CONCLUSIONS AND RECOMMENDATIONS

The area within the Rausch Creek Watershed comprising approximately sixty-three hundred (6,300) acres, is principally a coal mining area. Little, if any, of this area would be suitable for any land use other than limited recreational hunting. The streams are not conducive to supporting any aquatic life. The water quality in the area, for the majority of its volume, is non-potable and acidic. The land use would be solely for mining purposes and lumbering.

The potential of the land being utilized for commercial, industrial or recreational purposes seems very remote.

The potential of the land being utilized for camp-sites or tourism is as equally remote.

Poor drainage - both natural and man-made, along with mine drainage have been major factors attributing to the deterioration of the vegetation in the Watershed Area. Impoundage of run-off water in abandoned strip pits also contributes to the contamination of surface water in the Watershed.

Treatment of the mine waters will remove the acid and iron content so that the treated water will be able to meet the requirements of the Clean Streams Laws and be capable of supporting aquatic life. With

the abatement of the pollution of the waters of Rausch Creek, a total of twenty-seven (27) miles of streams from the Susquehanna River eastward to Rausch Creek could be classified as "clean, unpolluted streams".

The total of twenty-seven (27) miles would include: eight (8) miles of Pine Creek westward from the Rausch Creek Watershed to its confluence with the Mahantongo Creek and nineteen (19) miles of the Mahantongo Creek from the point of confluence westward to the Susquehanna River, that point being approximately twenty-four (24) miles north of Harrisburg.

In order to accomplish these desires of "Operation Scarlift", that is, clean streams, etc., it has been determined that neutralization with lime treatment, plus oxidation via aeration, and removal of iron content to allowable limits, will help accomplish these goals.

In order to accomplish these goals, it has been decided that individual treatment plants at the sources or pollution are not economically feasible and will necessitate many "policing" problems. This method would not provide for iron removal and would not protect the main stream from contamination from surface drainage and rainfall runoffs.

Strategically located plants, although having considerably more advantages than individual plants, will be more expensive to construct and operate than a single large plant. They also would not provide for iron removal or treatment of surface runoff between the plant locations and the point where Rausch Creek leaves the areas of the coal measures.

A single plant treatment of the entire flow of Rausch Creek is the most practical and economically feasible method of abating the mine water pollution and contamination of the Rausch Creek Watershed. It will provide for the treatment of the entire runoff of the watershed.

It has been determined that an average daily flow of ten million gallons is a realistic volume to be treated by the plant with a provision of treating flows in excess of twenty million gallons per day with sodium hydroxide and allowing this treated water to enter the polishing lagoon. Neutralization with lime was found to give better results than a combination of lime and limestone. It has also been determined, through the pilot plant operation of "Yellowboy", that the waters of Rausch Creek respond more favorably to neutralization with lime slurry and

a polyelectrolyte which abets the settlements of the flocculants. Sludge removal, via hauling, had advantages in that it can be discontinued at any time without incurring any loss if a more feasible and economical method should be developed.

We recommend that a single plant treatment facility be constructed to provide for the neutralization of acidic mine waters as well as iron removal from the same waters. We recommend that the facilities be designed to treat a flow of 20.0 mgd, utilizing pebble lime as a neutralizing agent along with the mixing, aeration and sedimentation of sludge. We also recommend provisions for treating flows in excess of 20.0 mgd with the use of sodium hydroxide solution before entering the polishing lagoon.

We have included costs for sludge disposal in this report, but we recommend continued studies be made after initial operations begin to determine if more efficient and economical methods of sludge handling could be accomplished.

Cost estimates for the project are summarized as follows:

Construction Costs		
Total of three (3) contracts:		
1) General	$1,589,000.	
2) Electrical	159,947.	
3) Water Supply	4,658.	
		$1,753,605.
Engineering Design & Supervision		242,000.
		$1,995,605.
Operation & Maintenance		
(without sludge disposal)		93,000.
Sludge Disposal		55,000.

The plant site recommended north of the Gap in Bear Mountain is an ideal location to intercept the entire flow of Rausch Creek, treat it, and return it to the stream, uncontaminated, and meeting requirements of the Clean Streams Law.

It is recommended a program of backfilling strip pits be instituted to improve the natural drainage throughout the watershed. In so doing, influx of surface waters into the deep mines will be greatly, if not totally, reduced. Thus, with restoration of drainage, unpolluted waters to the streams will increase the natural alkalinity of the streams and neutralize some of the acidity.

There are approximately 300+ acres that should be backfilled, topsoiled and seeded in the watershed area. An approximated cost of this restoration is $1,400,000. This program could be segmented into certain areas as quoted in the estimated costs of restoration.

A thorough and comprehensive study of abatement measures, i.e., mine sealing, etc. was made and the conclusions are that there would be nothing gained in sealing any of the mine openings. The complex geological structure is such that any closures made at one level would only delay for a short period of time the outflow of underground water from a higher level.

We recommend that drainage controls, in addition to those already initiated, and completed by the Department, be carried out. A system of flumes and confinement of acid mine drainage to the main drainage channels should be instituted on the north side of the West Branch of Rausch Creek and both north and south sides of the East Branch of Rausch Creek. In carrying out a program of this nature, it could eliminate any possibilities of the recirculating of these acid mine waters. There has been no estimate of costs of this type of program included in the report.

POLLUTION SOURCES

At the time of this report, there were twenty-eight (28) active mine operations and nineteen (19) abandoned operations contributing to the pollution of Rausch Creek.

The twenty-eight (28) active operations contributed, where estimable, an estimated acid load of 2,300 lbs./day, and the nineteen (19) abandoned operations contributed an estimated acid load of 9,500 lbs./day.

The total acid load contributed by both active and abandoned operations was approximately 11,800 lbs./day.

In measuring the acid load per day beyond the confluence of the East and West Branches of Rausch Creek, there was found to be an estimated acid load of 12,000 lbs./day. The added difference was probably accountable in the additions of acid load contributed by the leaching of the various spoil and refuse banks along the routes of the two streams. Percentage wise, it was an increase of 1.04%.

The total iron (Fe) load contributed by both active and abandoned operations was approximately 3,600 lbs./day. Of this total 670 lbs./day was contributed from the active operations and the balance 2,945 lbs./day was contributed from the

abandoned operations. Beyond the confluence of the East and West Branches of Rausch Creek, there was found to be an estimated iron load of 3,050 lbs./day. The decrease, approximately 18.0%, was due to oxidation and deposition of iron along the stream beds.

The total sulfate load contributed by active and abandoned operations was 21,000 lbs./day. Beyond the confluence of the two Branches of Rausch Creek, there was an estimated 25,850 lbs./day, or an increase of approximately 20.0%. This increase was undoubtedly due to the two breaker operations in the area.

Results of daily testing were listed, averaged on a monthly and yearly basis, and those averages are posted on the following pages. Monthly averages of pH, Fe, sulfates and acidity were placed upon graphs and are included as part of this report.

Description of Major Source Areas:

Active Operations:

1. Source No.7 Harner Coal Company

	High	Low	Mean
flow (gpd)	-	-	43,200
pH	7.20	5.21	6.20
acidity (mg/l)	55.67	41.07	48.00
iron (mg/l)	40.82	30.12	35.20
sulfates (mg/l)	477.82	345.64	412.00
acid load (lbs./day)	20.05	14.79	17.27
percent total acid load(%)	-	-	0.74

2. Source No.8 S. & S. Coal Company - later, Fireside Coal Company

	High	Low	Mean
flow (gpd)	-	-	83,520
pH	5.16	3.99	4.50
acidity (mg/l)	285.51	214.10	251.00
iron (mg/l)	69.39	52.03	61.00
sulfates (mg/l)	739.38	554.45	650.00
acid load (tbs./day)	198.90	149.08	174.56
percent total acid load(%)	-	-	7.56

3. Source No.9 B. & M. Tunnel

	High	Low	Mean
Flow	-	-	432,000
pH (gpd)	6.14	4.71	5.38
acidity (mg/l)	21.49	16.41	19.10
iron (mg/l)	13.27	10.14	11.80
sulfates (mg/l)	61.88	47.25	55.00
acid load (lbs./day)	77.40	59.10	68.71
percent total acid load(%)	-	-	2.98

4. Source No. 12 Marby Coal Company

	High	Low	Mean
flow (gpd)	-	-	108,000
pH	3.12	2.24	2.72
acidity (mg/l)	914.94	682.27	799.80
iron (mg/l)	312.10	226.06	265.00
sulfates (mg/l)	1707.0	1236.93	1450.00
acid load (lbs./day)	848.12	614.32	719.27
percent total acid load (%)	-	-	31.20

5. Source No. 15 Split Vein Coal Company

	High	Low	Mean
flow (gpd)	-	-	144,000
pH	7.50	5.28	6.50
acidity (mg/l)	21.49	16.91	18.10
iron (mg/l)	7.60	5.42	6.40
sulfates (mg/l)	208.38	148.54	175.00
acid load (lbs./day)	25.80	20.30	21.70
percent total acid load (%)	-	-	.94

6. Source No. 16 J. & C. Coal Company

	High	Low	Mean
flow (gpd)	-	-	237,600
pH	4.69	3.24	4.06
acidity (mg/l)	103.99	85.38	86.50
iron (mg/l)	42.32	29.76	35.20
sulfates (mg/l)	343.83	241.81	286.00
acid load (lbs./day)	205.99	169.13	171.14
percent total acid load (%)	----------	----------	7.42

7. Source No. 17 Williamson Coal Company

	High	Low	Mean
Flow	-	-	122,400
pH	3.90	2.72	3.40
acidity (mg/l)	99.58	70.76	83.00
iron (mg/l)	43.19	30.69	36.00
sulfates (mg/l)	263.94	187.57	220.00
acid load (lbs./day)	101.61	72.21	84.70
percent total acid load (%)	-	-	3.66

8. Source No. 20 Hatter Coal Company

	High	Low	Mean
Flow	-	-	100,800
pH	3.34	2.42	3.00
acidity (mg/l)	259.30	192.78	217.50
iron (mg/l)	23.84	17.73	20.00
sulfates (mg/l)	226.52	168.41	190.00
acid load (lbs./day)	217.91	162.01	182.56
percent total acid load (%)	-	-	7.90

9. Source No. 25 Shade & Morgan Coal Company

	High	Low	Mean
Flow	-	-	136,800
pH	4.27	3.00	3.75
acidity (mg/l)	145.31	104.32	121.20
iron (mg/l)	35.61	25.56	29.70
sulfates (mg/l)	161.86	116.20	135.00
acid load (lbs./day)	165.73	118.98	138.06
percent total acid load (%)	-	-	5.98

10. Source No. 28 Sweetwater Coal Company

	High	Low	Mean
flow (gpd)	-	-	432,000
pH	7.60	5.49	6.80
acidity (mg/l)	20.27	15.00	17.00
iron (mg/l)	5.01	3.70	4.20
sulfates (mg/l)	107.31	79.40	90.00
acid load (lbs./day)	70.00	54.02	61.23
percent total acid load (%)	-	-	2.68

11. Source No. 31 Bush Coal Company

	High	Low	Mean
flow (gpd)	-	-	648,000
pH	7.06	4.85	6.08
acidity (mg/l)	34.28	23.90	28.50
iron (mg/l)	11.66	8.13	9.70
sulfates (mg/l)	375.24	261.67	312.00
acid load (lbs./day)	185.19	129.12	152.78
percent total acid load (%)	-	-	6.66

12. Source No. 32 Erdman Coal Company

	High	Low	Mean
flow (gpd)	-	-	72,000
pH	3.50	2.29	2.86
acidity (mg/l)	553.19	401.27	462.10
iron (mg/l)	128.09	92.91	107.00
sulfates (mg/l)	1045.09	758.07	873.30
acid load (lbs./day)	332.06	240.90	277.05
percent total acid load(%)	-	-	12.0

13. 50urce No. 33 R. & K. Coal Company

	High	Low	Mean
flow (gpd)	-	-	57,600
pH	3.22	2.24	2.80
acidity (mg/l)	592.86	420.48	494.50
iron (mg/l)	95.91	68.02	80.00
sulfates (mg/l)	1198.92	850.32	1000.00
acid load (lbs./day)	284.70	201.92	237.18
percent total acid load (%)	-	-	7.90

These sources constitute the total overland discharges of acidic mine waters. Among the twenty-eight (28) sources listed in the Active Deep Mines' Outfalls table, there are fifteen (15) sources that do not discharge to the surface. These sources contribute to the aforementioned sources in the following manner:

S-5, S-21	Water 5eeping into ground at wash line
S-29, S-30	Pumping to Bush Coal Co. (S-31)
S-257	Pumped to Buck Mountain Drift (S-22)
S-258	Water flows into Goodspring No.1 Mine (S-37, S-37A)
S-259	Water flows to Markson Pool (S-26)
S-261,S-262, S-263	Pumped to surface - seeps into ground to Markson Pool (S-26)
S-265, S-267	Pumped underground and gravitates to Markson Pool (S-26)

S-13, S-14	Drainage _into north side of Bear Mountain (non-contributing sources for typical analysis 5ee S-12)
S-266	Gravitates underground to Markson Pool (S-26)

Abandoned Operations

1. Source No. 22 Buck Mountain Drift

	High	Low	Mean
flow (gpd)	-	-	720,000
pH	3.06	2.69	2.84
acidity (mg/l)	300.93	258.10	276.40
iron (mg/l)	65.60	56.20	61.00
sulfates (mg/l)	408.40	353.90	382.80
acid load (lbs./day)	1806.37	1549.28	1657.14
percent total acid load	-	-	17.48

2. Source No. 24 Erdman Coal Company

	High	Low	Mean
flow (gpd)	-	-	14,400
pH	3.07	2.65	2.85
acidity (mg/l)	546.69	470.30	503.50
iron (mg/l) .	113.20	98.20	106.00
sulfates (mg/l)	845.35	714.10	775.00
acid load (lbs./day)	65.63	56.46	60.37
percent total acid load	-	-	.636

3. Source No. 26 Markson Columnway

	High	Low	Mean
flow(gpd)	-	-	1,728,000
pH	3.40	2.17	3.18
acidity (mg/l)	309.51	265.90	287.90
iron (mg/l)	85.59	73.30	78.50
sulfates (mg/l)	389.70	330.40	357.70
acid load (lbs./day)	4458.91	3830.65	4142.61
percent total acid load	-	-	43.70

4. Source No. 27 Valley View Tunnel

	High	Low	Mean
flow (gpd)	-	-	4,464,000
pH	6.64	5.66	6.16
acidity (mg/l)	73.11	62.40	67.40
iron (mg/l)	32.60	27.70	30.10
sulfates (mg/l)	130.60	112.20	120.00
acid load (lbs./day)	2720.89	2322.30	2505.37
percent total acid load	-	-	26.43

5. Source No. 37 Goodspring No.1 Borehole

	High	Low	Mean
flow (gpd)	-	-	710,000
pH	7.24	6.22	6.80
acidity (mg/l)	9.60	8_0	8.80
iron (mg/l)	0.087	0.07	0.08
sulfates (mg/l)	41.82	35.90	38.80
acid load (lbs./day)	56.82	48.53	52.03
percent total acid load	-	-	.55

6. Source No. 37A Goodspring No.1 Airhole

	High	Low	Mean
flow (gpd)	-	-	907,000
pH	6.56	5.27	5.75
acidity (mg/l)	151.30	130.20	140.50
iron (mg/l)	44.90	38.70	42.00
sulfates (mg/l)	327.20	275.60	300.00
acid load (lbs./day)	1144.08	984.53	1061.14
percent total acid load	-	-	11.19

These sources constitute the total overland discharges of acidic mine waters. Among the nineteen (19) sources listed in the Abandoned Deep Mines' Outfall table, there are thirteen (13) sources that do not discharge to the surface. These sources contribute to the aforementioned sources in the following manner:

S-4	Tap to Harner Coal Company (S-7)
S-6	Via borehole to Harner Coal Company (S-7)
S-10, S-11	Drainage into wash on north side of Bear Mountain (non-contributing source_ for typical analysis See S-12)
S-18, S-19 S-23	Thru surface wash to Rausch Creek
S-256	Flows underground to Markson Pool (S-26)
S-260	Pumped to surface then seeps into Markson Pool (S-26)
S-264	Gravitates to Green Coal Company Pool
S-34, S-35, S-36	Sealed at surface, flow intercepts groundwater, thence to East Branch Rausch Creek