SURFACE OVERFLOWS OF ABANDONED MINES IN THE EASTERN MIDDLE ANTHRACITE FIELD

Publication No. 207 *August 1999*

Jerrald R. Hollowell, P.G.
Consultant

This report was prepared for Pennsylvania Department of Environmental Protection, Pottsville District Mining Office, under Grant ME97105.

SUSQUEHANNA RIVER BASIN COMMISSION

Paul O. Swartz, Executive Director

The Susquehanna River Basin Commission was created as an independent agency by a federal-interstate compact* among the states of Maryland, New York, Commonwealth of Pennsylvania, and the federal government. In creating the Commission, the Congress and state legislatures formally recognized the water resources of the Susquehanna River Basin as a regional asset vested with local, state, and national interests for which all the parties share responsibility. As the single federal-interstate water resources agency with basinwide authority, the Commission's goal is to coordinate the planning, conservation, management, utilization, development and control of basin water resources among the public and private sectors.

**Statutory Citations: Federal - Pub. L. 91-575, 84 Stat. 1509 (December 1970); Maryland - Natural Resources Sec. 8-301 (Michie 1974); New York - ECL Sec. 21-1301 (McKinney 1973); and Pennsylvania - 32 P.S. 820.1 (Supp. 1976).*

For additional copies of this publication, contact the Susquehanna River Basin Commission, 1721 N. Front Street, Harrisburg, Pa. 17102-2391, (717) 238-0423, FAX (717) 238-2436, E-mail srbc@srbc.net. For more information concerning the Commission, visit our web site: www.srbc.net.

CONTENTS

APPENDIX

FIGURES

PLATES

TABLES

SURFACE OVERFLOWS OF ABANDONED MINES IN THE EASTERN MIDDLE ANTHRACITE FIELD

Jerrald R. Hollowell
Consultant

INTRODUCTION

The Eastern Middle Anthracite Field consists mainly of comparatively small, parallel discontinuous coal basins, most of which lie above the regional drainage system. The geologic structure of the coal field is typical of the geology in the anthracite region. The major structural fold in the field is the Hazleton basin, whose axis parallels the major regional folds trending southwest to northeast. The basin becomes broader and shallower in the eastern and western margins.

HYDROLOGY

The Eastern Middle Anthracite Field has been extensively mined since the early 1800s. The subsurface is a maze of collapsed gangways, tunnels, and chambers that interconnect the Buck Mountain, Gamma, Wharton, three splits of the Mammoth Vein, and numerous other beds of lesser thickness and poor quality coal. The surface also has been extensively disturbed by previously unregulated surface mining operations and is presently scarred with open abandoned pits, spoil piles, and refuse banks. These abandoned deep and surface mining operations have completely destroyed the natural surface and ground-water systems within the mining area. The open pits and fractured strata allow all surface water not controlled at the surface to infiltrate into the deep mine workings. The quality of this water has been greatly affected through contact with acid-producing minerals present in the coal and associated rock exposed to infiltrating water.

The Eastern Middle field is mostly drained to the surface by the drainage tunnels and surface outfalls listed in Table 1. Plate 1 is a composite U.S. Geological Survey topographic map of the area showing the location of the outfalls listed in Table 1 and the coal basin's approximate surfical contact with the lowest mined bed. Also designated are approximate surface projections of underground mine tunnel systems that drain to the surface. Included in the appendix are detailed maps showing principal mine outfalls in the Eastern Middle Anthracite Field and their water quality characteristics.

There are thirteen functional mine drainage tunnels in the Eastern Middle field that were specifically driven to dewater the mine workings. This drainage system was most successful in the Eastern Middle field because of the comparable elevation of the drainage tunnel discharge to the receiving streams. The Jeddo Tunnel is the most extensive, constructed gravity-drainage system in the Eastern Middle field. Much has been written about the Jeddo Tunnel, in terms of the extraordinary engineering feat, the eventual success of dewatering approximately 33 square miles of coal basins (Ash and others, 1950), and more recently, its environmental impact. The other discharges each yield a comparatively minor amount of water.

The Jeddo Tunnel system drains mine water from the Little Black Creek, Big Black Creek, Cross Creek, and Hazleton Basins. Since the completion of the initial rock tunnels and subsequent connecting tunnels and slopes, the Jeddo Tunnel collects and discharges about half of the precipitation and ground water infiltrating the Eastern Middle field mines. Figure 1 is a plan map showing the Jeddo Tunnel drainage system and general internal flow directions.

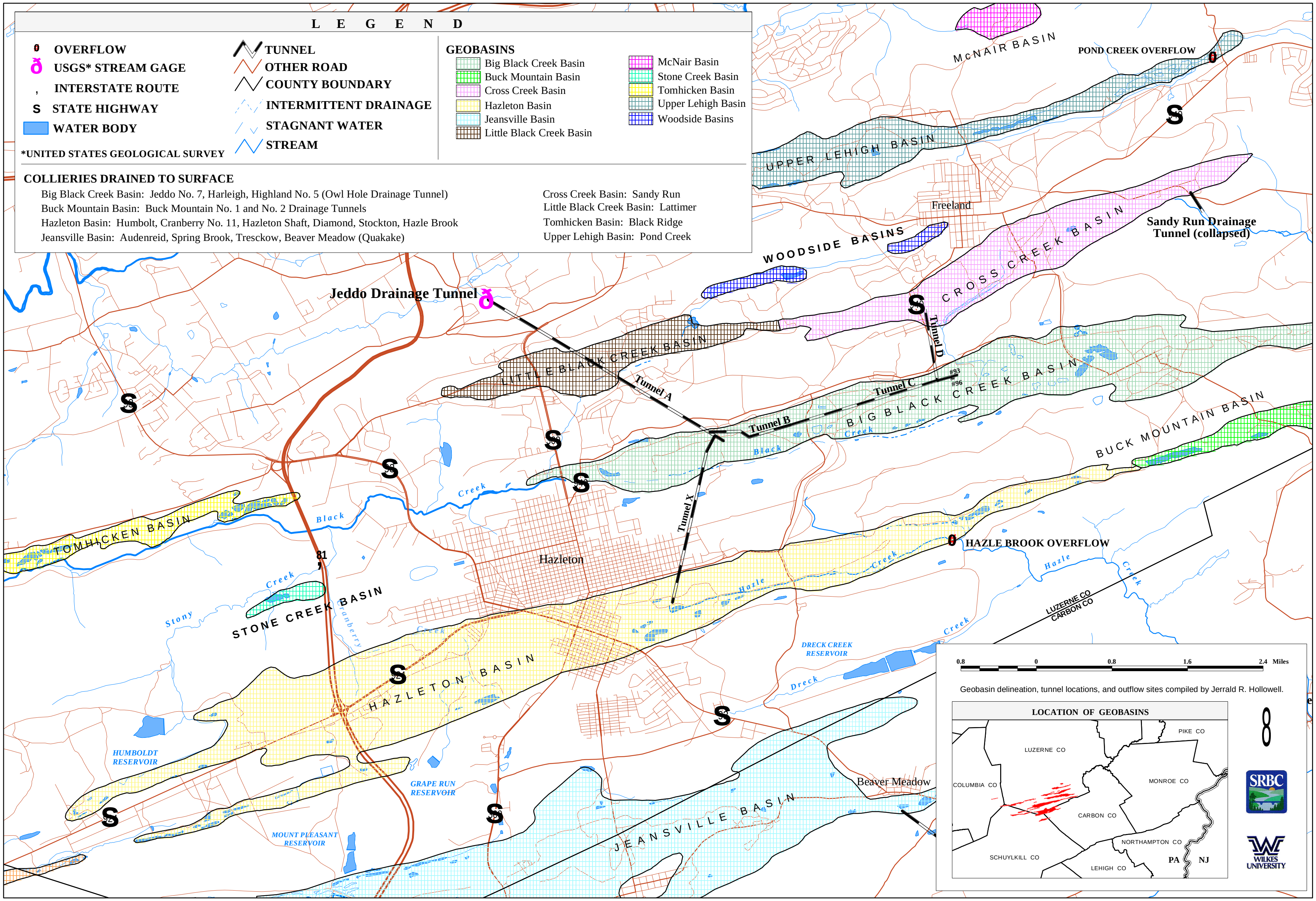


Figure 1. Jeddo Tunnel Drainage System

Table 1. Mine Drainage Tunnels and Outflows in the Eastern Middle Anthracite Field

Coal Basins	Tunnel/ Overflow[1]	Latitude	Longitude	Receiving Stream	Flow in April 1975 (cfs)
Roberts Run	Gowen	40°56'54"	76°10'47"	Black Creek	6.6
West Black Creek	Derringer	40°56'48"	76°10'43"	Black Creek	8.8
Green Mountain	Oneida No. 3	40°55'06"	76°08'50"	Tomhicken Creek	9.1
Green Mountain	Oneida No. 1	40°55'32"	76°07'25"	Tomhicken Creek	6.4
Green Mountain	Catawissa	40°54'39"	76°03'59"	Catawissa Creek	0.8
Green Mountain	Green Mountain	40°43'52"	76°04'03"	Catawissa Creek	2.1
Jeansville	Audenreid	40° 53'52"	96°03'59"	Catawissa Creek	19.0
Little Black Creek, Big Black Creek, Cross Creek, and Hazleton	Jeddo Tunnel	41°00'09"	75°59'38"	Little Nescopeck	65.0
Jeansville	Beaver Meadow[2]	40°55'09"	75°54'07"	Wetzel Creek	20.0
Hazleton	Hazle Brook	40°58'08"	75°53'52"	Hazle Creek	1.5
Buck Mountain	No. 1 Tunnel	40°58'53"	75°48'49"	Buck Mountain Creek	1.7
Buck Mountain	No. 2 Tunnel	40°58'51"	75°49'27"	Buck Mountain Creek	0.1
Big Black Creek	Owl Hole	40°00'02"	75°49'11"	Sandy Run	4.5
Cross Creek	Sandy Run	41°00'58"	75°50'55"	Sandy Run	2.3
Upper Lehigh	Pond Creek	41°02'29"	75°50'44"	Sandy Run	13.0
Silver Brook	Silver Brook	40°52'24"	76°00'12"	Little Schuylkill	4.2

[1] Overflows listed include Hazle Brook, Pond Creek, and Silver Brook.
[2] Beaver Meadow Tunnel is locally known as Quakake Tunnel.

Most of the Eastern Middle Anthracite Field drains westward to the Susquehanna River. The eastern-most basins drain to the Lehigh River. The drainage divide is approximately along a line between Freeland, to the north, and Weatherly, to the south. An expression of this divide on the surface is a broadening of the coal basins. This is shown by a broadening of Cross Creek Basin and Big Black Creek Basin and easterly pinching out of the Hazleton and Jeansville Basins.

Infiltration of precipitation, seepage from stream channels, and ground-water discharge are principal sources of water to the drainage tunnels. Both underground and surface mining, with associated subsidence, create surface catchment basins, fractured rock strata, and artificial ponding that increases the amount of water discharged by the tunnel. Surface runoff will have to be controlled to reduce mine water drainage in the Eastern Middle field.

CHEMICAL CHARACTERISTICS

A number of factors affect the quality of abandoned mine water discharges. The role of these factors (physical, chemical, and biological) vary with underground and surface mining conditions, spoil distribution, geology and mineralogy, and abundance of biological catalysts. These factors are discussed in detail in scientific literature on coal mine drainage (Hornberger, 1990; Carruccio, 1978).

The water discharges from the mine drainage tunnels are predominately acidic. Highest pH levels do not exceed 4.8, with 9 of the 16 discharges measuring less than 4.0. The plots of loads in Figures A1 through A16 show that alkalinity is minimal for discharges from the eastern-most basins. Although alkalinity is not high for the western and central basins, the plots suggest some buffering sources are present. This could include the presence of minor carbonate strata, or cementing, in the clastic rocks. Because of the complexity of sedimentation in the northern Appalachians, the distribution of coal and intervening sediments that influence mine water quality are poorly described in the literature.

The source strata associated with the alkalinity is below the Buck Vein. In addition, the source strata are common to those basins discharging water with some alkalinity and having a mine-to-surface drainage tunnel altitude below 1,290 feet. These basins are indicated in Plate 1. Although some alkalinity is available to the Eastern Middle Anthracite Field, it is inadequate to neutralize the acidic discharges from the field. The loads are flow-related, with the higher flows carrying the greater loads. It would require a very large amount of carbonate buffering material to neutralize the tremendous discharge of the Jeddo Tunnel. The loads of metals are relatively low, with magnesium being the highest and iron the lowest (Figures A1 through A16).

REFERENCES

Ash, S.H., W.E. Cassap, W.L. Eaton, K.L. Hughes, W.M. Romischer, and J. Westfield. 1947. Flood-Prevention Projects at Pennsylvania Anthracite Mines. U.S. Bureau of Mines, Report of Investigations 4288, 51 pp.

Ash, S.H., W.L. Eaton, K.L. Hughes, W.M. Romischer, and J. Westfield. 1949. Water Pools in Pennsylvania Mines. U.S. Bureau of Mines, Technical Paper 727, 22 pp.

Ash, S.H., H.D. Kynor, R.W. Fatzinger, B.S. Davies, and J.C. Gilbert. 1950. Inundated Anthracite Reserves: Eastern Middle Field of Pennsylvania. U.S. Bureau of Mines, Bulletin 491, 28 pp.

Carruccio, F.T. and G. Geidel. 1978. Geochemical Factors Affecting Coal Mine Drainage Quality *in* Reclamation of Drastically Disturbed Lands, Proceedings. Madison, Wisconsin, ASA-CSSA-SSA, pp. 129-147.

Growitz, D.J., L.A. Reed, and M.M. Beard. 1985. Reconnaissance of Mine Drainage in the Coal Fields of Eastern Pennsylvania. U.S. Geological Survey, Water Resources Investigation 83-4274, 54 pp.

Inners, Jon D. 1988. Bedrock and Glacial Geology of the North Branch Susquehanna Lowland and the Eastern Middle Anthracite Field of Northeastern Pennsylvania. Guidebook for the 53rd Annual Field Conference of Pennsylvania Geologists, pp. 32-39, 69-74, 181-283.

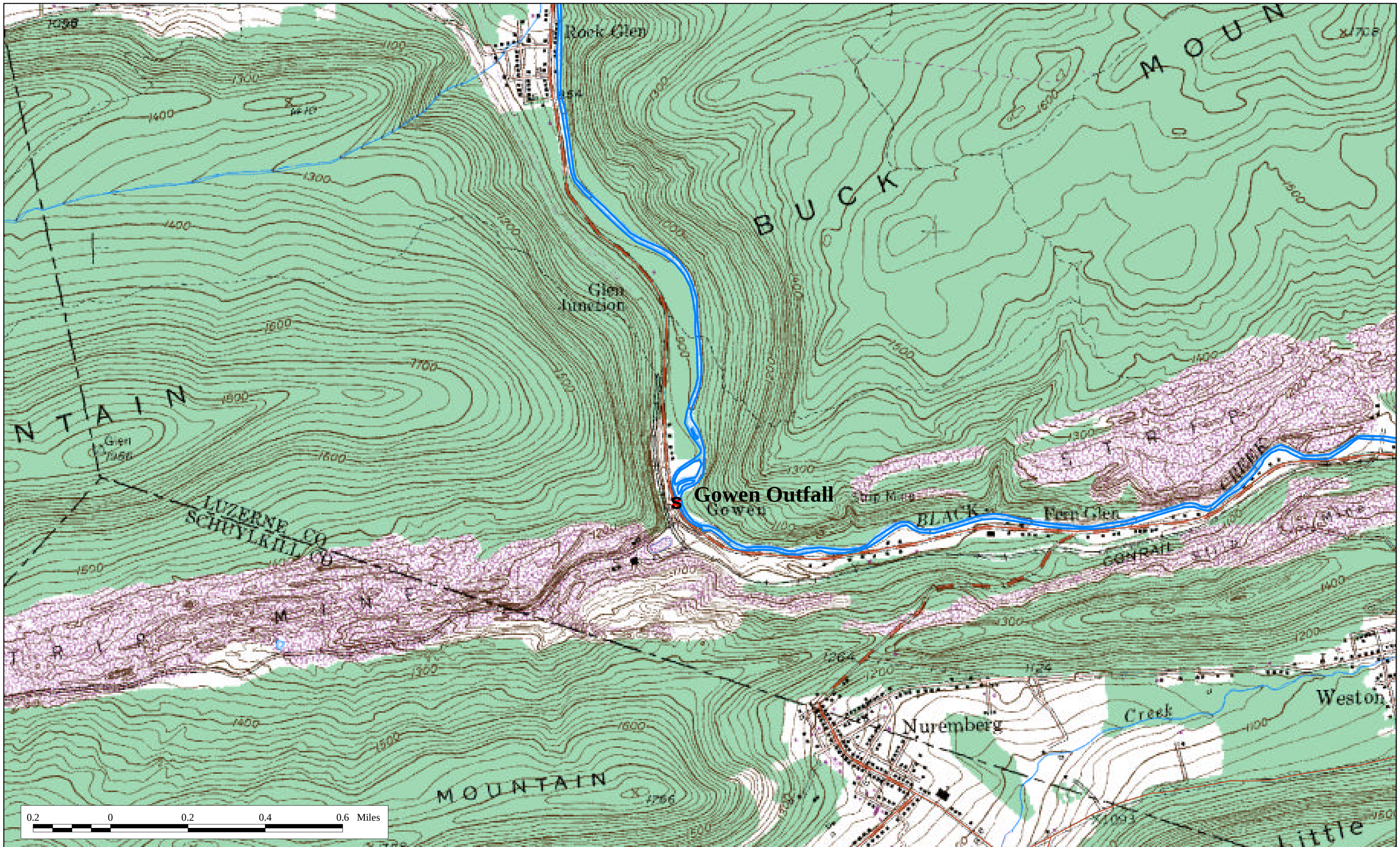
Hornberger, R.J., M.S. Smith, A.E. Friedrich, and H.L. Lovell. 1990. Acid Mine Drainage From Active and Abandoned Coal Mines in Pennsylvania: Water Resources in Pennsylvania. Chapter 32, Pennsylvania Academy of Science, Philadelphia, Pa.

Susquehanna River Basin Commission. 1973. Coal Mine Drainage in the Susquehanna River Basin. 297 pp., 1 plate.

Wood, C.R. 1988. Water Quality of Large Discharges From Mines in the Anthracite Region of Eastern Pennsylvania. U.S. Geological Survey, Water Resources Investigations Report 95-4243, 68 pp.

APPENDIX

EASTERN MIDDLE ANTHRACITE FIELD MINE DRAINAGE OUTFALL DETAILS AND COLLIERY WATER QUALITY CHARACTERISTICS



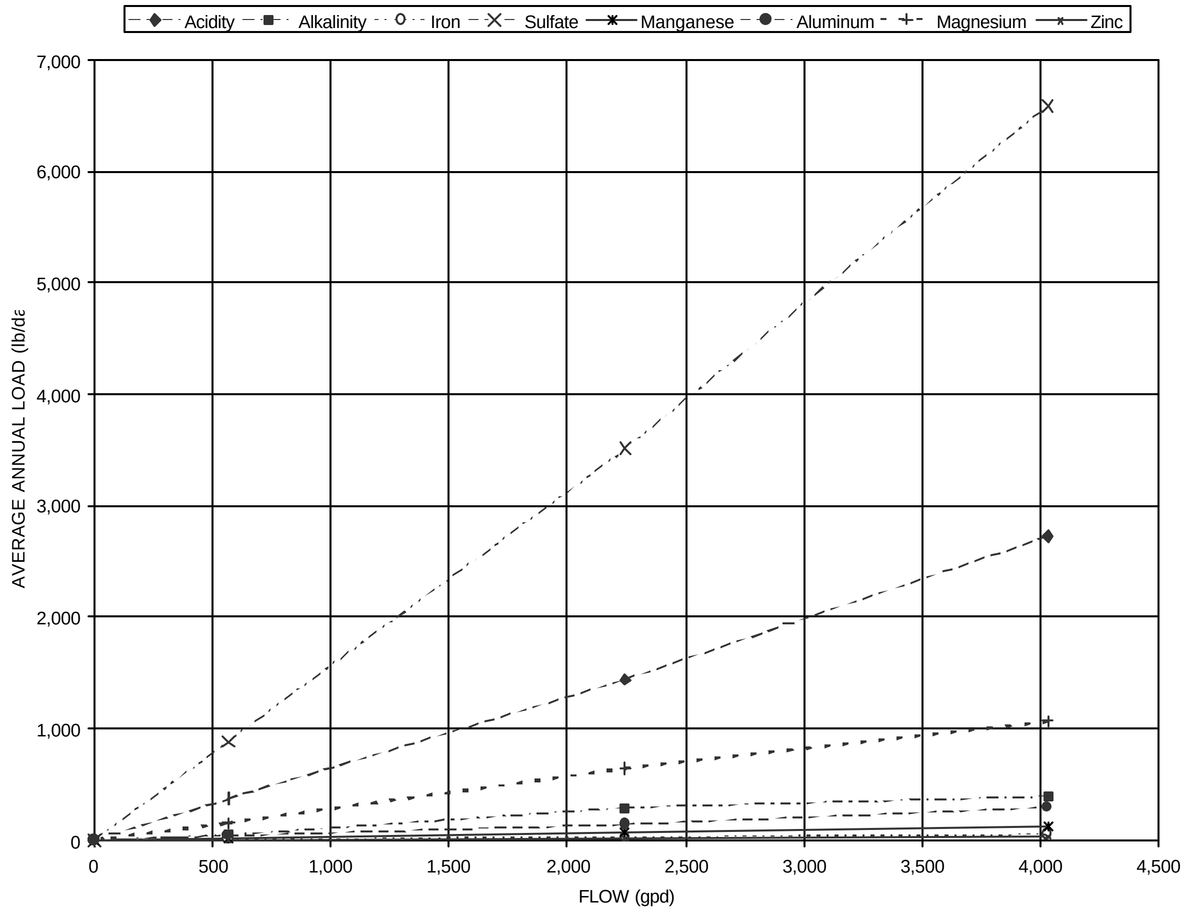
L E G E N D

S OUTFALL
DISTURBED AREA
FORESTED AREA
AGRICULTURAL AREA
20 FOOT CONTOUR
COUNTY BOUNDARY
RIVER/STREAM/DAM
ROAD

SRBC

Portal Altitude: 956 feet above mean sea level USGS Coordinates: 40°56'54" Latitude, -76°10'47" Longitude

Figure A1a. Roberts Run Basin Showing Gowen Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	71.67	5.93	1.090	228.83	4.340	8.42	31.58	0.928
1997	67.60	5.24	1.260	143.60	4.490	7.79	28.91	0.959
1998	64.40	5.92	1.160	155.20	3.24 0	6.69	23.68	0.686

Figure A1b. Gowen Colliery Water Quality Characteristics

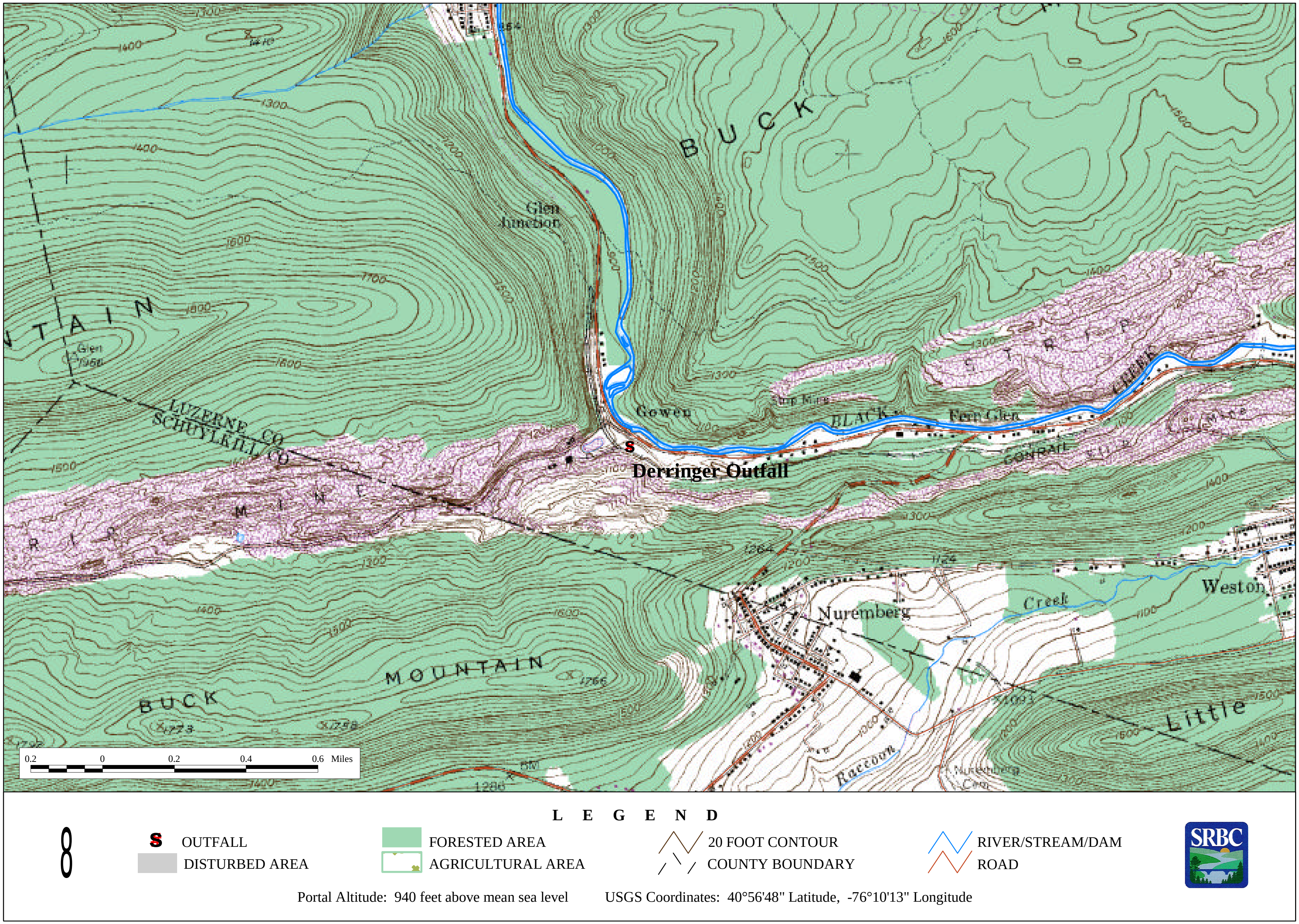
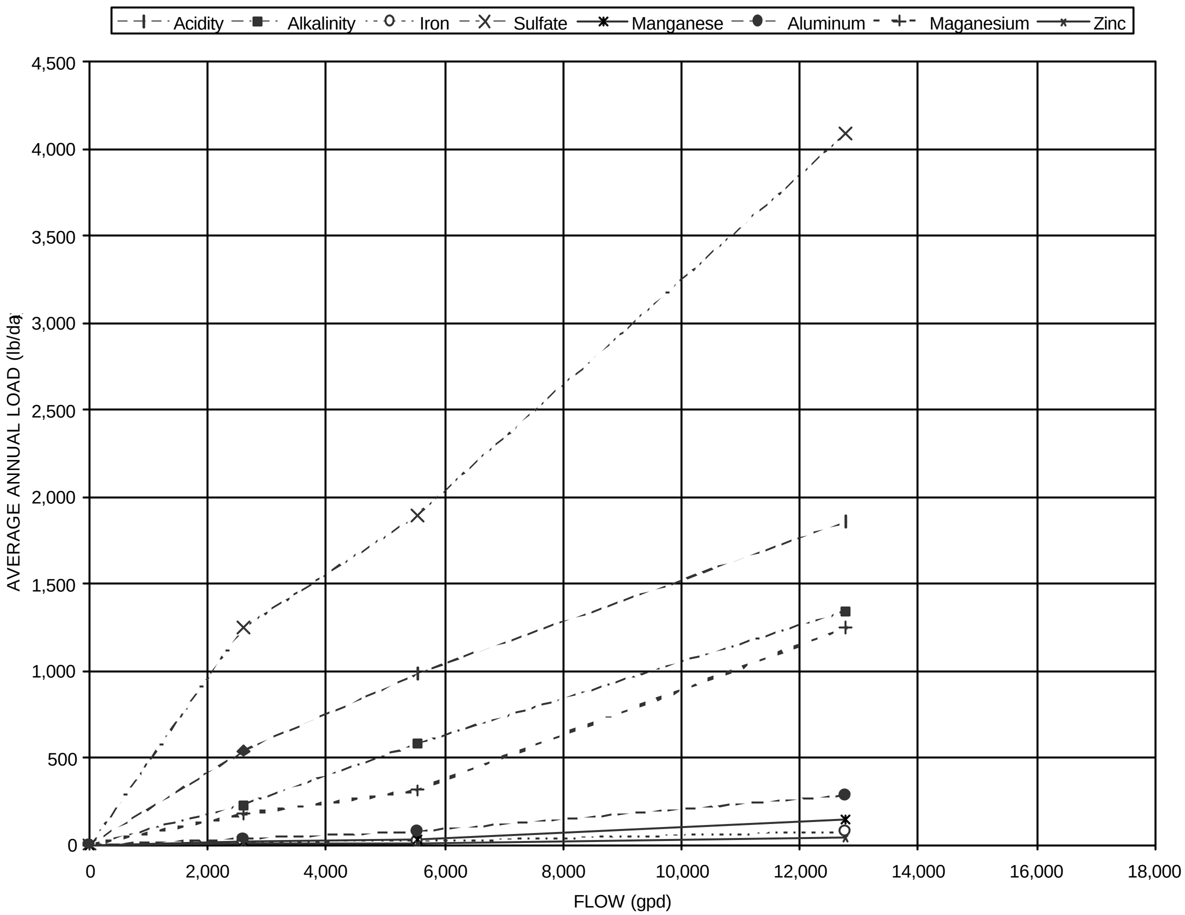


Figure A2a. West Black Creek Basin Showing Derringer Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	20.03	6.97	0.332	45.17	0.672	1.48	6.68	0.184
1997	18.75	7.38	0.523	40.00	0.633	1.29	5.93	0.166
1998	11.56	8.32	0.574	26.80	1.200	2.42	10.10	0.305

Figure A2b. Derringer Colliery Water Quality Characteristics

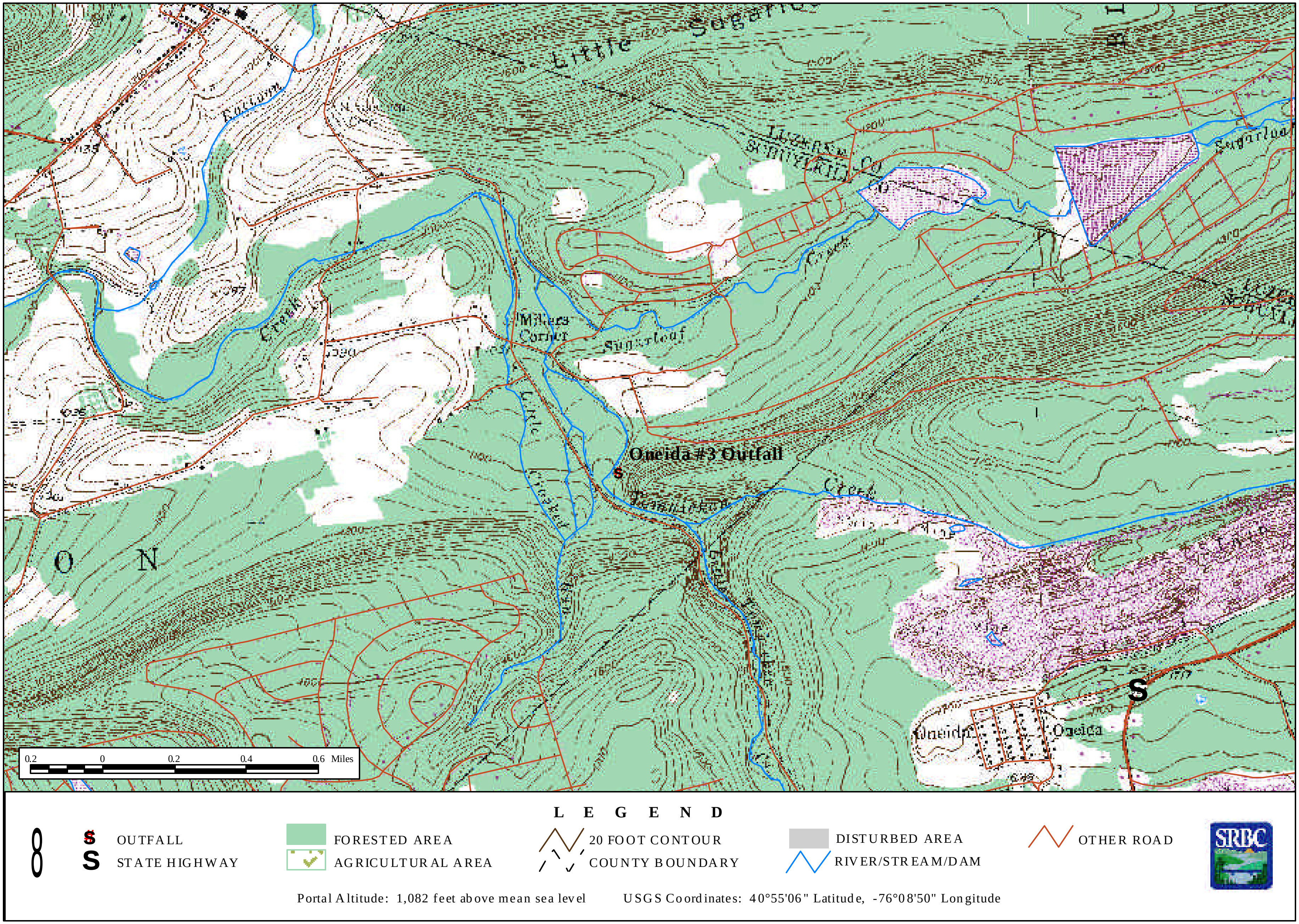
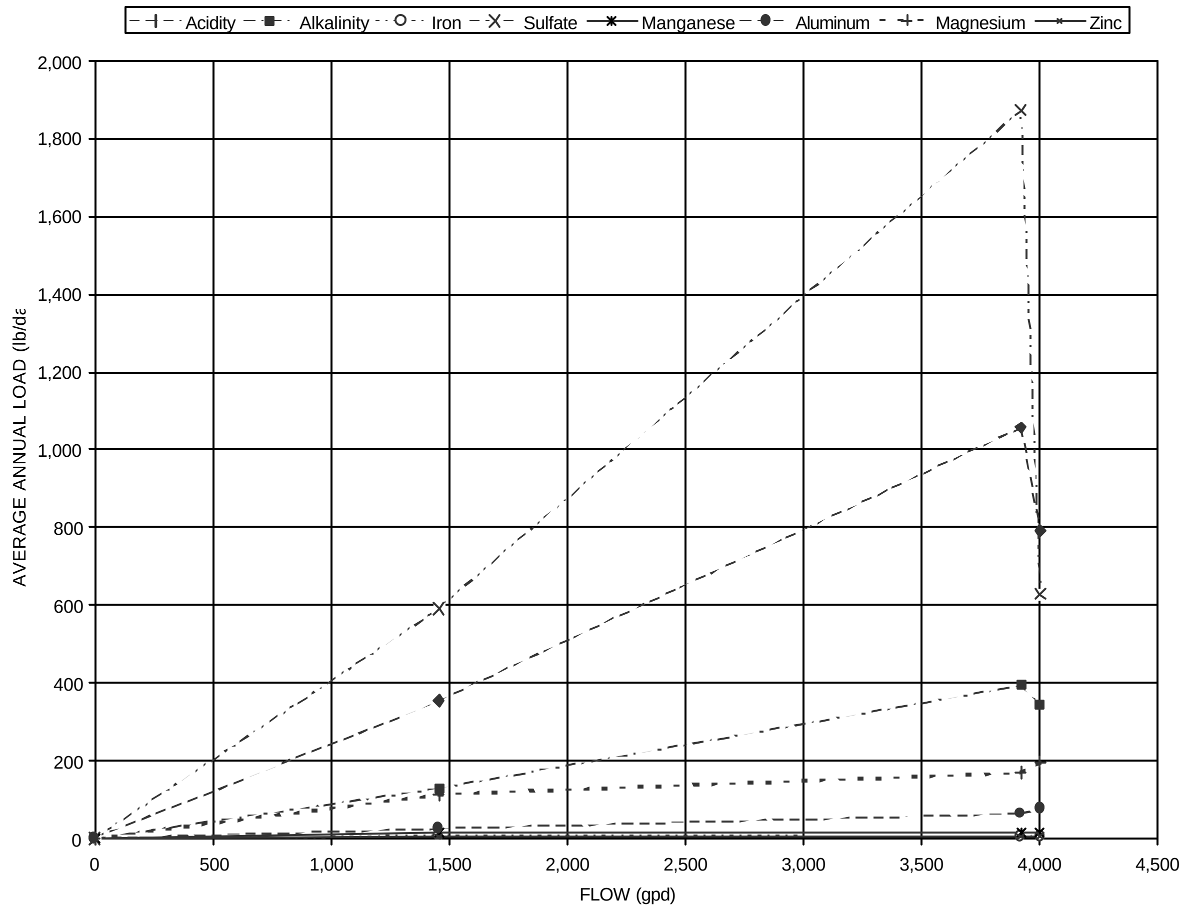


Figure A3a. Green Mountain Basin Showing Oneida No. 3 Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	18.83	7.47	0.114	42.50	0.387	1.59	4.11	0.158
1997	22.78	7.20	0.341	57.86	1.070	1.54	7.74	0.287
1998	16.15	7.30	0.142	26.00	0.382	1.75	4.18	0.157

Figure A3b. Oneida No. 3 Colliery Water Quality Characteristics

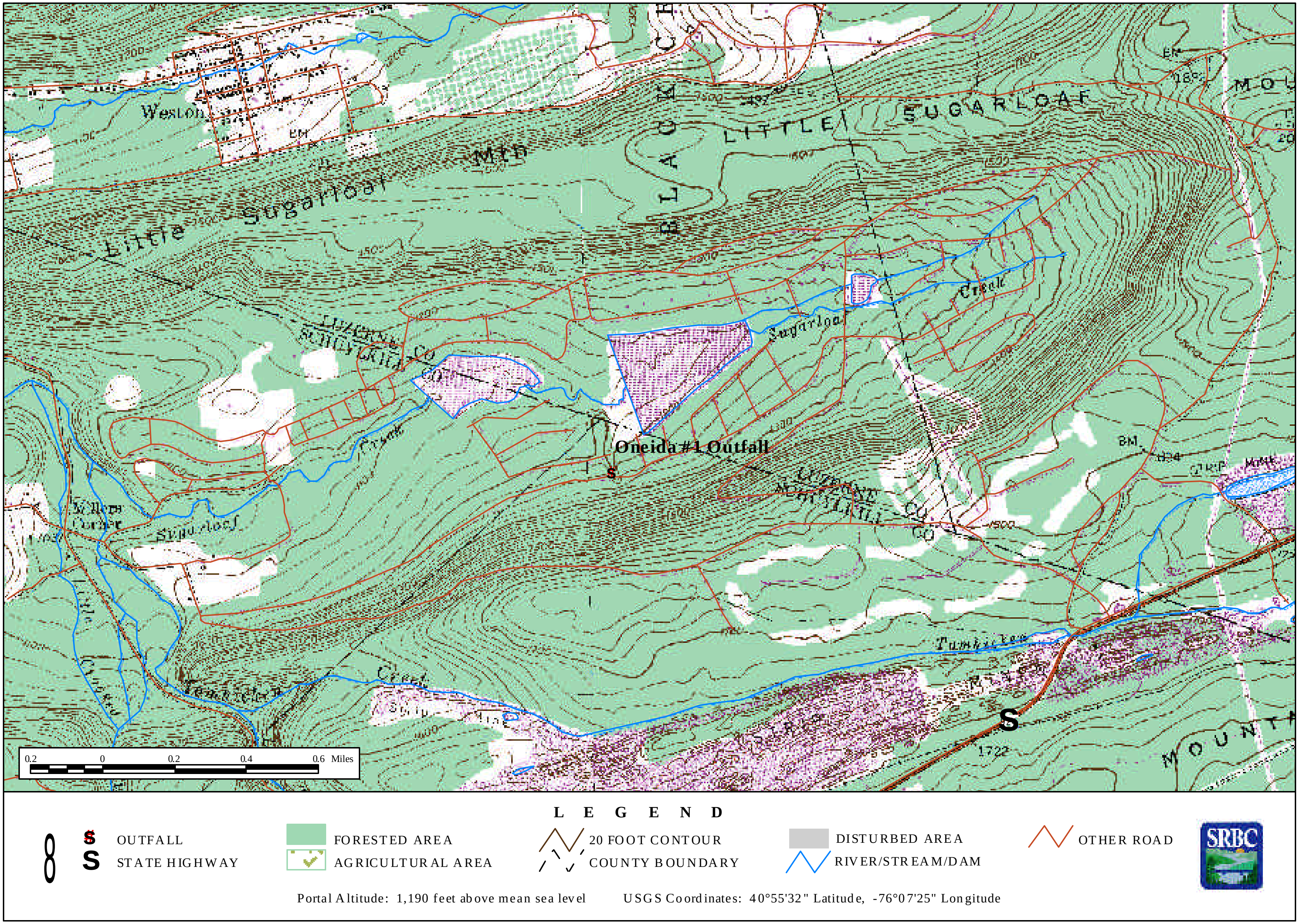
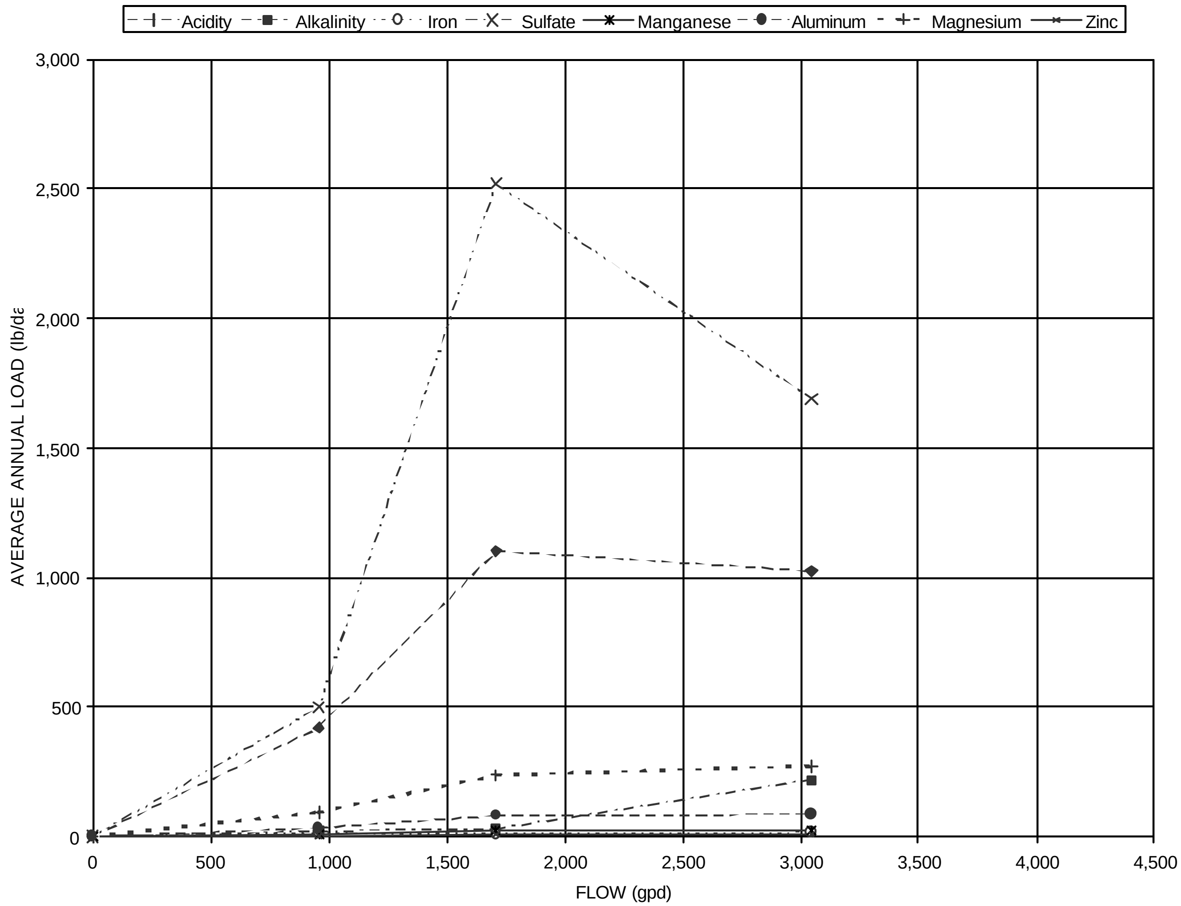


Figure A4a. Green Mountain Basin Showing Oneida No. 1 Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	51.00	1.03	0.530	98.83	1.230	4.32	12.39	0.361
1997	45.92	1.68	1.670	50.40	1.080	3.62	10.39	0.313
1998	27.60	5.32	0.462	47.60	0.693	2.41	7.52	0.212

Figure A4b. Oneida No. 1 Colliery Water Quality Characteristics

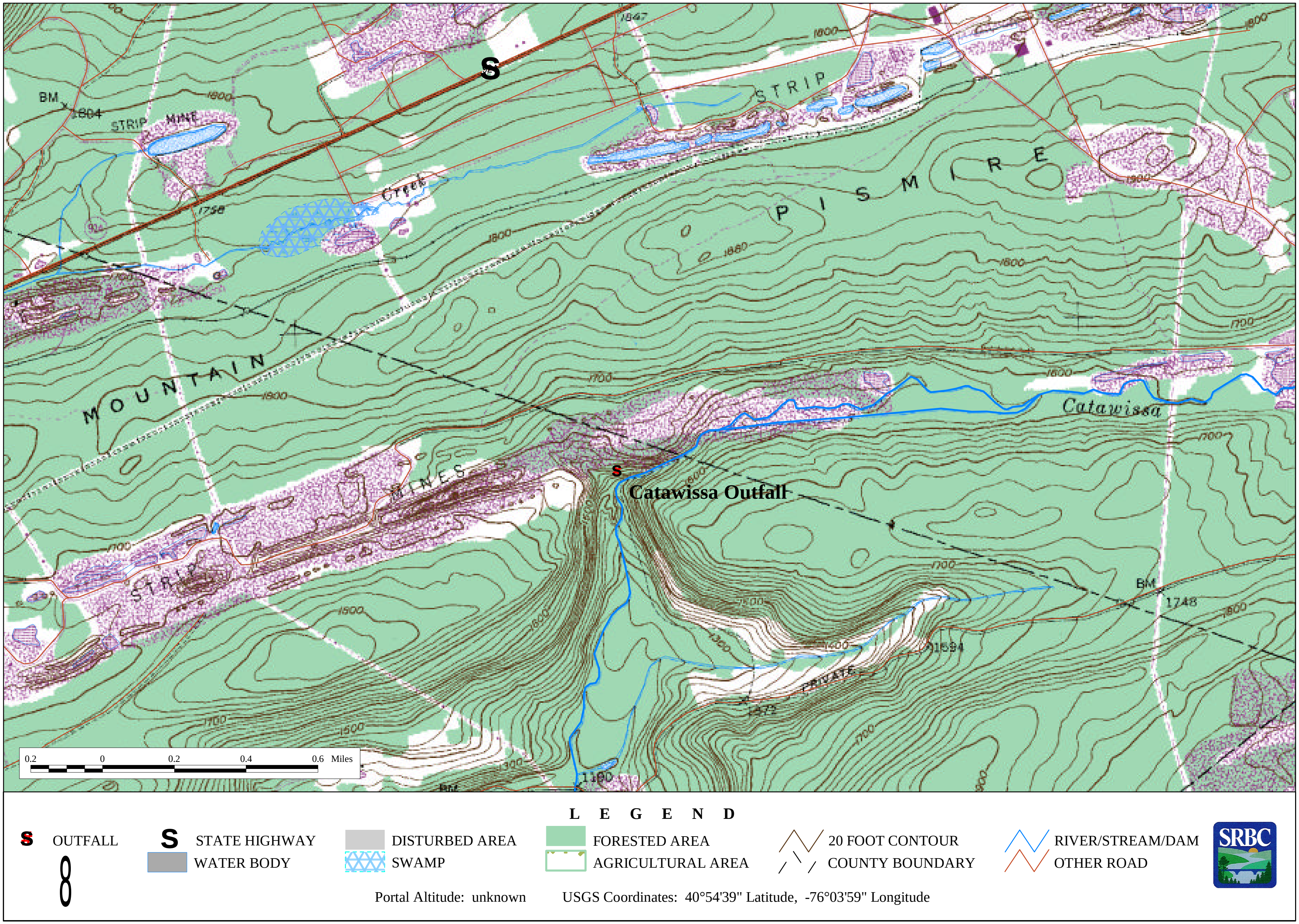
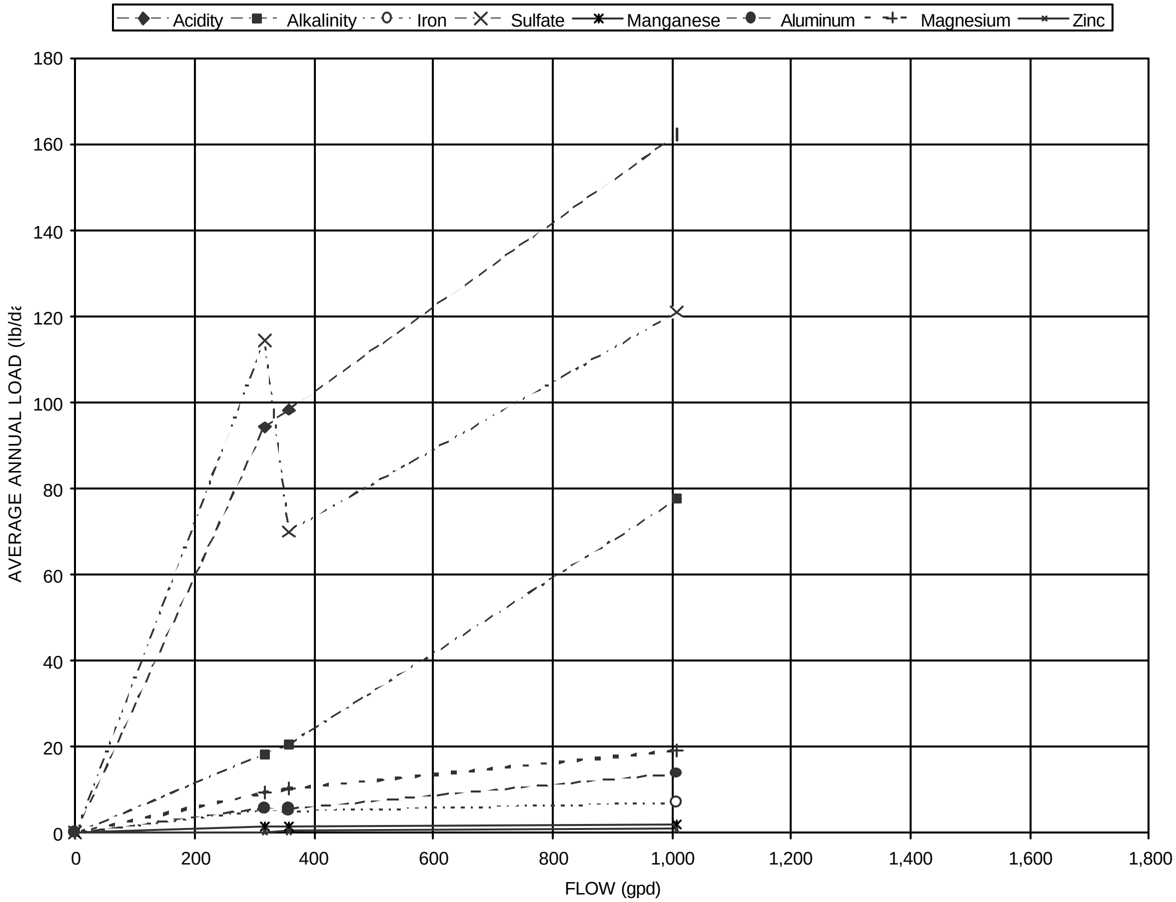


Figure A5a. Green Mountain Basin Showing Catawissa Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	26.00	3.65	1.420	24.25	0.371	1.52	2.51	0.098
1997	21.50	4.50	1.160	27.33	0.344	1.31	2.30	0.088
1998	13.40	6.40	0.577	<20.00	0.172	1.14	1.58	0.064

Figure A5b. Catawissa Colliery Water Quality Characteristics

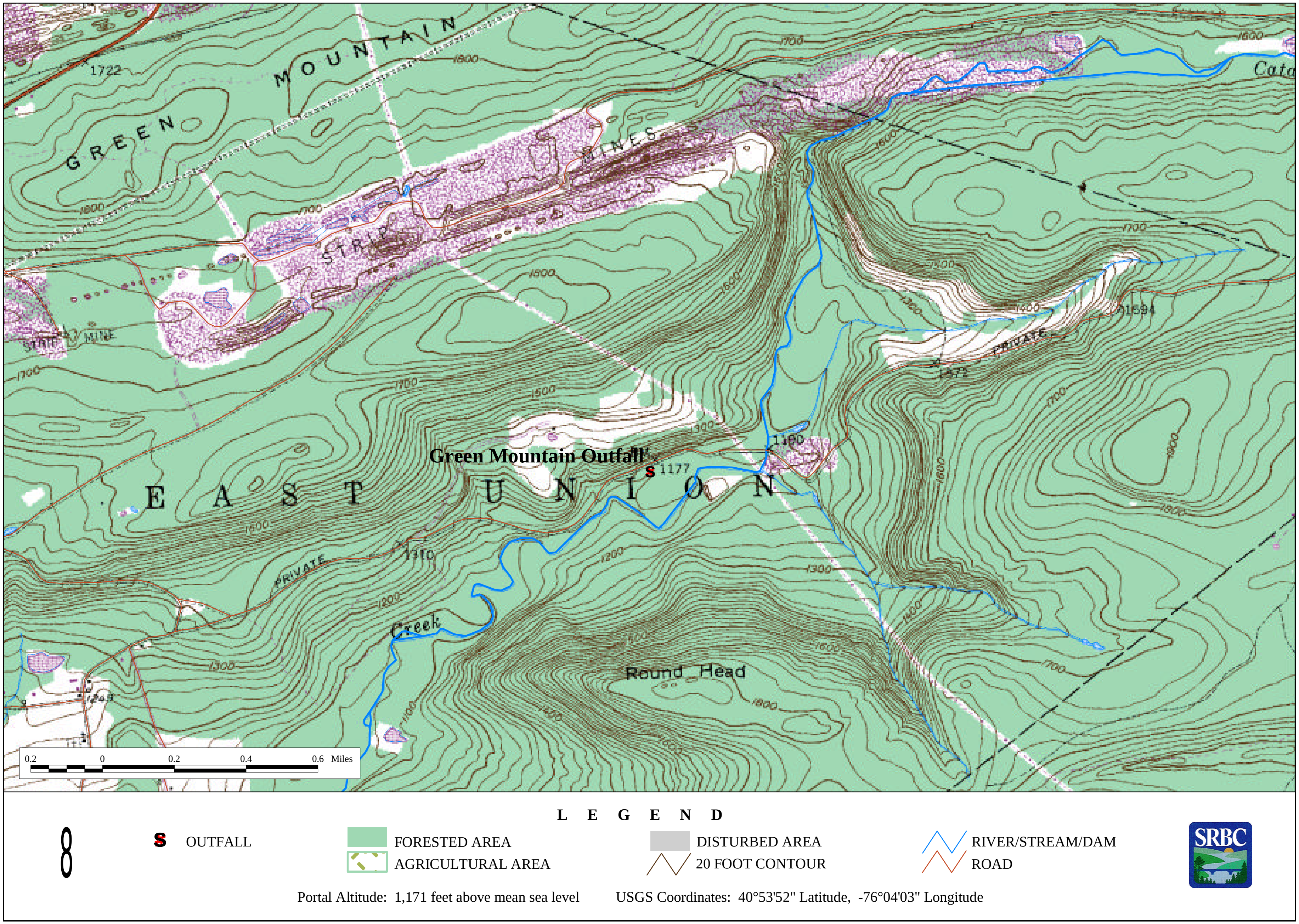
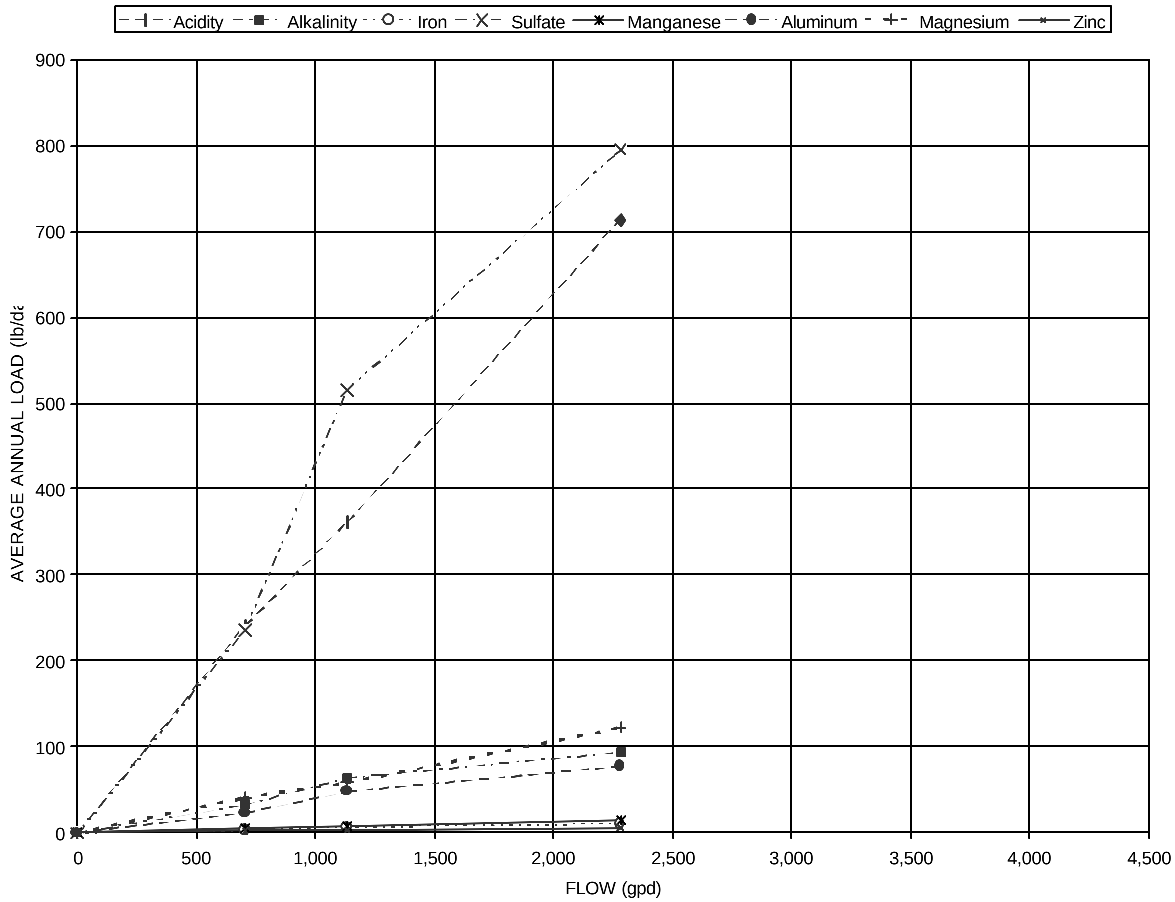


Figure A6a. Green Mountain Basin Showing Green Mountain Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	28.40	3.48	0.500	41.40	0.574	3.86	4.49	0.215
1997	28.89	3.67	0.273	32.29	0.686	2.80	5.04	0.250
1998	26.00	3.40	0.373	29.00	0.532	2.81	4.46	0.218

Figure A6b. Green Mountain Colliery Water Quality Characteristics

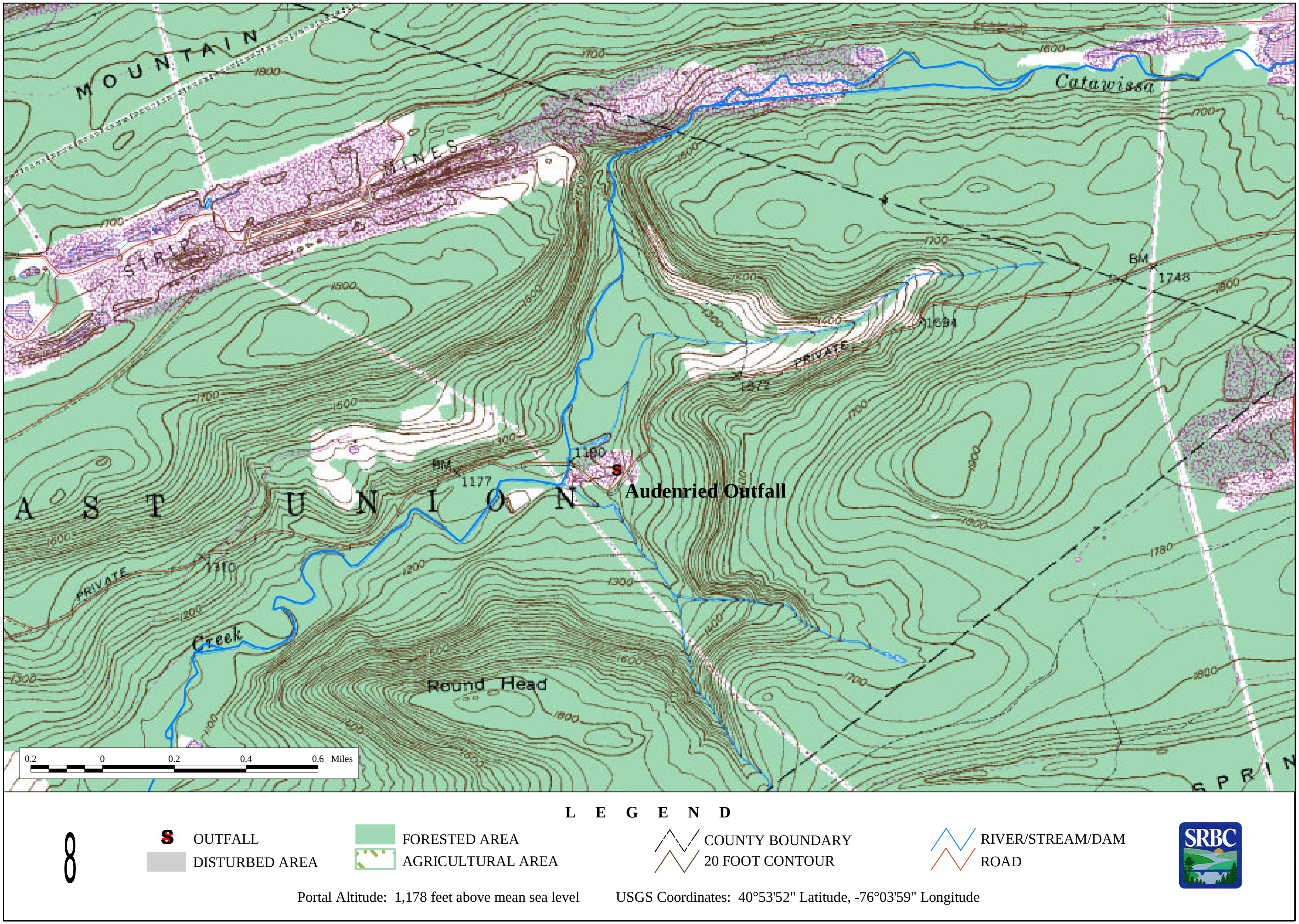
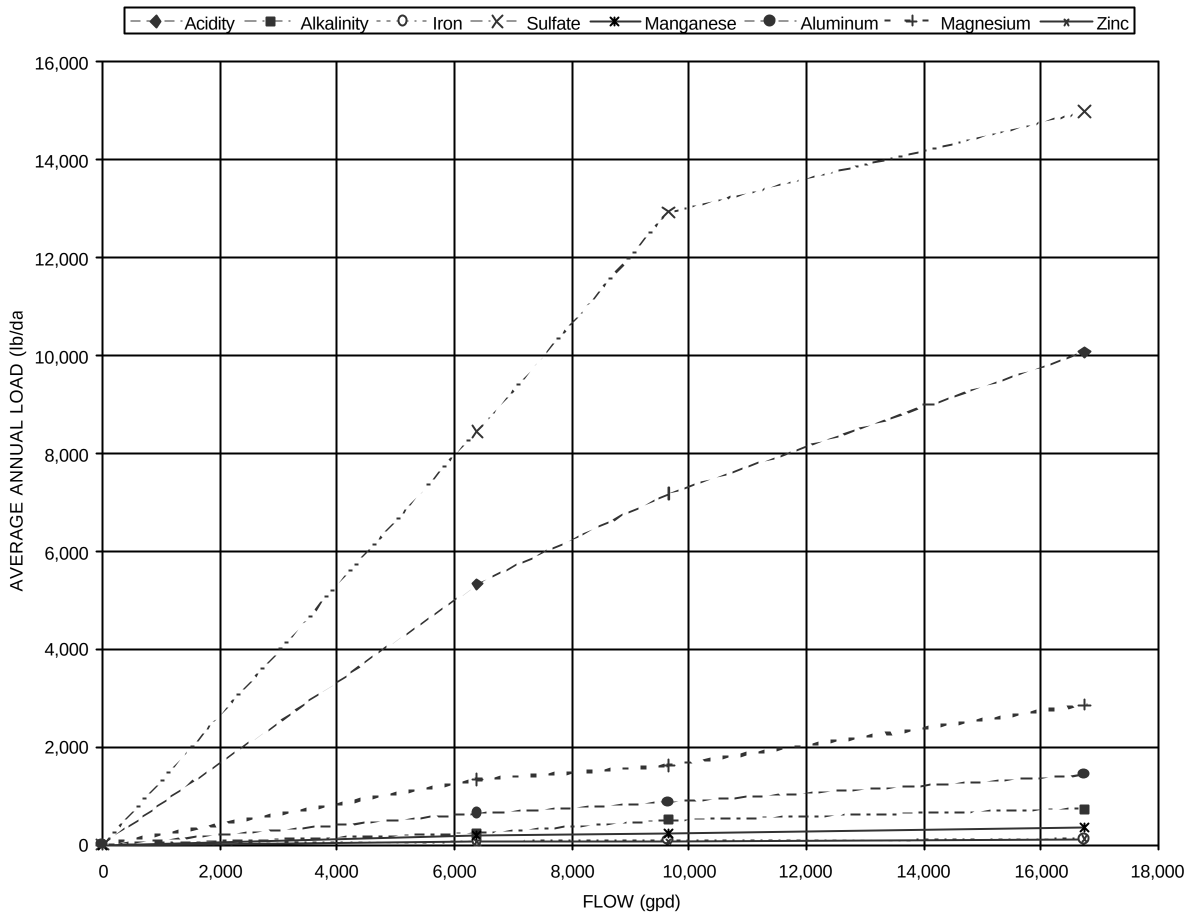


Figure A7a. Jeansville Basin Showing Audenried Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	68.80	2.32	0.803	122.00	2.200	8.11	16.04	0.670
1997	70.44	2.87	0.906	113.10	2.460	8.52	17.57	0.727
1998	50.00	3.70	0.582	74.00	1.820	7.09	14.25	0.596

Figure A7b. Audenreid Colliery Water Quality Characteristics

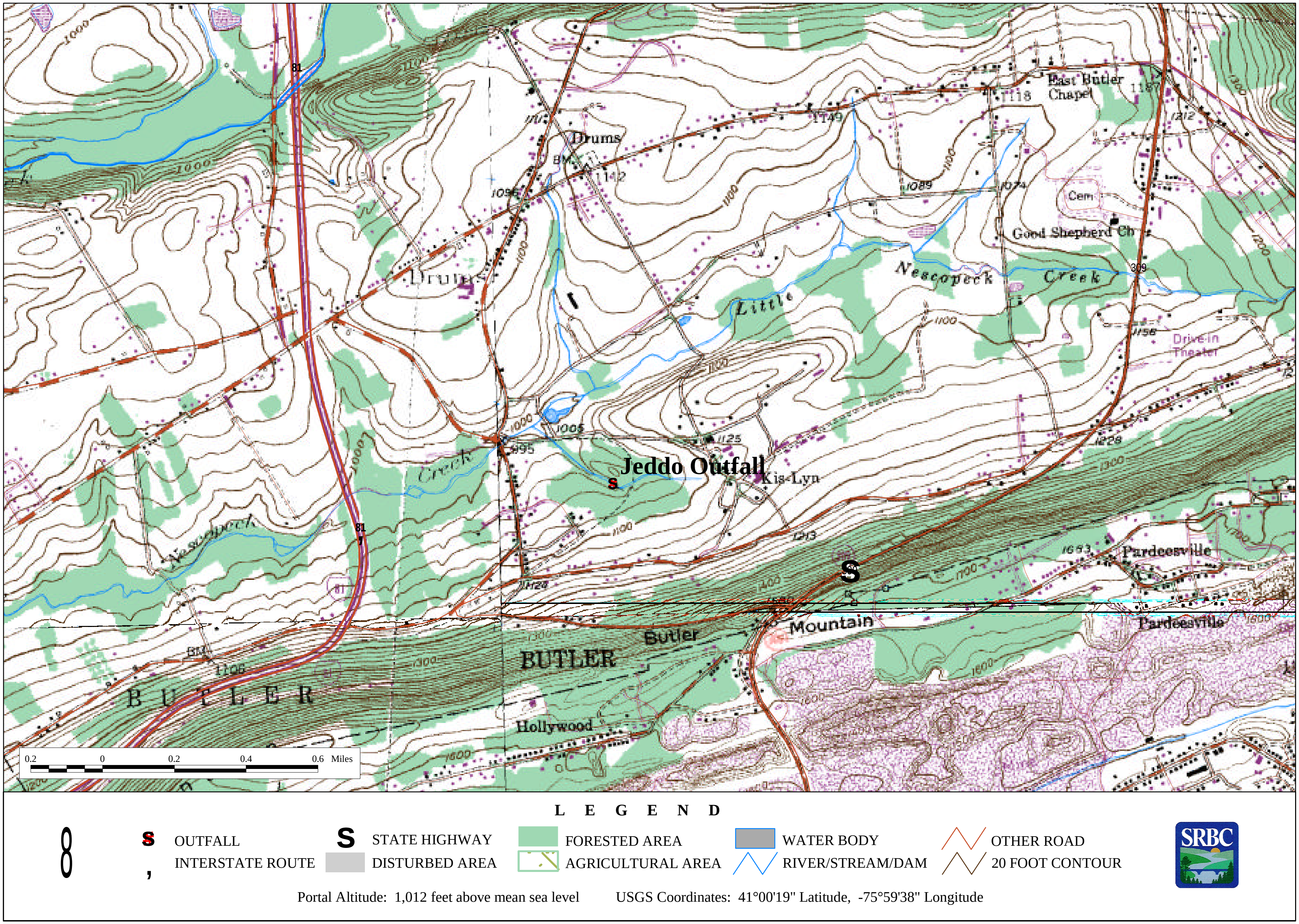
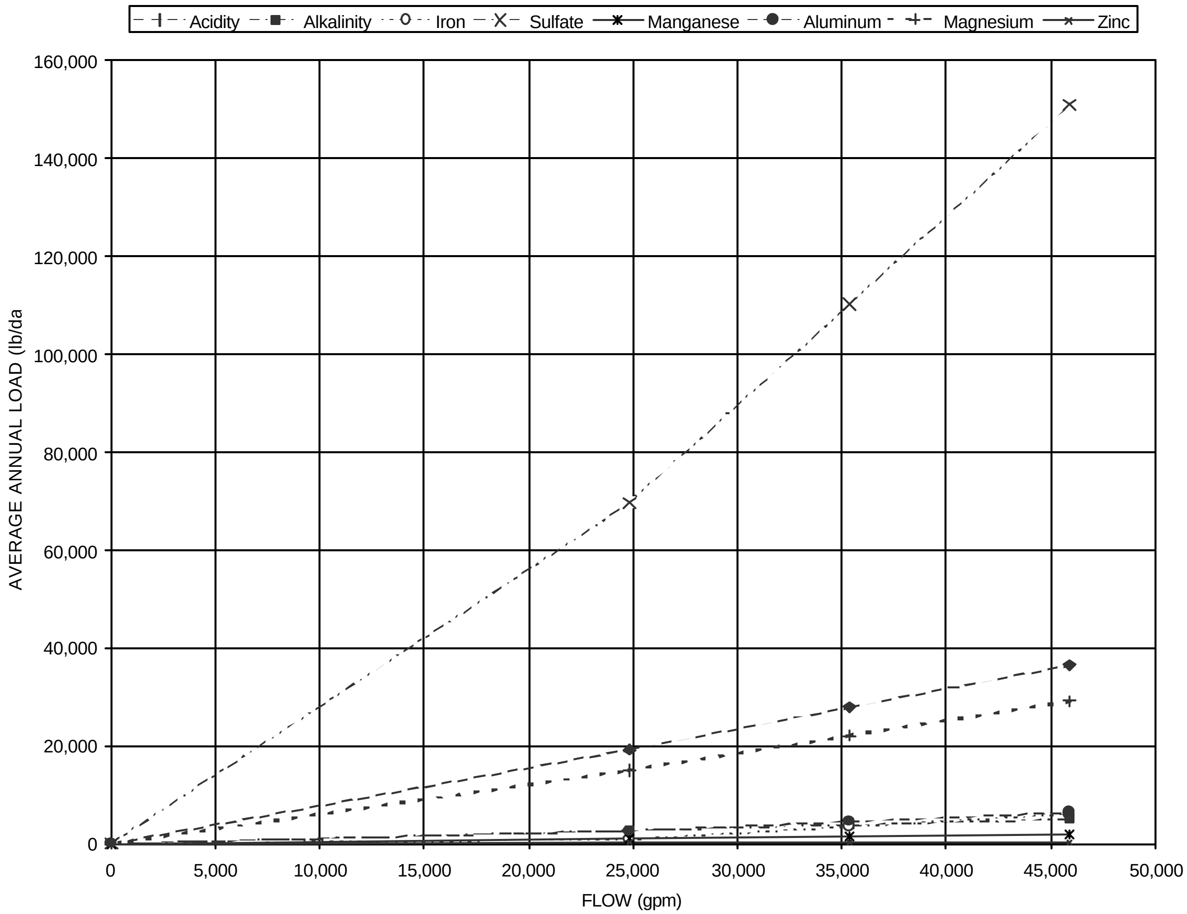


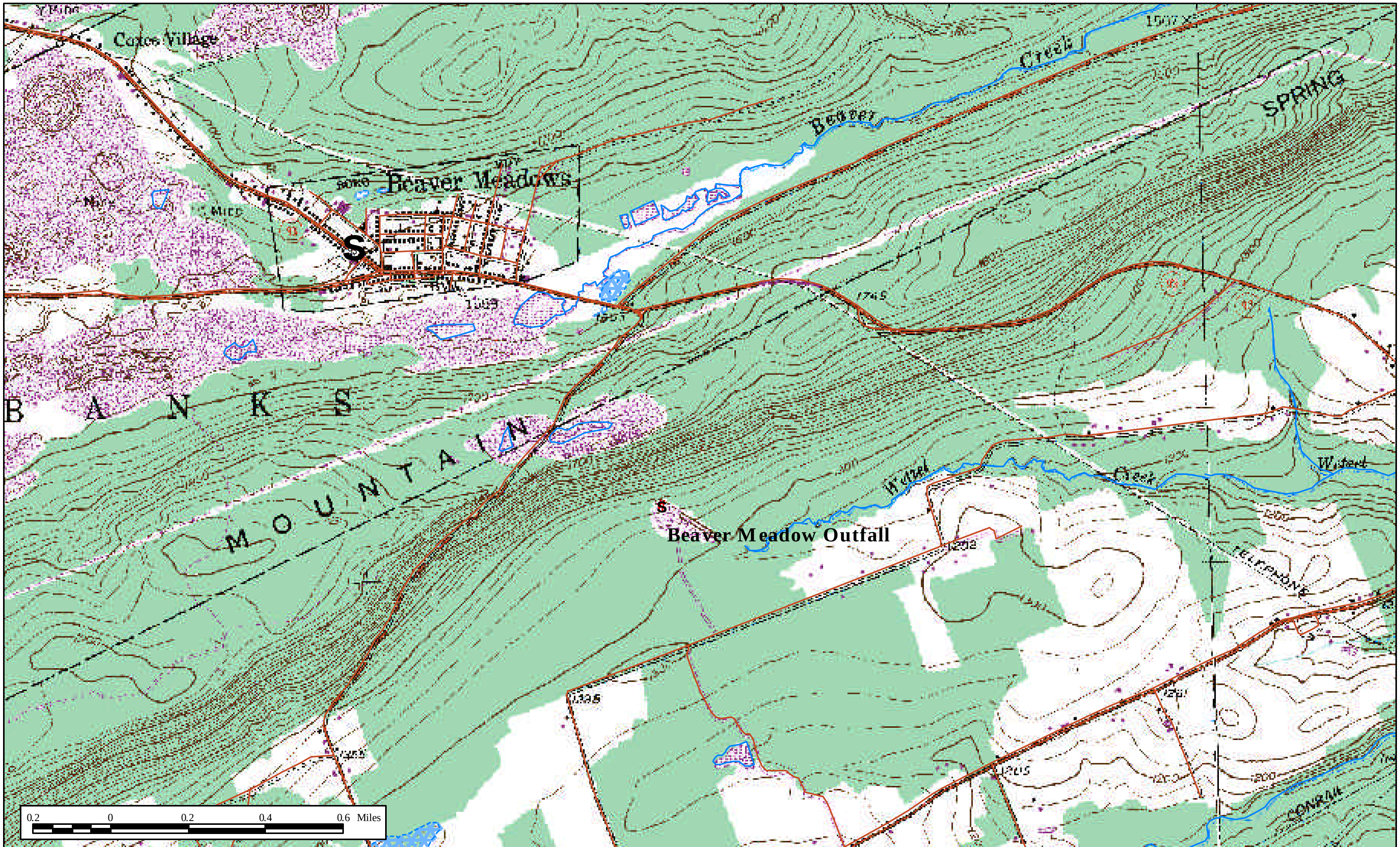
Figure A8a. Jeddo Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	71.83	7.78	12.600	268.70	4.132	12.89	53.67	0.671
1997	71.86	8.25	3.560	248.00	4.333	9.74	55.44	0.663
1998	59.75	9.33	2.480	244.90	3.656	8.24	49.07	0.607

Figure A8b. Jeddo Colliery Water Quality Characteristics

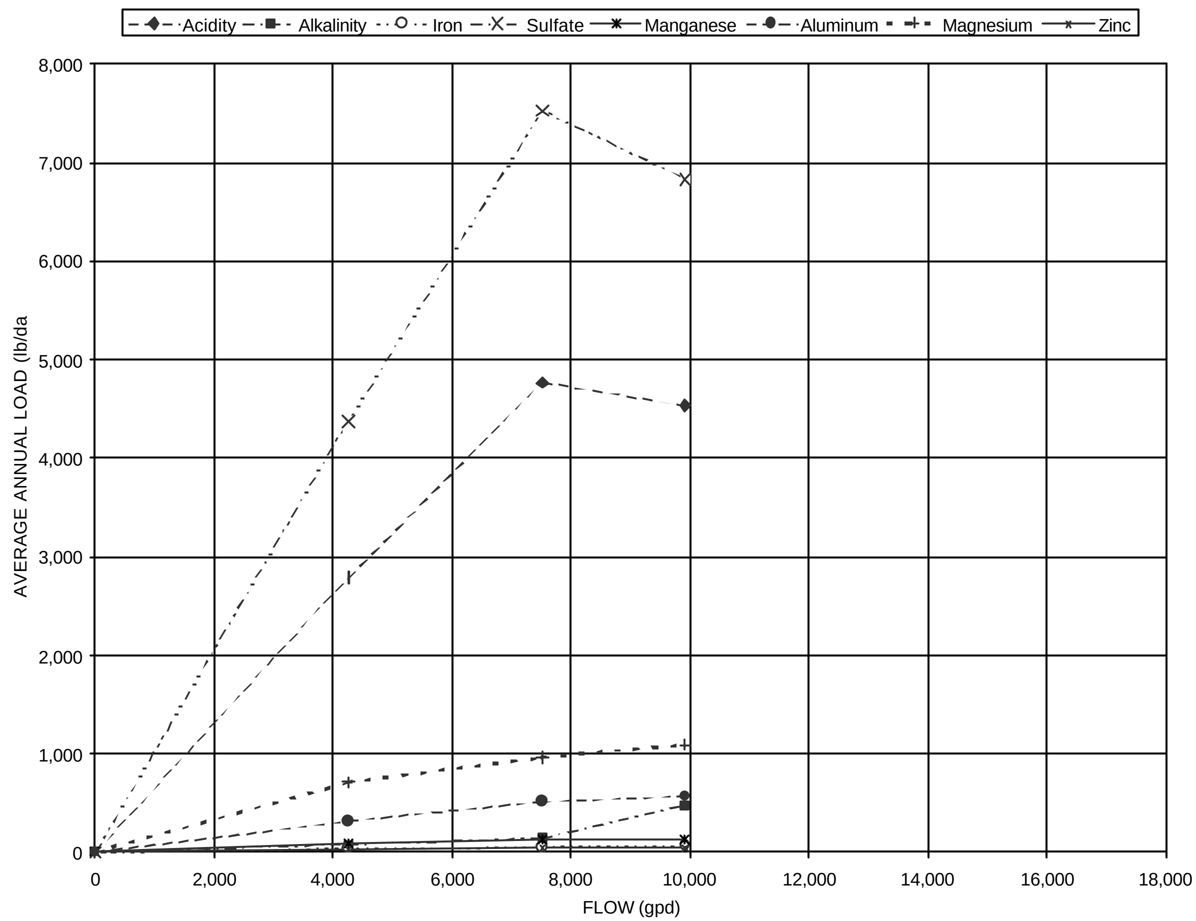


L E G E N D

OUTFALL
STATE HIGHWAY
FORESTED AREA
AGRICULTURAL AREA
DISTURBED AREA
SWAMP
RIVER/STREAM/DAM
20 FOOT CONTOUR
OTHER ROAD

Portal Altitude: 1,290 feet above mean sea level USGS Coordinates: 40°55'09" Latitude, -75°54'07" Longitude

Figure A9a. Jeansville Basin Showing Beaver Meadow (Quakake) Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	58.00	0.92	0.852	101.00	1.57	6.18	12.80	0.481
1997	55.33	1.50	0.681	86.25	1.68	6.31	14.24	0.491
1998	38.00	4.30	0.543	56.50	1.08	4.77	9.14	0.331

Figure A9b. Beaver Meadow Colliery Water Quality Characteristics

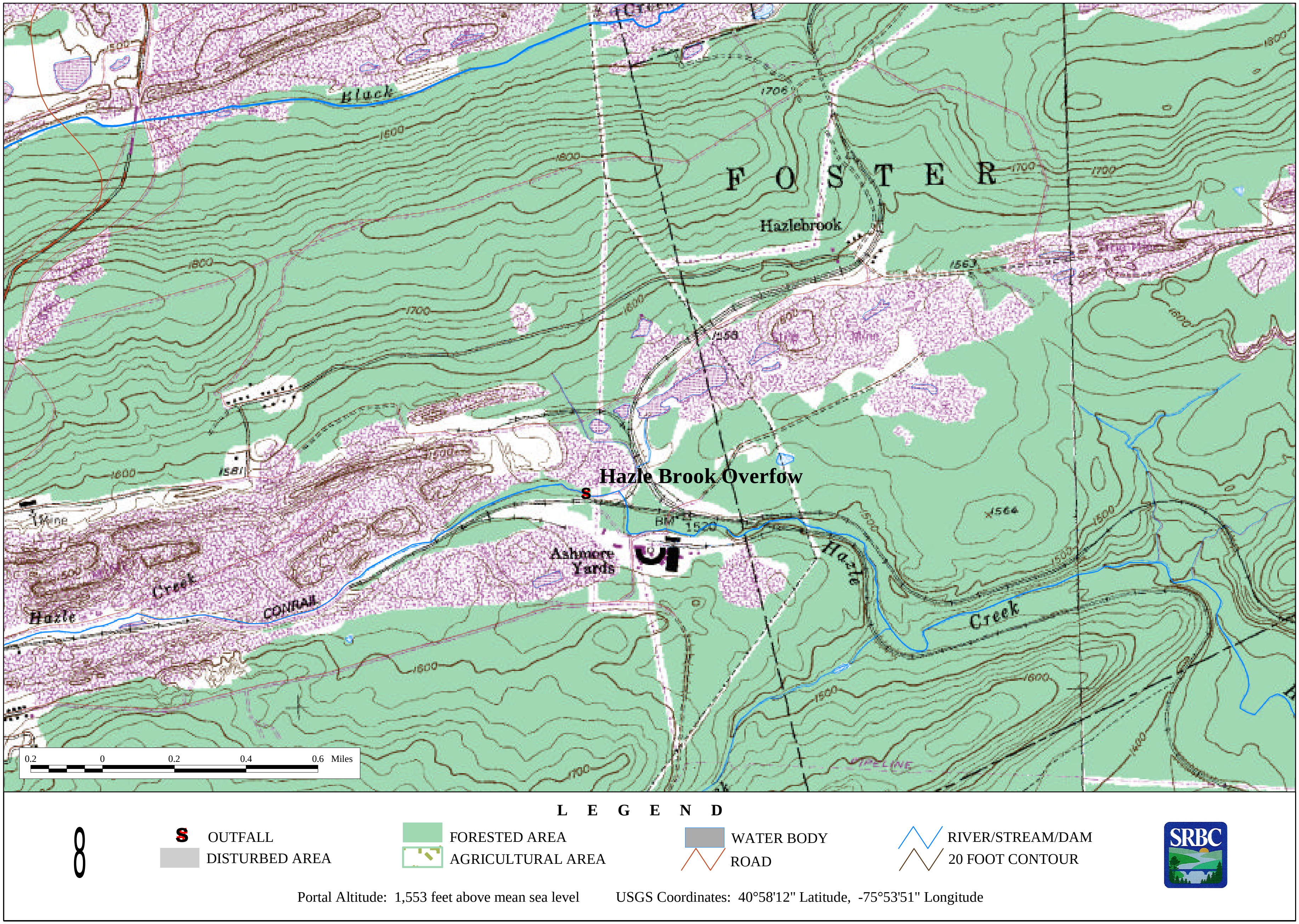
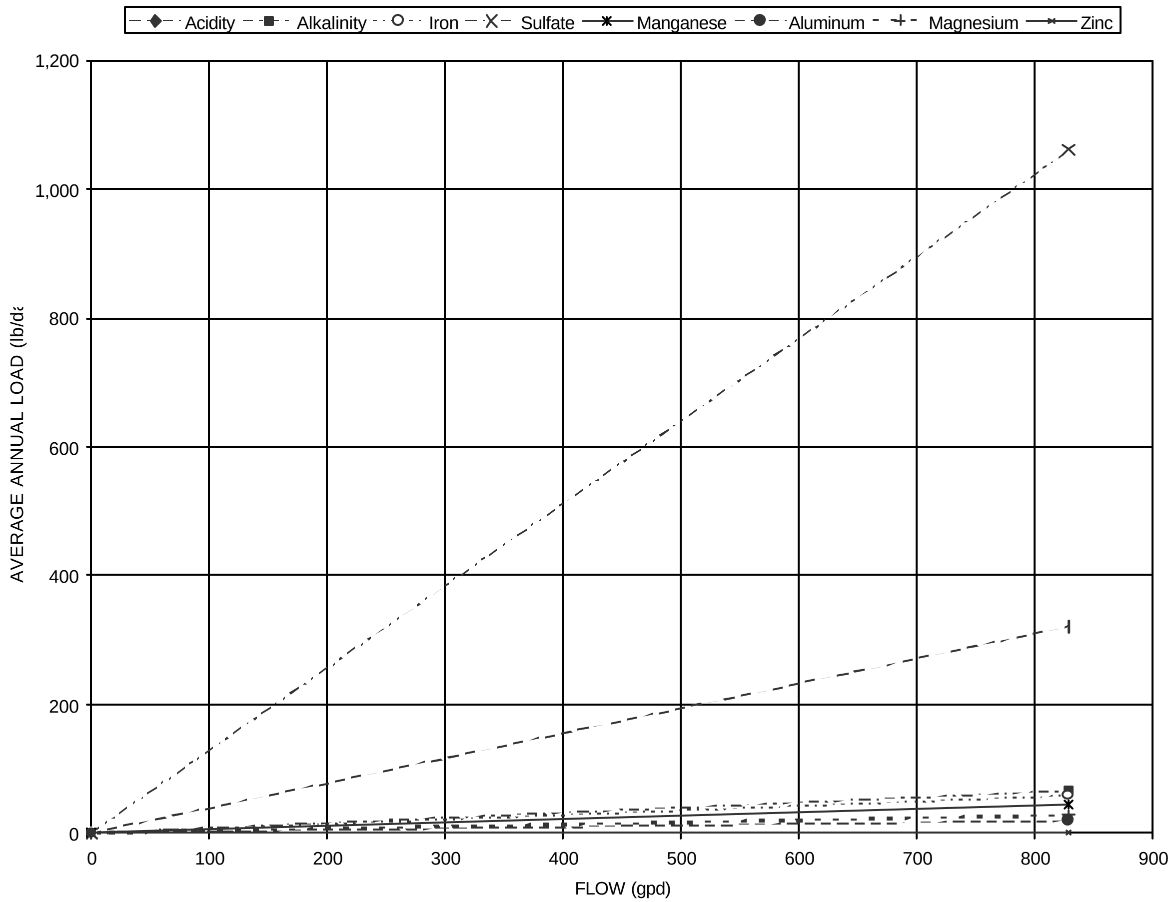


Figure A10a. Hazelton Basin Showing Hazel Brook Overflow Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	NA	NA	NA	NA	NA	NA	NA	NA
1997	NA	NA	NA	NA	NA	NA	NA	NA
1998	29.00	6.43	5.46	88.00	0.453	1.77	2.57	0.091

Figure A10b. Hazle Brook Colliery Water Quality Characteristics

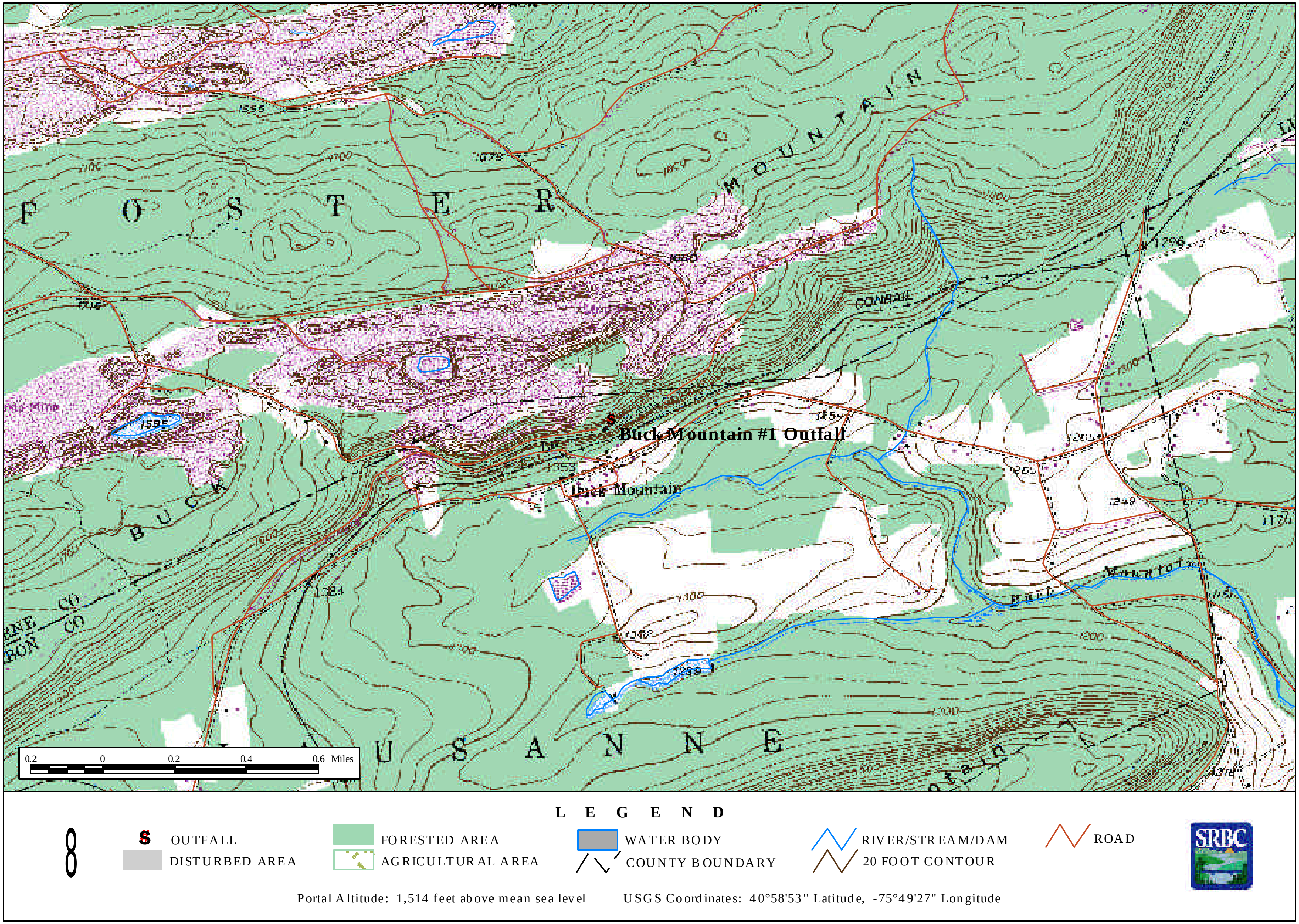
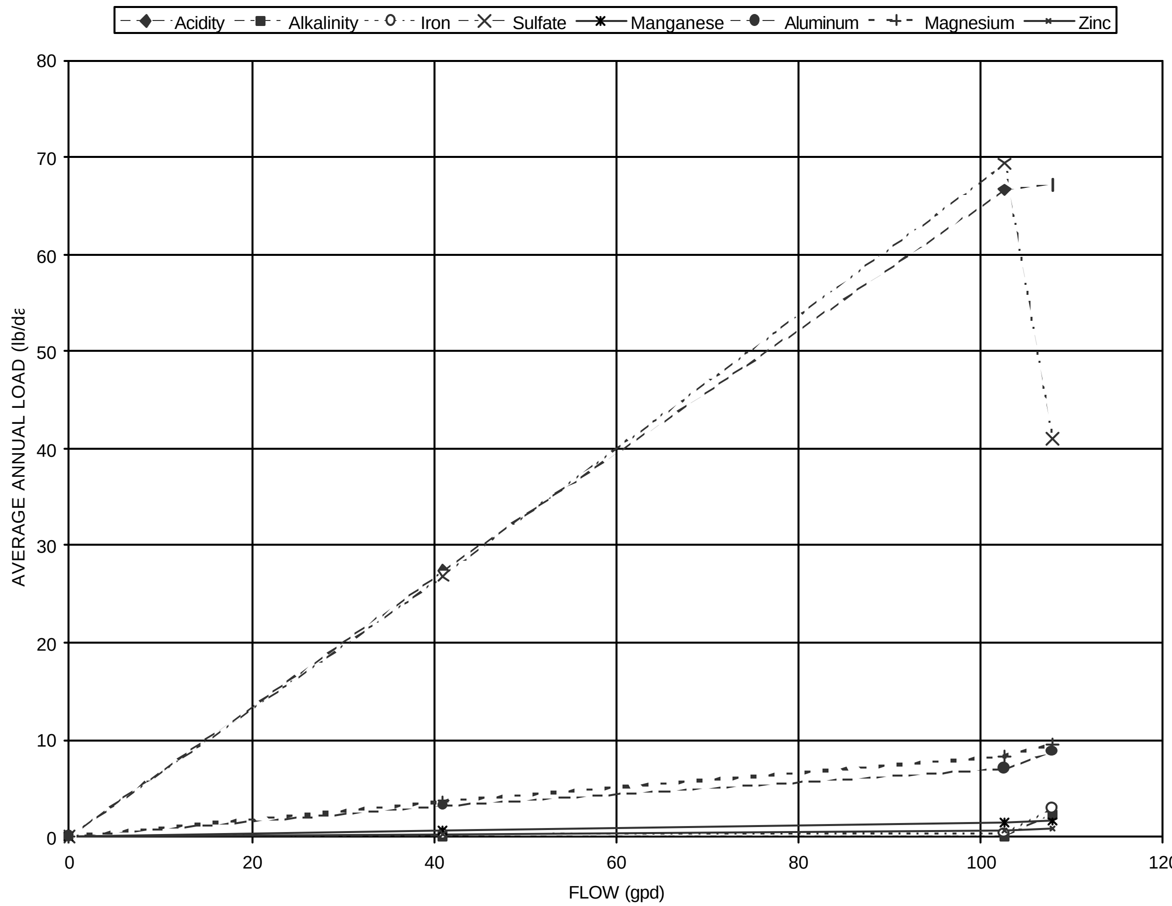


Figure A11a. Buck Mountain Basin Showing Buck Mountain No. 1 Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	54.80	0.000	0.322	70.20	1.19	5.94	7.06	0.583
1997	55.50	0.433	0.424	52.17	1.32	6.32	7.58	0.642
1998	52.00	1.700	2.110	30.00	1.20	6.72	7.35	0.614

Figure A11b. Buck Mountain No. 1 Colliery Water Quality Characteristics

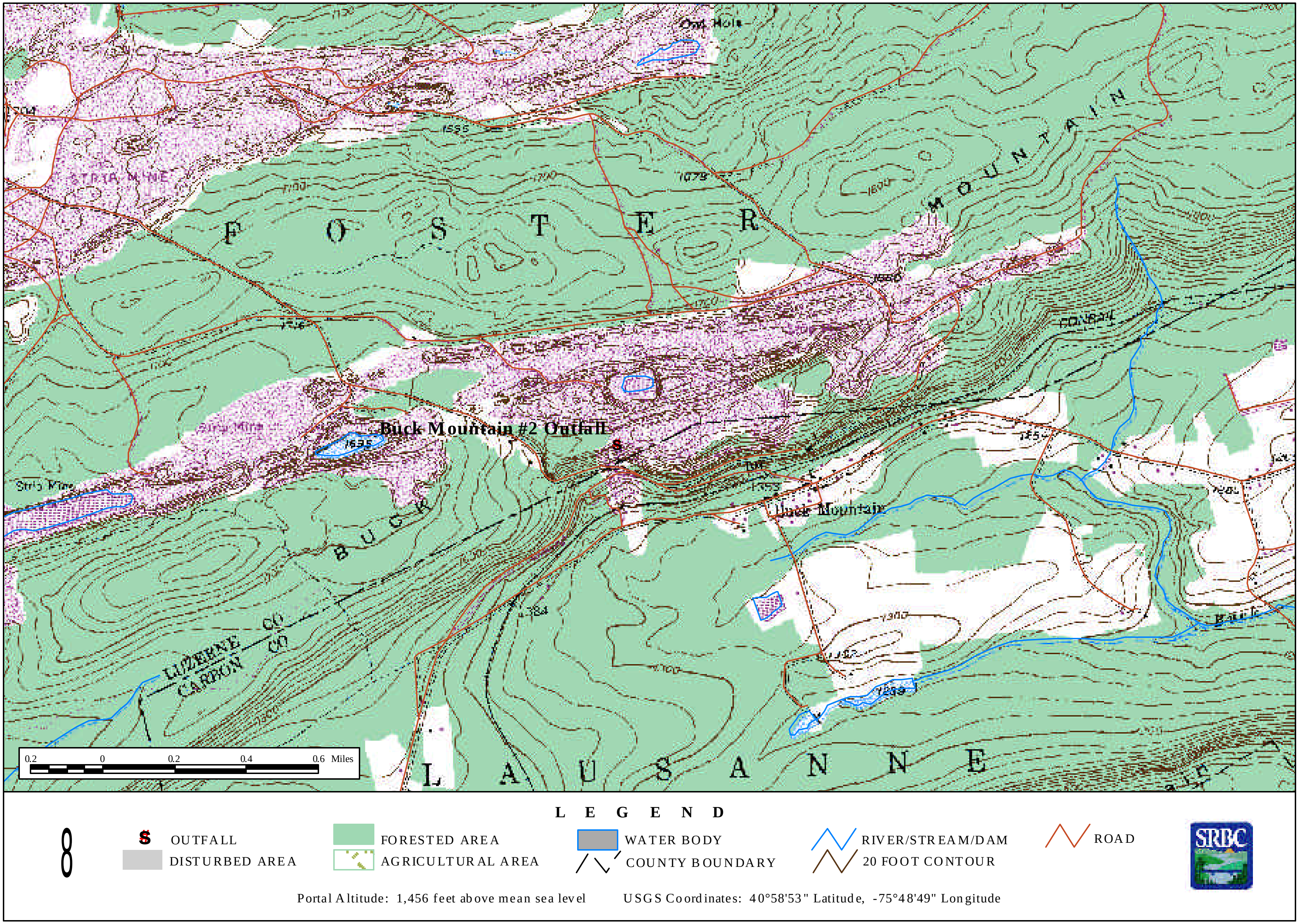
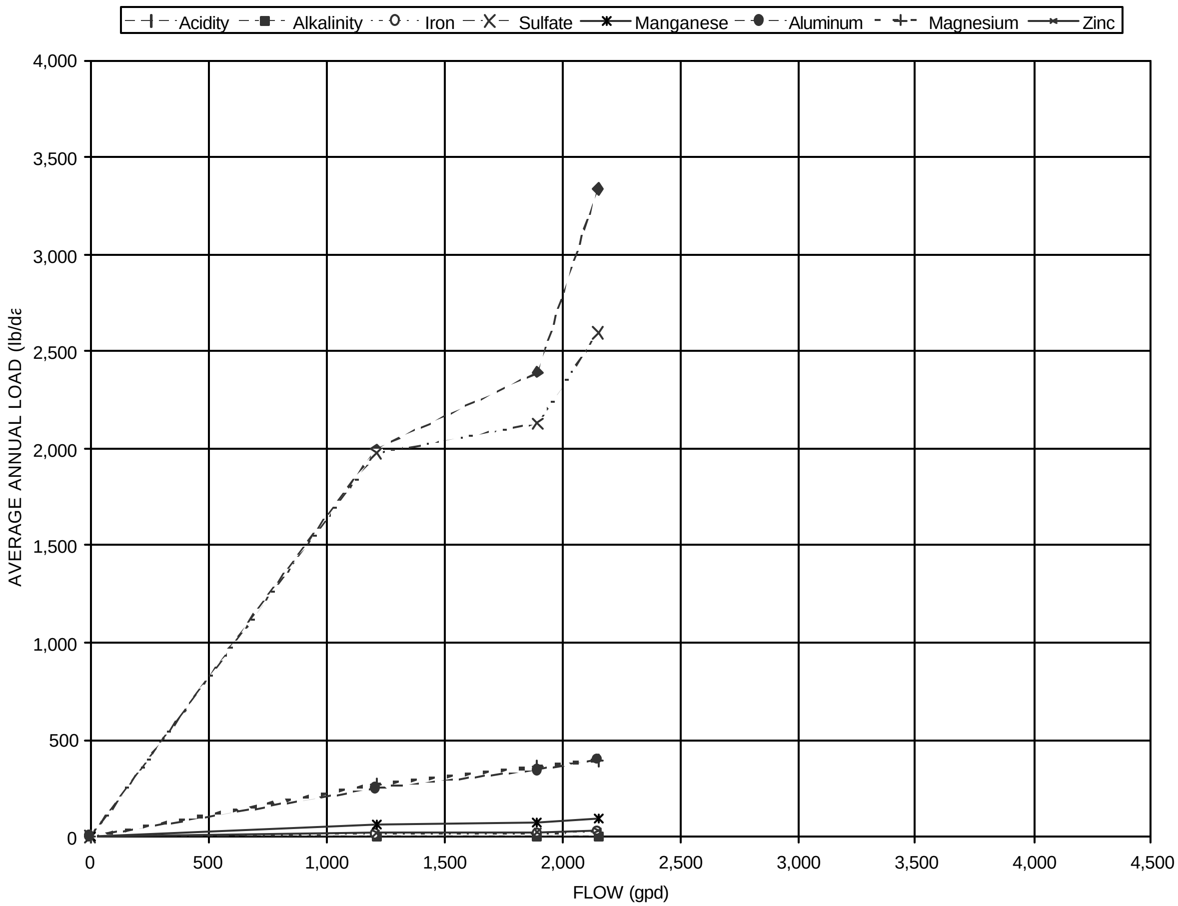


Figure A12a. Buck Mountain Basin Showing Buck Mountain No. 2 Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	145.60	0	1.240	145.60	4.23	18.322	17.86	1.380
1997	134.50	0	0.868	146.92	3.77	15.96	17.05	1.220
1998	105.00	0	0.651	93.50	3.36	15.00	15.85	1.130

Figure A12b. Buck Mountain No. 2 Colliery Water Quality Characteristics

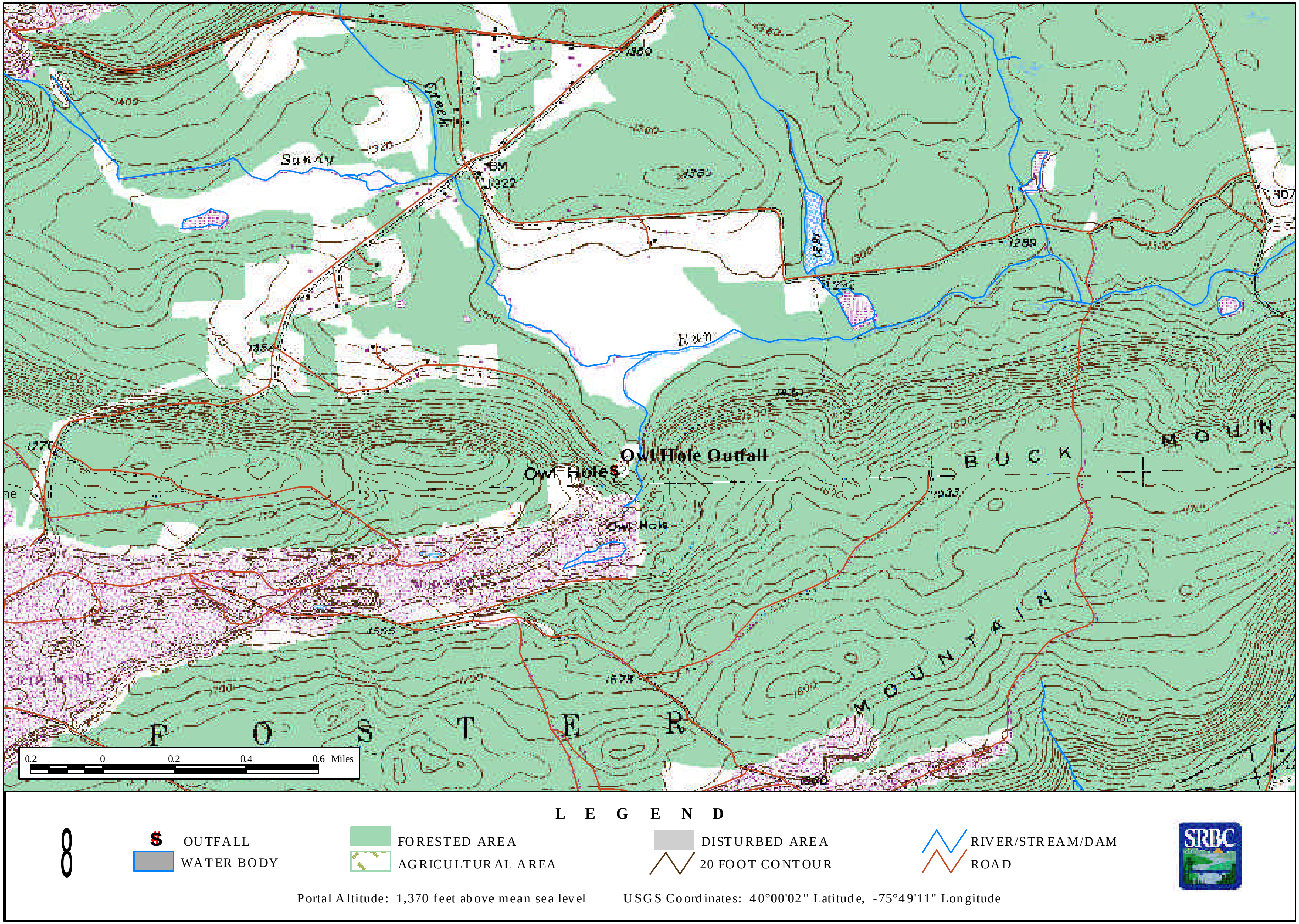
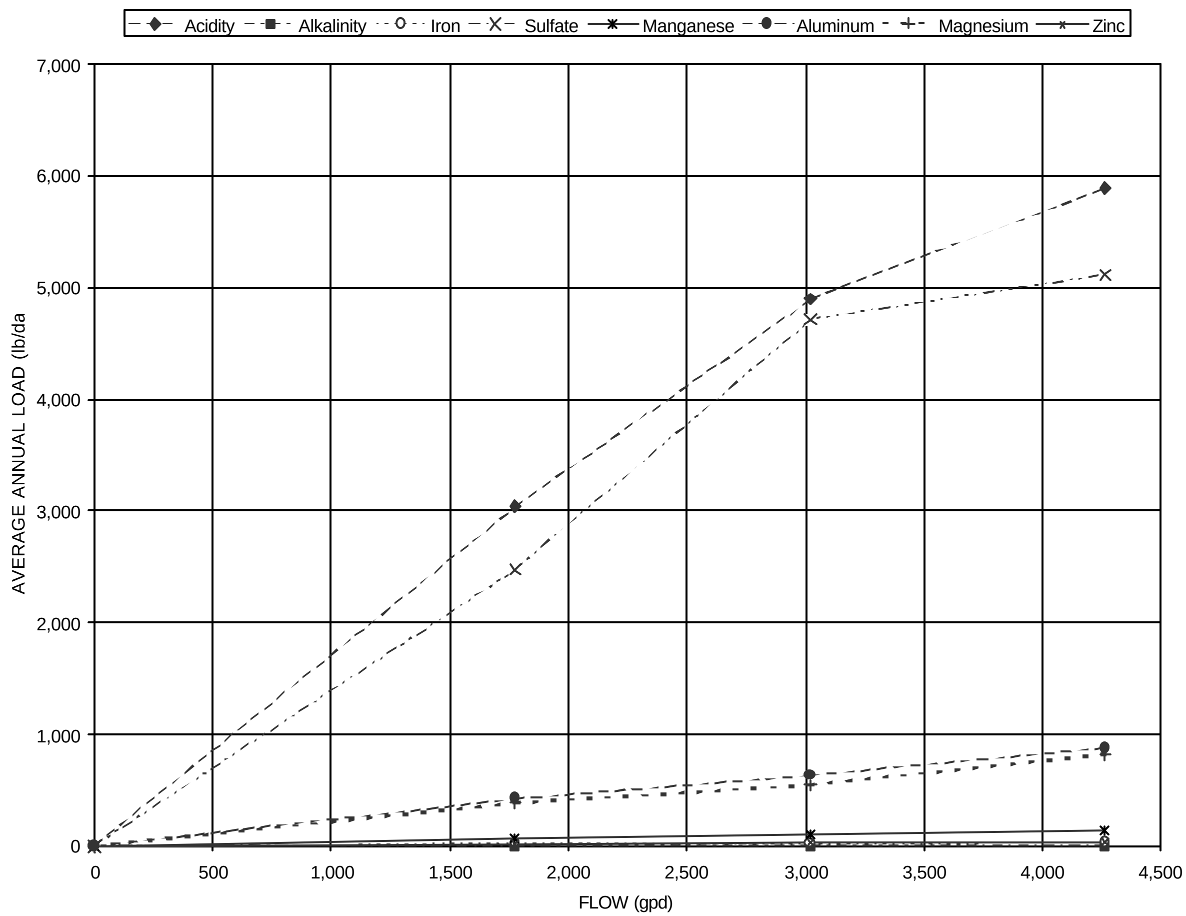


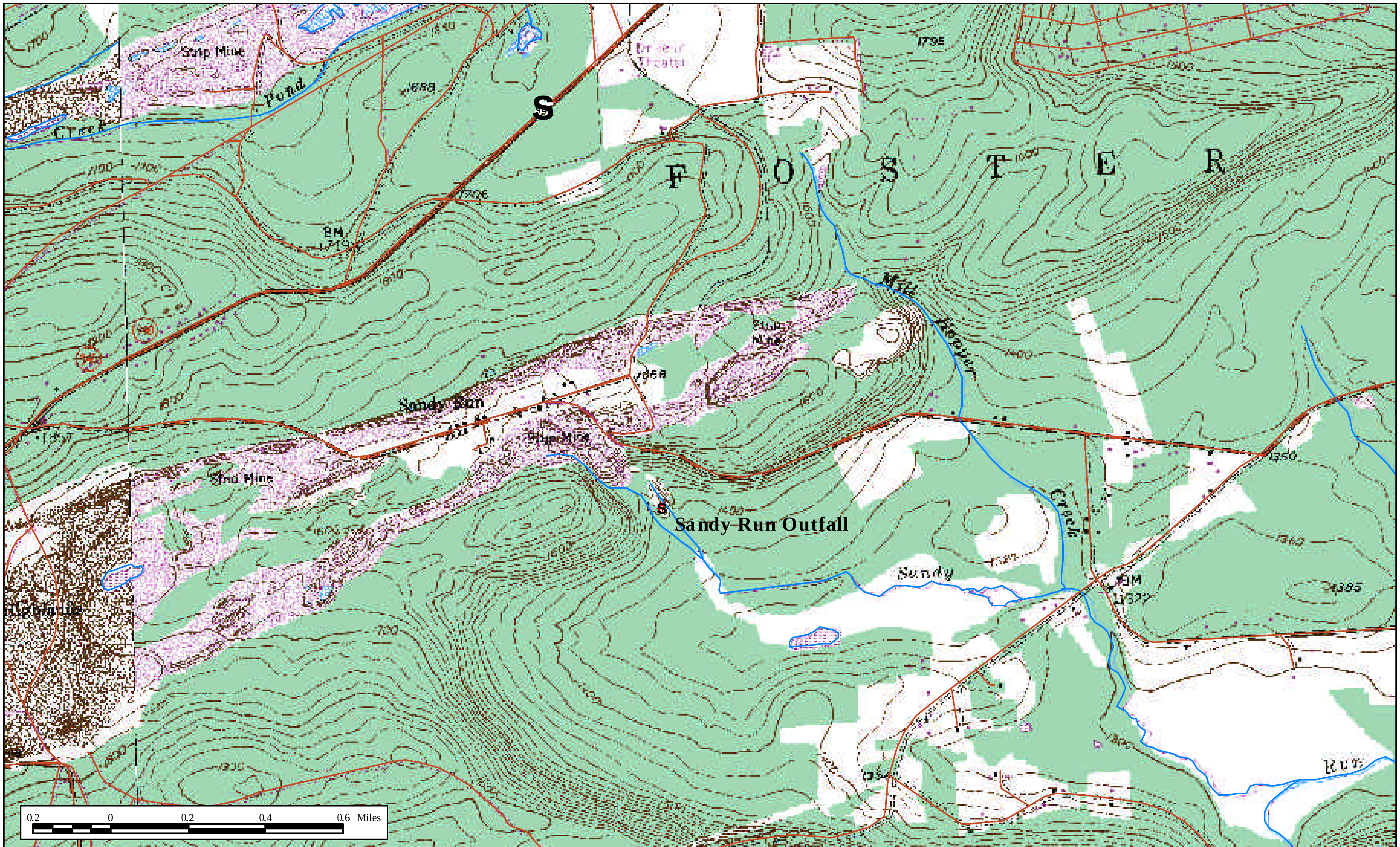
Figure A13a. Big Black Creek Basin Showing Owl Hole Tunnel Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	156.40	0	0.865	174.80	3.63	21.54	17.90	1.010
1997	147.17	0	0.986	118.92	3.40	19.88	18.01	0.951
1998	114.67	0	0.697	95.33	2.87	17.43	15.97	0.805

Figure A13b. Owl Hole Colliery Water Quality Characteristics

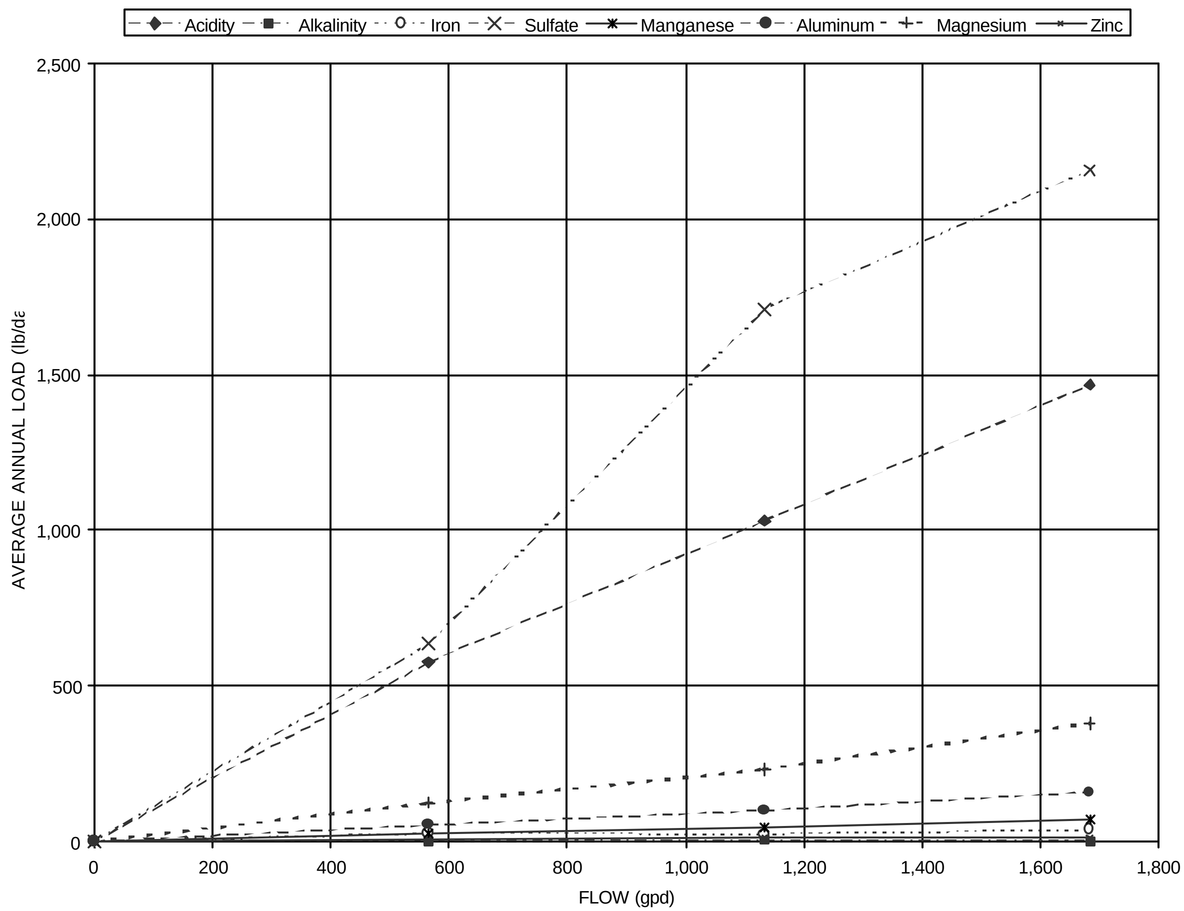


L E G E N D

OUTFALL
STATE HIGHWAY
FORESTED AREA
AGRICULTURAL AREA
WATER BODY
DISTURBED AREA
RIVER/STREAM/DAM
20 FOOT CONTOUR
OTHER ROAD

Portal Altitude: 1,408 feet above mean sea level   USGS Coordinates: 41°00'58" Latitude, -75°50'55" Longitude

Figure A14a. Cross Creek Basin Showing Sandy Run Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	78.67	0.43	2.37	135.33	3.58	7.63	17.20	0.676
1997	83.45	0.58	3.73	94.18	3.77	7.77	18.13	0.613
1998	74.00	0	1.95	109.67	3.57	8.07	18.90	0.700

Figure A14b. Sandy Run Colliery Water Quality Characteristics

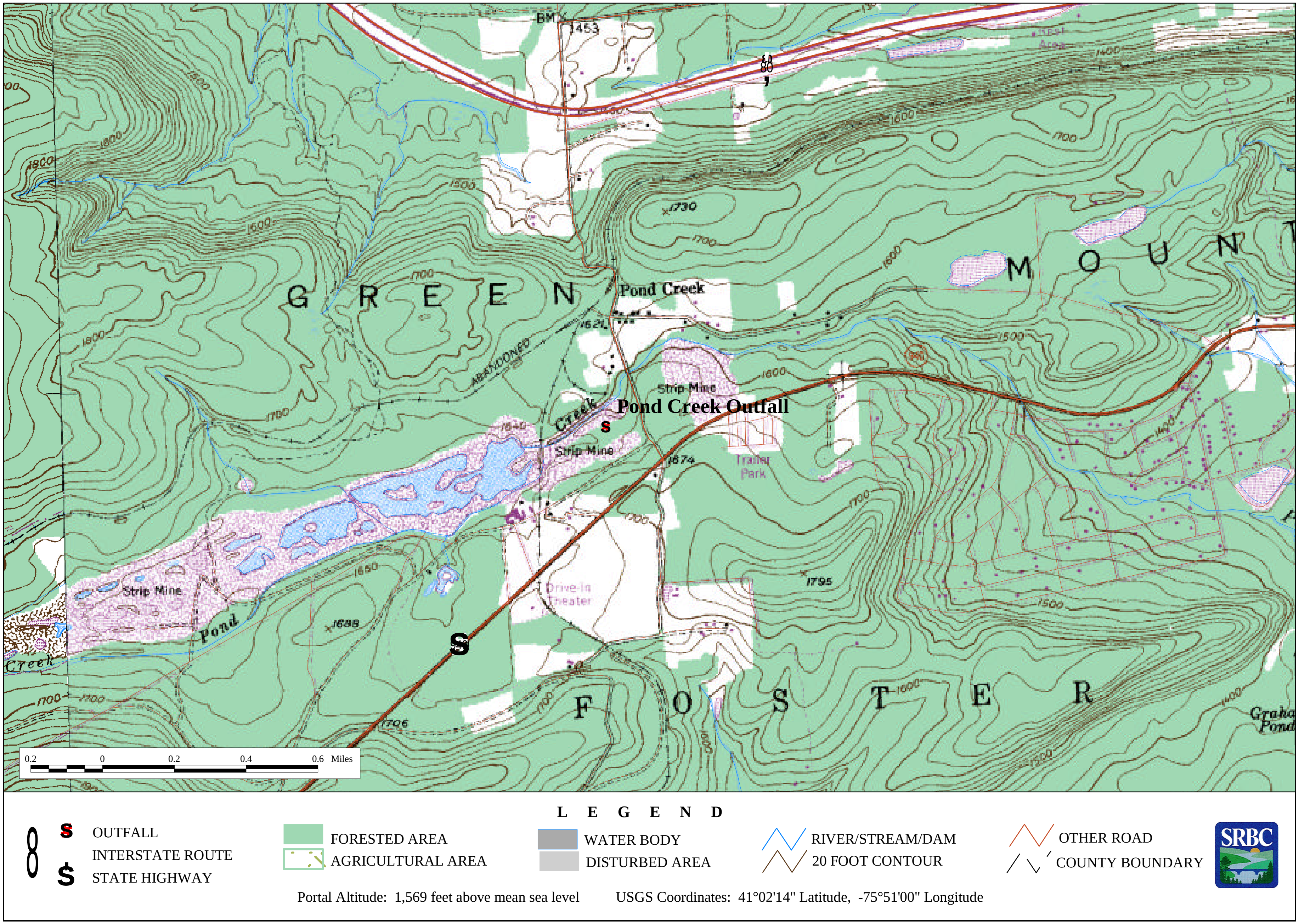
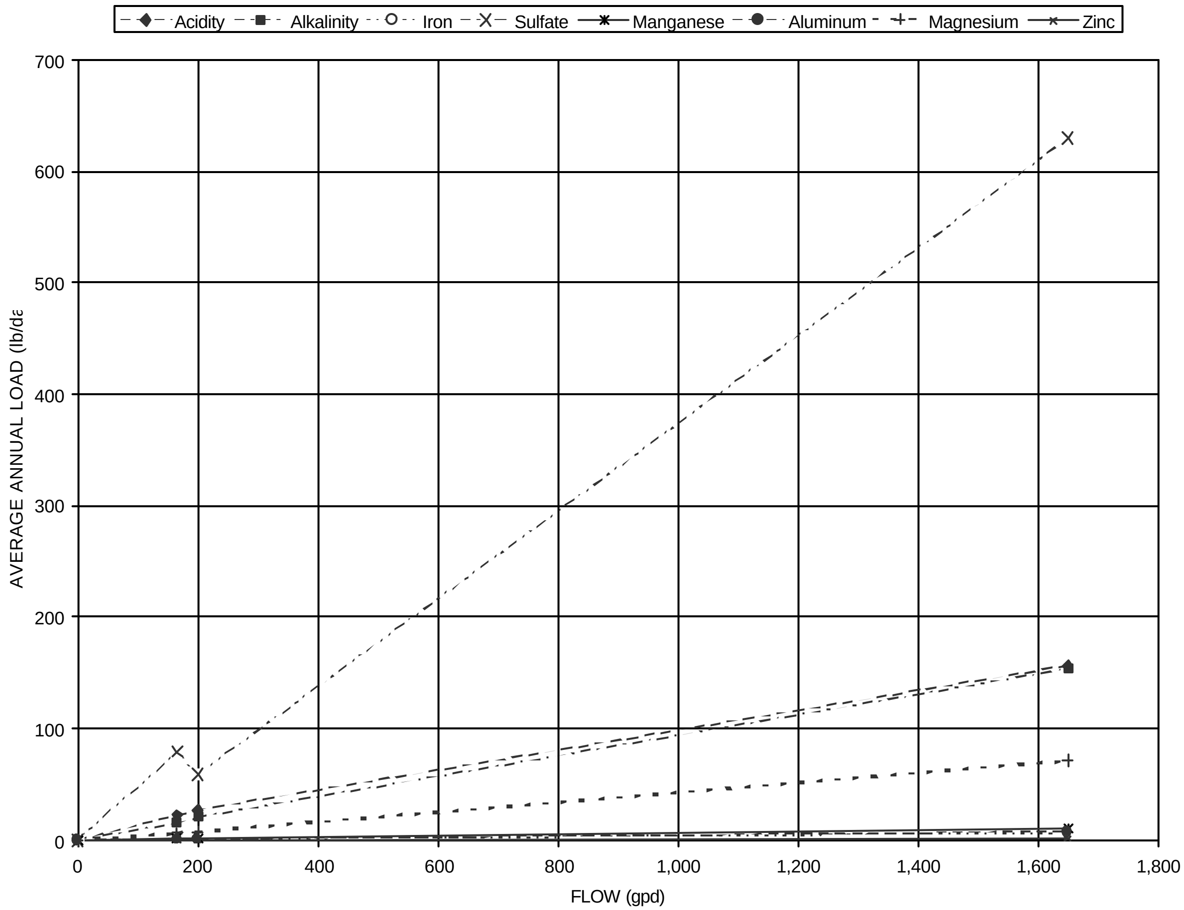


Figure A15a. Upper Lehigh Basin Showing Pond Creek Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	10.70	7.57	0.285	39.67	0.489	0.38	3.30	0.068
1997	11.30	8.73	0.246	26.60	0.503	0.37	3.57	0.076
1998	7.13	8.33	0.313	29.67	0.510	0.44	3.62	0.073

Figure A15b. Pond Creek Colliery Water Quality Characteristics

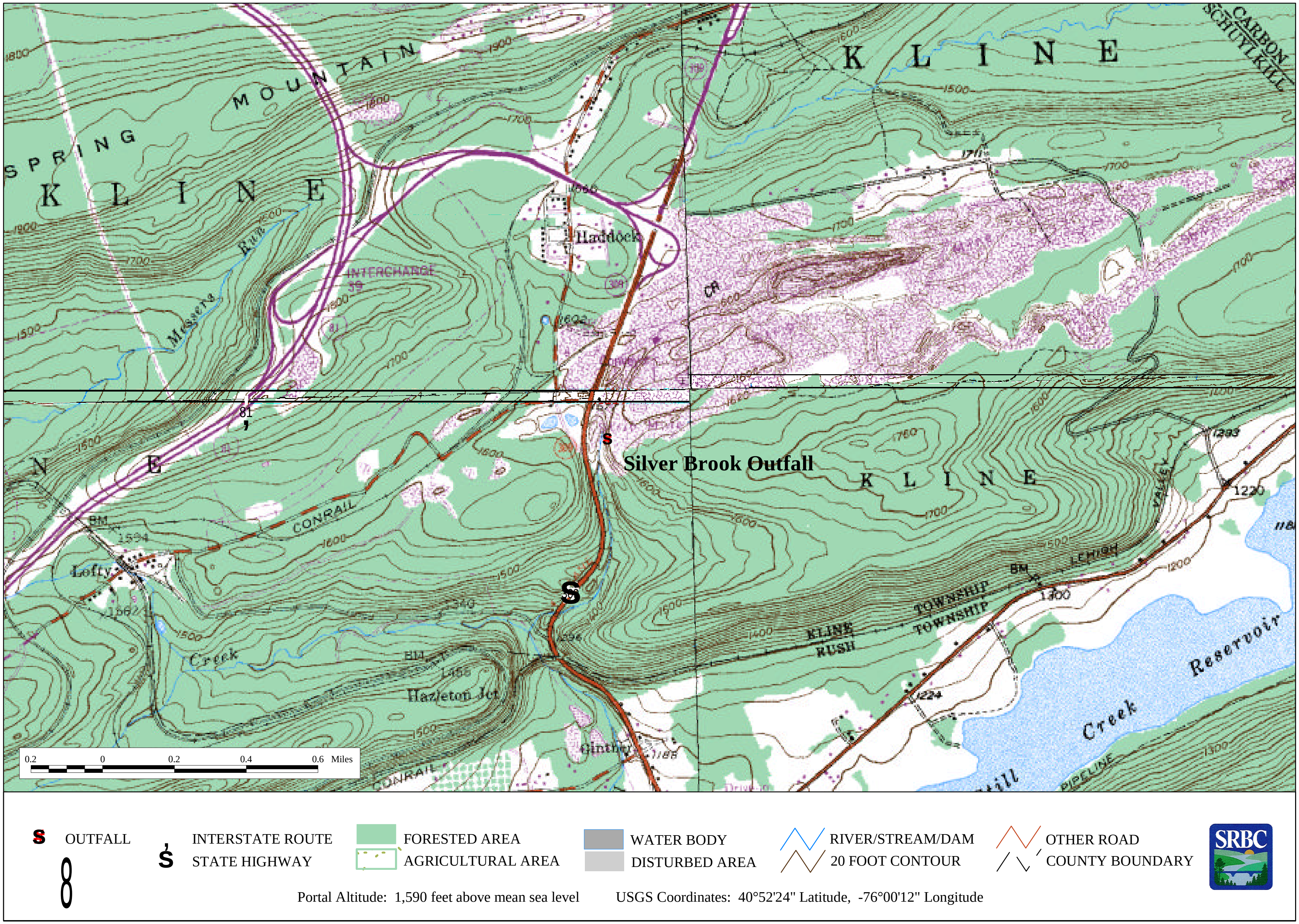
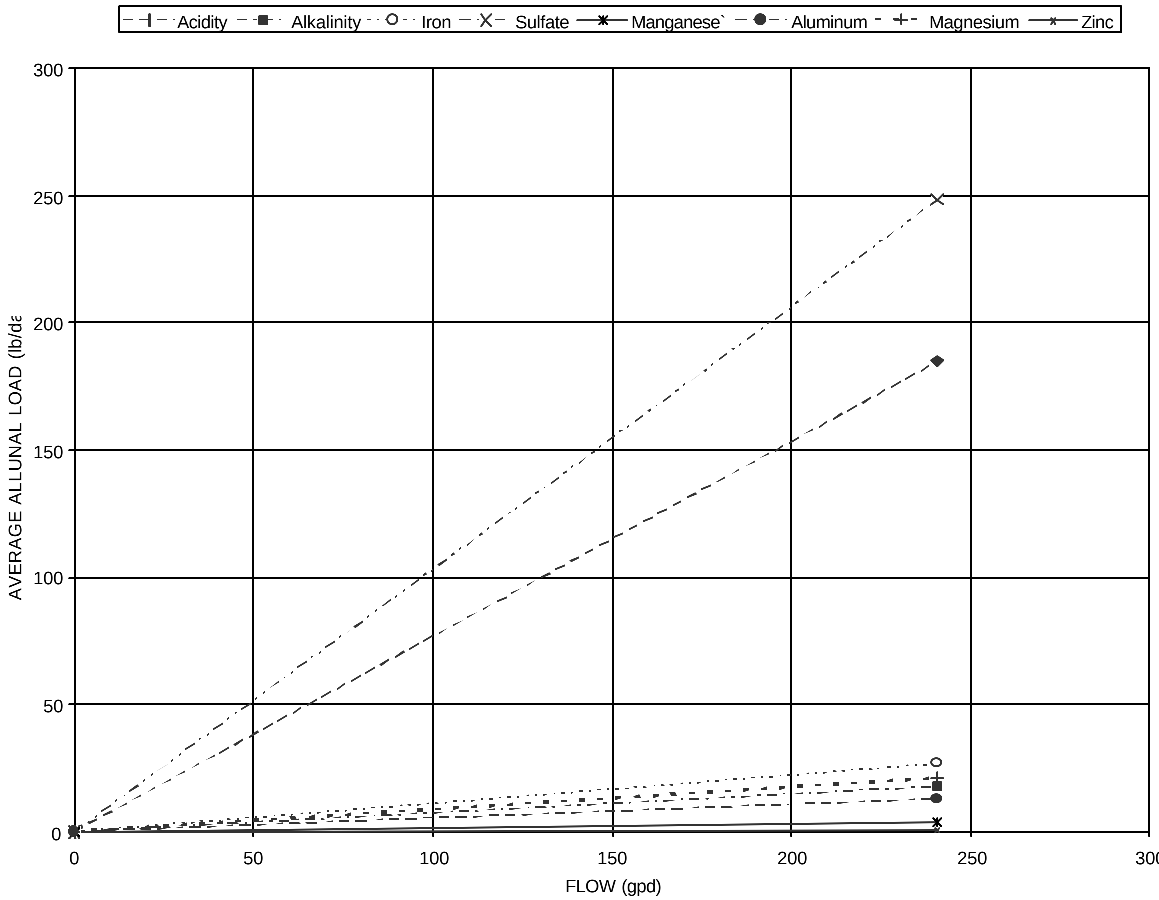


Figure A16a. Silver Brook Basin Showing Silver Brook Outfall Location



AVERAGE ANNUAL CONCENTRATIONS (mg/l)

Year	Acidity	Alkalinity	Iron	Sulfate	Manganese	Aluminum	Magnesium	Zinc
1996	49.63	4.97	8.180	82.50	1.34	4.66	7.27	0.241
1997	71.17	4.40	9.600	76.42	1.61	5.75	8.78	0.297
1998	60.67	1.67	9.260	72.00	1.50	5.03	8.18	0.235

Figure A16b. Silver Brook Colliery Water Quality Characteristics

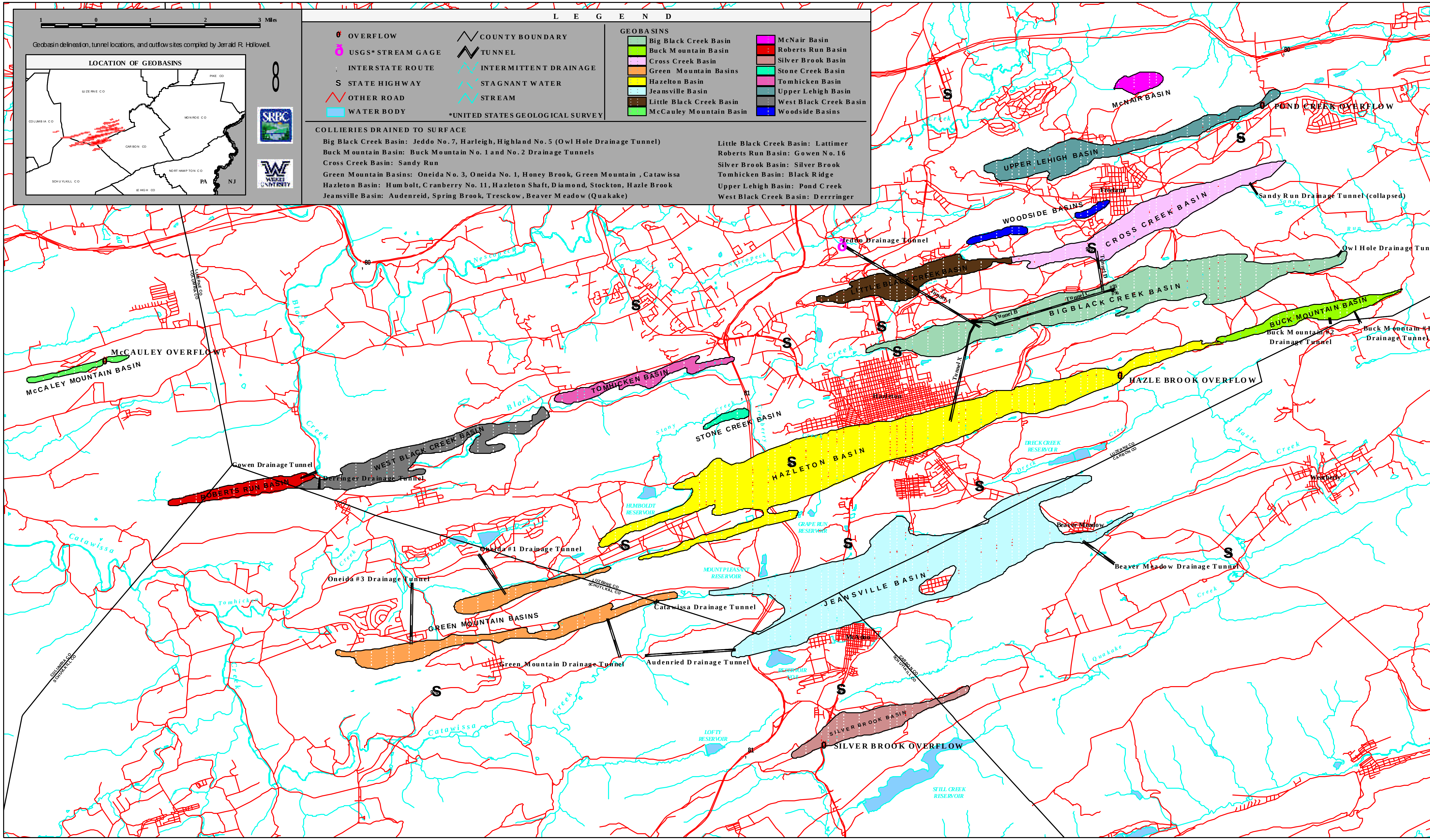


Plate 1. Eastern Middle Anthracite Field Showing Mine Drainage Outfalls and Surfical Projections of the Individual Coal Basins