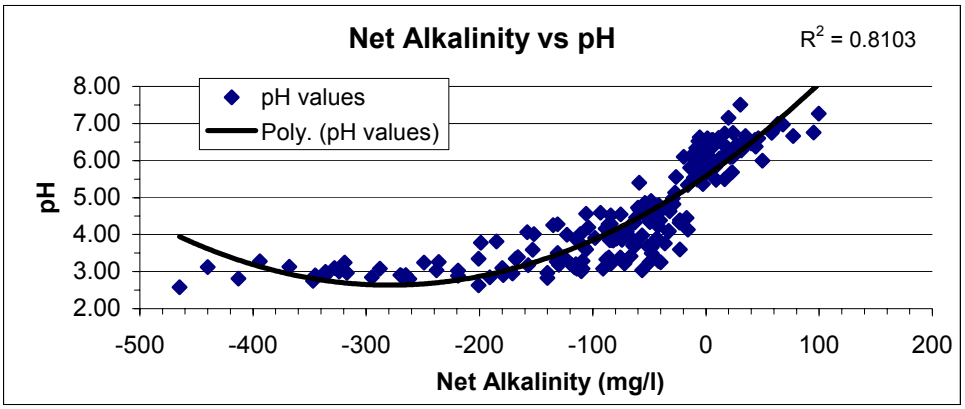
pH as the Critical Controlling Parameter
pH was cited as the cause of impairment of designated use to various stream segments in the upper Raccoon Creek study area on the 303d list, which resulted in those segments being listed as impaired in the 1998 305b report. This parameter, listed more frequently than any other cause, is listed in nine segments totaling 169.5 miles. The sources include; mining (both subsurface and surface) and mine tailings.

pH, as defined by Sorenson is -log [H^+], it is the "intensity" factor of acidity. Because of ionic interactions in all but very dilute solutions, it is necessary to use the "activity" of an ion and not its molar concentration. Use of the term pH assumes that the activity of the hydrogen ion a_H +, is being considered. The *approximate* equivalence to molarity, [H^+] can be presumed only in very dilute solutions (ionic strength < 0.1) (Eaton, Clesceri, Greenberg, pg. 4-65,1995).

pH is not so much the cause of impairment as it is the measure of the cause of impairment. The impairment in biological populations, is caused by acidity. In the heavily mined area of the upper Raccoon Creek acidity is formed from the hydrolyzing salts such as; iron, aluminum and manganese sulfates. Any one of these measures; pH, acidity or metals could be used in the TMDL to reflect stream health.

pH Target Development
Ohio's statewide water quality criteria for the protection of aquatic life for pH outside mixing zone average of 6.5 - 9.0 were used as the pH target. This is also the Federal recommended nearly maximum level of protection, with 6.0 - 9.0 being the federal recommended high level of protection. When the net alkalinity target of 20 mg/l is met, pH tends around 6.0 to 6.5, (Figure C1). The regression line crosses closer to pH of 6.0 than to 6.5, as shown in Table C1. Sites where net alk is $\geq$ 20 mg/l shows that 57% of the sites met the pH target of 6.5.

Figure C1: Net Alkalinity versus pH



Acidity/Net Alkalinity Target Development

Acidity of water is its quantitative capacity to react with a strong base to a designated pH. The measured (acid) value may vary significantly with the end-point pH used in the determination. Acidity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition is known (Eaton, Clesceri, Greenberg, pg. 2-23, 1995). pH is the measure of hydrogen ion activity and not acid molarity so pH should not be used to determine acidity concentration. As mentioned in Appendix A, net alkalinity is used to evaluate pH because it is difficult to predict exact pH values with acidity due to latent acidity. Net alkalinity is alkalinity minus acidity and in this study is used in place of acidity to predict instream pH. Within a localized area, a strong relationship between net alkalinity and pH can be built. In the Upper Raccoon Creek, the correlation is strong, $R^2 = 0.81$, and demonstrates that when the instream net alkalinity is 20 mg/l or greater the pH target of 6.5 is met 57% of the time. However it meets 6.0, the national recommended high level of protection (USEPA, 1973) 96% of the time (Table C1). The target for pH is 6.5 - 9.0.

Figure C2: A Comparison of the Target Percent Ranks between Sites that meet Warmwater Habitat and Sites that meet the 20 mg/l Net Alkalinity Target

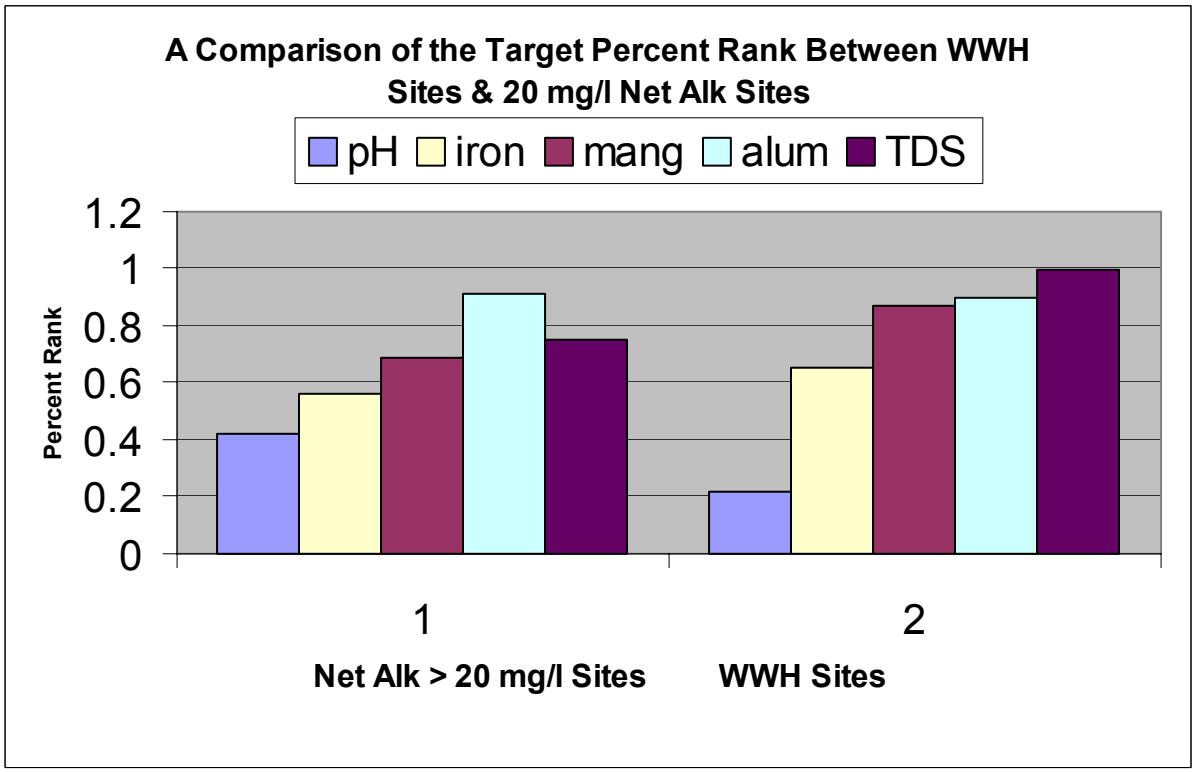


Figure C2 compares what the percent rank of the targets are within two databases. The data for all sites meeting Warmwater Habitat Use designation and all the data for which net alkalinity equaled or exceeded 20 mg/l. For example, the iron target of 1000 ug/l was ranked the 65 percentile in the sites that meet WWH. At sites for which net alkalinity is 20 ug/l or greater it is ranked the 56 percentile.

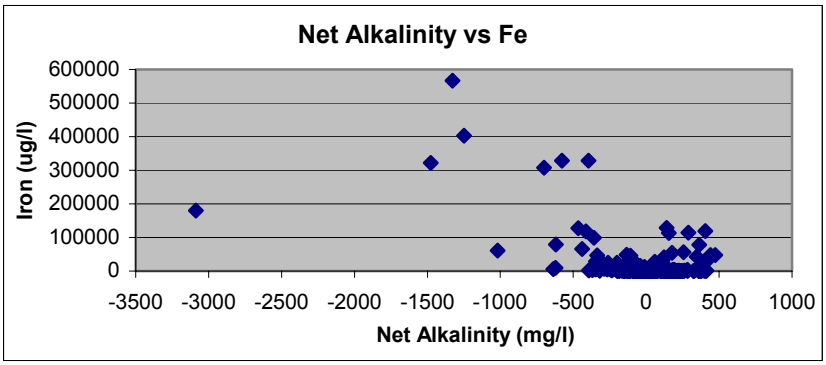
Table C1: Statistics for Targeted Parameters

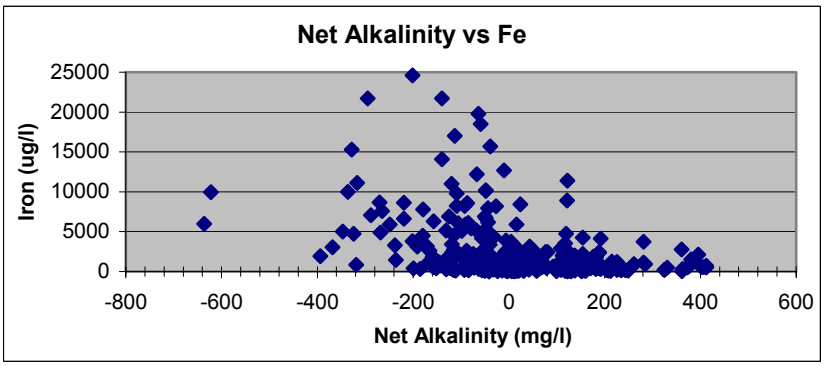
Statistics for Targeted Parameters						
	pH		Iron	Aluminum	Manganese	TDS
target =	**6.0**	**6.5**	**1000** (ug/l)	**750** (ug/l)	**2000** (ug/l)	**1500** (mg/l)
	All Samples		All Samples			
min	1.80	1.80	0	100	40	170
max	7.51	7.51	567000	103000	79000	6570
tot samples	212	212	363	364	363	149
no. of samples not meeting target	160	191	199	184	213	41
% of samples not meeting target	0.75	0.90	55	51	59	28
% of samples meeting target	0.25	0.10	45	49	41	72
	Samples with Net Alk. > 20		Samples with Net Alk. > 20			
tot samples	23	23	154	154	154	129
no. of samples not meeting target	1	10	66	13	46	32
% of samples not meeting target	0.04	0.43	43	8	30	25
% of samples meeting target	0.96	0.57	57	92	70	75

Metals and TDS Target Development

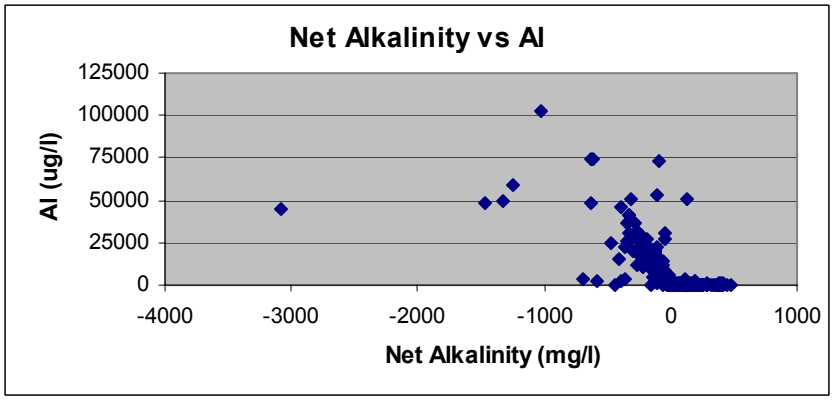
The pH and metal targets are assumed met once the net alkalinity target of 20 mg/l is achieved. Figure C1 above demonstrates this for pH. Figure C3 shows that the majority of instream concentrations of iron, aluminum and manganese are below their respective targets when the instream concentration of net alkalinity is at its target of 20 mg/l. The figures also show that the metal concentrations are high with high acidity (negative net alkalinity) but are lower low when net alkalinity exceeds zero.

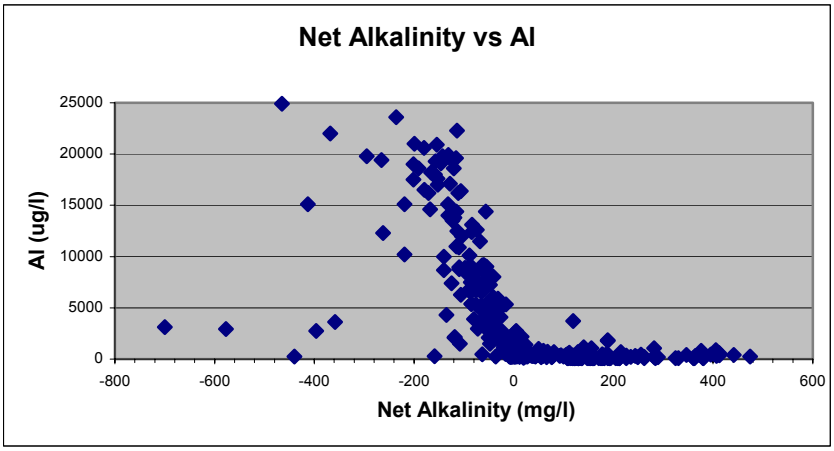
Figure C3: Net Alkalinity versus the Metals of Concern



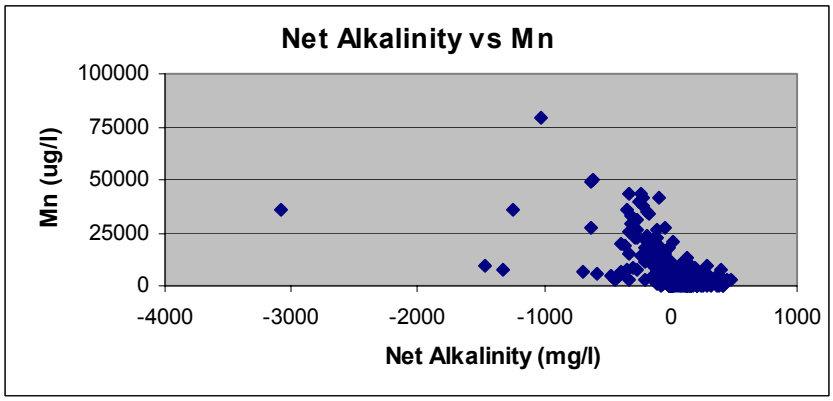


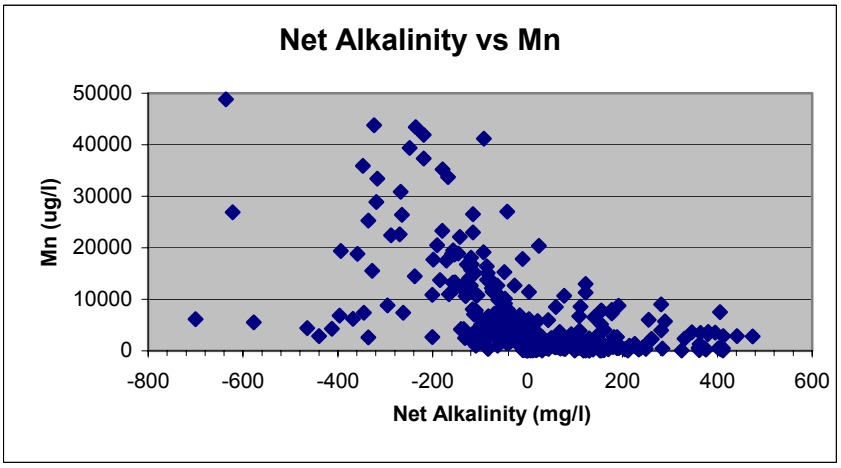
The iron target is 1000 ug/l.



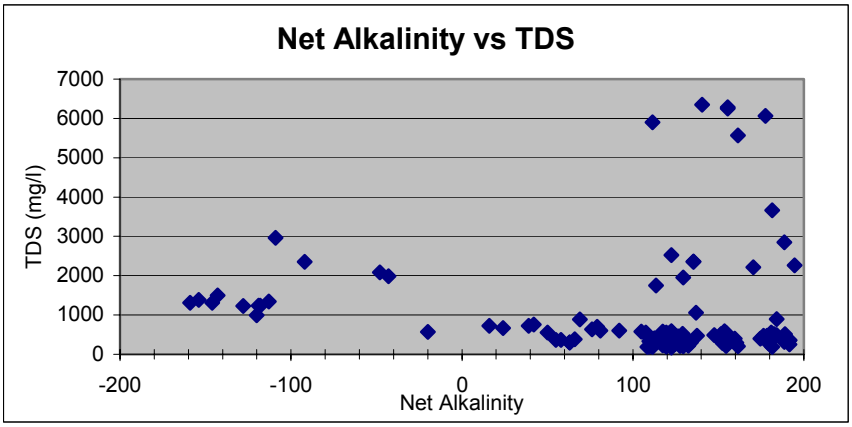


The aluminum target is 750 ug/l.





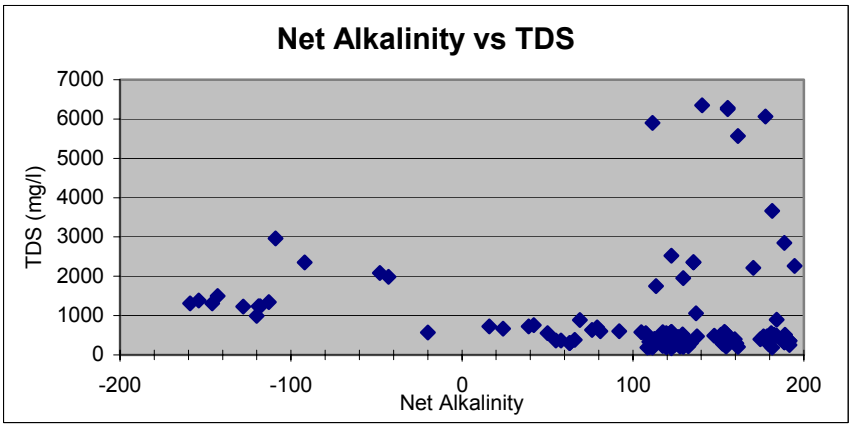
The manganese target is 2000 ug/l.



The TDS target is 2000 ug/l.

USGS found that aluminum (Al) moved from a dissolved form at a low pH to a colloidal form at a higher pH then ultimately dropped out as sediment near a pH of 7. At a pH of 3.9 in Cement Creek Al mostly was dissolved, and at a pH of 6.4 in Mineral Creek, Al mostly was colloidal. Dissolved Al from Cement Creek was transformed to colloidal Al after it was discharged to the Animas River, which had a pH near 7. Downstream sampling showed a net loss of Al which suggests that colloidal Al continued to form in the stream, and that it was lost from the water as it aggregated into larger particles and settled to the streambed (USEPA, 1997).

Unlike metals, TDS tends to be high with high acidity and high net alkalinity, but low around the target of 20 mg/l net alkalinity.



Target Deviation Under Existing Conditions
Table C2 shows the results of the model for cumulative net alkalinity concentration for each site under existing conditions. They are compared to the net alkalinity target of 20 mg/l.

Table C2: A Look at the Net Alkalinity Target Deviation for each Site Under Existing Conditions

NET ALKALINITY						
Existing Conditions						
UNIQUENUM	MAIN STEM	SAMPLEDATE	NEWID	CUMULATIVE CONC. (mg/l)	TARGET (mg/l)	DEVIATION FROM TARGET (mg/l)
		EAST BRANCH RACCOON CREEK				
691		8/31/00	EB300	31.2	20	target is met
1016		2/6/01	EB280	31.2	20	target is met
688		8/31/00	EB280	19.3	20	-0.7
1015		2/6/01	EB260	7.8	20	-12.2
683		10/2/00	EB240	7.8	20	-12.2
1014		2/6/01	EB240	-22.9	20	-42.9
678		8/30/00	EB220	-22.9	20	-42.9
1013		2/6/01	EB220	-95.7	20	-115.7
674		8/30/00	EB200	-95.7	20	-115.7
1012		2/6/01	EB200	-99.8	20	-119.8
			unknown reach end			
897		10/2/00	EB197			
896		10/2/00	EB196			
893		10/2/00	EB195			
		6/18/96	EB194			
887		10/2/00	EB193			
		6/18/96	EB193			
		6/18/96	EB192	-158.0	20	-178.0
		6/18/96	EB191	-158.0	20	-178.0
883		10/2/00	EB191	-146.4	20	-166.4
			unknown reach end	-107.5	20	-127.5
881		8/30/00	EB190			
		6/18/96	EB190	-215.0	20	-235.0
			EB190+EB200S	-165.3	20	-185.3
			unknown	-96.5	20	-116.5

			reach end			
		6/20/96	EB170			
658	MBR	7/9/96	EB170			
		6/19/96	EB163			
655		7/3/96	EB162			
		6/19/96	EB161			
		6/19/96	EB160			
651		7/9/96	EB160			
653		9/25/00	EB160	-118.0	20	-138.0
648		10/3/00	EB140	-117.8	20	-137.8
	MBR	6/20/96	EB130			
645		10/2/00	EB122			
644		10/2/00	EB121			
643		10/2/00	EB120	-115.3	20	-135.3
			unknown	-83.0	20	-103.0
			reach end			
	MBR	6/20/96	EB110			
		6/19/96	EB092			
		6/20/96	EB091			0.0
		6/20/96	EB090	-55.0	20	-75.0
			unknown	-64.0	20	-84.0
			reach end			0.0
		6/20/96	EB080			
631		10/3/00	EB070	-63.2	20	-83.2
625		9/25/00	EB040	-59.3	20	-79.3
623		9/25/00	EB030	-59.0	20	-79.0
694		9/25/00	EB320	-59.0	20	-79.0
			unknown			
			reach end			
			EBR. Mouth	-59.0	20	-79.0
	M	11/15/00	EB010			
		WEST BRANCH RACCOON CREEK				
726		10/16/00	WB170			
725	MBR	6/5/00	WB160	18.6	20	-1.4
724		5/22/00	WB150	16.3	20	-3.7
880		5/22/00	WB140	17.5	20	-2.5
722		6/5/00	WB130	13.5	20	-6.5
877		5/22/00	WB120	21.2	20	target is met
717		7/15/96	WB110	21.2	20	target is met
718		5/22/00	WB110	21.2	20	target is met
719		10/3/00	WB110	15.6	20	-4.4

714		7/15/96	WB100	15.6	20	-4.4
715		5/17/00	WB100	15.6	20	-4.4
716		10/3/00	WB100	1.3	20	-18.7
875		5/22/00	WB090	2.1	20	-17.9
710		5/16/00	WB080	2.1	20	-17.9
711		10/3/00	WB080	2.0	20	-18.0
707		5/16/00	WB070	2.0	20	-18.0
708		10/16/00	WB070	-14.3	20	-34.3
704		5/17/00	WB060	-14.3	20	-34.3
705		10/3/00	WB060	-23.2	20	-43.2
729		5/16/00	WB050	-23.2	20	-43.2
702		10/3/00	WB050	-23.6	20	-43.6
866		5/16/00	WB040	6.5	20	-13.5
865		5/16/00	WB030	7.2	20	-12.8
842		5/16/00	WB020	7.5	20	-12.5
			unknowns	-20.2	20	-40.2
			reach end			
		11/15/00	WB010			
		MIDDLE SECTION BRUSHY CREEK				
			EBR. Mouth	-59.0	20	-79.0
			WBR. Mouth	-20.2	20	-40.2
			EBR+WBR	-47.9	20	-67.9
			unknown	-0.9	20	-20.9
			reach end			
728	M	11/16/00	MSBC010			
		6/28/96	MSBC025	1.0	20	-19.0
731		6/26/00	MSBC030	1.0	20	-19.0
732		10/26/00	MSBC030	1.1	20	-18.9
733		6/26/00	MSBC040	1.1	20	-18.9
734		10/26/00	MSBC040	1.1	20	-18.9
735		6/26/00	MSBC050	1.1	20	-18.9
736		10/26/00	MSBC050	1.1	20	-18.9
738		10/26/00	MSBC060	1.1	20	-18.9
740		10/26/00	MSBC070	1.1	20	-18.9
741		6/26/00	MSBC080	1.1	20	-18.9
742		10/26/00	MSBC080	1.2	20	-18.8
747		10/25/00	MSBC092	1.2	20	-18.8
746		10/25/00	MSBC091	1.2	20	-18.8
744		6/26/00	MSBC090	1.2	20	-18.8
745		10/25/00	MSBC090	1.2	20	-18.8
		6/28/96	MSBC090	0.5	20	-19.5
748	M	7/22/96	MSBC100			
750		6/28/00	MSBC110	0.5	20	-19.5
751		10/25/00	MSBC110	-0.6	20	-20.6

752	6/28/00	MSBC120	-0.6	20	-20.6
753	10/25/00	MSBC120	-6.1	20	-26.1
		BRUSHY CREEK			
792	10/16/00	BC180			
789	10/18/00	BC160	19.9	20	-0.1
787	6/7/00	BC151	19.9	20	-0.1
788	10/25/00	BC151	19.9	20	-0.1
784	7/16/96	BC150	19.9	20	-0.1
785	6/7/00	BC150	19.9	20	-0.1
786	10/25/00	BC150	-22.7	20	-42.7
782	6/21/00	BC140	-22.7	20	-42.7
783	10/18/00	BC140	-21.7	20	-41.7
		unknown	-5.8	20	-25.8
		reach end			
781	6/7/00	BC130			
1027	2/28/01	BC130			
841	6/7/00	BC120 110 trib below	38.2	20	target is met
778	10/24/00	BC114			
776	7/16/96	BC113			
777	10/24/00	BC113	-316.0	20	-336.0
775	7/16/96	BC112	-227.5	20	-247.5
773	7/16/96	BC111	-227.5	20	-247.5
774	10/24/00	BC111	-186.0	20	-206.0
		unknown trib reach end	-56.4	20	-76.4
770	7/1/96	BC110			
771	6/7/00	BC110			
772	10/24/00	BC110			
769	6/7/00	BC100	-27.5	20	-47.5
768	10/25/00	BC095	-27.5	20	-47.5
765	7/1/96	BC090	-27.5	20	-47.5
766	6/21/00	BC090	-27.5	20	-47.5
767	10/18/00	BC090	-46.2	20	-66.2
838	6/7/00	BC080	-37.7	20	-57.7
762	6/21/00	BC070	-37.7	20	-57.7
763	10/18/00	BC070	-37.7	20	-57.7
1026	2/28/01	BC070	-63.8	20	-83.8
760	6/21/00	BC060	-63.8	20	-83.8
761	10/18/00	BC060	-136.7	20	-156.7
		unknown trib reach end	-50.0	20	-70.0
759	7/1/96	BC050			
	7/16/96	BC040	-42.2	20	-62.2

757		6/21/00	BC030	-41.9	20	-61.9
		11/20/00	BC020	-31.6	20	-51.6
			unknown trib reach end	-24.8	20	-44.8
		11/20/00	BC013			
		11/20/00	BC012	-19.0	20	-39.0
			unknown trib reach end	-13.2	20	-33.2
		11/15/00	BC010			
		7/1/96	BC010			
		MIDDLE SECTION LAKE HOPE				
753		10/25/00	MSBC mouth	-6.1	20	-26.1
		7/1/96	BC mouth	-13.2	20	-33.2
			MSBC+BC	-7.7	20	-27.7
			unknown			
794		6/28/00	MSLH010			
		7/1/96	MSLH010	-7.6	20	-27.6
			unknown			
			reach end			
		7/17/96	MSLH020			
797	M	11/14/00	MSLH020			
798		7/1/96	MSLH030			
799		6/28/00	MSLH030	-9.1	20	-29.1
830		7/9/00	MSLH151	-9.0	20	-29.0
829		6/28/00	MSLH150	-9.0	20	-29.0
		7/17/96	MSLH140	-8.7	20	-28.7
			unknown			
			reach end			
		7/1/96	MSLH050			
800		7/9/00	MSLH040			
801		10/30/00	MSLH040	-8.7	20	-28.7
803		7/1/96	MSLH060	-8.7	20	-28.7
804		7/5/00	MSLH060	-8.7	20	-28.7
805		10/30/00	MSLH060	-9.8	20	-29.8
806		7/5/00	MSLH070	-9.8	20	-29.8
		7/2/96	MSLH 080	-9.9	20	-29.9
812		7/2/96	MSLH091	-9.9	20	-29.9
811		11/13/00	MSLH090	-9.9	20	-29.9
817		7/9/00	MSLH110	-9.9	20	-29.9
		11/13/00	MSLH110	-9.8	20	-29.8
815		7/12/00	MSLH100	-9.8	20	-29.8
		6/27/96	MSLH122	-9.8	20	-29.8
		7/17/96	MSLH122	-9.8	20	-29.8
		6/27/96	MSLH121	-10.3	20	-30.3

		unknown	12.0	20	-8.0
		reach end			
	6/27/96	MSLH130			
		HEWETT FORK			
870	8/21/00	HF180	-135.0	20	-155.0
		unknown	-39.2	20	-59.2
		reach end			
865	8/30/00	HF150			
862	8/21/00	HF140			
	12/11/00	HF140	-40.8	20	-60.8
	12/11/00	HF131	-156.9	20	-176.9
	12/11/00	HF130	-156.9	20	-176.9
	12/11/00	HF120	-155.5	20	-175.5
		reach end			
	12/5/00	HF116			
	12/5/00	HF115	-221.0	20	-241.0
854	9/27/00	HF114	-221.0	20	-241.0
	12/5/00	HF114	-245.2	20	-265.2
		unknown	-413.0	20	-433.0
		reach end			
853	7/18/96	HF113			
		unknown	-262.0	20	-282.0
		reach end			
852	8/21/00	HF112			
		unknown	-140.0	20	-160.0
		reach end			
848	8/30/00	HF110			
845	4/30/00	HF100			
846	9/27/00	HF100	-145.0	20	-165.0
		HF120+HF100	-153.4	20	-173.4
887	4/30/00	HF080	-130.9	20	-150.9
		unknown	-88.2	20	-108.2
		reach end			
843	8/21/00	HF090			
	11/20/00	HF090			
840	5/1/00	HF070	-79.6	20	-99.6
		unknown	-48.0		
		reach end			
839	7/18/96	HF060			
888	4/30/00	HF050	-68.6	20	-88.6
883	4/30/00	HF040	-56.1	20	-76.1
836	5/1/00	HF031	-51.6	20	-71.6
		unknown	-85.0	20	-105.0
		reach end			

		6/28/96	HF020			
			unknown	-33.0	20	-53.0
			reach end			
		6/28/96	HF010			
833		8/21/00	HF010			
		MIDDLE SECTION BOLINS MILLS				
			MSLH mouth	12.0	20	-8.0
			HF mouth	-33.0	20	-53.0
			MSLH+HF	1.7	20	-18.3
			unknown	2.5	20	-17.5
			reach end			
		11/14/00	MSBM010			
		6/27/96	MSBM010			
881		5/1/00	MSBM020	2.6	20	-17.4
891		4/30/00	MSBM030			
		7/17/96	MSBM030	3.5	20	-16.5
			unknown	-9.5	20	-29.5
			reach end			
878	M	7/2/96	MSBM040			
		11/15/00	MSBM040			

The table below shows the results of the model for cumulative net alkalinity concentration for each site under post Acid Mine Drainage Abatement and Treatment (AMDAT) Plan remediation conditions. They are compared to the net alkalinity target of 20 mg/l.

Table C3: A Look at the Net Alkalinity Target Deviation for each Site under Post Remediation Conditions

NET ALKALINITY

Post AMDAT Remediation Results

UNIQUENUM	MAINSTEM	SAMPLEDATE	NEWID	CUMULATIVE CONC. (mg/l)	TARGET (mg/l)	DEVIATION FROM TARGET (mg/l)
		EAST BRANCH RACCOON CREEK				
691		8/31/2000	EB300	31.2	20	target is met
1016		2/6/2001	EB280	31.2	20	target is met
688		8/31/2000	EB280	29.9	20	target is met
1015		2/6/2001	EB260	26.7	20	target is met
683		10/2/2000	EB240	26.7	20	target is met
1014		2/6/2001	EB240	20.9	20	target is met
678		8/30/2000	EB220	20.9	20	target is met
1013		2/6/2001	EB220	15.9	20	-4.1
674		8/30/2000	EB200	15.9	20	-4.1
1012		2/6/2001	EB200	13.7	20	-6.3
			unknown reach end			
897		10/2/2000	EB197			
896		10/2/2000	EB196			
893		10/2/2000	EB195			
		6/18/1996	EB194			
887		10/2/2000	EB193			
		6/18/1996	EB193			
		6/18/1996	EB192	0.0	20	-20.0
		6/18/1996	EB191	0.0	20	-20.0
883		10/2/2000	EB191	0.0	20	-20.0
			unknown reach end	26.1	20	target is met
881		8/30/2000	EB190			
		6/18/1996	EB190	26.1	20	target is met
			EB190+EB200S	20.8	20	target is met
			unknown reach end	-43.8	20	-63.8
		6/20/1996	EB170			
658	MBR	7/9/1996	EB170			

		6/19/1996	EB163			
655		7/3/1996	EB162			
		6/19/1996	EB161			
		6/19/1996	EB160			
651		7/9/1996	EB160			
653		9/25/2000	EB160	-31.2	20	-51.2
648		10/3/2000	EB140	-31.4	20	-51.4
	MBR	6/20/1996	EB130			
645		10/2/2000	EB122			
644		10/2/2000	EB121			
643		10/2/2000	EB120	-32.0	20	-52.0
			unknown	-15.0	20	-35.0
			reach end			
	MBR	6/20/1996	EB110			
		6/19/1996	EB092			
		6/20/1996	EB091			
		6/20/1996	EB090	-6.9	20	-26.9
			unknown	-22.6	20	-42.6
			reach end			
		6/20/1996	EB080			
631		10/3/2000	EB070	-22.0	20	-42.0
625		9/25/2000	EB040	-20.4	20	-40.4
623		9/25/2000	EB030	-20.3	20	-40.3
694		9/25/2000	EB320	-20.3	20	-40.3
			unknown			
			reach end			
			EBR. Mouth	-20.3	20	-40.3
	M	11/15/2000	EB010			
	WEST BRANCH RACCOON CREEK					
726		10/16/2000	WB170			
725	MBR	6/5/2000	WB160	18.6	20	-1.4
724		5/22/2000	WB150	16.3	20	-3.7
880		5/22/2000	WB140	17.5	20	-2.5
722		6/5/2000	WB130	13.5	20	-6.5
877		5/22/2000	WB120	21.2	20	target is met
717		7/15/1996	WB110	21.2	20	target is met
718		5/22/2000	WB110	21.2	20	target is met
719		10/3/2000	WB110	15.6	20	-4.4
714		7/15/1996	WB100	15.6	20	-4.4
715		5/17/2000	WB100	15.6	20	-4.4
716		10/3/2000	WB100	14.6	20	-5.4
875		5/22/2000	WB090	13.9	20	-6.1

710		5/16/2000	WB080	13.9	20	-6.1
711		10/3/2000	WB080	13.7	20	-6.3
707		5/16/2000	WB070	13.7	20	-6.3
708		10/16/2000	WB070	12.2	20	-7.8
704		5/17/2000	WB060	12.2	20	-7.8
705		10/3/2000	WB060	11.4	20	-8.6
729		5/16/2000	WB050	11.4	20	-8.6
702		10/3/2000	WB050	11.2	20	-8.8
866		5/16/2000	WB040	24.3	20	target is met
865		5/16/2000	WB030	24.3	20	target is met
842		5/16/2000	WB020	24.6	20	target is met
			unknowns	-8.5	20	-28.5
			reach end			
		11/15/2000	WB010			
	MIDDLE SECTION BRUSHY CREEK					
			EBR. Mouth	-20.3	20	-40.3
			WBR. Mouth	-8.5	20	-28.5
			EBR+WBR	-16.9	20	-36.9
			unknown	28.3	20	target is met
			reach end			
728	M	11/16/2000	MSBC010			
		6/28/1996	MSBC025	28.4	20	target is met
731		6/26/2000	MSBC030	28.4	20	target is met
732		10/26/2000	MSBC030	28.1	20	target is met
733		6/26/2000	MSBC040	28.1	20	target is met
734		10/26/2000	MSBC040	28.1	20	target is met
735		6/26/2000	MSBC050	28.1	20	target is met
736		10/26/2000	MSBC050	28.0	20	target is met
738		10/26/2000	MSBC060	28.1	20	target is met
740		10/26/2000	MSBC070	28.0	20	target is met
741		6/26/2000	MSBC080	28.0	20	target is met
742		10/26/2000	MSBC080	28.1	20	target is met
747		10/25/2000	MSBC092	28.1	20	target is met
746		10/25/2000	MSBC091	28.1	20	target is met
744		6/26/2000	MSBC090	28.1	20	target is met
745		10/25/2000	MSBC090	28.1	20	target is met
		6/28/1996	MSBC090	27.7	20	target is met
748	M	7/22/1996	MSBC100			
750		6/28/2000	MSBC110	27.7	20	target is met
751		10/25/2000	MSBC110	27.4	20	target is met
752		6/28/2000	MSBC120	27.4	20	target is met
753		10/25/2000	MSBC120	26.9	20	target is met
		BRUSHY CREEK				
792		10/16/2000	BC180			

789	10/18/2000	BC160	19.9	20	-0.1
787	6/7/2000	BC151	19.9	20	-0.1
788	10/25/2000	BC151	19.9	20	-0.1
784	7/16/1996	BC150	19.9	20	-0.1
785	6/7/2000	BC150	19.9	20	-0.1
786	10/25/2000	BC150	18.4	20	-1.6
782	6/21/2000	BC140	18.4	20	-1.6
783	10/18/2000	BC140	18.9	20	-1.1
		unknown	30.4	20	target is met
		reach end			
781	6/7/2000	BC130			
1027	2/28/2001	BC130			
841	6/7/2000	BC120	38.2	20	target is met
		110 trib below			
778	10/24/2000	BC114	0.0	20	-20.0
		unknown	-113.6	20	-133.6
		reach end		20	-20.0
775	7/16/1996	BC112		20	-20.0
776	7/16/1996	BC113	-113.6	20	-133.6
777	10/24/2000	BC113	-67.0	20	-87.0
773	7/16/1996	BC111	-67.0	20	-87.0
774	10/24/2000	BC111	-53.3	20	-73.3
		unknown	-30.8	20	-50.8
		trib reach end			
770	7/1/1996	BC110			
771	6/7/2000	BC110			
772	10/24/2000	BC110			
769	6/7/2000	BC100	3.3	20	-16.7
768	10/25/2000	BC095	3.3	20	-16.7
765	7/1/1996	BC090	3.3	20	-16.7
766	6/21/2000	BC090	3.3	20	-16.7
767	10/18/2000	BC090	3.0	20	-17.0
838	6/7/2000	BC080	7.7	20	-12.3
762	6/21/2000	BC070	7.7	20	-12.3
763	10/18/2000	BC070	7.7	20	-12.3
1026	2/28/2001	BC070	6.7	20	-13.3
760	6/21/2000	BC060	6.7	20	-13.3
761	10/18/2000	BC060	6.5	20	-13.5
		unknown	111.2	20	target is met
		trib reach end			
759	7/1/1996	BC050			
	7/16/1996	BC040	104.2	20	target is met
757	6/21/2000	BC030	103.9	20	target is met
	11/20/2000	BC020	95.4	20	target is met

			unknown	73.7	20	target is met
			trib reach end			
		11/20/2000	BC013			
		11/20/2000	BC012	74.9	20	target is met
			unknown	54.9	20	target is met
			trib reach end			
		11/15/2000	BC010			
		7/1/1996	BC010			
	MIDDLE SECTION LAKE HOPE					
753		10/25/2000	MSBC mouth	26.9	20	target is met
		7/1/1996	BC mouth	54.9	20	target is met
			MSBC+BC	33.1	20	target is met
			unknown			
794		6/28/2000	MSLH010			
		7/1/1996	MSLH010	33.1	20	target is met
			reach end			
		7/17/1996	MSLH020			
797	M	11/14/2000	MSLH020			
798		7/1/1996	MSLH030			
799		6/28/2000	MSLH030	31.3	20	target is met
830		7/9/2000	MSLH151	31.3	20	target is met
829		6/28/2000	MSLH150	31.3	20	target is met
		7/17/1996	MSLH140	31.2	20	target is met
			unknown			
			reach end			
		7/1/1996	MSLH050			
800		7/9/2000	MSLH040			
801		10/30/2000	MSLH040	31.1	20	target is met
803		7/1/1996	MSLH060	31.1	20	target is met
804		7/5/2000	MSLH060	31.1	20	target is met
805		10/30/2000	MSLH060	29.6	20	target is met
806		7/5/2000	MSLH070	29.6	20	target is met
		7/2/1996	MSLH 080	29.4	20	target is met
812		7/2/1996	MSLH091	29.2	20	target is met
811		11/13/2000	MSLH090	29.2	20	target is met
817		7/9/2000	MSLH110	29.2	20	target is met
		11/13/2000	MSLH110	29.2	20	target is met
815		7/12/2000	MSLH100	29.2	20	target is met
		6/27/1996	MSLH122	29.2	20	target is met
		7/17/1996	MSLH122	29.2	20	target is met
		6/27/1996	MSLH121	28.3	20	target is met
			unknown	47.3	20	target is met
			reach end			
		6/27/1996	MSLH130			

		HEWETT FORK				
870		8/21/2000	HF180	-135.0	20	-155.0
			unknown	-39.2	20	-59.2
			reach end			
865		8/30/2000	HF150			
862		8/21/2000	HF140			
		12/11/2000	HF140	-37.9	20	-57.9
		12/11/2000	HF131	-23.8	20	-43.8
		12/11/2000	HF130	-23.8	20	-43.8
		12/11/2000	HF120	-23.3	20	-43.3
			reach end			
		12/5/2000	HF116			
		12/5/2000	HF115	-221.0	20	-241.0
854		9/27/2000	HF114	-221.0	20	-241.0
		12/5/2000	HF114	-245.2	20	-265.2
			unknown	-413.0	20	-433.0
			reach end			
853		7/18/1996	HF113			
			unknown	-262.0	20	-282.0
			reach end			
852		8/21/2000	HF112			
			unknown	0.0	20	-20.0
			reach end			
848		8/30/2000	HF110			
845		4/30/2000	HF100			
846		9/27/2000	HF100	-7.8	20	-27.8
			HF120+HF100	-20.2	20	-40.2
887		4/30/2000	HF080	-12.5	20	-32.5
			unknown	-7.5	20	-27.5
			reach end			
843		8/21/2000	HF090			
		11/20/2000	HF090			
840		5/1/2000	HF070	-6.7	20	-26.7
			unknown	71.2	20	target is met
			reach end			
839		7/18/1996	HF060			
888		4/30/2000	HF050	-1.3	20	-21.3
883		4/30/2000	HF040	3.8	20	-16.2
836		5/1/2000	HF031	3.7	20	-16.3
			unknown	-11.2	20	-31.2
			reach end			
		6/28/1996	HF020			
			unknown	34.8	20	target is met

			reach end			
		6/28/1996	HF010			
833		8/21/2000	HF010			
	MIDDLE SECTION BOLIN MILLS					
			MSLH mouth	47.3	20	target is met
			HF mouth	34.8	20	target is met
			MSLH+HF	44.4	20	target is met
			unknown	47.8	20	target is met
			reach end			
		11/14/2000	MSBM010			
		6/27/1996	MSBM010			
881		5/1/2000	MSBM020	47.8	20	target is met
891		4/30/2000	MSBM030			
		7/17/1996	MSBM030	48.0	20	target is met
			unknown	16.3	20	-3.7
			reach end			
878	M	7/2/1996	MSBM040			
		11/15/2000	MSBM040			

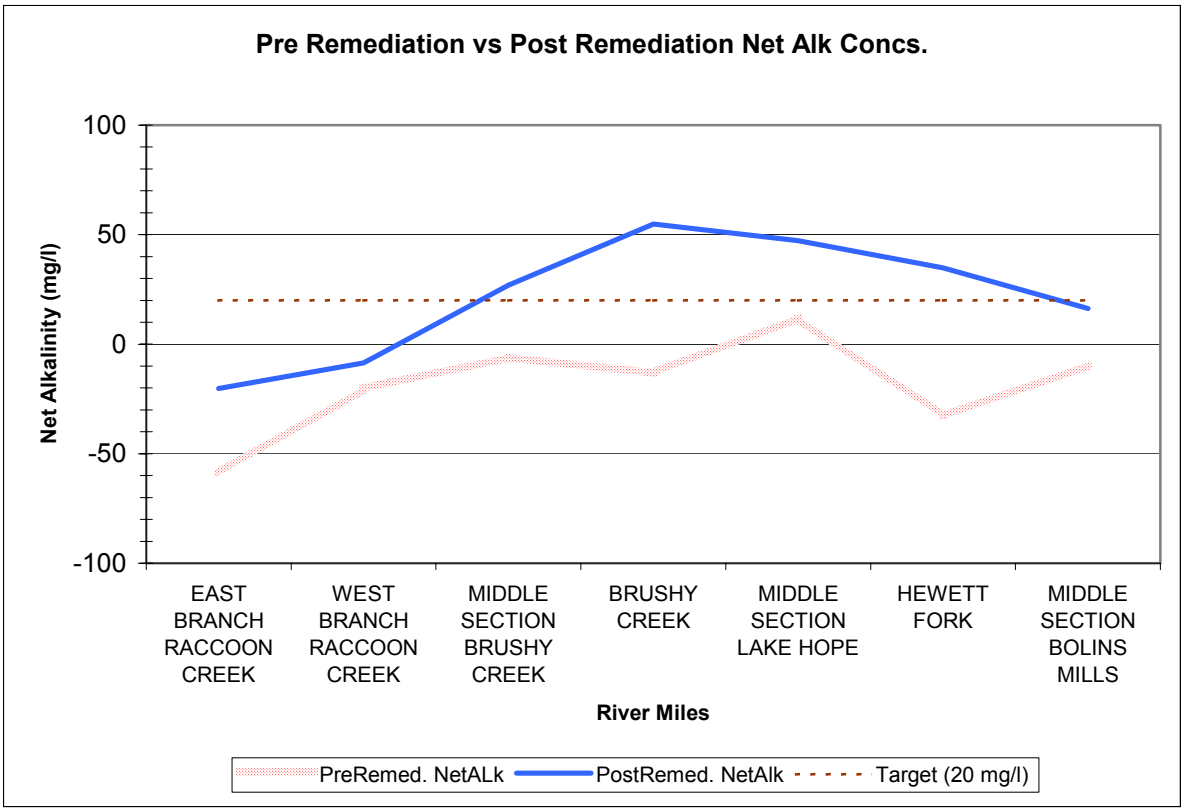



Figure C4: Net Alkalinity Results for the Modeled Segment Ends