

LEHIGH RIVER MINE DRAINAGE
ASSESSMENT AND ABATEMENT
PLAN TO MITIGATE THE MINE
DRAINAGE IMPACTS TO THE
LEHIGH RIVER WATERSHED

*A Project of Wildlands Conservancy and
Parkland High School's Lehigh River Watch*

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Parkland High School's "Lehigh River Watch":

Parkland biology teacher Bob Miller was responsible for coordination of student volunteers who helped collect the water quality and macro-invertebrate information for this report. Students Selina Bower, Julian Detmount-Smith, David Johnson, Amanda Kindt, Jay Knadpe, Ari Mittleman, Max Shmookler, Kyle Shoenberger, Aaron Snyder, Ben Snyder and Ben Rosenau aided in the data collection each month for one full year.

Pa. DEP Bureau of Abandoned Mine Reclamation:

Pa. DEP BAMR served as technical advisor to the project and provided lab services, analyzing nine water samples each month for the yearlong study. Todd Wood provided sample bottles and coolers and arranged for the pick up and transport of the water samples. Pa. DEP BAMR also aided in the determination of appropriate restoration options for the mine discharges.

Pa. DEP Bureau of Mining and Reclamation:

PA. DEP BMR served as technical advisor to the project and sampled all the mine discharges entering the Lehigh River from the Eastern Middle Anthracite field as part of their ongoing study. They provided Wildlands Conservancy with the water quality data, and Dan Koury, who acted as project officer, worked with Mike Menghinni to provide additional information for inclusion in the report.

Pa. DCNR Hickory Run State Park:

The State Park provided vehicular access through the Lehigh Gorge State Park. Kevin Fassini, Park Manager was instrumental in making these arrangements. The project would not have been possible without easy access to sample the tributaries containing mine drainage.

Lehigh River Stocking Association:

The association provided vehicles for the transport of students and equipment for the collection of water samples. Ted Miller, Dave Jane and Mark Zovak dedicated their time and vehicles in order to make the sample collection possible.

Bertsch Creek Fishery:

Bertsch Creek Fishery (Bob and Ted Miller, particularly) provided gas for the vehicles to complete the monthly water sampling.

C & S Railroad:

The railroad, particularly Jim Zurn, provided vehicular access along C&S railroad property to the Lausanne Tunnel.

Carbon County

The county, especially Commissioners Tom Gerhard, Wayne Nothstein and Charles Getz, allowed access across their property.

Eastern Pennsylvania Coalition for Abandoned Mine Reclamation:

Robert Hughes, EPCAMR coordinator, provided valuable information and resources for the project and was instrumental in aiding in the identification of appropriate remediation options to address the mine impacts to the Lehigh River.

Kidder Township Volunteer Fire Department

The Fire Hall served as a drop-off point for the collected water samples, and this project would not have been possible without their cooperation.

Friends of the Nescopeck:

Drew Magill and Alan Gregory provided anecdotal information and assisted in the location of many of the mine discharges.

Susquehanna River Basin Commission:

Paula Ballaron and Donna Fiscus provided background information and Geographic Information System maps for the project. Portions of the report prepared by the Susquehanna River Basin Commission and Wildlands Conservancy titled *Assessment of the Conditions Contributing Acid Mine Drainage to the Little Nescopeck Creek Watershed* were used in the preparation of this report.

Wilkes University:

Jim Thomas and Bill Toothill provided Geographic Information System maps and support for the project.

Lehigh University:

Carl Moses provided Geographic Information System maps for the project.

Additional Wildlands Conservancy Staff:

Tom Gettings of Wildlands Conservancy provided the photographs in this report. Gregg Woodruff, an intern with Wildlands Conservancy, helped gather background research needed for the report and provided general office assistance. Brian Vadino, with the Conservancy's Rivers Department, provided additional support and assistance with the report.

APPENDIX A

AMD Tributary Water Quality Data

Table A4. Nesquehoning Creek Water Quality Data (at Lehigh River Confluence)

Date	Location	Flow cfs	Flow gpm	Alkalinity mg/L	Hardness mg/L	Iron mg/L	Ferrous mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Acidity mg/L	Total Dissolved Solids mg/L
2/22/1998	NC1	129.08	57797.43	16.60	80.00	0.73	0.27	0.49	0.64	80.0	0.0	143.0
3/22/1998	NC1	174.03	77925.04	19.20	89.00	0.62	0.25	0.54	0.62	86.0	0.0	158.0
4/26/1998	NC1	102.80	46030.54	24.00	97.00	1.34	0.62	0.72	0.73	93.0	0.0	184.0
5/17/1998	NC1	94.44	42287.20	19.00	64.00	1.22	0.52	0.60	0.62	80.0	0.0	166.0
6/28/1998	NC1	27.05	12110.33	32.00	267.00	1.80	1.20	1.10	0.73	121.0	0.0	260.0
7/19/1998	NC1	22.14	9915.69	38.00	173.00	2.60	1.74	1.52	0.98	178.0	0.0	332.0
8/23/1998	NC1	7.91	3540.01	24.00	219.73	3.13	0.96	1.33	2.41	171.0	0.0	295.0
9/27/1998	NC1	22.83	10221.20	17.80	113.84	1.44	0.58	0.74	0.92	78.0	0.0	176.0
10/25/1998	NC1	54.29	24309.32	11.00	63.65	0.72	0.36	0.41	0.64	50.0	0.0	112.0
11/19/1998	NC1	16.00	7164.29	34.00	256.35	3.19	1.32	1.75	1.23	204.0	0.0	363.0
12/21/1998	NC1	25.54	11434.65	26.00	168.74	1.14	0.87	1.04	0.23	175.4	0.0	244.0

Table A1. Sandy Run Water Quality Data (at Lehigh River Confluence)

Date	Location	Flow cfs	Flow gpm	Alkalinity mg/L	Hardness mg/L	Iron mg/L	Ferrous mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Acidity mg/L	Total Dissolved Solids mg/L
2/22/1998	SR1	94.40	42270.23	1.60	25.00	0.22	0.10	0.57	2.28	25.0	20.0	76.3
3/22/1998	SR1	85.17	38136.39	1.80	25.00	0.15	0.10	0.45	1.59	19.0	14.2	63.8
4/26/1998	SR1	53.73	24059.02	2.60	45.00	0.18	0.09	0.55	2.20	41.0	15.2	75.8
5/17/1998	SR1	58.56	26222.18	1.40	28.00	0.21	0.12	0.52	2.17	33.0	15.2	84.3
6/28/1998	SR1	48.52	21725.70	1.60	41.00	0.16	0.10	0.75	2.85	52.0	22.0	149.0
7/19/1998	SR1	14.98	6709.40	0.00	39.00	0.09	0.04	0.76	2.64	39.0	19.4	96.0
8/23/1998	SR1	23.56	10548.20	1.20	38.69	0.07	0.04	0.88	3.25	46.0	22.0	101.0
9/27/1998	SR1	13.80	6179.20	0.00	39.40	0.30	0.10	0.92	3.50	44.0	20.0	106.0
10/25/1998	SR1	11.53	5161.87	0.00	50.04	0.50	0.24	1.34	6.54	67.0	40.0	136.0
11/19/1998	SR1	6.95	3110.20	0.00	44.47	0.24	0.09	1.03	4.68	60.0	30.0	114.0
12/21/1998	SR1	9.97	4464.60	1.40	42.01	0.15	0.04	0.87	3.58	33.5	24.0	101.0

Table A2. Buck Mountain Creek Water Quality Data (at Lehigh River Confluence)

Date	Location	Flow cfs	Flow gpm	Alkalinity mg/L	Hardness mg/L	Iron mg/L	Ferrous mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Acidity mg/L	Total Dissolved Solids mg/L
2/22/1998	BM5	45.40	20328.66	2.20	24.00	0.14	0.08	0.49	1.86	19.0	13.0	69.5
3/22/1998	BM5	36.16	16191.29	1.80	25.00	0.13	0.12	0.36	1.44	18.0	11.0	63.8
4/26/1998	BM5	40.59	18174.45	2.00	43.00	0.16	0.09	0.52	1.99	35.0	11.4	71.7
5/17/1998	BM5	29.24	13091.39	2.00	41.00	0.20	0.10	0.56	1.96	27.0	11.4	75.9
6/28/1998	BM5	4.19	1877.36	2.00	34.00	0.14	0.11	0.63	1.89	31.0	14.2	122.2
7/19/1998	BM5	9.45	4232.35	2.00	34.00	0.10	0.05	0.68	1.81	32.0	12.0	77.7
8/23/1998	BM5	9.02	4039.36	2.40	32.72	0.08	0.05	0.59	1.32	32.0	8.8	70.8
9/27/1998	BM5	7.99	3576.23	2.00	32.10	0.05	0.05	0.57	1.22	30.0	7.2	72.4
10/25/1998	BM5	5.54	2481.98	0.80	43.47	0.15	0.11	0.92	2.71	40.0	18.2	94.4
11/19/1998	BM5	4.97	2227.20	2.20	37.97	0.13	0.06	0.64	1.77	41.0	11.6	1.2
12/21/1998	BM5	5.52	2469.71	2.40	35.41	0.12	0.04	0.49	1.14	22.7	7.2	70.6

Table A3. Black Creek Water Quality Data (at Lehigh River Confluence)

Date	Location	Flow cfs	Flow gpm	Alkalinity mg/L	Hardness mg/L	Iron mg/L	Ferrous mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Acidity mg/L	Total Dissolved Solids mg/L
2/22/1998	BC1	143.60	64299.47	2.20	15.00	0.12	0.06	0.19	0.74	10.0	6.0	48.4
3/22/1998	BC1	216.09	96758.16	2.40	19.00	0.19	0.11	0.18	0.75	10.0	5.0	57.2
4/26/1998	BC1	141.45	63336.77	2.20	32.00	0.16	0.08	0.25	1.00	16.0	3.6	56.4
5/17/1998	BC1	126.91	56826.22	2.60	21.00	0.17	0.10	0.22	0.75	16.0	4.4	56.1
6/28/1998	BC1	35.93	16090.05	1.60	40.00	0.09	0.07	0.50	1.67	36.0	14.0	87.8
7/19/1998	BC1	20.19	9041.33	1.40	32.00	0.08	0.04	0.54	1.45	54.0	9.8	91.9
8/23/1998	BC1	29.60	13253.03	2.00	43.87	0.20	0.06	0.61	1.63	44.0	9.4	96.0
9/27/1998	BC1	20.14	9017.15	2.00	47.11	0.04	0.04	0.70	1.67	44.0	11.0	108.0
10/25/1998	BC1	20.88	9349.84	1.40	51.65	0.10	0.10	0.83	2.93	50.0	17.8	117.0
11/19/1998	BC1	19.24	8613.71	2.00	49.47	0.10	0.05	0.74	2.39	52.0	13.0	104.0
12/21/1998	BC1	13.92	6231.14	2.00	40.76	0.07	0.04	0.59	1.84	43.0	12.4	96.0

Table A5. F.E.W. Water Quality

Date	Location	Flow cfs	Flow gpm	Alkalinity mg/L	Hardness mg/L	Iron mg/L	Ferrous mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Acidity mg/L	Total Dissolved Solids mg/L
2/22/1998	FEW	1250.00	559709.00	3.80	11.00	0.10	0.02	0.06	0.20	10.0	3.2	47.2
3/22/1998	FEW	1623.00	726727.00	3.80	13.00	0.13	0.10	0.05	0.19	10.0	1.4	36.8
4/26/1998	FEW	891.00	398961.00	3.80	22.00	0.18	0.13	0.07	0.14	10.0	1.2	35.5
5/17/1998	FEW	68.80	30806.00	5.00	10.00	0.30	0.23	0.10	0.15	10.0	1.4	33.9
6/28/1998	FEW	480.00	214929.00	6.60	10.00	0.52	0.27	0.11	0.24	10.0	3.4	34.4
7/19/1998	FEW	75.00	33583.00	7.80	10.00	0.44	0.07	0.10	0.09	32.0	0.0	37.8
8/23/1998	FEW	103.00	46120.00	8.80	15.70	0.43	0.06	0.09	0.12	20.0	0.0	42.0
9/27/1998	FEW	148.00	66270.00	9.20	15.99	0.31	0.08	0.07	0.06	20.0	0.0	45.6
10/25/1998	FEW	38.00	17015.00	7.40	16.00	0.21	0.15	0.05	0.20	20.0	0.0	45.5
11/19/1998	FEW	161.00	72090.63	7.80	16.39	0.19	0.12	0.03	0.11	20.0	0.0	43.2
12/21/1998	FEW	155.00	69404.02	7.40	16.73	0.14	0.04	0.02	0.04	20.0	0.0	418.0

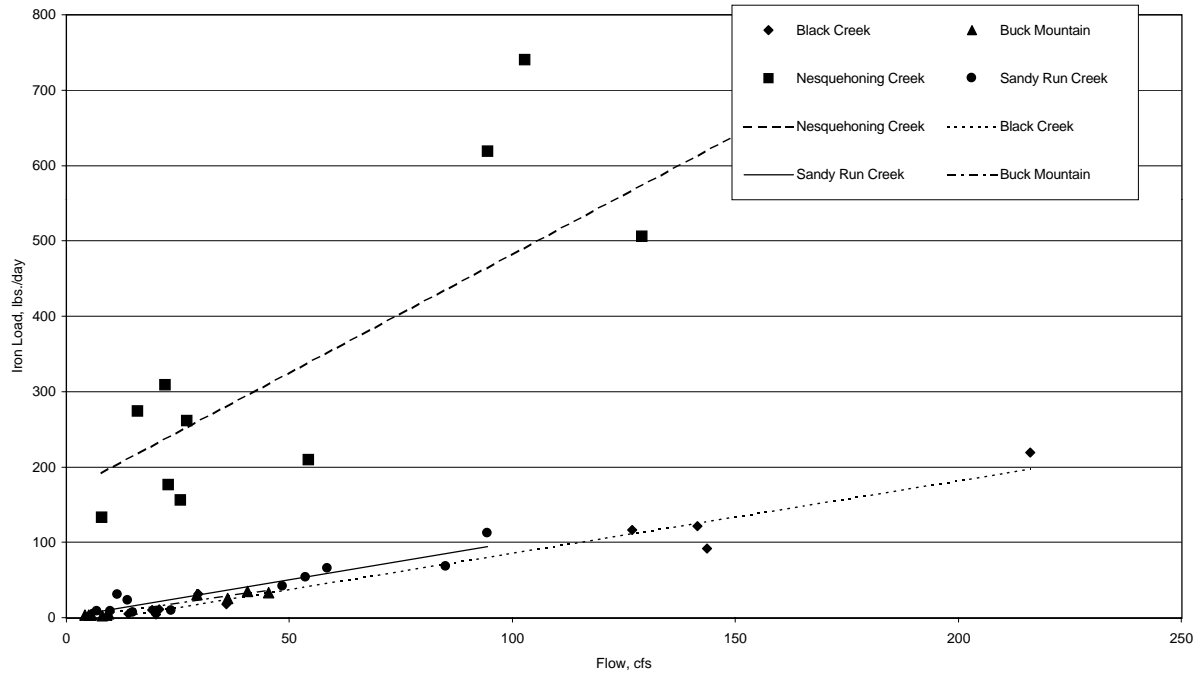
Table A6. Lehighon Water Quality Data

Date	Location	Flow cfs	Flow gpm	Alkalinity mg/L	Hardness mg/L	Iron mg/L	Ferrous mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Acidity mg/L	Total Dissolved Solids mg/L
2/22/1998	LR9	2680.00	1200018.00	3.60	14.00	0.14	0.05	0.09	0.28	10.0	2.2	52.9
3/22/1998	LR9	3540.00	1585098.20	4.20	17.00	0.18	0.10	0.09	0.26	10.0	1.6	56.1
4/26/1998	LR9	1780.00	797027.00	5.20	14.00	0.15	0.10	0.10	0.31	10.0	0.0	50.0
5/17/1998	LR9	1890.00	846281.00	5.00	41.00	0.21	0.14	0.09	0.22	11.0	0.0	46.3
6/28/1998	LR9	852.00	381498.00	7.00	17.00	0.21	0.15	0.07	0.20	11.0	2.8	50.8
7/19/1998	LR9	332.00	148659.00	7.00	19.00	0.37	0.05	0.08	0.20	20.0	0.0	60.0
8/23/1998	LR9	267.00	119554.00	9.40	46.83	0.35	0.05	0.19	0.37	38.0	0.0	91.6
9/27/1998	LR9	291.00	130300.00	9.00	31.00	0.18	0.05	0.11	0.25	20.0	0.0	71.2
10/25/1998	LR9	338.00	151346.00	7.40	29.94	0.14	0.11	0.13	0.36	23.0	0.0	65.9
11/19/1998	LR9	303.00	135673.67	8.20	28.64	0.20	0.09	0.13	0.30	27.0	0.0	64.1
12/21/1998	LR9	233.00	104329.92	7.40	26.10	0.08	0.04	0.10	0.20	20.0	0.0	61.1

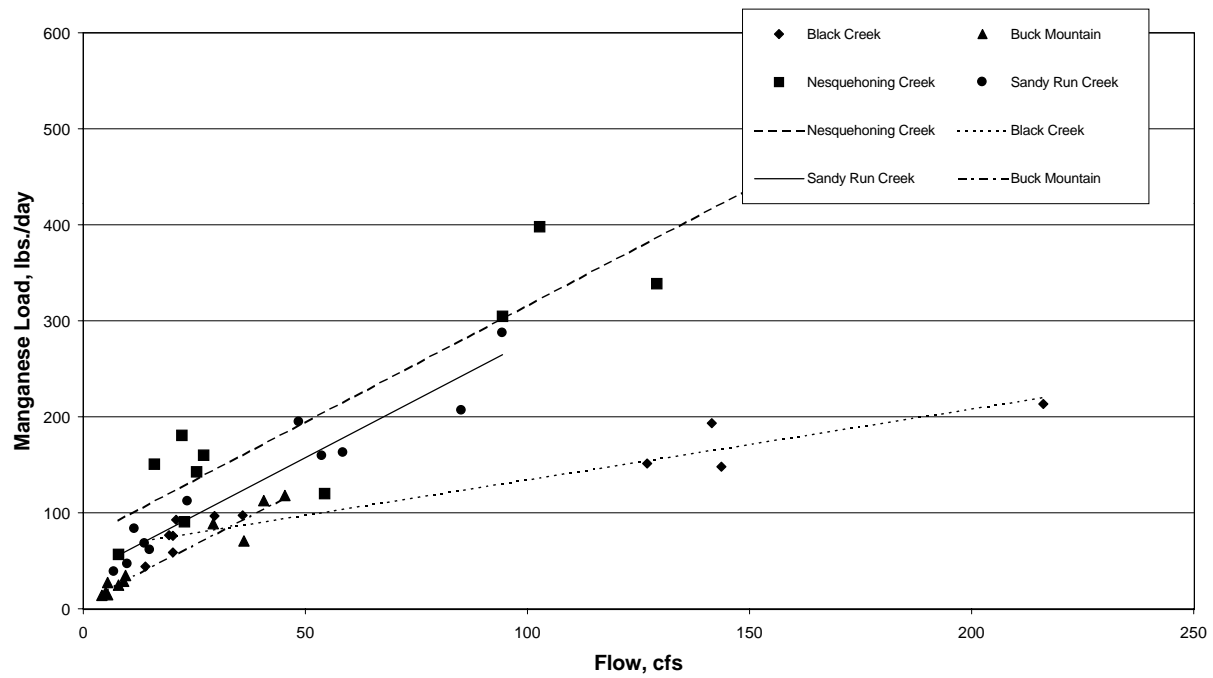
APPENDIX B

Flow vs. Loading in the Tributaries, F.E.W. and Lehigh

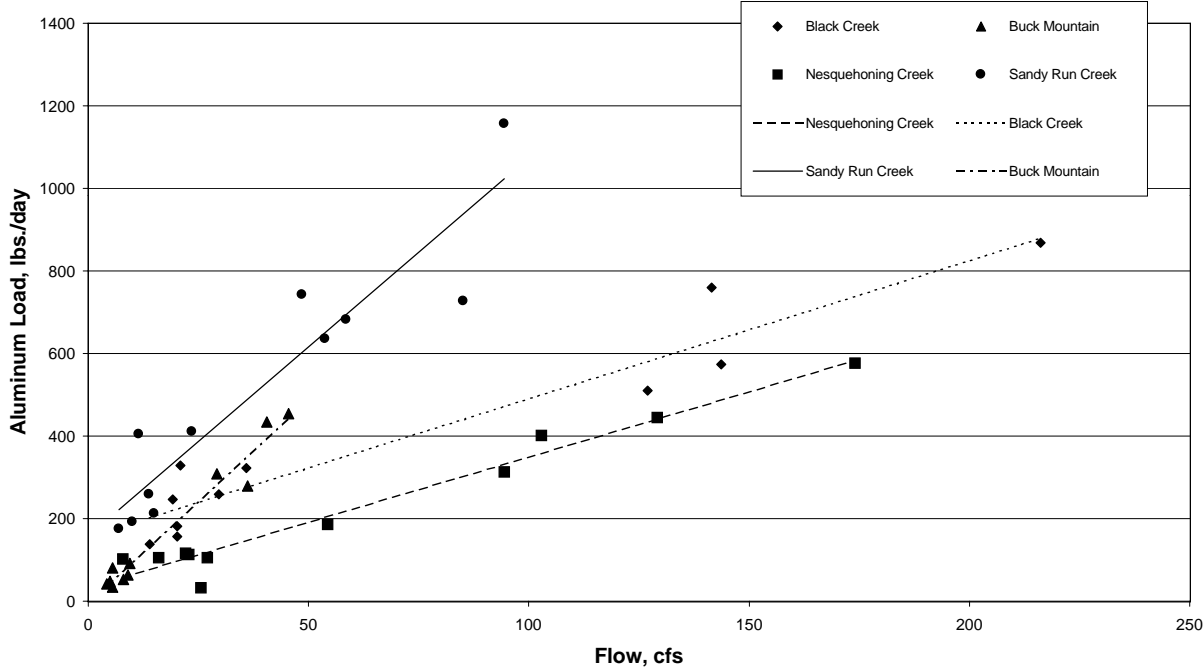
Flow vs. Iron Load



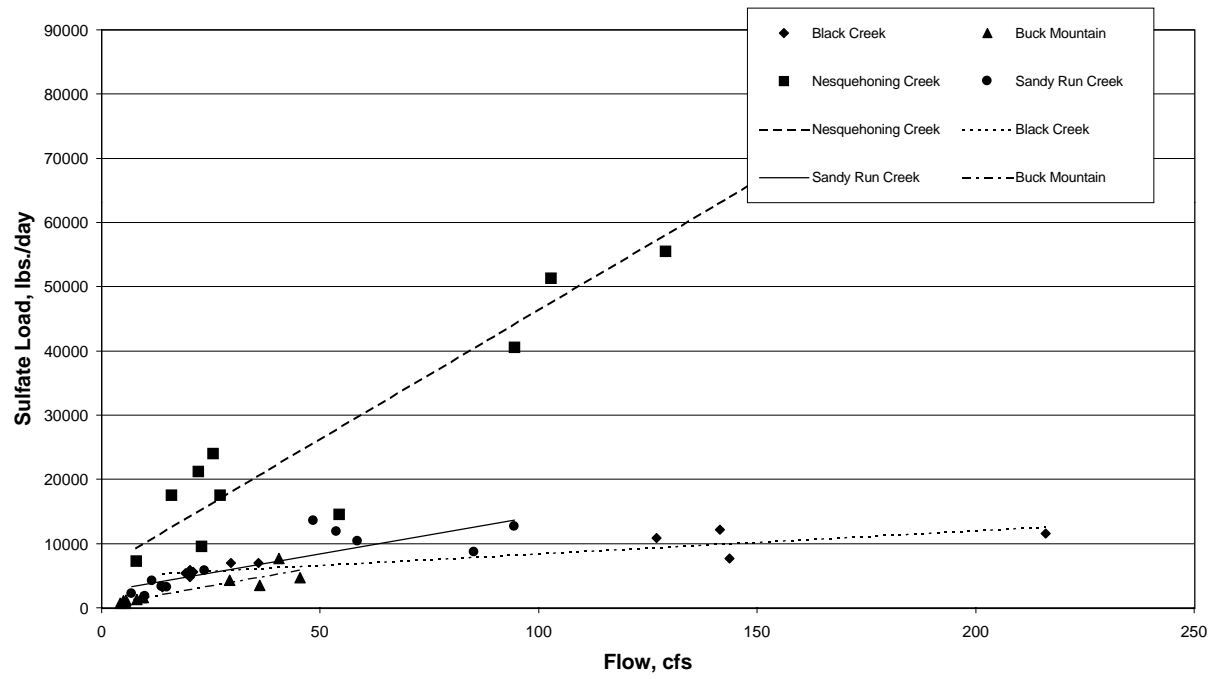
Flow vs. Manganese Load



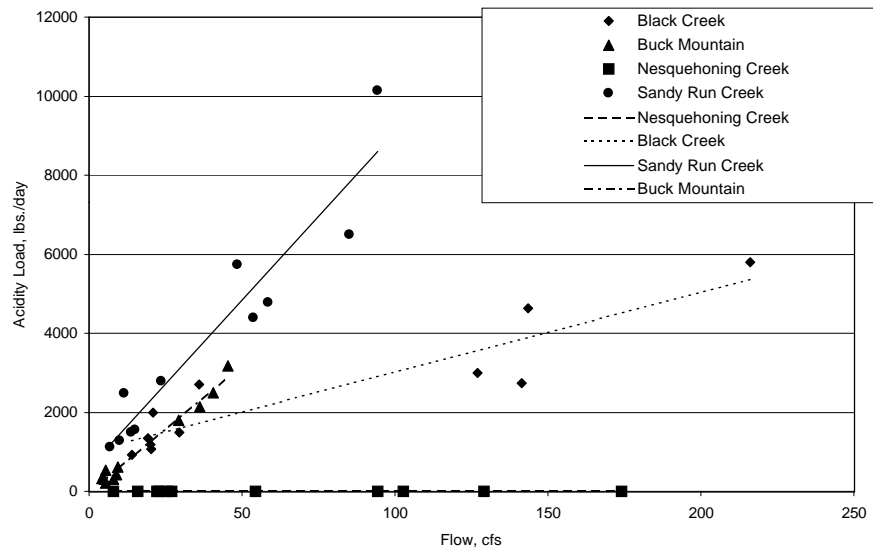
Flow vs. Aluminum Load



Flow vs. Sulfate Load



Flow vs. Acidity Load



APPENDIX C

AMD Discharge Water Quality Data

Table C2. Pond Creek Discharge Water Quality Data

Date	Sample #	Location	pH	Alkalinity mg/L	Chloride mg/L	Total Calcium mg/L	Magnesium mg/L	Sodium mg/L	Potassium mg/L	Iron mg/L
1/24/1998	4548 382	Pond Creek	4.7	9.8	15	5.6	3.65	8.67	1.50	0.240
2/21/1998	4548 399	Pond Creek	4.6	7.6	20	5.8	3.61	10.30	1.33	0.330
3/21/1998	4548 406	Pond Creek	4.7	7.6	16	5.5	3.60	10.00	<.5	0.370
4/25/1998	4553 271	Pond Creek	4.8	7.8	12	4.8	3.09	7.74	1.22	0.359
5/16/1998	4553 287	Pond Creek	4.7	8.4	12	5.1	3.26	7.84	1.16	0.464
6/20/1998	4553 308	Pond Creek	4.7	7.2	9	4.9	3.33	5.92	1.42	0.288
7/18/1998	4553 406	Pond Creek	4.7	7.8	8	5.3	0.50	5.91		0.350
8/22/1998	4548 433	Pond Creek	4.7	9.6	8	5.3	3.84	6.05	<1	0.317
9/26/1998	4548 451	Pond Creek	4.6	7.2	9	5.7	3.89	5.84	1.33	0.271
10/24/1998	4548 464	Pond Creek	4.7	8.0	10	6.1	4.31	6.61	1.76	0.203

Sample #	Manganese mg/L	Zinc mg/L	Aluminum mg/L	Specific Conductance microhoms/cm	Total Sulfate mg/L	Acidity mg/L	Total Solids mg/L	Dissolved Solids mg/L	Suspended Solids mg/L	Flow gpm
4548 382	0.528	0.083	0.535	135	24	5.0	106	106	<2	391.9
4548 399	0.511	0.076	0.363	145	33	9.4	82	80	2	2222.8
4548 406	0.490	0.061	0.407	128	32	7.0	96	86	10	2328.9
4553 271	0.442	0.060	0.231	119	21	7.4	116	106	10	96.9
4553 287	0.461	0.058	0.212	117	23	8.0	60	60	<2	216.4
4553 308	0.467	0.064	0.307	119	<20	8.6	98	98	<2	192.4
4553 406	0.498	0.066	0.310	119	27	9.4	68	68	<2	235.3
4548 433	0.544	0.080	0.354	124	24	8.6	127	127	<2	235.3
4548 451	0.550	0.080	0.406	133	31	1.3	138	122	16	155.9
4548 464	0.619	0.096	0.428	136	39	6.8	64	60	4	147.8

Table C3. Owl Hole Discharge Water Quality Data

Date	Sample #	Location	pH	Alkalinity	Chloride	Total Calcium	Magnesium	Sodium	Potassium	Iron
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1/24/1998	4548 380	Owl Hole	3.8	0.0	1	9.1	15.40	2.57	1.07	0.783
2/21/1998	4548 398	Owl Hole	3.7	0.0	2	8.8	16.70	2.58	1.20	0.756
3/21/1998	4548 408	Owl Hole	3.8	0.0	2	8.1	15.80	2.62	<.50	0.553
4/25/1998	4553 273	Owl Hole	3.7	0.0	2	8.8	14.74	2.87	1.15	0.677
5/16/1998	4553 289	Owl Hole	3.7	0.0	2	8.9	14.50	2.94	1.38	0.683
6/20/1998	4553 306	Owl Hole	3.6	0.0	1	9.9	19.60	2.54	1.78	0.838
7/18/1998	4553 404	Owl Hole	3.6	0.0	1	12.0	20.50	2.83	1.48	0.998
8/22/1998	4548 435	Owl Hole	3.7	0.0	1					
9/26/1998	4548 453	Owl Hole	3.6	0.0	1	14.1	26.10	3.03	1.40	1.270
10/24/1998	4548 466	Owl Hole	3.6	0.0	2	14.7	27.20	3.49	1.60	1.430

Sample #	Manganese	Zinc	Aluminum	Specific Conductance	Total Sulfate	Acidity	Total Solids	Dissolved Solids	Suspended Solids	Flow
	mg/L	mg/L	mg/L	microhoms/cm	mg/L	mg/L	mg/L	mg/L	mg/L	gpm
4548 380	3.060	0.872	19.400	444	68	112.0	338	334	4.0	3094.9
4548 398	2.770	0.783	16.700	414	64	118.0	296	294	2.0	4746.3
4548 408	2.780	0.760	16.200	401	154	114.0	296	292	4.0	4951.5
4553 273	2.850	0.818	16.340	400	100	112.0	28	18	10.0	5348.5
4553 289	2.810	0.827	15.200	391	133	110.0	320	320	<2	5329.8
4553 306	3.430	0.929	21.400	505	158	134.0	554	554	<2	1445.0
4553 404	3.880	1.060	23.400	541	219	158.0	566	566	<2	805.5
4548 435				574	208	170.0	566	562	4.0	674.8
4548 453	4.770	1.290	29.500	647	304	192.0	688	680	8.0	649.5
4548 466	5.400	1.510	30.900	676	307	218.0	506	496	10.0	404.6

Table C4. Buck Mountain #1 Discharge Water Quality Data

Date	Sample #	Location	pH	Alkalinity mg/L	Chloride mg/L	Total Calcium mg/L	Magnesium mg/L	Sodium mg/L	Potassium mg/L	Iron mg/L
1/24/1998	4548 379	Buck Mtn #1	4.0	3.4	1	4.6	7.72	1.56	1.31	4.020
2/21/1998	4548 396	Buck Mtn #1	3.8	0.0	2	4.2	6.98	1.95	1.56	0.191
3/21/1998	4548 409	Buck Mtn #1	3.9	0.0	2	4.0	6.61	1.62	<.5	0.314
4/25/1998	4553 275	Buck Mtn #1	3.9	0.0	2	4.1	6.75	1.66	1.62	0.200
5/16/1998	4553 290	Buck Mtn #1	3.8	0.0	2	4.2	7.15	1.65	1.14	0.166
6/20/1998	4553 305	Buck Mtn #1	3.7	0.0	2	4.2	7.01	1.67	1.61	0.241
7/18/1998	4553 403	Buck Mtn #1	3.8	0.0	1	4.7	7.61	1.52	1.66	0.328
8/22/1998	4548 436	Buck Mtn #1	3.8	0.0	1	4.7	8.14	1.61	1.53	0.406
9/26/1998	4548 454	Buck Mtn #1	3.7	0.0	<1	4.7	7.44	1.24	1.46	0.403
10/24/1998	4548 467	Buck Mtn #1	3.8	0.0	1	4.9	8.74	1.20	1.86	0.302

Sample #	Manganese mg/L	Zinc mg/L	Aluminum mg/L	Specific Conductance microhoms/cm	Total Sulfate mg/L	Acidity mg/L	Total Solids mg/L	Dissolved Solids mg/L	Suspended Solids mg/L	Flow gpm
4548 379	1.320	0.647	7.140	240	50	50.0	180	152	28.0	116.7
4548 396	1.080	0.580	6.300	226	<20	54.0	146	140	6.0	99.2
4548 409	1.160	0.539	5.970	226	70	50.0	190	188	2.0	119.6
4553 275	1.110	0.549	5.920	228	68	52.0	246	224	22.0	42.5
4553 290	1.160	0.576	6.020	226	67	50.0	168	168	<2	61.4
4553 305	1.190	0.583	5.970	259	70	54.0	216	212	4.0	48.8
4553 403	1.330	0.636	5.870	262	74	54.0	210	202	8.0	20.0
4548 436	1.470	0.680	6.270	272	81	56.0	242	242	<2	20.0
4548 454	1.350	0.666	5.880	279	81	52.0	296	288	8.0	20.0
4548 467	1.480	0.742	7.310	282	80	60.0	172	142	36.0	28.2

Table C5. Buck Mountain #2 Discharge Water Quality Data

Date	Sample #	Location	pH	Alkalinity	Chloride	Total Calcium	Magnesium	Sodium	Potassium	Iron
				mg/l	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1/24/1998	4548 378	Buck Mtn #2	3.7	0.0	<1	8.4	15.30	1.95	1.34	0.803
2/21/1998	4548 395	Buck Mtn #2	3.6	0.0	1	7.9	16.40	1.97	1.12	0.498
3/21/1998	4548 410	Buck Mtn #2	3.7	0.0	1	7.4	16.00	2.01	<.5	0.519
4/25/1998	4553 274	Buck Mtn #2	3.7	0.0	1	8.0	14.70	2.13	1.60	0.581
5/16/1998	4553 291	Buck Mtn #2	3.7	0.0	<1	8.3	14.70	2.26	1.33	0.483
6/20/1998	4553 304	Buck Mtn #2	3.6	0.0	<1	9.8	19.70	2.68	1.50	0.868
7/18/1998	4553 402	Buck Mtn #2	3.6	0.0	<1	10.9	21.30	2.17	1.56	1.190
8/22/1998	4548 437	Buck Mtn #2	3.7	0.0	<1	10.6	24.80	2.32	1.01	1.600
9/26/1998	4548 455	Buck Mtn #2	3.6	0.0	<1	11.9	24.80	2.13	1.20	1.810
10/24/1998	4548 468	Buck Mtn #2	3.6	0.0	<1	12.1	24.40	2.12	1.50	1.950

Sample #	Manganese	Zinc	Aluminum	Specific Conductance	Total Sulfate	Acidity	Total Solids	Dissolved Solids	Suspended Solids	Flow
	mg/L	mg/L	mg/L	microhoms/cm	mg/L	mg/L	mg/L	mg/L	mg/L	gpm
4548 378	3.560	1.190	16.300	442	90	106.0	342	342	<2	1942.0
4548 395	3.160	1.060	13.700	405	97	104.0	264	254	10	1853.1
4548 410	3.120	1.040	13.400	404	157	104.0	310	310	<2	1860.5
4553 274	3.250	1.050	12.500	391	134	100.0	400	400	<2	1979.7
4553 291	3.460	1.130	12.900	395	151	106.0	276	276	<2	2117.2
4553 304	4.260	1.440	17.700	494	143	122.0	488	488	<2	934.4
4553 402	4.680	1.490	19.800	528	121	144.0	520	512	8	669.5
4548 437	5.330	1.640	22.100	565	194	156.0	570	570	<2	443.7
4548 455	5.400	1.700	23.500	598	260	156.0	270	260	10	285.2
4548 468	5.710	1.850	22.200	590	239	162.0	476	440	36	292.6

Table C8. Lausanne Tunnel Discharge Water Quality Data

Date	Location	Flow cfs	Flow gpm	Alkalinity mg/L	Hardness mg/L	Iron mg/L	Ferrous mg/L	Manganese mg/L	Aluminum mg/L	Sulfate mg/L	Acidity mg/L	Total Dissolved Solids mg/L
2/22/1998	Lausanne	12.88	5766.09	64.00	292.00	1.08	1.10	1.77	1.92	401.0	0.0	417.0
3/22/1998	Lausanne	19.91	8915.06	78.00	289.00	2.19	0.83	1.92	1.42	285.0	0.0	451.0
4/26/1998	Lausanne	20.00	8954.46	78.00	363.00	3.50	2.20	2.09	1.35	292.0	0.0	472.0
5/17/1998	Lausanne	24.07	10775.98	70.00	296.00	3.12	1.92	2.04	1.28	210.0	0.0	457.0
6/28/1998	Lausanne	10.17	4554.29	86.00	387.00	4.67	3.54	2.38	1.53	253.0	0.0	483.0
7/19/1998	Lausanne	8.59	3844.49	88.00	376.00	5.19	4.26	2.61	1.51	293.0	0.0	510.0
8/23/1998	Lausanne	3.93	1761.70	90.00	522.94	5.10	3.90	3.19	0.77	336.0	0.0	538.0
9/27/1998	Lausanne	2.40	1073.43	86.00	490.86	8.33	3.48	3.14	1.55	373.0	0.0	557.0
10/25/1998	Lausanne	5.35	2397.53	74.00	476.23	6.92	3.12	2.96	2.27	352.0	0.0	531.0
11/19/1998	Lausanne	3.43	1537.86	86.00	473.30	4.98	3.12	2.98	1.41	371.0	0.0	540.0
12/21/1998	Lausanne	2.73	1220.93	90.00	518.40	3.73	3.00	2.89	0.59	459.7	0.0	555.0

Table C7. Hazlebrook Discharge Water Quality Data

Date	Sample #	Location	pH	Alkalinity	Chloride	Total	Magnesium	Sodium	Potassium	Iron
						Calcium				
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1/24/1998	4548 383	Hazlebrook	4.4	8.4	<1	2.1	2.55	1.00	0.75	5.610
2/21/1998	4548 393	Hazlebrook	4.3	6.2	<1	2.0	2.56	1.04	1.00	5.300
3/21/1998	4548 413	Hazlebrook	4.3	5.8	<1	2.1	2.55	1.01	<.50	4.920
4/25/1998	4553 278	Hazlebrook	4.3	6.6	<1	2.1	2.57	1.02	0.86	5.400
5/16/1998	4553 294	Hazlebrook	4.3	6.6	<1	2.2	2.70	1.20	1.13	5.740
6/20/1998	4553 309	Hazlebrook	4.2	5.0	<1	1.9	2.49	0.95	1.00	5.770
7/18/1998	4553 407	Hazlebrook	4.3	6.2	<1	2.1	2.61	0.99		6.110
8/22/1998	4548 439	Hazlebrook	4.4	7.8	<1	2.5	2.00	1.01	<1	5.870
9/26/1998	4548 457	Hazlebrook	4.3	5.8	1	1.9	2.45	0.91	<1	5.700
10/24/1998	4548 463	Hazlebrook	4.4	7.2	1	2.1	2.68	1.05	<1	6.580

Sample #	Manganese	Zinc	Aluminum	Specific	Total	Acidity	Total	Dissolved	Suspended	Flow
	mg/L	mg/L	mg/L	Conductance	Sulfate		Solids	Solids	Solids	
		mg/L	mg/L	microhoms/cm	mg/L	mg/L	mg/L	mg/L	mg/L	gpm
4548 383	0.451	0.114	1.600	107	23	24.0	66	46	20	
4548 393	0.438	0.085	1.720	115	28	28.0	92	76	16	1202.2
4548 413	0.465	0.088	1.700	115	24	30.0	96	90	6	888.1
4553 278	0.451	0.086	1.890	117	386	30.0	150	142	8	870.6
4553 294	0.476	0.091	1.860	124	33	32.0	70	70	<2	922.6
4553 309	0.437	0.080	1.830	125	34	30.0	316	302	14	587.1
4553 407	0.441	0.082	1.770	120	<20	28.0	74	70	4	500.2
4548 439	0.413	0.073	1.620	114	34	26.0	112	112	<2	416.0
4548 457	0.421	0.079	1.520	116	29	24.0	350	342	8	314.0
4548 463	0.465	0.091	1.580	117	28	28.0	68	62	8	312.8

Table C6. Quakake Discharge Water Quality Data

Date	Sample #	Location	pH	Alkalinity mg/L	Chloride mg/L	Calcium mg/L	Magnesium mg/L	Sodium mg/L	Potassium mg/L	Iron mg/L
1/24/1998	4548 377	Quakake	4.1	5.6	11	8.6	8.94	7.15	1.25	0.542
2/21/1998	4548 394	Quakake	4.1	3.0	10	8.8	9.33	6.55	0.92	0.544
3/21/1998	4548 411	Quakake	4.1	3.4	8	3.1	3.37	2.18	<.50	0.212
4/25/1998	4553 276	Quakake	4.1	4.4	8	8.9	9.49	5.99	1.17	0.426
5/16/1998	4553 292	Quakake	4.1	4.8	8	<2	10.00	6.32	1.10	0.423
6/20/1998	4553 303	Quakake	3.9	0.0	8	14.4	17.30	6.96	1.62	0.712
7/18/1998	4553 401	Quakake	3.8	0.0	9	13.7	16.30	6.84	1.43	0.718
8/22/1998	4548 438	Quakake	4.0	2.2	8	13.7	17.30	6.82	1.07	0.617
9/26/1998	4548 456	Quakake	3.9	0.0	8	13.8	16.40	6.22	1.16	0.528
10/24/1998	4548 469	Quakake	3.8	0.0	8	15.1	18.10	6.69	1.30	0.895

Sample #	Manganese mg/L	Zinc mg/L	Aluminum mg/L	Specific Conductance microhoms/cm	Total Sulfate mg/L	Acidity mg/L	Total Solids mg/L	Dissolved Solids mg/L	Suspended Solids mg/L	Flow gpm
4548 377	1.140	0.333	4.790	278	53	38.0	192	192	<2	7631.6
4548 394	1.020	0.329	4.740	255	60	38.0	180	176	4	12208.5
4548 411	0.404	0.128	1.590	234	72	38.0	172	166	6	12533.9
4553 276	1.130	0.356	4.580	258	83	38.0	230	214	16	13439.7
4553 292	1.450	0.379	4.580	252	82	40.0	252	160	160	8707.5
4553 303	1.820	0.563	7.250	375	126	60.0	370	370	<2	4172.1
4553 401	1.890	0.553	7.170	385	112	60.0	300	288	12	2492.5
4548 438	1.960	0.541	6.950	370	104	52.0	320	320	<2	1438.2
4548 456	1.910	0.519	6.920	383	131	54.0	654	640	12	1474.6
4548 469	2.370	0.654	9.320	429	137	72.0	274	194	80	1404.1

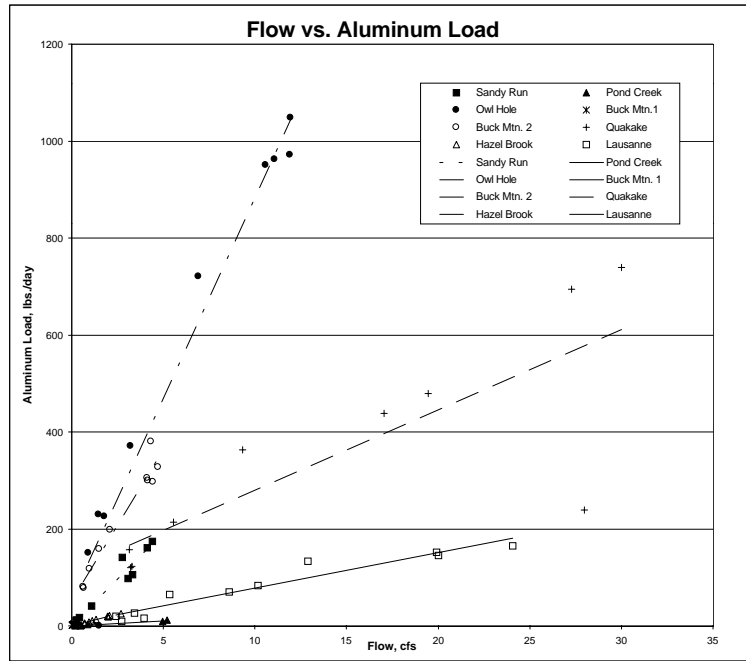
Table C1. Sandy Run Discharge Water Quality Data

Date	Sample #	Location	pH	Alkalinity	Chloride	Calcium	Magnesium	Sodium	Potassium	Iron
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1/24/1998	4548 381	Sandy Run	3.9	0.0	3	14.2	19.60	3.48	1.23	2.710
2/21/1998	4548 397	Sandy Run	3.8	0.0	4	11.2	17.60	3.72	1.22	1.690
3/21/1998	4548 407	Sandy Run	3.8	0.0	4	13.1	19.50	3.93	<.50	1.440
4/25/1998	4553 272	Sandy Run	3.8	0.0	3	9.2	15.40	3.57	1.37	1.100
5/16/1998	4553 288	Sandy Run	3.8	0.0	2	8.9	13.40	2.93	1.16	1.050
6/20/1998	4553 307	Sandy Run	3.7	0.0	3	11.9	17.70	3.40	1.23	2.910
7/18/1998	4553 405	Sandy Run	3.6	0.0	3	12.9	18.70	3.51	1.41	3.970
8/22/1998	4548 434	Sandy Run	3.8	0.0	3	13.5	21.30	3.70	1.06	7.460
9/26/1998	4548 452	Sandy Run	3.7	0.0	4	14.3	21.70	3.42	1.07	10.300
10/24/1998	4548 465	Sandy Run	3.8	0.0	<2	13.5	20.40	3.88	1.50	11.300

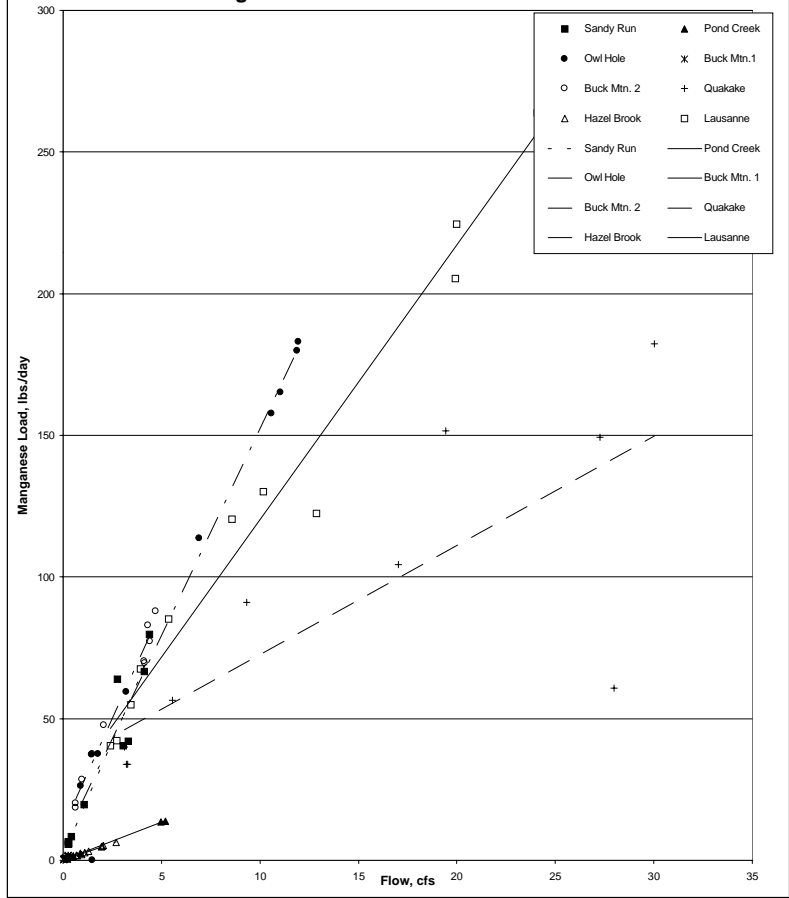
Sample #	Manganese	Zinc	Aluminum	Specific Conductance	Total Sulfate	Acidity	Total Solids	Dissolved Solids	Suspended Solids	Flow
	mg/L	mg/L	mg/L	microhoms/cm	mg/L	mg/L	mg/L	mg/L	mg/L	gpm
4548 381	4.320	0.733	9.570	438	134	84.0	302	302	<2	1235.4
4548 397	3.020	0.588	7.280	365	87	72.0	242	238	4	1841.7
4548 407	3.370	0.780	7.350	366	108	66.0	278	278	<2	1970.7
4553 272	2.460	0.553	5.900	323	103	58.0	478	466	12	1370.5
4553 288	2.350	0.531	5.930	299	117	56.0	218	218	<2	1491.3
4553 307	3.370	0.558	6.920	418	120	66.0	390	386	4	485.3
4553 405	3.640	0.556	7.210	442	135	72.0	282	278	4	192.4
4548 434	3.940	0.519	7.740	477	138	76.0	456	450	6	124.8
4548 452	4.100	0.483	7.670	496	156	74.0	474	450	24	114.1
4548 465	4.760	0.520	8.330	506	140	88.0	322	322	<2	114.6

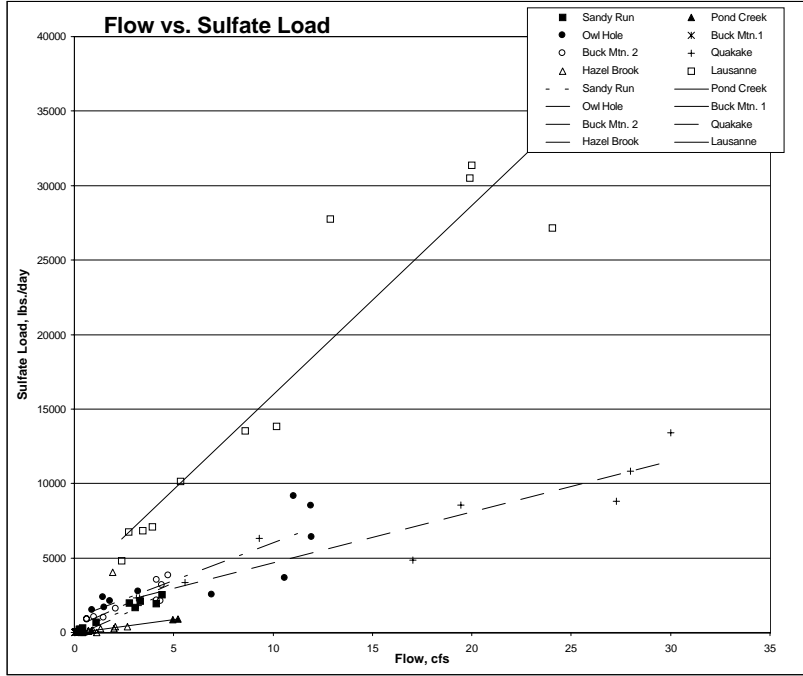
APPENDIX D

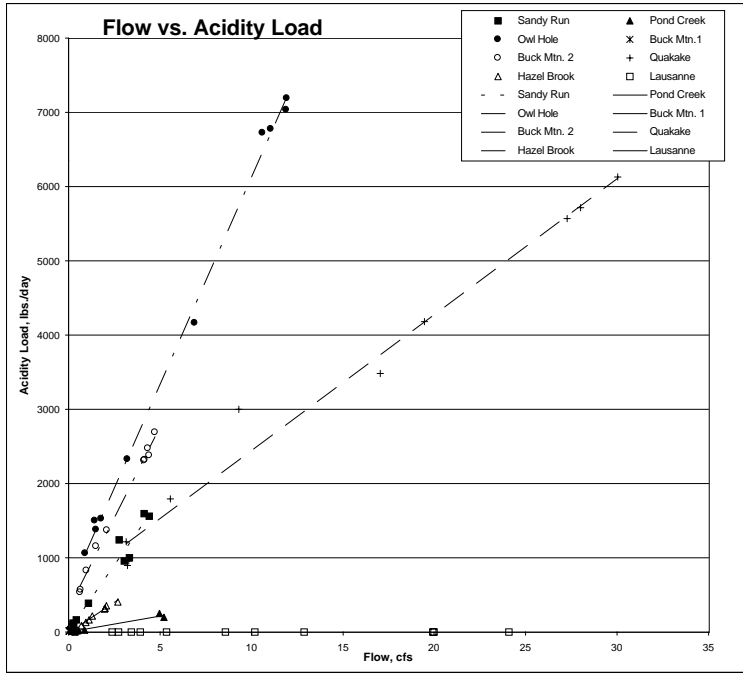
Flow vs. Loading at the AMD Discharges



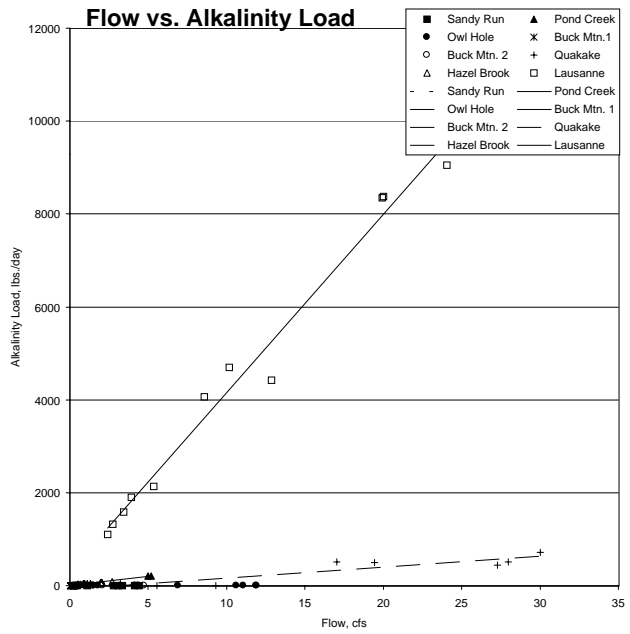
Flow vs. Manganese Load

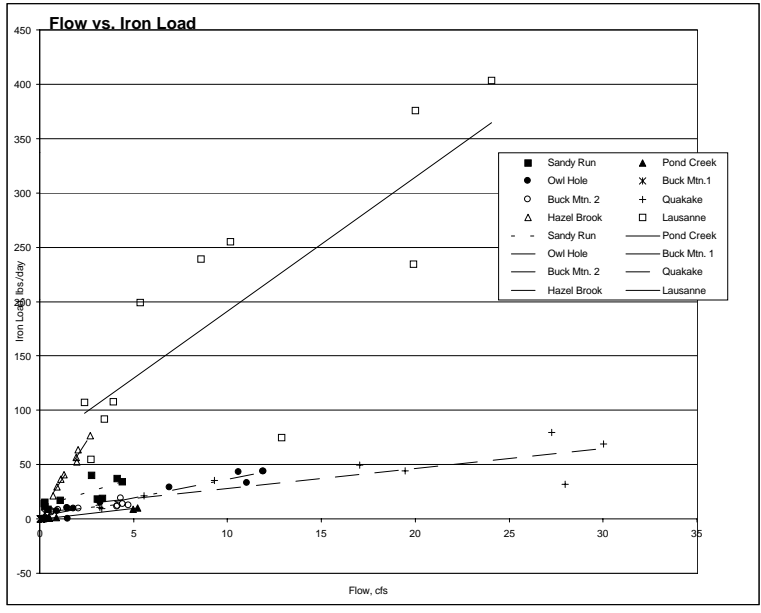






Flow vs. Alkalinity Load





APPENDIX E

Locations of Mining Operations and Remediation Sites

PERMITTED ANTHRACITE MINING OPERATIONS

Pennsylvania DEP BMR, Pottsville District Mining Office has identified 14 permitted mining operations located in the Lehigh River watershed or areas draining to the Lehigh River. The site name, company name, county, municipality and permit number of the mining operations are listed in Table E1. The permits consist of eight surface coal mining operations and six coal refuse reprocessing operations. Of the permitted operations nine are active, four are inactive and one permit is soon to be issued. The permitted mining operations are located within Carbon and Luzerne counties in Banks, Nesquehoning, Foster and Hazle townships.

TABLE E1. List of Active Mining Permits in the Lehigh River Drainage Area

SITE NAME	COUNTY	MUNICIPALITY	COMPANY NAME
Rossi Excavating Banks Mine	Carbon	Banks	Rossi Excavating Company
Pagnotti Enterprises Spring Mountain Mine	Carbon	Banks	Pagnotti Enterprises Incorporated
Rossi Excavating Centown Mine	Carbon	Banks	Rossi Excavating Company
Rossi Excavating Greenfeild Mine	Carbon	Banks	Rossi Excavating Company
Panther Creek Partners	Carbon	Nesquehoning	Panther Creek Partners
JEZ Nesquehoning Mine	Carbon	Nesquehoning	JEZ Incorporated
JEZ Nesquehoning 2 Mine	Carbon	Nesquehoning	JEZ Incorporated
Jeddo Highland Coal 2 N mine	Luzerne	Foster	Jeddo Highland Coal Company
Jeddo Highland Coal Lehigh 6 Mine	Luzerne	Foster	Jeddo Highland Coal Company
Jeddo Highland Coal Lehigh 6 Mine	Luzerne	Foster	Jeddo Highland Coal Company
Pagnotti Enterprises Highland 2 S Mine	Luzerne	Foster	Pagnotti Enterprises Incorporated
Pagnotti Enterprises Highland 5 Mine	Luzerne	Foster	Pagnotti Enterprises Incorporated
No. 1 Contracting Corporation	Luzerne	Foster	No. 1 Contracting Corporation
Coal Contracting 1991 Stockton Mine	Luzerne	Hazel	Coal Contracting 1991 Incorporated

CURRENT AND PAST AREAS OF REMEDIATION

Several projects have been completed in the mined areas draining to the Lehigh River. Most of these projects were the work of the Pa. Bureau of Abandoned Mine Reclamation. Figures E1-E3 display the locations of the areas that have been or will be restored. To date, several projects on abandoned mine lands have been completed in the Lehigh River watershed. These areas of reclamation reduce infiltration through the mine workings and therefore reduce the contact of water with pyretic bearing materials, reducing AMD.

Two mine abatement projects were completed in the Lehigh River watershed but are no longer in operation. They include a lime slurry tower at Buck Mountain #2 discharge and a demonstration project utilizing limestone at the Quakake Tunnel.

Additional work is planned by Pa. BAMR that will complete reclamation projects in the watershed. These areas are also shown in Figures E1-E3.