Fox Run Restoration Project - Phase I

Yellow Creek Watershed
Jackson Township
Mercer County, Pennsylvania

A Public-Private Partnership Effort

June 2005

Stream Restoration Incorporated
A PA Non-Profit Organization 501(c)(3)
3016 Unionville Rd., Cranberry Twp., PA 16066
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Date: July 15, 2005

To: John Sims, Project Officer
Sherry Carlin, Watershed Manager
PA Department of Environmental Protection
Bureau of District Mining Operations
P.O. Box 669, Knox, PA 16232-0669

Re: Final Report
ME# 352997; Project # NW-20194
Fox Run Restoration Area – Phase I
Jackson Township, Mercer County, PA
870102/01 FR-trans 87

Enclosed are three copies of the final report for the above noted project. Construction of the passive treatment system was completed in October of 2004. The wetland, however, was just recently planted (06/20/05) through a volunteer effort. The wetland is projected to be established by the end of the 2006 growing season.

This restoration project could not have been completed without the support of The Kish Family (landowner), Mercer County Conservation District, and the PA DEP. As part of the partnership effort, in addition to successfully treating the mine drainage, the project has been expanded by the Mercer County Conservation District to include education and outreach efforts. On 7/16/03, an Environmental Outreach Workshop highlighted the site and future programs are planned. In addition to the project sign, interpretive signs are in process.

From: Stream Restoration Incorporated

Shaun Busler, GISP Cliff Denholm, Env. Sci. Kyle Durrett, Env. Tech.

Tim Danehy, QEP Margaret H. Dunn, PG

Sent: First Class Mail

FOX RUN Restoration Area - PHASE 1: FINAL REPORT

Jackson Township, Mercer County, PA

"Making it Happen" through a Public-Private Partnership Effort

A Pennsylvania Growing Greener Watershed Restoration Project

Brief Description of Project Work through Grant and Partnership Contributions

- Completed and submitted to the appropriate agencies, applications and notifications including Environmental Assessment, Cultural Resource Notice, General Information Form, PA Natural Diversity Inventory request, Erosion and Sediment Pollution Control Plan, PA One Call request; received permits/approvals;
- Installed E & S Controls approved by Mercer County Conservation District (MCCD);
- Conducted a rapid bioassessment of Fox Run in coordination with PA DEP Bureau of Mining and Reclamation and Grove City College;
- Designed a passive treatment system for an alkaline, metal-laden abandoned mine discharge (87-7) and numerous seeps to enhance metal precipitation and settling of particulates prior to entering Fox Run; design based on raw water monitoring of discharge #87-7 conducted by MCCD and BioMost, Inc. with the following "worst case" characteristics: 50 gpm, 245 mg/l alkalinity, 31 mg/l dissolved Fe, 3 mg/l dissolved Mn;
- Construction included creation of a multi-component (in series) passive treatment system including a Collection Channel (540' length and 3,900 SF), Settling Pond (3,000 SF), and Aerobic Wetland (10,200 SF); existing impacted wetland reconfigured to include micro-topographical relief and planted with native vegetation;
- Planted live stakes of Black Willow and container-grown White Pine and Eastern Hemlock with volunteers and as contributions in-kind from the MCCD Munnell Farm to help stabilize seep zones and create shade as part of the wildlife habitat;
- Removed ~1,200-cubic yard relic spoil pile and revegetated with grasses and legumes;
- Developed preliminary Project Page on Datashed (www.datashed.org) for use by MCCD and others;
- Conducted education and outreach programs including wetland planting by volunteers;
- Conducted tours; kept photographic log; submitted quarterly status reports and final report; administered contract.

Grant Program and Funding: Environmental Stewardship and Watershed Protection Grant (Growing Greener) - $132,681

In-Kind/Matching: Mercer County Conservation District; Brenner's Ecological Services; The Fike Family; Grove City College; Urban Wetland Institute; Quality Aggregates Inc.; Quality Wetland Products; Kosmic Signs & Designs; BioMost, Inc.; Stream Restoration Inc.

PUBLIC-PRIVATE PARTNERSHIP EFFORT

Landowner Support
The Kish Family, Jackson Twp., Mercer Co., PA

Conceptual and Engineering Design of Passive Treatment System, Environmental Assessment, and Water Quality Monitoring
Brenner's Ecological Service, 789 N. Liberty Rd., Grove City, PA 16127
BRENNER, Fred, PhD, President (724) 748-4310

BioMost, Inc., 3016 Unionville Rd., Cranberry Twp., 16066
DANEHY, Timothy, QEP; DUNN, Margaret, PG; BUSLER, Shaun, GISP, Biologist; DENHOLM, Cliff, Environmental Scientist; DURRETT, Kyle, Intern (724) 776-0161

Passive Treatment System Construction
Quality Aggregates Inc., 200 Neville Rd., Neville Island, PA 15225
ALOE, Joseph, President; ANKROM, Jeff, Vice President; STOOPS, John, Foreman; STEINER, Kevin & HJORTEN, Mike, Equipment Operators (412) 777-6717

Quality Wetland Products, 200 Neville Rd., Neville Island, PA 15225
JESSLOSKI, Dave, Director; MATHIS, Carl, Env. Sci., (724) 290-2101

Construction Inspection and State Grant Administration
PA DEP, District Mining Operations, PO Box 669, Knox, PA 16232
KOWALSKY, Robert, SMCI; BISH, Bradley, SMCI; SIMS, John, Insp. Supervisor; CARLIN, Sherry, Watershed Manager; HEFERLE, Elias, Water Pollution Biologist; ODENTHAL, Lorraine, Permit Chief; MIRZA, Javed, Dist. Mining Mgr. (814) 797-1191

Water Monitoring, Stream Assessment
PA Department of Environmental Protection, Bureau of Mining & Reclamation, Rachel Carson State Office Building, PO Box 8461, Harrisburg, PA 17105-8461
ALEXANDER, Scott, Water Pollution Biologist (717) 783-9579

Watershed Assessment, Public Outreach, Volunteer Effort, Water Monitoring, O & M
Mercer County Conservation District, 747 Greenville Rd., Mercer, PA 16137
MONDOK, James, Manager; HEDGLIN, Shawn, Nutrient Management; SHANKEL, Jill, Watershed Coordinator; MCDONALD, Robert, E & S Tech (724) 662-2242

Stream Restoration Incorporated, 3016 Unionville Rd., Cranberry Twp., 16066
DANEHY, Timothy, QEP; DUNN, Margaret, PG; BUSLER, Shaun, GISP, Biologist; DENHOLM, Cliff, Environmental Scientist; DURRETT, Kyle, Intern (724) 776-0161

Kosmic Signs & Designs, 205 Freeport Road, Butler, PA 16002
MCMILLIN, Shane (724) 283-1011

Aquatic Life and Wetland Monitoring
Grove City College, 100 Campus Dr., Grove City, PA 16127
BRENNER, Frederick, PhD, Biologist, Biology Dept. (724) 458-2113

Urban Wetland Institute [non-profit], 789 North Liberty Rd., Grove City, PA 16127
BRENNER, Frederick, President (724) 748-4310

Grant Administration
Stream Restoration Incorporated, 3016 Unionville Rd., Cranberry Twp., 16066
DANEHY, Timothy, QEP; DUNN, Margaret, PG; BUSLER, Shaun, GISP, Biologist; DENHOLM, Cliff, Environmental Scientist; DURRETT, Kyle, Intern (724) 776-0161

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FOX RUN RESTORATION PROJECT – PHASE 1 FINAL REPORT

Fox Run Watershed, Jackson Township, Mercer County, PA

Submitted to

Pennsylvania Department of Environmental Protection

EXECUTIVE SUMMARY

Supporters of the Fox Run Phase 1 restoration project were awarded a grant from the Pennsylvania Department of Environmental Protection through the Commonwealth's Growing Greener initiative. The purpose of the grant was to fund, in combination with matching/in-kind contributions, the installation of a passive system to treat a metal-bearing discharge and several associated seeps and to provide related educational and public outreach activities.

Within two years of grant approval all necessary permits/approvals were received and the passive treatment system was designed and installed. The timely project implementation and use of resources were made possible by cooperation through a public-private partnership effort that included federal, state, and local agencies; private industry; nonprofits; landowners; and volunteers.

The passive treatment system was constructed to conform with and enhance pre-construction topography to minimize construction costs and utilize space. The system includes a 3,900-ft^2 collection channel (540' in length), a 3,000-ft^2 settling pond, and a 10,200-ft^2 aerobic wetland. When combined these components capture an estimated **4,000 pounds** of metals annually before the drainage enters Fox Run.

Fox Run Phase 1 Passive Treatment System

Sample Point	Description	Flow (gpm)	pH (field/lab)	Alk. (field/lab)	Acidity	Fe	Mn
Inlet (87-7)	Raw discharge	20	6.3/6.7	416/328	-279	24	3
Outlet (WL)	Constructed wetland (pre-planting)	~20 +Seeps	6.8/7.4	344/350	-270	3	3

Average alkalinity, acidity, and dissolved metals in mg/L; average pH values not determined from H-ion concentrations; pre-construction 87-7 flow measured at weir; post-construction flow by estimation; (See monitoring sheets for more details.)

The success of Phase 1 further supports that the passive system planned for Phase 2 will restore the remaining degraded headwaters. With the combined treatment capacity of both systems, Fox Run is expected not only to be able to sustain a viable fish habitat but also to be reclassified and eliminated from the PA DEP 303d list as a high priority for restoration due to abandoned mine drainage impacts.

In addition, through the generosity and commitment of volunteers from the Mercer County Conservation District (MCCD) and The Fike Family, a successful wetland planting was recently completed. Wildlife habitat will be further enhanced with the placement of wood duck boxes and an owl box. This site will continue as a model for future clean up efforts and community education, through the placement of educational signs, tours by the MCCD, and monitoring conducted by Grove City College students.

COMPREHENSIVE TIMELINE

Tour/Site Visit News Item DEP Inspection

Date	Description
02/08/02	Growing Greener grant submitted for **Fox Run Restoration Project- Phase 1**
08/26/02	Preliminary Environmental Assessment and vegetative cover assessed by Shaun Busler and Dr. Brenner
01/15/03	Growing Greener Grant Awarded to Stream Restoration Inc for $132,681.00 for Fox Run Restoration Project- Phase I
04/17/03	Quarterly report submitted to DEP for the months of Jan.-Mar. 2003
04/30/03	Topographic survey by Earthtech Inc.
06/17/03	Site investigation of Phase I area; Rapid bioassessment of Fox Run with S. Alexander, PA DEP, BMR and Grove City College students
06/18/03	Rapid bioassessment of Fox Run with S. Alexander, PA DEP, BMR and Grove City College students
07/10/03	Quarterly report submitted to DEP for the months of Apr.-June 2003
07/16/03	Environmental Outreach workshop. Visitors from Munnell Run Farm investigate effects of Acid Mine Drainage (AMD) and discuss design of restoration projects. They also visit a wetland and listen to presentations by Dr. Fred Brenner and Margaret Dunn on AMD reclamation
10/15/03	Quarterly report submitted to DEP for the months of July-Sept. 2003
10/23/03	Cultural Resource Notice Form submitted to PA Historical & Museum Comm.
10/24/03	First Site inspection by PA DEP (B.Bish). No activity at site.
10/24/03	General Information Form submitted to Mercer County Commissioners and Jackson Township Supervisors
10/27/03	Potential conflicts identified by PNDI – further documentation needed by US Fish & Wildlife Service and PA Fish & Boat Commission
10/31/03	PHMC clearance issued
11/--/03	SRWC "The Catalyst", Highlighting Other Partnership Efforts (HOPE!) article – "Mercer County Conservation District"
11/05/03	Pennsylvania Natural Diversity Inventory Search submitted by Stream Restoration Inc. Site investigated and field meeting with landowner
11/12/03	PNDI potential conflict cleared by PA Fish & Boat Commission
11/20/03	PNDI potential conflict cleared by US Fish & Wildlife Service
11/26/03	Site investigated by Shaun Busler and Dr. Brenner, existing wetlands delineated with survey flags
12/05/03	Wetlands surveyed with elevations taken by Earthtech Inc.
12/18/03	Environmental Assessment submitted to Patrick Williams at PA DEP
01/04/04	Quarterly report submitted to DEP for the months of Oct.-Dec. 2003
01/07/04	Site inspection by PA DEP (B.Bish) No activity on site.
03/01/04	Erosion & Sediment Pollution Control Plan submitted to the Mercer County Conservation District
03/25/04	Site inspection by PA DEP (B.Bish). Status of site unchanged - not started.
04/01/04	Quarterly report submitted to DEP for Jan.-Mar. 2004

04/29/04	Resubmission of Environmental Assessment with requested revisions
05/12/04	PA One Call request (Serial #1336865)
07/12/04	Quarterly report submitted to DEP for months of Apr.-June 2004
08/20/04	Preliminary wetland biomonitoring by Dr. Brenner and Shaun Busler; Site not yet logged.
08/23/04	Restoration waiver approved by PA DEP
08/30/04	Site investigation and field meeting with landowner
09/20/04	Site investigation and review design plan with loggers and construction crew.
09/23/04	Exploratory pits dug; Site investigation
09/28/04	Site inspection. Hillside logging nearing completion. Spoil pile removed to construct spillway. Began clearing southern end of site for collection channel.
10/04/04	Site inspection by PA DEP (R. Kowalsky). Wide-track dozer and excavator on site. Site active for last 10 days. Filter fence noted along stream where ground is disturbed. Hay bale, at "pipe" outlet needs attention. Operator to control muddy slop and reduce mud into stream. Large pond 40% complete.
10/08/04	Quarterly report submitted to DEP for the months of July-Sept. 2004
10/13/04	Site Inspection by PA DEP (R. Kowalsky). Wide-track dozer and excavator on site. Main wetland nearly complete, excavator and dozer cleaning/building primary settling pond. Mushroom compost and tree stumps noted in main pond. Filter fence noted along stream bank.
10/18/04	Site inspection and field meeting with Shawn Hedglin, Mercer County Conservation District. Construction crew finishing wetland.
10/18/04	Quarterly report for the months of Oct.-Dec. 2004
10/21/04	Site inspection by PA DEP (R. Kowalsky). Excavation work completed. Settling pond and main wetland area, discharge outlet finished. Plantings remain to be completed. Size and location appear to be close to plan; however, slightly smaller due to coal encountered.
12/14/04	Water sampling by Mercer County Conservation District
11/--/04	SRWC "The Catalyst", Highlighting Other Partnership Efforts (HOPE!) article – "Fox Run Watershed"
02/07/05	Water sampling by Mercer County Conservation District
03/17/05	Water sampling by Mercer County Conservation District
03/31/05	"As-Built" survey by Earthtech Inc.
04/13/05	Water sampling by Mercer County Conservation District
04/22/05	Quarterly report submitted to DEP for the months of Jan.-Mar. 2005
05/09/05	Water sampling by Mercer County Conservation District
06/01/05	Site Inspection and water quality sampling by Mercer County Conservation District and BioMost, Inc.
06/20/05	Wetland planting with volunteers from Mercer County Conservation District and the Fike Family
06/29/05	Field checked as-builts; Site inspection
06/30/05	News article posted on SRI web page – "The Fox Run Restoration Project"

PROJECT DESCRIPTION

Introduction

In Mercer County, western Pennsylvania, coal mining has been conducted in the Yellow Creek Watershed since the early part of the 19^{th} century. While in the past, coal mining was vital to rural life, times have changed and so have mining practices. Historically, people did not fully understand or consider the impacts that mining can often have on the countryside and the waterways that flow through it. Evidence from some of these older mining practices is still visible on the current landscape of the Yellow Creek Watershed, more specifically the Fox Run tributary. It can be seen in the form of depressions in the ground due to roof falls in the underground mines, artificial hills from spoil piles, and an orange sludge coating on streambeds from metals dissolved in the water seeping from abandoned mines.

The 5,267-acre Fox Run Watershed lies within Lake, Sandy Lake, Jackson, and Worth Townships in Mercer County. Fox Run is a tributary of Yellow Creek, a stocked trout fishery. In the 1998 303d list the Pennsylvania Department of Environmental Protection (PADEP) classified Fox Run as a high priority for restoration due to the impacts of abandoned mine drainage (AMD). The main cause of pollution is from iron dissolved in the discharges. The abundance of iron precipitating in the upper reaches of Fox Run, and at least a mile downstream from the discharges, has had a substantial impact on the quality of the aquatic habitat. When sampling for aquatic macroinvertebrates, the results were low, yielding less than seven taxa. Based on DEP studies, however, Fox Run has been identified as having the potential to be restored to a high quality habitat.

In 1999 and 2000, the Mercer County Conservation District (MCCD) received a state grant and conducted an assessment of the abandoned mine drainage and the impacts on the stream. This study identified, monitored, and characterized three perennial discharges that were responsible for the majority of the degradation to Fox Run. All of the discharges were high in alkalinity and iron-bearing in nature.

After the initial study, the MCCD contacted Stream Restoration Incorporated (SRI), with experience in AMD reclamation efforts, about a partnership aimed at restoring the watershed. SRI conducted a preliminary assessment and a two-phase restoration project was decided upon using passive treatment systems. SRI then received a Growing Greener grant from the Pennsylvania Department of Environmental Protection enabling the first phase of the project to be constructed.

Site Location

Fox Run Restoration Area - Phase 1 is located along State Route 62 (SR-0062) in Jackson Township, Mercer County, directly upstream from the road culvert for Fox Run and south of Filer Corners. The site is on private property owned by Steve and Emma Kish. The site can be found on the 7 ½’ USGS Jackson Center and Sandy Lake topographic maps at latitude 41° 18’ 03” and longitude 80° 07’ 19”. (See attached location map.)

Site History

Mining has played an important role in the history of the Fox Run Watershed. The area, known as Jackson Center and Garvins Station, was probably first settled around 1805 following establishment of the nearby community of Sandy Lake in 1792. Coal production for household heating began no doubt, not long after the English emigrants discovered the Sandy Lake region to be rich in coal. A deed map from 1873 documents a mine along Fox Run (Figure 1) near Garvins Station (a.k.a. Filer Corners).

Early mining activities predate permitting records and mine maps are often non-existent or have been lost. It is difficult, therefore, to determine the extent of some of the early mining activities. The Geologic Map of Mercer County (Figure 2) illustrates the general location of the Clarion coalbeds in the region and other significant stratigraphic units. (The mapping, however, appears to be several thousand feet off in relation to the crop of the Clarion coalbed.) A "Works Progress Administration" map (Figure 3) from the 1930s shows a large mine north of Filer Corners but does not show the underground mine associated with the discharges inside the Phase I restoration area. Permitted mines on record at the PA Department of Environmental Protection are indicated on the Mine Permit Index Map (Figure 4 and Table I). The mine that most likely influences the Phase I area, FOX MINE 4109, is marked by a mine entry symbol.

Table I. Mine Permit Index Key ("A" seam; Brookville/Clarion coalbed)

Quad	Index #	Company/ *Permit #*	Date	Mine Name	Type	Notes
Jackson Center	4109	Fox Mine *1227*	08/17/49	Fox	Drift	Entry shown in proximity of restoration area; seam not identified
	1623	Willowbrook Mining Co. *3070BSM6*	07/30/70	Jones	Surface	Company later owned by Adobe Coal Co.
Sandy Lake	11362	Chutz Brothers *13885*	10/07/54	Truxell	Surface	Small surface mine upstream and in proximity of restoration area
	2759	Miller & McKnight Coal Co. *2568BSM11*	1968	Truxell	Surface	Large surface mine adjacent to Fox Run stream corridor
	1623	Willowbrook Mining Co. *3070BSM6*	07/30/70	Jones	Surface	Company later owned by Adobe Coal Co.

The Phase I restoration site was characterized as disturbed minelands with upland subsidence features and with a "face up" area having a 1,200-cubic yard spoil pile and tree-covered, earthen berms forming the streambank. The pollution emanating from an abandoned underground mine was highly visual as bright-orange iron sludge not only accumulated along the flow path of discharge (87-7) but also caused an orange plume in Fox Run as the substrate was coated. (See photos.)

Figure 1. Jackson Township from the Combination Atlas of Mercer County and the State of Pennsylvania, 1873

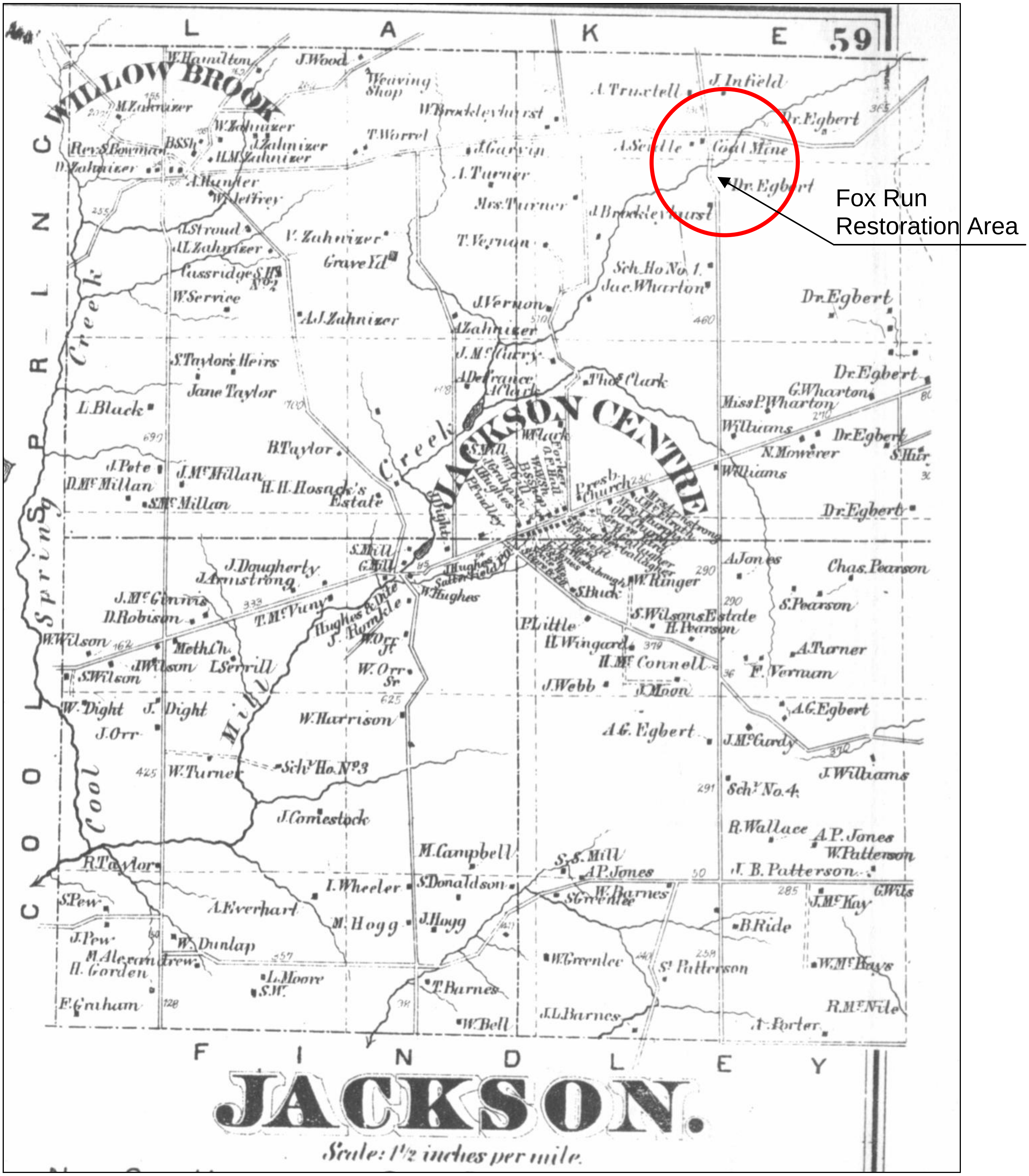
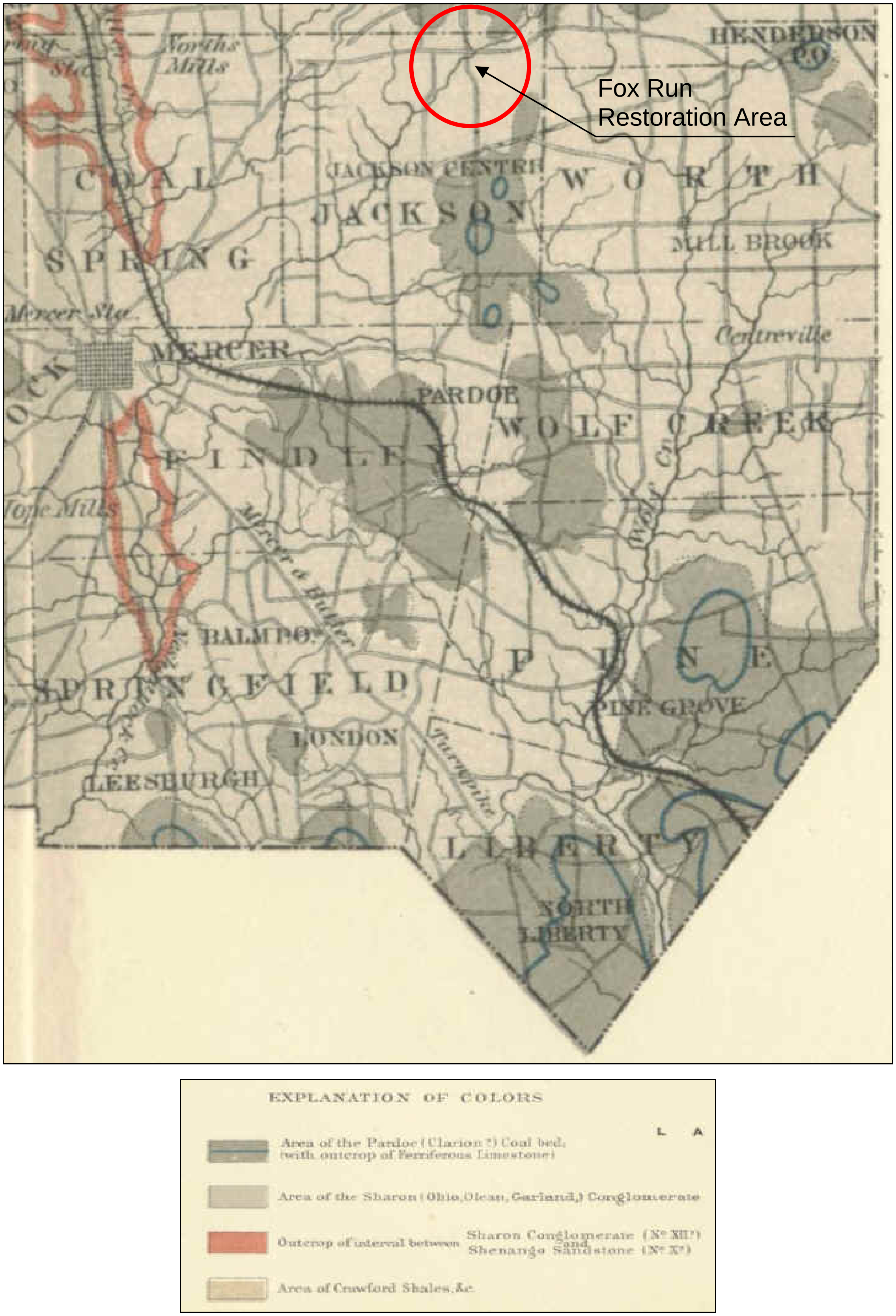


Figure 2. Geologic Map of Mercer County, 1878 (portion)



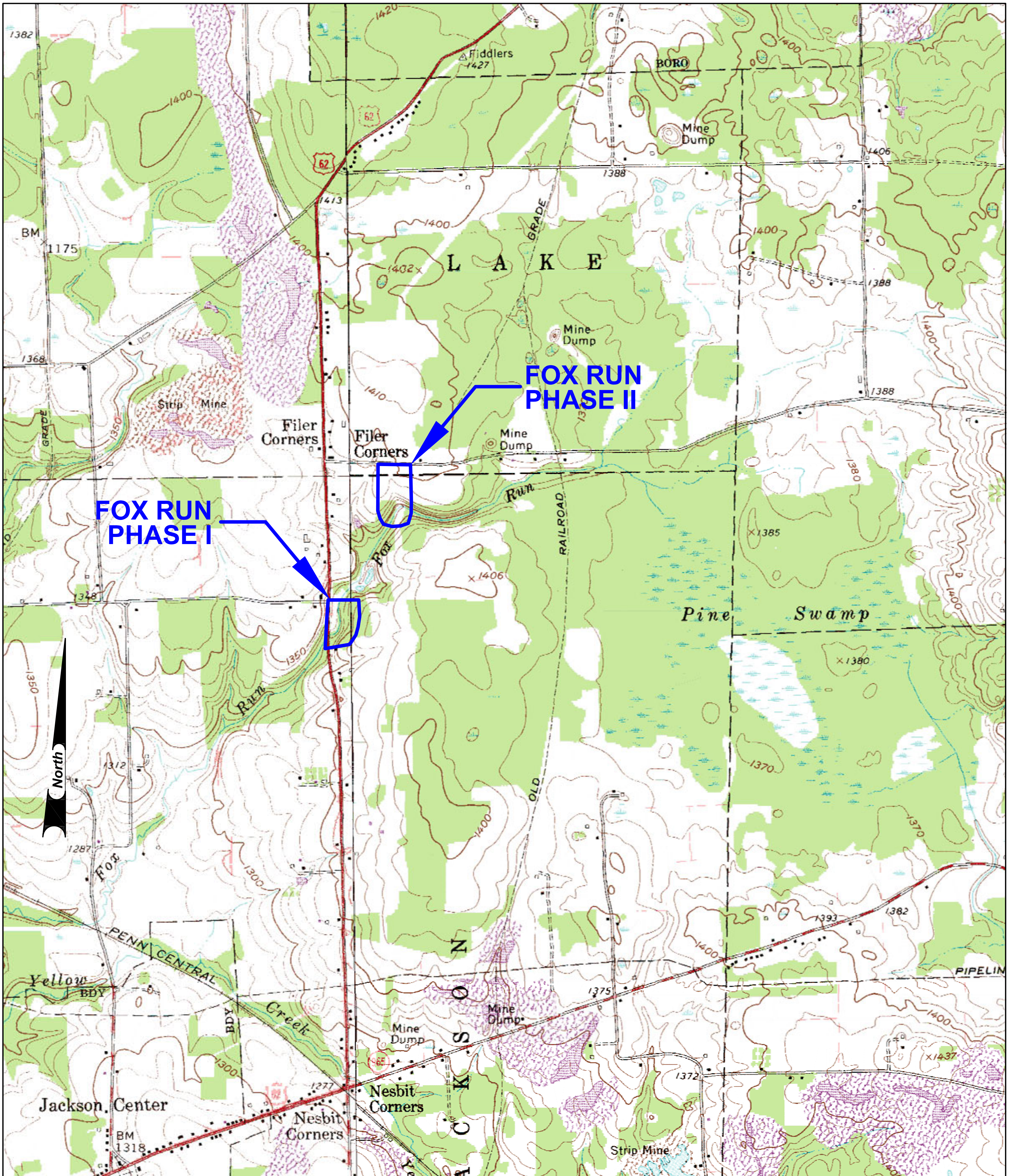


FIGURE 3: LOCATION MAP - USGS 7.5' JACKSON CENTER, PA (PR1970) AND USGS 7.5' SANDY LAKE, PA (PR1970)

FOX RUN RESTORATION PROJECT - PHASE I

Approximate Center of Project (deg-min-sec)
41-18-03 latitude 80-07-19 longitude

2000 1000 0 2000

Jackson Township, Butler County, PA

Stream Restoration Incorporated

June 2005, Scale 1" = 2000'

BioMost, Inc., Mining and Reclamation Services
Cranberry Twp., PA: loc map

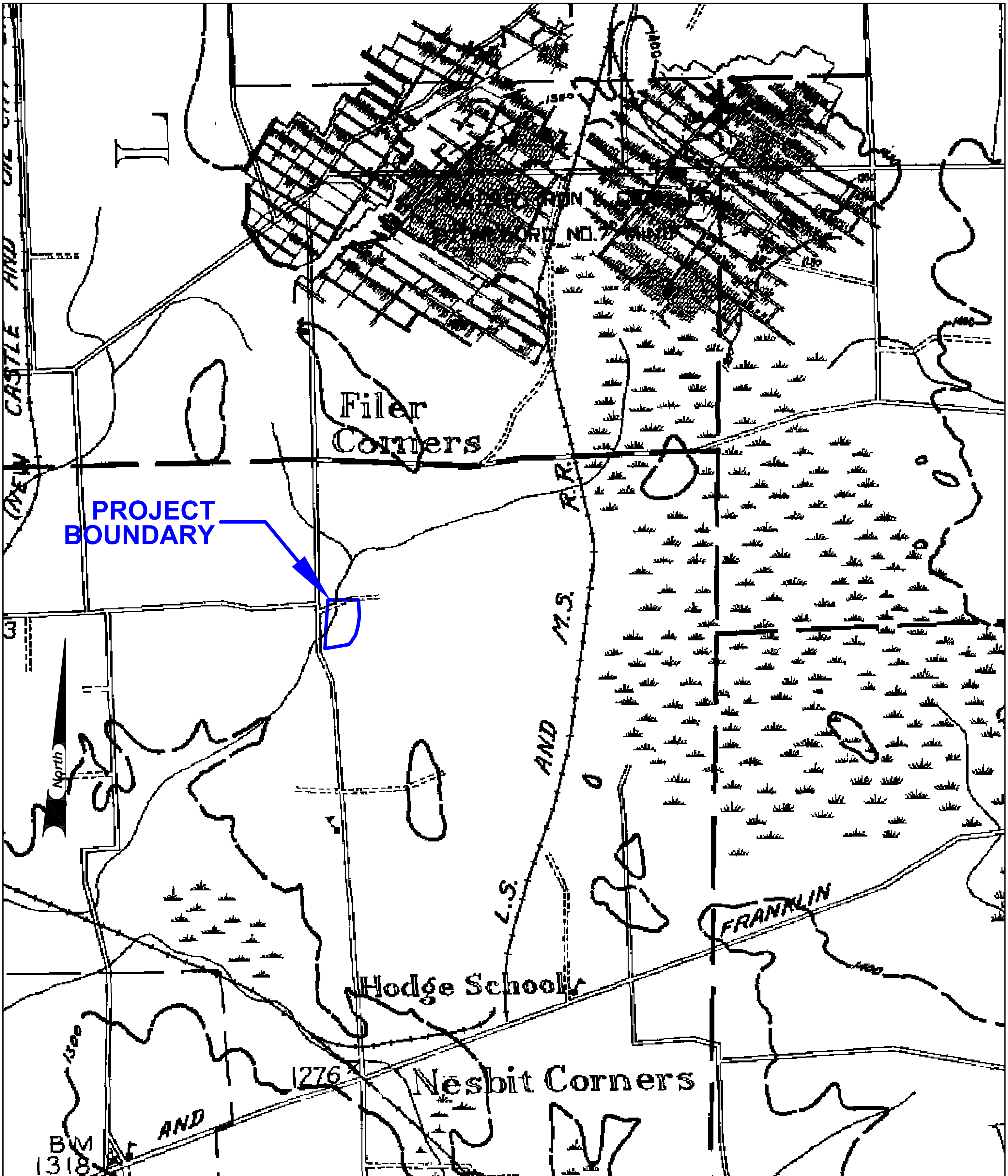


FIGURE 4: WPA MINE MAP - STONEBORO SHEET NO. 8 (ST. 8)

FOX RUN RESTORATION PROJECT - PHASE I

Jackson Township, Butler County, PA

Stream Restoration Incorporated

June 2005, Scale 1" = 2000'

Approximate Center of Project (deg-min-sec)
41-18-03 latitude 80-07-19 longitude

2000 1000 0 2000

BioMost, Inc., Mining and Reclamation Services
Cranberry Twp., PA: wpa map

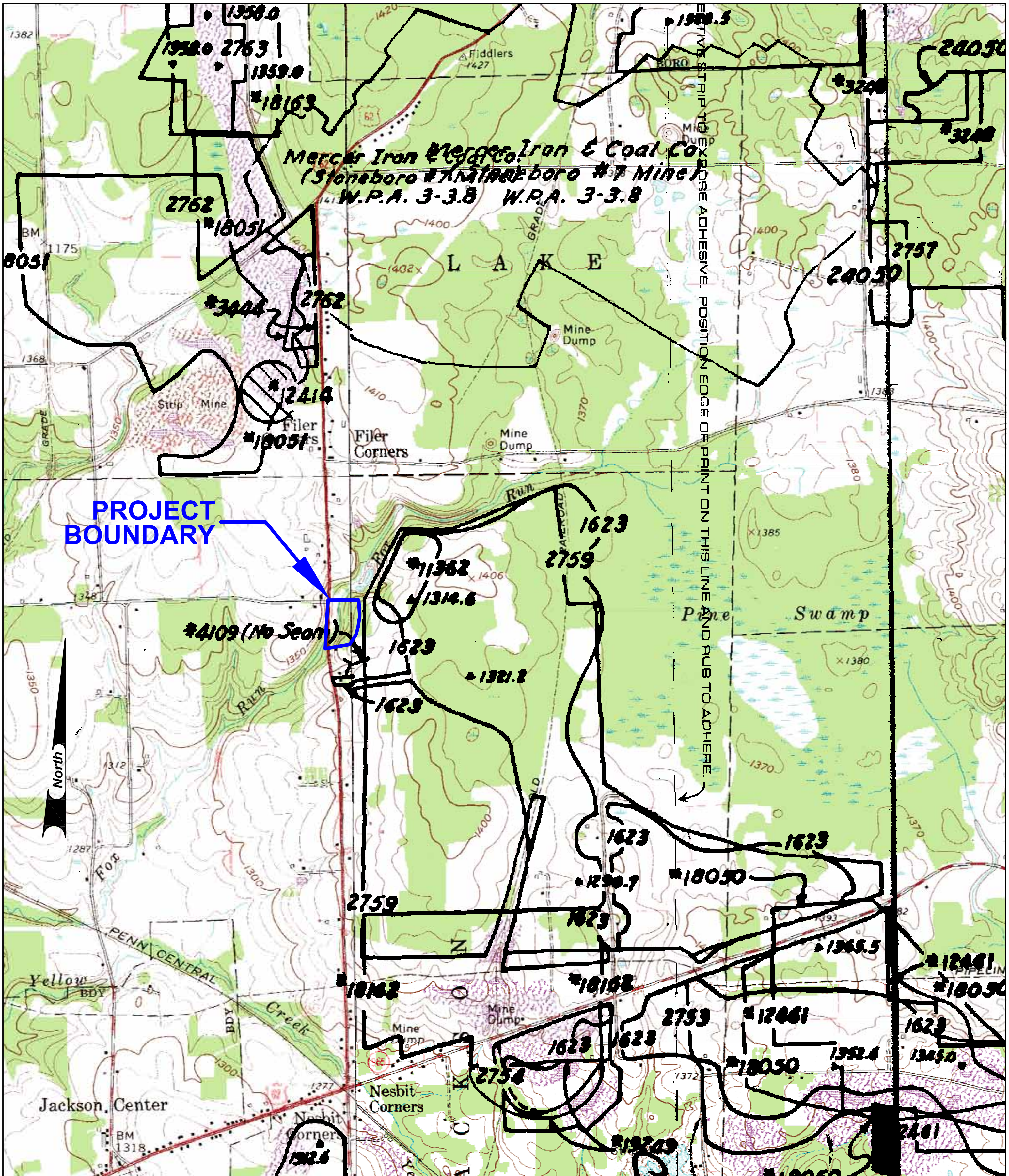


FIGURE 5: MINE PERMIT INDEX MAP - "A" SEAM (BROOKVILLE/CLARION COALBED)
USGS 7.5' JACKSON CENTER, PA (PR1970) AND USGS 7.5' SANDY LAKE, PA (PR1970)

FOX RUN RESTORATION PROJECT - PHASE I

Jackson Township, Butler County, PA

Stream Restoration Incorporated

June 2005, Scale 1" = 2000'

Approximate Center of Project (deg-min-sec)
41-18-03 latitude 80-07-19 longitude

2000 1000 0 2000

BioMost, Inc., Mining and Reclamation Services
Cranberry Twp., PA: permit index map

Site Preparation

Erosion and Sediment Pollution Controls were installed upon completion of a written plan approved by the Mercer County Conservation District. Controls included a diversion ditch upgradient and silt fence downgradient of the earth disturbance activities. An Environmental Assessment was conducted and submitted and a waiver of permit requirements was received under Pennsylvania Code Title 25, Chapter 105.12(a)(16). Passive system design plans were completed by Brenner's Ecological Service and BioMost, Inc. and submitted to the PA DEP, Knox District Mining Office. PA One Call relating to underground utilities was contacted. The site of the passive treatment system was cleared and grubbed.

On 9/23/04, several exploratory pits were dug with an excavator in order to determine subsurface characteristics including the location of the Clarion coalbed and existing underground workings with associated mine pool.

Passive Treatment System Installation and Reclamation Effort

The passive treatment system at Fox Run Restoration Area – Phase 1 includes the following components:

1. Collection Channel
2. Settling Pond
3. Limestone Rip-Rap Level Spreader
4. Precipitation Pool
5. Aerobic Wetland planted with native species
6. Micropool

The upland planting included about 50 live stakes of Black Willow and 8 containerized trees including White Pine and Eastern Hemlock. Seeding consisted of grasses and legumes. (Volunteers cut live stakes as part of the education and outreach effort and as contributions in-kind from the Mercer County Conservation District Munnell Farm.)

Collection Channel: Facing north on State Route 62 and approaching the Phase 1 Restoration Area from the southern end of the project, the main source of abandoned mine drainage (sample # **87-7**), is located near the base of the hill at the eastern edge of the project. The discharge flows 10' northwest into a pool at the upper end of the Collection Channel. The Collection Channel carries the discharge north/ northeast along the contour of the hill for ~540'. After ~380', a log check dam provides a half-foot drop aiding in aeration. Nine additional AMD seeps are intercepted in the Collection Channel increasing the flow rate and impacting water quality. Near the end of the channel the discharge makes a sharp turn to the west (left) into the **Settling Pond.**

Settling Pond: The pond provides for the oxidation and settling of metal solids. A Limestone Rip-Rap Level Spreader at the outlet maintains the water level in the pond.

Limestone Rip-Rap Level Spreader: Consisting of R-4 rip-rap, the level spreader maintains the water elevation of the settling pond at 1317.7± feet and equally distributes the flow into the precipitation pool. A half-foot drop from the settling pond to the precipitation pool aids in aeration. The level spreader is ~60' in width and ~10' in length.

Precipitation Pool: With a depth of ~2.5', the ~60'W x ~5'L precipitation pool is used to settle metal solids after flowing through the level spreader. The water depth also discourages the growth of emergent wetland plants allowing the water to freely flow into the wetland, discouraging the formation of preferential flow paths.

Aerobic Wetland: The effluent from the precipitation pool is captured in a ~165' long by ~75' wide oval-shaped wetland. Spent mushroom compost was mixed with onsite soil material to provide a ~½-foot organic substrate. This **~¼-acre** wetland was designed with strategic flow path diverters, including hummocks and woody debris, and microtopographic relief to enhance the system performance for treatment and wildlife value. In addition, the wetland was planted with a variety of primarily native species (see Table II below).

Table II. Plant List

Common Name	**Scientific Name**
Burreed	*Sparganium eurycarpum*
Hardstem Bulrush	*Scirpus acutus*
Softstem Bulrush	*Scirpus validus*
Three-Square Rush	*Scirpus americanus*
Soft Rush	*Juncus effusus*
Blue Water Iris	*Iris versicolor*
Yellow Water Iris	*Iris pseudacorus*
Arrow Arum	*Peltandria virginica*
Nodding Smartweed	*Polygonum muhlenbergh*
Pickerel Plant	*Pontederia cordata*
Arrowhead	*Sagittaria latifolia*
Deep Water Duck Potato	*Sagittaria rigida*
Spadderdock	*Nuphar luteum*

As more vegetation becomes established over time, the amount of iron particulates settling within the wetland will increase. An existing hummock with several Eastern Hemlock trees was preserved during construction to provide shade to help regulate water temperature and to contribute to the overall diversity of the wetland. In addition, careful effort was made to preserve the riparian buffer, as this vegetation stabilizes the slope along Fox Run and provides additional shade. A micropool is located at the outlet of the aerobic wetland.

Micropool: With a depth of ~2.2', the micropool is a small structure used to prevent clogging of the outlet with debris, to encourage uniform flow into the limestone rip-rap spillway, and to allow for the final settlement of metal particulates. The depth of the pool discourages the growth of emergent wetland plants helping to prevent the formation of preferential flow paths. The final effluent is conveyed by a ~20' long by ~25' wide limestone rip-rap spillway to Fox Run.

Spoil Pile Removal

A small spoil pile, approximately 1,200 cubic yards in size, remained as a relic of the past mining activities at the site. The pile was removed for site access and utilized to construct berms and fill upland subsidence depressions. After grading, grasses and legumes were planted in the ~6300-SF footprint left from the spoil pile.

PASSIVE TREATMENT SYSTEM PERFORMANCE

Drainage Treatment

The passive treatment system at Fox Run Phase 1 has been online and functional since November 2004. Project partners (Mercer County Conservation District and BioMost, Inc.) have conducted post-construction water monitoring.

As sampling has only been conducted for 6 months, the results must be regarded as preliminary when considering the design life of the system to be 25 years. Table II identifies the water quality characteristics through selected components from the influent to the effluent.

Table III. Water Quality Through the Fox Run Passive Treatment System

Component	pH (field/lab)	Alkalinity (field/lab)	Acidity	Iron	Manganese
87-7 (Raw) (n=27)	6.3/6.7	416/328	-279	24	3
Settling Pond (n=6)	6.6/7.1	346/476	-258	7	3
Wetland (n=6)	6.8/7.4	344/350	-270	3	3

Average values; lab and field pH not averaged from H-ion concentrations; alkalinity, acidity, dissolved metals expressed in mg/L; (See attached sample analyses.)

Overall, the passive system appears to be working well. The raw mine drainage based on available water quality data can be characterized as being net alkaline with significant concentrations of dissolved ferrous iron, low concentrations of manganese, and very low concentrations (typically at or below detection limit) of aluminum. Based on average values, the final effluent from the constructed aerobic wetland, which discharges to Fox Run is net alkaline (350 mg/L alkalinity and –270 mg/L acidity) with 3 mg/L each of dissolved iron and manganese.

Figures 6–8 illustrate the changes in pH, alkalinity, and dissolved iron as the water flows through the passive treatment system. Dissolved iron and alkalinity decrease through the system. The alkalinity is consumed as hydrogen ions are released during the formation of iron precipitates. The pH increases throughout the system through the degassing of dissolved carbon dioxide from the mine water.

Comparing only the concentration of the raw water at discharge 87-7 with the final effluent of the system, approximately 80% of the iron is being retained within the passive treatment system. Based upon the pre-construction monitoring for discharge 87-7, the estimated iron loading to be retained in the passive system was 1,500 lbs per year. Using average pre-construction flow data and post-construction concentration, the estimate has been increased by over 2.5x to approximately 4,000 lbs per year. As about 9 other degraded seeps were encountered and captured by the passive system, which is a typical occurrence during construction in a discharge zone, the actual amount of iron solids retained probably exceeds more than 4,000 lbs per year.

Function of Individual Components

Collection Channel: The collection channel is successfully conveying not only 87-7, but also numerous other small seeps. Each of the seeps is estimated to be from less than 1 gpm to 5 gpm. While conveying the water to the settling pond, the discharges degas with respect to carbon dioxide, are oxygenated, and orange, iron-bearing solids are observed to be precipitating within the channel.

Settling Pond: The settling pond further serves to provide for the oxidation and precipitation of metals and storage of solids. Based on available monitoring data, the collection channel and settling pond are removing the majority of the iron associated with 87-7 and the additional seeps. On average, these two components are oxidizing a minimum of about 17 mg/L of dissolved iron (probably higher removal as the numerous small seeps encountered are not considered) or approximately 70% by concentration.

Aerobic Wetland: The aerobic wetland serves to provide additional oxidation and precipitation of metals and final polishing. The wetland is on average oxidizing about 4 mg/L of the dissolved iron or about 17% by concentration. All water samples of the wetland effluent were collected before the wetland was vegetated. Once the wetland plants become established it is expected that more iron will be retained within the wetland.

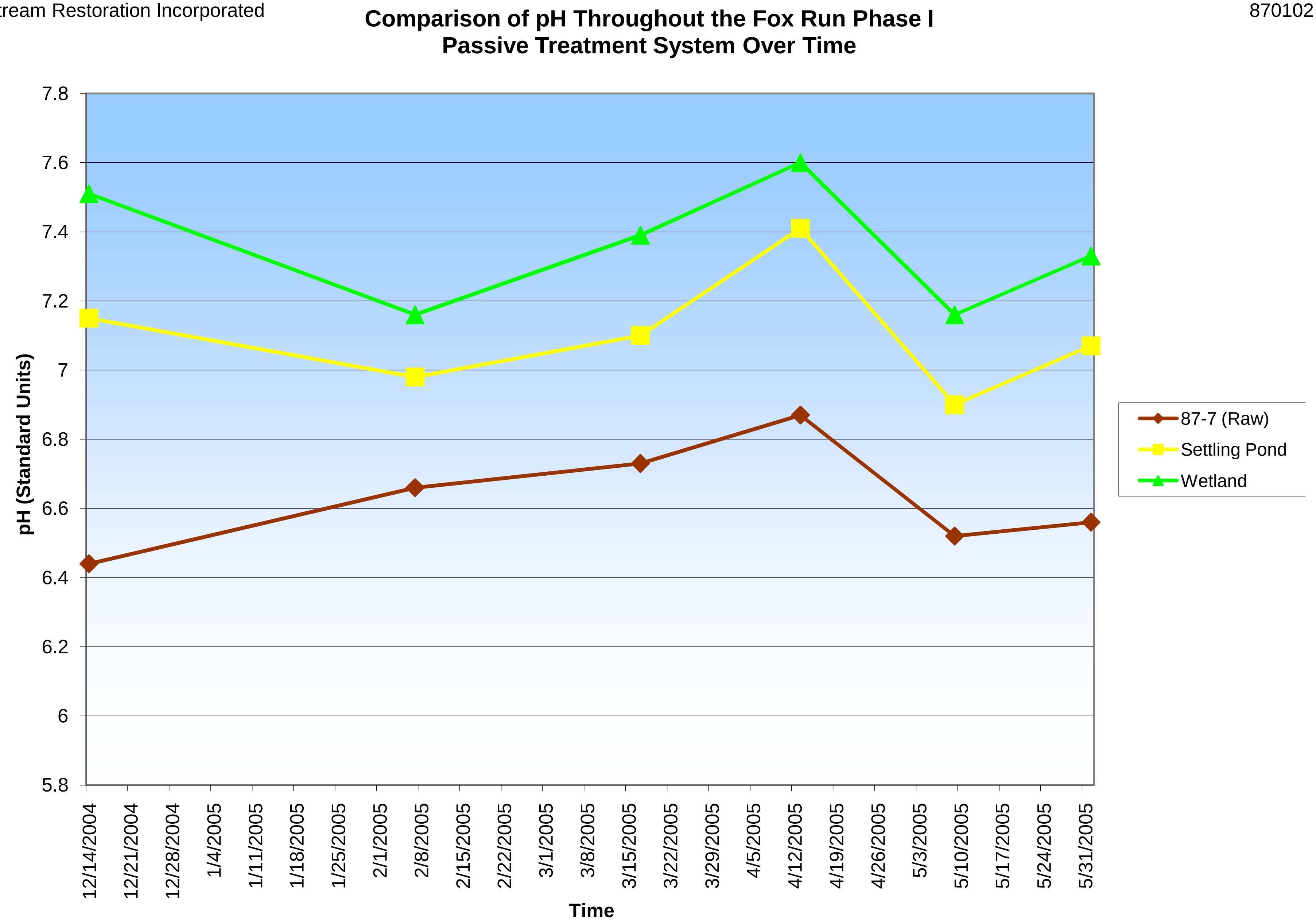

Comparison of pH Throughout the Fox Run Phase I
Passive Treatment System Over Time
pH (Standard Units)
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
6
5.8
12/14/2004
12/21/2004
12/28/2004
1/4/2005
1/11/2005
1/18/2005
1/25/2005
2/1/2005
2/8/2005
2/15/2005
2/22/2005
3/1/2005
3/8/2005
3/15/2005
3/22/2005
3/29/2005
4/5/2005
4/12/2005
4/19/2005
4/26/2005
5/3/2005
5/10/2005
5/17/2005
5/24/2005
5/31/2005
Time
87-7 (Raw)
Settling Pond
Wetland

Figure 6.

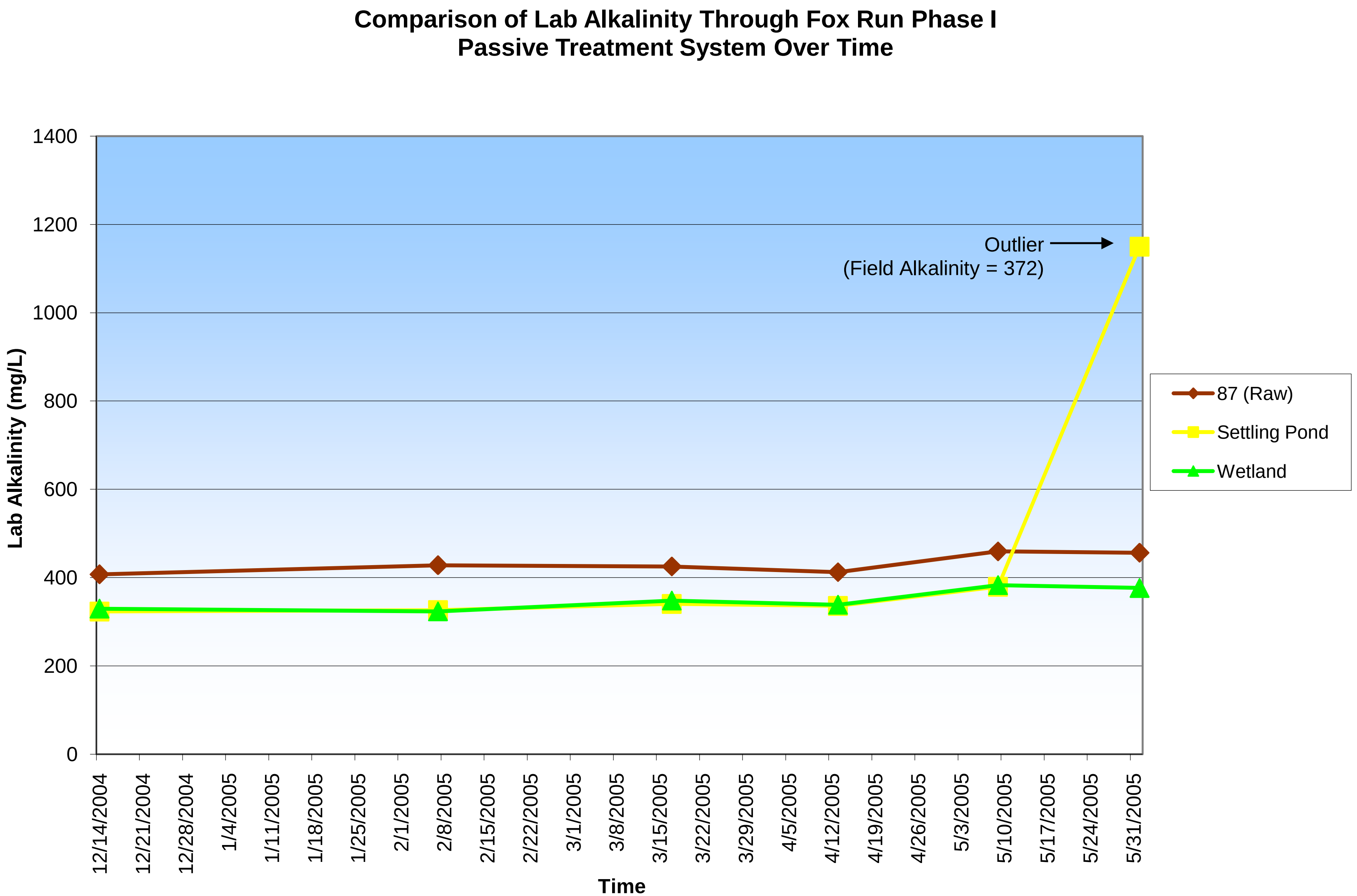

Comparison of Lab Alkalinity Through Fox Run Phase I
Passive Treatment System Over Time
Lab Alkalinity (mg/L)
1400
1200
1000
800
600
400
200
0
Outlier
(Field Alkalinity = 372)
87 (Raw)
Settling Pond
Wetland
12/14/2004
12/21/2004
12/28/2004
1/4/2005
1/11/2005
1/18/2005
1/25/2005
2/1/2005
2/8/2005
2/15/2005
2/22/2005
3/1/2005
3/8/2005
3/15/2005
3/22/2005
3/29/2005
4/5/2005
4/12/2005
4/19/2005
4/26/2005
5/3/2005
5/10/2005
5/17/2005
5/24/2005
5/31/2005
Time

Figure 7.

Comparison of Dissolved Iron Concentrations Through the Fox Run Phase I Passive Treatment System Over Time

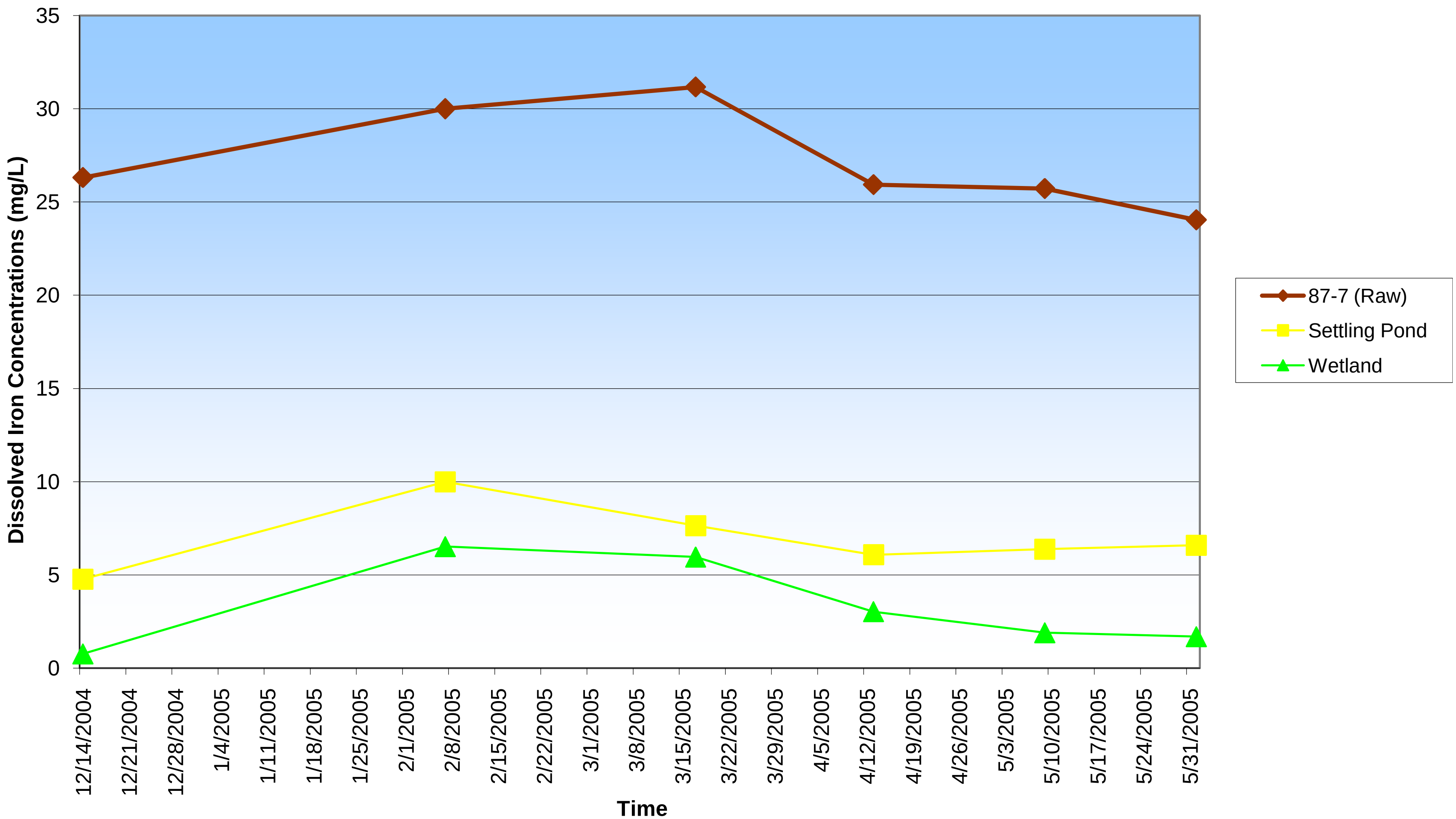


Figure 8.

MEASURABLE ENVIRONMENTAL RESULTS

About 80% of the iron associated with the 87-7 discharge is being retained within the passive treatment system, which equates to an estimated 4,000 lbs per year of iron that is no longer entering Fox Run.

Impact to Receiving Stream

Upstream monitoring of Fox Run at 87-6, conducted by the Mercer County Conservation District (MCCD) from 12/1999 through 9/2000, indicated that the stream [total iron ranged from 1 to 7 mg/l] was degraded prior to being impacted by abandoned mine discharge 87-7. (Note, in the database provided in this report, that the low concentration was measured during the highest flow rate for that period, suggesting dilution due to surface or near surface runoff.)

During the same time period, the MCCD conducted downstream monitoring on Fox Run at 87-9 about 2/3 of a mile below the confluence with abandoned mine discharge 87-7. Even though much of the 4000 lbs per year of iron contained in 87-7 (located only 40 feet from the stream) entered Fox Run, the sustained net alkaline conditions precipitated the iron on the streambed substrate prior to reaching downstream monitoring point 87-9. (See photo section.) At this downstream monitoring point, the average total iron content in Fox Run is 1.3 mg/l. (See analyses in data section.)

Prior to construction of the Fox Run Phase 1 passive system, on June 18, 2003 the PA DEP Bureau of Mining and Reclamation conducted a "Bioassessment of Fox Run" with supporting chemical parameters. (See attached draft.) This survey identified that discharge 87-7 had a negative impact on Fox Run.

Table IV. Pre-Construction: Fox Run Above and Below Discharge 87-7

Sample Point	**Flow** (gpm)	**pH** (field)	Alkalinity	T Fe	T Mn	DO
Fox Run upstream (FR04A)	1900	7.00	140	6.1	0.6	8.0
Fox Run downstream (FR03)	NA	7.00	150	8.2	0.8	6.0

alkalinity, acidity, and total metals concentrations in mg/L

Even though the constructed wetland is expected to take a year or so to mature, since placement of the Phase 1 passive system online, Fox Run is no longer being significantly impacted by the degraded drainage from 87-7. In fact, the upstream water quality is very similar to the downstream water quality currently monitored at the SR0062 bridge about 200 feet downstream of the 87-7 confluence with Fox Run. Future monitoring will determine the long-term impact of Phase 1.

Table V. Post-Construction: Fox Run Above and Below Passive System

Sample Point	**pH** (field/lab)	**Alkalinity** (field/lab)	Acidity	T Fe	T Mn
Fox Run upstream (similar location to FR04A)	6.9/7.3	152/138	-111	2.4	0.5
Fox Run downstream (similar location to FR03)	6.9/7.2	169/141	-121	2.6	0.6

Average values; alkalinity, acidity, and total metals concentrations in mg/L; average pH not calculated from H-ion concentrations; (See attached analyses.)

Comparison of pH and Alkalinity of Fox Run Upstream and Downstream of Phase I Passive Treatment System

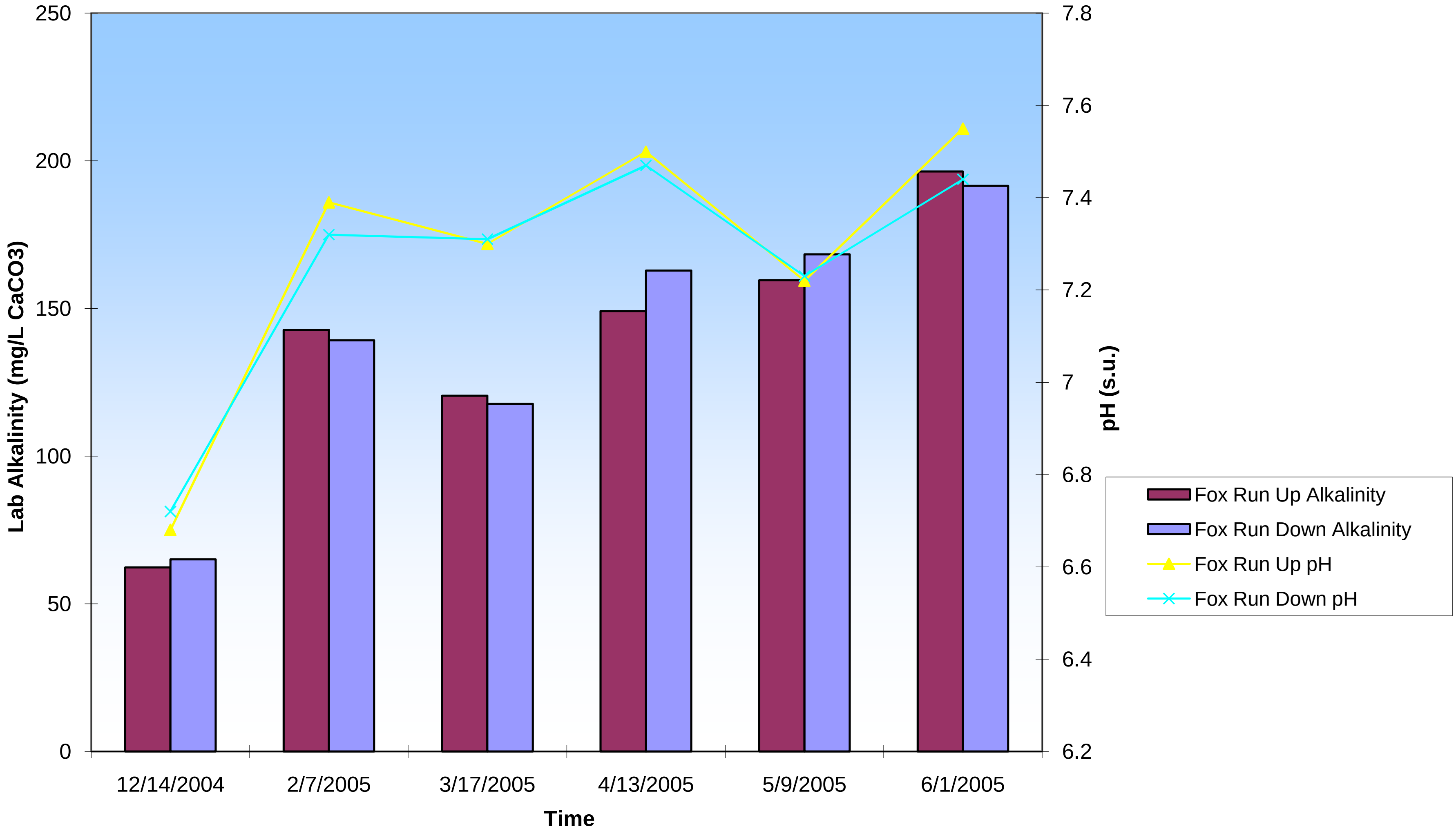


Figure 9.

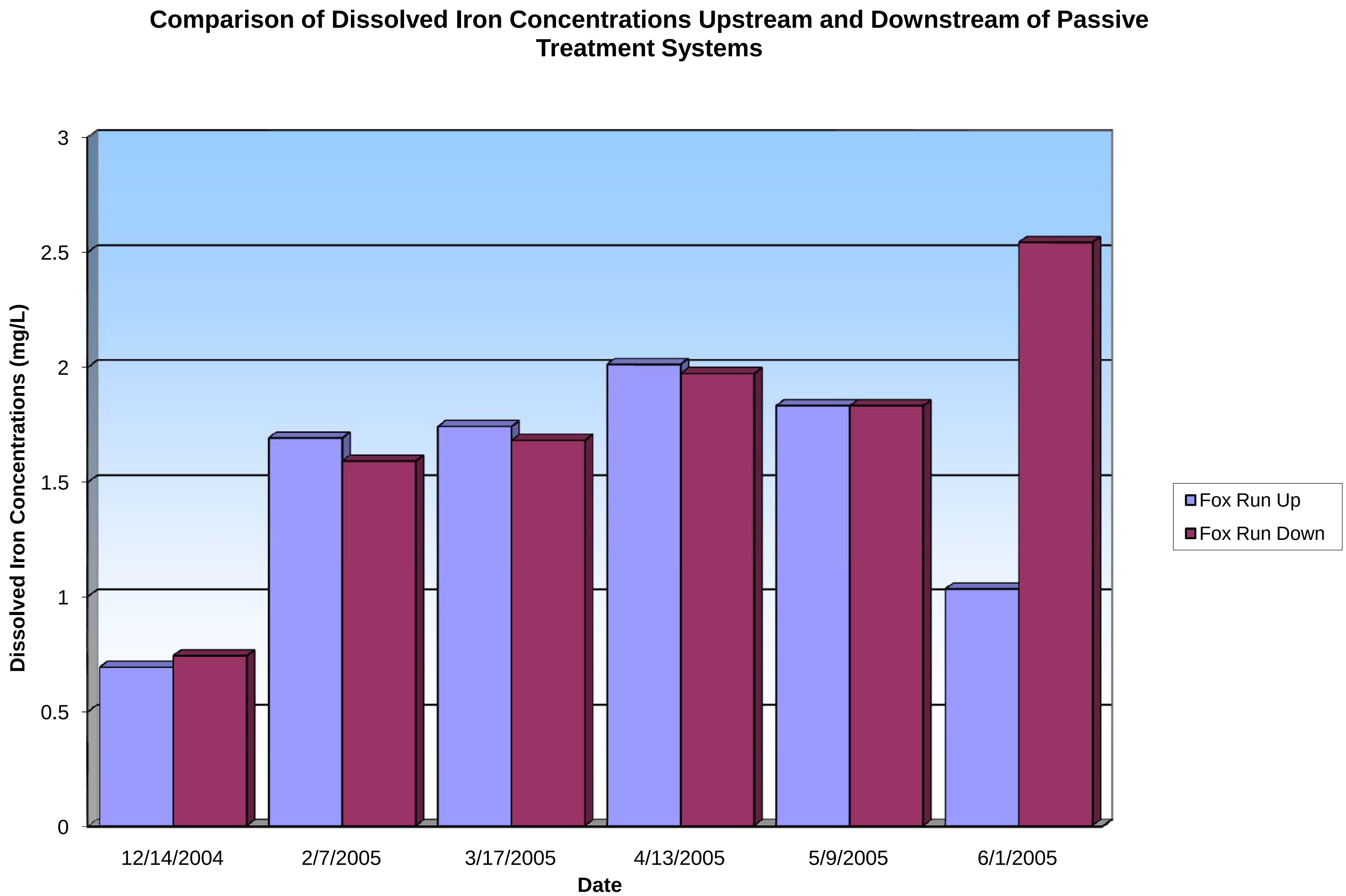

Comparison of Dissolved Iron Concentrations Upstream and Downstream of Passive Treatment Systems
Dissolved Iron Concentrations (mg/L)
3
2.5
2
1.5
1
0.5
0
12/14/2004
2/7/2005
3/17/2005
4/13/2005
5/9/2005
6/1/2005
Date
Fox Run Up
Fox Run Down

Figure 10.

This is the main discharge (87-7) at Fox Run Phase 1. The weir in the picture was installed during the initial assessment of Fox Run conducted by the Mercer County Conservation District (ca. 1999). The proximity of Fox Run (seen in foreground) was problematic.

Margaret Dunn and Shawn Hedglin test water quality and determine flow rate of 87-7 and identify available construction area to determine feasibility of installing a passive treatment system. Notice the proximity of Fox Run and State Route 62 to the site in the background.

These are photographs of Fox Run taken directly downstream from discharge 87-7. The iron precipitate completely covers the substrate making it difficult for aquatic life to survive.

John Stoops, foreman for Quality Aggregates Inc., roughly measures the depth of iron precipitate that has accumulated from the 87-7discharge. Notice the depth of sludge within the channel was over 42”!!!

Dr. Fred Brenner from the Urban Wetland Institute and Grove City College assessing Fox Run during field investigations.

Dr. Fred Brenner and Shaun Busler (BioMost, Inc.) collected data regarding the existing wetland within the project area.

This is Fox Run shortly before construction illustrating the amount of remediation needed to restore the stream.

Multiple seeps, such as the one pictured above, are present along the banks of the stream. When combined, the seeps are responsible for a considerable amount of degradation to the stream.

Margaret Dunn of BioMost, Inc. reviewed topographic and geologic maps of the area prior to excavating test pits to determine coal and potential mine pool elevations.

Construction on the site began with a temporary access road from State Route 62.

Test pits were dug to determine soil profile and depth to Brookville coalbed and the associated mine pool.

Kevin Stiner from Quality Aggregates clearing the site for the future wetland.

Mike Hjorten and John Stoops from Quality Aggregates Inc. discuss field changes with Margaret Dunn of BMI.

Looking toward State Route 62 during construction of the access road.

A post-construction view from the diversion ditch on the hilltop above Fox Run shows the newly installed channel that conveys the mine water (above). In the lower picture you see the end of the channel emptying into the settling pond and part of the wetland area. The site was timbered by the landowner with non-marketable treetops later placed in windrows for wildlife.

A natural hummock with native hemlock was left as part of the new wetland to naturally distribute water flow and create habitat.

Standing at the southern end of the project near State Route 62 and looking north, the discharge is now flowing north toward the setting pond.

Despite being blanketed in snow, post-construction monitoring of the project was conducted by BMI and MCCD. Shawn Hedglin of MCCD sampled water quality this day.

Shawn Hedglin from MCCD and Kyle Durrett (pictured) from BioMost sampled water quality on 6/1/05 to monitor the continued increase in metals captured by the passive treatment system as vegetation starts to become established.

During site inspection by MCCD and BMI on 6/1/05, water quality is tested at the main discharge in order to calculate the effectiveness of the passive treatment system, shown below.
(Kyle Durrett in photo)

Suspended solids are retained in the settling pond where the water slows down before crossing the spillway.

The settling pond water flows through a limestone aggregate spillway to aerate and distribute the mine drainage evenly prior to entering the wetland area.

Volunteers from the Mercer County Conservation District and the Fike Family arriving at the restoration site prepared to plant.

The Fike Family is reconfiguring a portion of the wetland near the settling pond to make better habitat for more plants.

Shawn Hedglin and Bob McDonald from MCCD planting Burreed in the wetland.

Jill Shankel and Bob McDonald from MCCD planting Nodding Smartweed.

Kyle Durrett from BioMost Inc. finds a nice home for some Bullrush plants.

Shawn Hedglin from MCCD planting some Water Iris in the collection channel next to the main discharge.

The plants visible in the foreground are newly-planted Bullrush and Spadderdock at the location of discharge 87-7.

The recently-planted healthy bullrush are expected to reproduce to help establish the wetland by the end of the 2006 growing season.

Naturally-grouped communities of species in the wetland were planted to create a more diverse "realistic" wetland by the end of the 2006 growing season. Diversity will provide stability to discourage invasive plants.

About a week after the live stakes were planted new growth could already be seen.

Fox Run Watershed Abandoned Mine Drainage Survey
(Portion)

Mercer County Conservation District

US EPA Section 104(b)(3)

2000

Introduction

Historic mining activity within the state of Pennsylvania has led to the contamination of numerous waterways throughout the coal mining regions. This contamination occurs when water passes through altered coal stratigraphy or abandoned mine waste and then discharges to our waterways. The oxidation and precipitation of metals associated with the chemical constituents of bituminous coal is one impact of abandoned mine drainage. The most common reaction associated with AMD is the weathering of pyrite (FeS2). During this process oxidation of the pyrite leads to Ferric Hydroxide precipitation and frequently a lowered water pH. This reaction gives rise to the visible rust-colored stain within streams, which is often referred to as yellowboy. Also, metals such as aluminum and manganese may be present in AMD discharges. The occurrence of these metals, their precipitates, and associated chemical reactions can lead to degraded water quality in previously mined areas.

Fox Run, located in Mercer County, has been impacted by historic mining activities. It has been identified as impacted by metals from AMD by the PA DEP in the 2000 303(d) List of Waters. In 1999 the Mercer Conservation District began a study to identify the impact of mining activities on Fox Run. The watershed was first deep mined circa 1900. In the 1980s Adobe Coal Company and the FW & RR Incorporated surface mined coal within the watershed. The survey conducted by the District during 1999 and 2000 sought to accomplish three things: locate and inventory the discharges to Fox Run on previously mined land, quantify the physical and chemical attributes of those discharges, and identify the zone of influence on impacted stream reaches. The remainder of this paper will describe the materials and methods used to collect the data and what the results imply. Finally, the District will propose a possible treatment option for the restoration of Fox Run.

Materials and Methods

Discharge measurements were performed twice each month on twelve locations in the watershed. These measurements were taken to provide average flow rates of Fox Run and contributing springs/seeps. To begin, weirs were placed on identified discharges that could be captured in a channel (overland discharges and seeps were excluded from this process). The channel served to provide an area for a standing pool of water to develop behind the weirs and accommodate discharge measurement. The weirs were constructed in the field and installed with the assistance of the Pennsylvania Conservation Corps. Both V-notch and rectangular notch weirs were constructed of 2X4-lumber and 1/2 inch exterior plywood. Measurements were taken by determining the height of water above the notch with a carpenter's rule (H). These measurements were made on the upstream side of the weir. The following equations were then used to determine the discharge rates in cubic feet per second: V-notch = 2.5H^5/2

Rectangular notch =3.33 [width of notch in feet – (0.2H) H^3/2]

This discharge rate was then converted and subsequently reported in gallons per minute.

In addition to the weirs, a Price type-AA current meter was employed to sample the discharge rates at four locations on the main branch of Fox Run. The stream was first cross-sectioned with a line and markers were placed in locations to achieve transects of flow across the cross section. These markers were located to try to obtain measurable partitions of flow that made up no more than 10% of the total cross sectional flow at the sampling location. The current meter was then utilized to obtain a number of clicks (representing one revolution of the sampling device) per second. These clicks were measured over a time period which averaged 40 seconds. Measurements began at the end of one revolution and were measured for an elapsed time to the end of a revolution and recorded to the nearest second. The following equation was then used to obtain a velocity of flow in feet per second at each transect:

[2.2048(revolutions/second)+0.0178]. The area (in square feet) of each transect was then determined and the overall discharge at that location was obtained by the following equation: [SUM(area 1X velocity 1) + (area 2 X velocity 2)…]. The resulting discharge rate in cubic feet per second was then converted and subsequently reported in gallons per minute. The Pennsylvania Conservation Corps assisted in the collection of discharge data during the project.

Three additional parameters were collected during the District's survey of Fox Run. Chemical, biological, and location data were also collected. Chemical samples were collected once a month and analyzed by C and G Coal Analysis Labs of Summerville, Pennsylvania. Two samples were collected at each of the twelve locations and immediately refrigerated for shipment to the lab. The samples were collected in the stream of water discharging from the weirs and also in the middle of the stream. During the collection of the samples, a field pH and temperature were taken with a YSI 60 pH meter. The meter was calibrated the morning of each sampling event using standard solutions of pH 7, 4.01, 10.01. Biological monitoring was performed using the Save Our Streams protocol developed by the Isaak Walton League of America. Sampling for this parameter was done a total of six times during the survey. Aquatic macroinvertebrate sampling was performed as close to the four main stem discharge locations as possible. The sites were selected for proximity to the discharge sampling locations and suitable habitat. Again, Pennsylvania Conservation Corps members and members of Trout Unlimited assisted in the data collection. Finally, a latitude and longitude for all monitoring locations and the locations of spring/seeps that could not be captured for measurement were sampled using a Magellan 320 Global Positioning System.

Results/Conclusions

Fox Run is a perennial stream that derives its base flow from springs, which display evidence of continued influence of historical mining operations. Fox Run, by default, can be classified as a WWF (Warm Water Fishes) stream. In addition to various seeps there are three persistent springs which sustain Fox Run. The first instance of impact is noted at 80 07' 19" W longitude, 41 18' 06" N latitude. During the summer the waters above this spring completely vanished and only minimally appeared after substantial rainfall events. This discharge averaged 723.04 gallons per minute during the assessment. The average total iron content of this discharge was 6.63 mg/l. Statewide criteria indicate that a total daily maximum of this constituent be 1.5 mg/l for sustaining aquatic life and for use as a water supply. Evidence of the high iron content can be visually seen immediately from the spring in the form of iron precipitate that coats the streambed. The next spring that influences Fox Run is located at 80 07' 30" W, 41 17' 54" N. This spring also has a high iron content that averaged 6.65 mg/l. Additionally, manganese, sulfates, and total dissolved solid (TDS) exceeded state criteria for water supplies. A pungent sulfur odor and excess of iron precipitate distinguish this spring from the others. It averaged 84.47 gallons per minute discharge. There is no noticeable precipitation of manganese in the discharge watercourse. Lastly, is the spring located just off of State Route 62 at 80 07' 34" W, 41 17' 47" N. This spring averaged 20.19 gallons per minute discharge and 15.11 mg/l total iron. Manganese, sulfates, and TDS were also above outlined criteria for water supply on this discharge. Again, the iron precipitate and sulfur odors were apparent at this discharge. In addition to these major influences, numerous seeps line the right bank of Fox Run looking upstream from Route 62 (See Appendix A for Entire Data Set). These seeps extend from the previously mentioned spring upstream to the area near the second spring. This portion of the stream is lined with residual mine waste. The seeps appear on the stream banks where the hydraulic conductivity of the sediment permits it to escape. During the course of the investigation, one seep turned to overland flow. Further investigation uncovered three small seeps that originate approximately 300 feet from Fox Run. These seeps then overland flow to a low area behind the mine spoil where they collect and likely supply a large portion of the noticed stream bank seeps. It was not feasible to capture and measure these discharges due to a lack of channel development. (See map and Appendix B for details)

The primary "pollutant" in Fox Run is iron. Although other metals are present in Fox Run, the iron hydroxide precipitate is the cause of not only impacted aesthetics, but also is deleterious to macroinvertebrate habitat and species richness. The zone of AMD influence extends from 80 07' 19" W, 41 18' 06" N to 80 08' 07" W, 41 17' 25" N. Visual evidence of influence beyond this point is however evident and most likely can be correlated to flushes of the iron precipitate during storm events. The discharges and their metal content could likely be treated by three aerobic wetlands that capture and treat, at a minimum, the three major discharges. Metal removal would likely occur through bacterial activity and increased oxidation from atmospheric exposure. The current pH would facilitate precipitation of iron and manganese. An estimated size of each of three wetlands can be obtained by first calculating the pollutant loading rates of Acidity, Iron, and Manganese with the following equation:

[Flow Rate X mg/l concentration (.012)] = lb/day

The maximum discharge and pollutant concentrations were used in this calculation. Next, the minimum wetland size was determined by using the following equation :
[(Iron loading lb/day) / (180 lb/ac/day)] + [(Manganese loading lb/day) / (9 lb/ac/day)] + [(Acidity loading lb/day) / (60 lb/ac/day)] = Minimum Wetland Size (acres)
Based on the above calculations the first discharge averaging 723.04 gpm would require a minimum of 2.13 acres to effectively reduce the metals. The second discharge averaging 84.47 gpm would require 0.36 acres for treatment. Finally, the third discharge averaging 20.19 gpm would require a 0.26 acre wetland for treatment. These wetlands should maintain a water depth of 6 to 18 inches and include plants such as cattails, rushes, and reeds to slow the flow. In conclusion, the District feels that landowner permission to install such passive treatment technology is attainable.

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Partial Correlation Analysis of Some Chemical and Biological Parameters of Two Streams Receiving Mine Drainage. Fred Brenner, Richard Shertzer, Scott Corbett, and Jerry Centofani. 1977.

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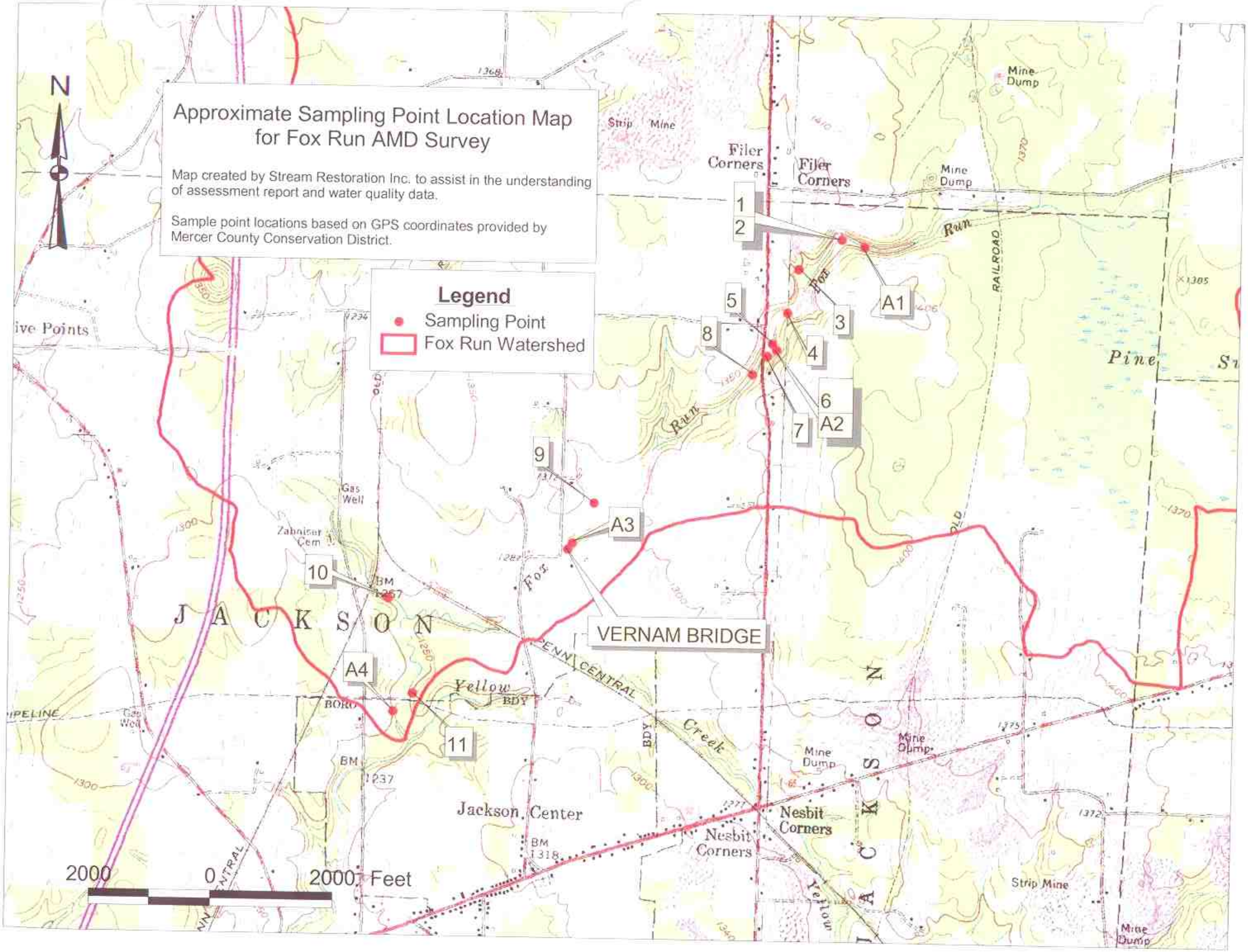


Approximate Sampling Point Location Map
for Fox Run AMD Survey
Map created by Stream Restoration Inc. to assist in the understanding of assessment report and water quality data.
Sample point locations based on GPS coordinates provided by Mercer County Conservation District.
Legend
Sampling Point
Fox Run Watershed
N
1
2
3
4
5
6
7
8
9
10
11
A1
A2
A3
A4
VERNAM BRIDGE
Filer Corners
Nesbit Corners
Jackson Center
Mine Dump
Strip Mine
Pine
RAILROAD
PENN CENTRAL
Yellow Creek
Fox Run
JACKSON
Zahniser Cem
Gas Well
2000 0 2000 Feet

Cumulative Macroinvertebrate Index Totals for Fox Run

Location: A-1

Date	Index Value
2/24/2000	13
5/31/2000	13
7/20/2000	
8/31/2000	
9/8/2000	
9/11/2000	

Average 13
Standard Deviation 0

Location: A-2

Date	Index Value
2/24/2000	9
5/31/2000	14
7/20/2000	11
8/31/2000	8
9/8/2000	9
9/11/2000	8

Average 9.83
Standard Deviation 2.32

NOTE: sampling location A-1 had insufficient flow to perform sampling or was completely dry on these sampling dates

Location: A-3

Date	Index Value
2/24/2000	19
5/31/2000	20
7/20/2000	22
8/31/2000	17
9/8/2000	18
9/11/2000	20

Average 19.33
Standard Deviation 1.75

Location: A-4

Date	Index Value
2/24/2000	13
5/31/2000	21
7/20/2000	20
8/31/2000	18
9/8/2000	20
9/11/2000	23

Average 19.17
Standard Deviation 3.43

Location: 1

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	389.10	7.60	7.89	549.00	0.90	124.99	0.00	0.42	0.27	0.02	81.60	5.00	376.00
1/28/2000	229.30												
1/31/2000	178.20	6.93	6.76	213.00	0.10	13.40	0.00	0.12	0.03	0.10	56.10	13.00	149.00
2/16/2000	4097.10												
2/28/2000	4434.60	7.30	6.60	130.00	3.70	8.75	1.83	0.19	0.12	0.12	45.60	5.00	91.00
3/13/2000	2218.90	7.25	7.00	159.00	3.90	11.32	0.00	0.11	0.06	0.11	36.00	2.00	113.00
3/27/2000	1523.07												
4/25/2000	935.20	7.28	7.05	128.00	13.40	16.70	0.00	0.52	0.03	0.12	26.00	4.00	90.00
4/28/2000	472.28												
5/25/2000	2521.27	6.94	6.94	115.00	14.70	20.82	3.49	1.20	0.08	0.23	26.60	11.00	81.00
5/30/2000	657.88												
6/20/2000	1252.02												
6/28/2000	2450.96	6.92	7.05	132.00	18.70	30.34	0.00	2.20	0.25	0.21	25.80	10.00	92.00
7/25/2000	0.00												
7/31/2000	0.00												
8/24/2000	87.50												
8/28/2000	0.00												
9/6/2000	0.00												
AVERAGE	1191.52	7.22	7.04	203.71	7.91	32.33	0.76	0.68	0.12	0.13	42.53	7.14	141.71
STANDARD													
DEVIATION	1411.00	0.26	0.41	155.72	7.49	41.48	1.38	0.77	0.10	0.07	20.69	4.14	105.81

Notes: A value of 0 in the Acidity column indicates Not Detecta
A value of .02 in the Aluminum column indicates a value less than .04 r

Location: 2

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	554.70	6.39	6.61	773.00	9.60	234.92	0.00	9.05	0.76	0.02	200.90	6.00	553.00
1/28/2000	320.40												
1/31/2000	556.06	6.28	6.77	782.00	9.80	242.78	0.00	10.25	0.75	0.02	211.40	9.00	547.00
2/16/2000	433.29												
2/28/2000	556.06	6.36	6.83	757.00	9.60	234.78	0.00	5.90	0.77	0.02	220.40	8.00	530.00
3/13/2000	660.65	6.63	6.68	769.00	9.70	227.96	0.00	5.86	0.74	0.02	194.30	5.00	537.00
3/27/2000	770.42												
4/25/2000	1190.06	6.33	6.56	768.00	10.10	211.11	0.00	5.34	0.67	0.02	221.50	7.00	538.00
4/28/2000	1286.32												
5/25/2000	884.96	6.38	6.61	761.00	10.10	225.71	0.00	5.75	0.70	0.02	237.30	6.00	533.00
5/30/2000	943.91												
6/20/2000	884.96												
6/28/2000	973.79	6.33	6.62	761.00	10.10	231.43	0.00	5.42	0.71	0.02	254.70	9.00	533.00
7/25/2000	770.42												
7/31/2000	660.65	6.27	6.61	760.00	9.90	235.28	0.00	5.92	0.71	0.02	235.70	4.00	532.00
8/24/2000	556.06												
8/28/2000	530.77	6.42	6.50	783.00	10.20	243.24	0.00	6.18	0.74	0.02	205.40	4.00	549.00
9/6/2000	481.23												
AVERAGE	723.04	6.38	6.64	768.22	9.90	231.91	0.00	6.63	0.73	0.02	220.18	6.44	539.11
STANDARD													
DEVIATION	261.81	0.10	0.10	9.00	0.22	9.20	0.00	1.66	0.03	0.00	18.45	1.83	7.94

Notes: A value of 0 in the Acidity column indicates Not Detecta
A value of .02 in the Aluminum column indicates a value less than .04 r

Location: 3

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	89.8	7.02	7.51	500.00	0.00	66.19	0.00	0.13	<0.02	0.08	57.70	2.00	354.00
1/28/2000													
1/31/2000	1.12	6.69	7.45	583.00	0.30	91.73	0.00	6.15	0.05	0.05	56.70	10.00	408.00
2/16/2000	130.44												
2/28/2000	164.03	7.13	7.16	430.00	5.50	31.65	0.00	0.08	0.02	0.11	69.50	3.00	302.00
3/13/2000	71.3	7.56	7.39	520.00	4.80	41.27	0.00	0.17	0.05	0.11	59.80	2.00	365.00
3/27/2000	25.32												
4/25/2000	25.32	7.83	7.72	456.00	15.50	68.17	0.00	0.10	0.03	0.14	59.30	4.00	320.00
4/28/2000	16.46												
5/25/2000	71.3	7.30	7.47	418.00	14.20	64.15	0.00	0.10	0.03	0.02	75.50	2.00	292.00
5/30/2000	25.32												
6/20/2000	35.34												
6/28/2000	71.3	7.32	7.50	378.00	17.60	87.43	0.00	0.20	0.12	0.13	39.10	4.00	264.00
7/25/2000	0												
7/31/2000	0												
8/24/2000	0.01												
8/28/2000	0.01	7.22	7.33	584.00	19.20	111.04	0.00	0.08	0.14	0.04	38.70	2.00	410.00
9/6/2000	0												
AVERAGE	42.77	7.26	7.44	483.63	9.64	70.20	0.00	0.88	0.06	0.09	57.04	3.63	339.38
STANDARD													
DEVIATION	49.74	0.34	0.16	76.20	7.84	26.21	0.00	2.13	0.05	0.04	12.91	2.72	53.81

Notes: A value of 0 in the Acidity column indicates Not Detecta

A value of .02 in the Aluminum column indicates a value less than .04 r

Location: 4

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	71.80	6.43	6.59	751.00	10.30	213.24	0.00	7.50	1.33	0.02	201.60	6.00	534.00
1/28/2000	71.98												
1/31/2000	96.62	6.38	6.77	739.00	10.40	207.96	0.00	7.03	1.27	0.02	233.70	8.00	517.00
2/16/2000	66.48												
2/28/2000	96.62	6.27	6.73	686.00	10.30	189.59	0.00	6.02	1.14	0.02	206.70	13.00	481.00
3/13/2000	96.62	6.46	6.66	681.00	10.50	189.27	0.00	6.19	1.18	0.02	175.70	5.00	476.00
3/27/2000	71.98												
4/25/2000	159.57	6.36	6.60	736.00	11.30	186.54	0.00	6.27	1.02	0.09	209.90	5.00	515.00
4/28/2000	96.62												
5/25/2000	83.76	6.41	6.66	842.00	10.50	232.12	0.00	7.09	1.34	0.02	307.30	5.00	590.00
5/30/2000	125.74												
6/20/2000	77.73												
6/28/2000	61.25	6.36	6.65	744.00	10.70	206.48	0.00	6.25	1.18	0.02	304.40	1.00	521.00
7/25/2000	66.48												
7/31/2000	71.98	6.34	6.65	802.00	10.70	221.01	0.00	6.74	1.29	0.02	231.20	5.00	561.00
8/24/2000	71.98												
8/28/2000	71.98	6.49	6.58	778.00	10.60	225.50	0.00	6.76	1.32	0.02	241.80	5.00	544.00
9/6/2000	61.25												
AVERAGE	84.47	6.39	6.65	751.00	10.59	207.97	0.00	6.65	1.23	0.03	234.70	5.89	526.56
STANDARD													
DEVIATION	25.02	0.07	0.06	51.42	0.31	16.72	0.00	0.50	0.11	0.02	44.96	3.22	36.16

Notes: A value of 0 in the Acidity column indicates Not Detecta

A value of .02 in the Aluminum column indicates a value less than .04 r

Location: 5

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	0.22	6.71	7.02	891.00	0.30	117.06	0.00	14.50	1.85	1.12	26.30	4.00	633.00
1/28/2000	2.25												
1/31/2000	0.40	6.64	7.09	1016.00	0.30	127.50	0.00	8.45	1.06	0.42	73.90	10.00	711.00
2/16/2000	2.25												
2/28/2000	2.25	6.85	7.36	1434.00	4.80	105.22	0.00	0.83	0.23	0.04	241.40	7.00	1005.00
3/13/2000	2.25	7.40	7.29	1307.00	5.10	89.19	0.00	1.36	0.23	0.02	23.70	5.00	915.00
3/27/2000	2.25												
4/25/2000	0.40	7.05	7.15	1447.00	10.90	117.97	0.00	4.78	0.81	0.14	297.70	6.00	1013.00
4/28/2000	0.40												
5/25/2000	1.10	7.12	7.40	1454.00	14.50	142.30	0.00	2.40	0.52	0.02	254.20	5.00	1019.00
5/30/2000	0.40												
6/20/2000	0.00												
6/28/2000	1.10	7.17	7.42	1116.00	17.50	163.67	0.00	2.46	0.57	0.02	13.60	10.00	781.00
7/25/2000	0.00												
7/31/2000	0.00												
8/24/2000	0.01												
8/28/2000	0.00												
9/6/2000	0.00												
AVERAGE	0.85	6.99	7.25	1237.86	7.63	123.27	0.00	4.97	0.75	0.25	132.97	6.71	868.14
STANDARD													
DEVIATION	0.95	0.27	0.16	230.25	6.80	24.38	0.00	4.93	0.57	0.41	125.60	2.43	159.29

Notes: A value of 0 in the Acidity column indicates Not Detecta
A value of .02 in the Aluminum column indicates a value less than .04 r

Location: 6

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	975.70	7.00	7.37	594.00	4.50	140.78	0.00	6.93	0.55	0.12	107.20	5.00	411.00
1/28/2000	933.00												
1/31/2000	903.90	6.94	7.55	689.00	6.10	193.79	0.00	4.70	0.66	0.02	191.60	14.00	482.00
2/16/2000	4216.90												
2/28/2000	6680.40	6.85	6.94	242.00	4.00	34.91	0.00	0.89	0.21	0.15	64.30	5.00	169.00
3/13/2000	3108.80	7.13	7.19	408.00	5.90	81.57	0.00	4.76	0.39	0.19	86.70	5.00	287.00
3/27/2000	2040.74												
4/25/2000	2409.50	7.02	7.14	563.00	11.10	136.79	0.00	2.63	0.47	0.02	151.50	7.00	394.00
4/28/2000	2175.79												
5/25/2000	4712.30	6.91	7.11	350.00	13.10	80.12	0.00	2.08	0.27	0.11	98.20	14.00	245.00
5/30/2000	1284.67												
6/20/2000	3200.3												
6/28/2000	4373.77	6.93	7.05	305.00	16.20	79.79	0.00	2.75	0.37	0.17	62.60	6.00	214.00
7/25/2000	1185.48												
7/31/2000	900.33	7.31	7.53	738.00	12.10	215.63	0.00	2.26	0.69	0.02	226.60	4.00	517.00
8/24/2000	985.48												
8/28/2000	741.60	7.58	7.54	738.00	12.90	227.72	0.00	2.17	0.70	0.02	207.30	4.00	517.00
9/6/2000	792.35												
AVERAGE	2312.28	7.07	7.27	514.11	9.54	132.34	0.00	3.24	0.48	0.09	132.89	7.11	359.56
STANDARD													
DEVIATION	1728.17	0.23	0.23	192.22	4.45	68.43	0.00	1.86	0.18	0.07	63.00	4.01	134.30

Notes: A value of 0 in the Acidity column indicates Not Detectable

A value of .02 in the Aluminum column indicates a value less than .04 mg/l

Location: 7

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	12.60	6.64	6.80	913.00	9.00	252.55	0.00	10.75	1.67	0.02	307.20	7.00	674.00
1/28/2000	19.55												
1/31/2000	12.72	6.62	6.90	916.00	9.20	247.88	0.00	1.51	1.68	0.02	294.10	20.00	641.00
2/16/2000	12.72												
2/28/2000	22.23	6.45	6.89	1012.00	8.50	250.00	0.00	10.40	1.68	0.02	408.30	25.00	707.00
3/13/2000	12.72	6.86	6.79	920.00	9.80	245.39	0.00	9.75	1.59	0.02	313.30	6.00	643.00
3/27/2000	12.72												
4/25/2000	12.72	6.46	6.66	1108.00	10.40	272.30	0.00	16.25	1.81	0.02	417.40	7.00	776.00
4/28/2000	17.08												
5/25/2000	22.23	6.30	6.64	1473.00	11.10	326.03	0.00	23.05	2.34	0.02	795.80	21.00	1031.00
5/30/2000	22.23												
6/20/2000	22.23												
6/28/2000	12.72	6.20	6.45	1476.00	11.00	325.30	0.00	26.60	2.53	0.02	926.20	16.00	1034.00
7/25/2000	35.06												
7/31/2000	51.55	6.28	6.55	1356.00	11.30	333.57	0.00	20.30	2.25	0.02	530.90	6.00	950.00
8/24/2000	28.21												
8/28/2000	17.08	6.47	6.57	1080.00	11.00	284.99	0.00	17.40	1.94	0.02	428.10	8.00	756.00
9/6/2000	17.08												
AVERAGE	20.19	6.48	6.69	1139.33	10.14	282.00	0.00	15.11	1.94	0.02	491.26	12.89	801.33
STANDARD													
DEVIATION	10.02	0.21	0.16	234.93	1.05	37.03	0.00	7.77	0.34	0.00	224.79	7.59	161.08

Notes: A value of 0 in the Acidity column indicates Not Detecta

A value of .02 in the Aluminum column indicates a value less than .04 r

Location: 8

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	0.45	6.47	6.40	761.00	0.60	55.83	0.00	23.80	1.35	2.27	92.60	6.00	533.00
1/28/2000	0.00												
1/31/2000	0.00	6.53	6.54	788.00	0.90	54.95	0.00	11.75	1.88	0.12	133.50	30.00	552.00
2/16/2000	0.40												
2/28/2000	0.07	6.19	6.58	825.00	7.00	57.27	0.00	18.20	1.28	0.06	149.30	33.00	578.00
3/13/2000	0.07	6.67	6.46	865.00	3.20	44.94	0.00	24.55	1.24	2.89	126.60	6.00	606.00
3/27/2000	0.07												
4/25/2000	0.00												
4/28/2000	0.00												
5/25/2000	0.00												
5/30/2000	0.40												
6/20/2000	0.07												
6/28/2000	0.19	6.40	6.58	803.00	15.80	93.03	0.00	17.25	1.17	0.09	95.60	4.00	562.00
7/25/2000	0.07												
7/31/2000	0.01	6.33	6.42	847.00	18.70	64.95	0.00	22.55	1.18	0.14	101.60	10.00	593.00
8/24/2000	0.07												
8/28/2000	0.07	6.50	6.50	872.00	17.00	110.42	0.00	27.90	1.53	1.46	90.50	32.00	611.00
9/6/2000	0.00												
AVERAGE	0.11	6.44	6.50	823.00	9.03	68.77	0.00	20.86	1.38	1.00	112.81	17.29	576.43
STANDARD													
DEVIATION	0.15	0.15	0.07	41.26	7.94	23.79	0.00	5.44	0.25	1.20	23.37	13.60	28.98

Notes: A value of 0 in the Acidity column indicates Not Detecta

A value of .02 in the Aluminum column indicates a value less than .04 r

Location: 9

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	809.60	7.37	7.88	580.00	3.70	141.37	0.00	0.79	0.38	0.02	77.00	4.00	411.00
1/28/2000	810.12												
1/31/2000	810.12	7.73	8.05	721.00	4.20	188.32	0.00	0.38	0.56	0.04	174.30	15.00	504.00
2/16/2000	3543.99												
2/28/2000	6399.57	6.00	7.08	226.00	3.90	32.53	0.00	0.62	0.19	0.09	60.50	6.00	159.00
3/13/2000	2719.84	6.94	7.56	401.00	4.20	82.51	0.00	1.15	0.29	0.02	117.90	4.00	281.00
3/27/2000	1869.56												
4/25/2000	2281.76	7.56	7.64	556.00	10.40	137.31	0.00	1.97	0.42	0.02	137.90	6.00	389.00
4/28/2000	1869.56												
5/25/2000	3182.16	7.38	7.49	346.00	13.10	81.02	0.00	2.21	0.27	0.18	82.90	5.00	242.00
5/30/2000	2072.32												
6/20/2000	2388.93												
6/28/2000	3918.17	7.26	7.37	312.00	16.10	79.84	0.00	2.53	0.34	0.13	63.50	4.00	218.00
7/25/2000	810.12												
7/31/2000	810.12	7.99	8.09	722.00	12.90	220.04	0.00	1.19	0.54	0.02	231.20	5.00	506.00
8/24/2000	810.12												
8/28/2000	735.56	8.24	8.10	758.00	12.70	226.05	0.00	0.82	0.51	0.02	216.60	4.00	531.00
9/6/2000	526.74												
AVERAGE	2020.46	7.39	7.70	513.56	9.02	132.11	0.00	1.30	0.39	0.06	129.09	5.89	360.11
STANDARD													
DEVIATION	1531.30	0.65	0.36	198.91	4.98	68.51	0.00	0.76	0.13	0.06	65.37	3.52	139.40

Notes: A value of 0 in the Acidity column indicates Not Detecta
A value of .02 in the Aluminum column indicates a value less than .04 r

Location: 10

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	248.60	7.64	7.67	321.00	0.40	72.51	0.00	0.17	0.04	0.08	22.90	2.00	219.00
1/28/2000	107.26												
1/31/2000	196.49	7.82	7.77	323.00	0.20	83.38	0.00	0.27	0.05	0.04	59.30	10.00	226.00
2/16/2000	1439.62												
2/28/2000	1626.74	6.76	7.36	227.00	4.20	34.30	0.00	0.16	0.02	0.13	36.80	5.00	160.00
3/13/2000	1003.85	7.91	7.64	295.00	1.60	47.41	0.00	0.15	0.03	0.02	46.70	3.00	207.00
3/27/2000	484.35												
4/25/2000	484.35	7.97	7.81	266.00	9.60	62.44	0.00	0.17	0.03	0.02	41.70	4.00	187.00
4/28/2000	274.03												
5/25/2000	766.92	7.54	7.66	224.00	13.80	57.60	0.00	0.35	0.03	0.20	26.90	4.00	157.00
5/30/2000	149.69												
6/20/2000	420.42												
6/28/2000	1003.85	7.50	7.51	195.00	17.40	54.95	0.00	0.47	0.04	0.26	16.40	2.00	137.00
7/25/2000	0.00												
7/31/2000	53.11	7.65	7.67	317.00	18.50	100.91	0.00	0.26	0.10	0.02	25.40	2.00	222.00
8/24/2000	69.76												
8/28/2000	38.03	7.77	7.63	330.00	16.80	104.73	0.00	0.27	0.15	0.02	30.80	2.00	231.00
9/6/2000	24.72												
AVERAGE	466.21	7.62	7.64	277.56	9.17	68.69	0.00	0.25	0.05	0.09	34.10	3.78	194.00
STANDARD													
DEVIATION	501.48	0.36	0.13	51.16	7.70	23.86	0.00	0.11	0.04	0.09	13.40	2.59	34.99

Notes: A value of 0 in the Acidity column indicates Not Detecta
A value of .02 in the Aluminum column indicates a value less than .04 r

Location: 11

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	1441.50	7.65	7.89	453.00	0.00	108.15	0.00	0.33	0.18	0.05	74.60	3.00	327.00
1/28/2000	2147.00												
1/31/2000	2200.90	7.90	7.99	547.00	0.00	136.47	0.00	0.27	0.28	0.10	123.60	11.00	383.00
2/16/2000	7479.20												
2/28/2000	13328.00	6.43	7.38	225.00	4.30	32.48	0.00	0.44	0.11	0.11	56.80	5.00	158.00
3/13/2000	4354.20	8.26	7.82	358.00	2.30	65.23	0.00	0.75	0.22	0.08	79.90	3.00	251.00
3/27/2000	4170.85												
4/25/2000	3706.90	8.15	8.02	438.00	9.70	107.61	0.00	0.63	0.19	0.02	120.40	5.00	307.00
4/28/2000	3114.86												
5/25/2000	7012.50	7.50	7.70	281.00	14.00	65.04	0.00	1.16	0.14	0.14	65.00	5.00	197.00
5/30/2000	3090.06												
6/20/2000	4521.09												
6/28/2000	10515.53	7.40	7.47	240.00	17.10	60.91	0.00	1.57	0.20	0.22	38.30	2.00	169.00
7/25/2000	1516.96												
7/31/2000	1704.78	8.00	8.15	655.00	18.40	186.78	0.00	0.60	0.30	0.05	185.40	3.00	459.00
8/24/2000	1407.15												
8/28/2000	1012.50	8.16	8.06	634.00	16.20	191.61	0.00	0.52	0.20	0.02	173.40	3.00	443.00
9/6/2000	897.26												
AVERAGE	4090.07	7.72	7.83	425.67	9.11	106.03	0.00	0.70	0.20	0.09	101.93	4.44	299.33
STANDARD													
DEVIATION	3451.74	0.57	0.27	162.74	7.58	56.53	0.00	0.42	0.06	0.06	51.92	2.70	113.87

Notes: A value of 0 in the Acidity column indicates Not Detecta
A value of .02 in the Aluminum column indicates a value less than .04 r

Location: Vernam Bridge

Date	Discharge	pH		Conductivity	Temperature	Alkalinity	Acidity	Total Iron	Manganese	Aluminum	Sulfate	Suspended Solids	TDS
		Field	Lab	(umhos/cm)	Celcius	(mg/L CaCO3)	(mg/L CaCO3)	(mg/L)	(mg/L)	(mg/L)	(mg/L SO4 -2)	(mg/L)	(mg/L)
12/29/1999	850.00	7.60	7.89	549.00	0.90	124.99	0.00	0.42	0.27	0.02	81.60	5.00	376.00
1/28/2000	1438.00												
1/31/2000	1441.10	8.18	8.15	651.00	2.20	178.05	0.00	0.13	0.35	0.04	152.00	10.00	456.00
2/16/2000	4780.20												
2/28/2000	8424.40	6.55	7.33	228.00	3.90	32.82	0.00	0.54	0.15	0.09	62.50	4.00	161.00
3/13/2000	3639.30	7.79	7.80	369.00	3.20	78.42	0.00	0.60	0.22	0.02	102.80	2.00	258.00
3/27/2000	2822.63												
4/25/2000	2810.60	8.00	7.97	529.00	9.60	131.83	0.00	1.21	0.33	0.02	134.10	6.00	370.00
4/28/2000	2237.03												
5/25/2000	3281.40	7.70	7.73	314.00	13.20	77.26	0.00	1.94	0.21	0.14	60.40	4.00	220.00
5/30/2000	2255.68												
6/20/2000	2814.64												
6/28/2000	4860.49	7.60	7.63	298.00	16.20	77.46	0.00	2.28	0.28	0.12	58.30	2.00	208.00
7/25/2000	1220.56												
7/31/2000	1129.06	8.19	8.24	708.00	14.30	207.69	0.00	0.44	0.26	0.02	203.70	3.00	496.00
8/24/2000	962.97												
8/28/2000	903.40	8.37	8.20	705.00	13.70	203.69	0.00	0.21	0.19	0.02	194.90	2.00	493.00
9/6/2000	842.05												
AVERAGE	2595.20	7.78	7.88	483.44	8.58	123.58	0.00	0.86	0.25	0.05	116.70	4.22	337.56
STANDARD													
DEVIATION	1943.19	0.54	0.30	185.54	6.02	62.33	0.00	0.77	0.07	0.05	57.20	2.59	129.39

Notes: A value of 0 in the Acidity column indicates Not Detecta
A value of .02 in the Aluminum column indicates a value less than .04 r

Bioassessment of Fox Run, Mercer County
(Draft)

PA Department of Environmental Protection,
Bureau of Mining and Reclamation

June 2003

BIOASSESSMENT OF FOX RUN, MERCER COUNTY, JUNE 2003

Water samples were collected at various stations from the mouth to the headwaters by the grab method using a 500 ml bottle and one 125 ml bottle (fixed with nitric acid for all metal analyses). Chemical analysis of the samples was conducted at the Department's Harrisburg laboratory using their prescribed Standard Methods. Standard mine drainage analyses were performed for specific conductivity, alkalinity, hot acidity, sulfates, aluminum, iron, and manganese, and total dissolved solids. Field measurements included air and water temperature and pH. Stream flow was measured using a Marsh-McBirney digital meter to determine velocity at approximately 6/10 of the stream depth at 0.5 to 1 foot intervals along the stream cross section.

Benthic macroinvertebrate and aquatic habitat assessments were performed following the Pennsylvania's Statewide Surface Waters Assessment Program (SSWAP) protocol. SSWAP uses a modified EPA Rapid Bioassessment Protocol (RBP) for Use in Streams and Rivers (Plafkin et al. 1996). The standardized and comprehensive, statewide method is used to delineate non-impaired, good quality waters and waters impaired by Non-point Source (NPS) and Point Source (PS) impacts. The protocol was designed for an efficient evaluation of water conditions for future, more in-depth studies such as in non-wadeable waters, NPS/PS intensive follow-up reviews, anti-degradation surveys, and TMDL development. The aquatic habitat evaluation consists of rating twelve habitat parameters to derive a station habitat score (EPA RBP). The range of habitat score totals for sampling stations are rated a number between 0 and 240; these reflect habitat conditions from poor to optimal.

Diverse taxonomy and large abundance of aquatic life are indications of excellent water quality conditions. While determining the overall health of Fox Run, a 0.3 meter by 0.3 meter D-frame net was used to collect macroinvertebrate samples. An upstream 0.5 meter section above the net was disturbed with a total of twenty kicks in "best available" multi-habitats of fast and slow velocity riffles. Additionally, a 1.0 meter by 1.0 meter kick net was used for an upstream 1.0 meter section above the net with a total of two kicks in "best available" single habitat of fast and slow velocity riffles. Preliminary abundance numeration and individual identification were recorded. Specimens were preserved in ethanol and taken to a biology lab for confirmation of taxonomy and Pennsylvania's modified Hilsenhoff tolerance to be used in bio-statistical analysis. The Hilsenhoff index, which numerically ranges from 0 to 10, indicates tolerance of the benthic community to water pollution. Aquatic insects with a zero tolerance are commonly found in clean, well-oxygenated water. Streams impacted by mine drainage precipitate, agricultural waste, or sedimentation tend to be dominated with higher-numbered families. Abundance, Hilsenhoff tolerance indexes, and habitat scores for each station were evaluated to see if they meet certain stream criteria that indicate either impairment or no impairment at each sampling station.

Sampling station information will be described in sequence from FR06, in the headwaters, to FR01, at the mouth of Fox Run. The locations of these sites are shown on the attached map. A summary of macroinvertebrate and habitat analysis data is listed on Table 1. Water quality data will be discussed in the narrative of this report.

FR06

Station FR06 is located in the headwaters of Fox Run off Parker Store Road, just downstream of Pine Swamp. Natural tannins and organic matter caused a noticeable rusty-brown tint to the water coming from the wetlands. June 18, 2003, a total of 6 taxa and 27 individuals macroinvertebrates were counted. Aquatic habitat was considered optimal with a score of 182 (out of 240). Low abundance primarily contributed to a majority of stream criteria that represents impairment to aquatic life at this station.

Supporting chemical parameters indicated influence from mine drainage:

Water T (C*)	Spec. Cond.	DO T (C*)	Field pH Units	Alka. mg/l	Acid. mg/l	Sulfates mg/l	T Al mg/l	T Fe mg/l	T Mn mg/l	Ca mg/l	Mg mg/l	TDS mg/l	Flow g/min.
17.00	110.20	*	6.00	53.20	33.60	22.20	0.76	17.50	1.49	18.50	4.81	256.00	502.87

* Not available

UT04

Station UT04 is located on an unnamed tributary to Fox Run, north of the Parker Store Road bridge. Although forested, erosion and possible mine drainage from an old mine dump to the west impact this tributary. June 18, 2003. a total 4 taxa and 9 individual macroinvertebrates were counted. Aquatic habitat was considered sub-optimal with a score of 134. Abundance, Hilsenhoff tolerance indexes, and the habitat score contributed to a majority of stream criteria that represents impairment to aquatic life at this station.

Supporting chemical parameters indicated influence from mine drainage and low dissolved oxygen from Pine Swamp:

Water T (C*)	Spec. Cond.	DO T (C*)	Field pH Units	Alka. mg/l	Acid. mg/l	Sulfates mg/l	T Al mg/l	T Fe mg/l	T Mn mg/l	Ca mg/l	Mg mg/l	TDS mg/l	Flow g/min.
16.50	127.60	5.00	6.00	34.40	28.40	30.70	0.23	4.67	0.82	15.20	3.73	146.00	154.49

FR05

South of Parker Store Road, in a non-exact location between station FR06 and less than a half mile downstream to station FR05, a bioassessment was done on September 11, 1997 by the DEP, NW Regional Office. A total of 11 taxa and range of 144 to 187 macroinvertebrate individuals were found. Abundance and Hilsenhoff tolerance indexes contributed to a majority of stream criteria that represented no impairment to aquatic life at this station.

June 18, 2003, a total of 8 taxa and 36 macroinvertebrates were counted. Two bluegill were sampled. Aquatic habitat was considered optimal with a score of 192. Abundance, Hilsenhoff tolerance indexes, and the habitat score contributed to an equal amount of stream criteria that indicated a borderline between impairment and no impairment to aquatic life at this station. Continued degradation or improvement in water quality will determine future designations.

Supporting chemical parameters indicated influence from mine drainage and was not noted in 1997:

Water T (C*)	Spec. Cond.	DO T (C*)	Field pH Units	Alka. mg/l	Acid. mg/l	Sulfates mg/l	T Al mg/l	T Fe mg/l	T Mn mg/l	Ca mg/l	Mg mg/l	TDS mg/l	Flow g/min.
16.30	116.50	8.00	7.00	45.40	0.00	21.50	0.40	7.21	0.45	16.50	3.97	184.00	*

*Not available

FR04

Station FR04 is located on the main-stem of Fox Run, approximately 300 yards downstream of station FR05, southeast of the town of Filer Corner. June 18, 2003, a total of 5 taxa and 59 individual macroinvertebrates were counted. Aquatic habitat was considered optimal with a score of 191. High Hilsenhoff tolerance indexes contributed to a majority of stream criteria that represents impairment to aquatic life at this station.

Supporting chemical parameters indicated influence from mine drainage:

Water T (C*)	Spec. Cond.	DO T (C*)	Field pH Units	Alka. mg/l	Acid. mg/l	Sulfates mg/l	T Al mg/l	T Fe mg/l	T Mn mg/l	Ca mg/l	Mg mg/l	TDS mg/l	Flow g/min.
*	511.00	8.00	7.00	143.40	0.00	113.70	< 0.20	5.69	0.61	65.5	23.40	406.00	1640.67

* Not available

FR04A

Station FR04A is located on the main-stem of Fox Run, approximately 300 yards downstream of station FR04. June 18, 2003, a total of 7 taxa and 38 individual macroinvertebrates were counted. Blacknose dace, sculpin, and bluegill were sampled. Aquatic habitat was considered sub-optimal with a score of 173. High Hilsenhoff tolerance indexes and metal precipitate on the benthic environment contributed to a majority of stream criteria that represents impairment to aquatic life at this station.

Supporting chemical parameters indicated influence from mine drainage:

Water T (C*)	Spec. Cond.	DO T (C*)	Field pH Units	Alka. mg/l	Acid. mg/l	Sulfates mg/l	T Al mg/l	T Fe mg/l	T Mn mg/l	Ca mg/l	Mg mg/l	TDS mg/l	Flow g/min.
12.30	498.00	8.00	7.00	139.80	0.00	119.50	< 0.20	6.11	0.61	64.30	22.90	464.00	1897.18

FR03

Station FR03 is located on the main-stem of Fox Run, just downstream of the Route 62 bridge. A bioassessment was done at this site on September 11, 1997 by the DEP, NW Regional Office. A total of 5 taxa and a range of 15 to 21 individual macroinvertebrates were counted. Abundance and Hilsenhoff tolerance indexes contributed to a majority of stream criteria that indicated impairment to aquatic life at this station.

June 18, 2003, a total of 8 taxa and 36 macroinvertebrates were counted. Two bluegill were sampled. Aquatic habitat was considered optimal with a score of 192. Abundance, Hilsenhoff tolerance indexes, and the habitat score contributed to an equal amount of stream criteria that indicated a borderline between impairment and no impairment to aquatic life at this station. Continued degradation or improvement in water quality will determine future designations.

Supporting chemical parameters indicated influence from mine drainage:

Water T (C*)	Spec. Cond.	DO T (C*)	Field pH Units	Alka. mg/l	Acid. mg/l	Sulfates mg/l	T Al mg/l	T Fe mg/l	T Mn mg/l	Ca mg/l	Mg mg/l	TDS mg/l	Flow g/min.
13.00	536.00	6.00	7.00	150.00	0.00	129.00	0.25	8.20	0.77	71.40	25.70	454.00	*

* Not availble

FR02

Station FR02 is located on the main-stem of Fox Run, approximately a mile downstream from station FR03 and east of Clark Road. June 19, 2003, a total of 11 taxa and 65 individual macroinvertebrates were counted. Aquatic habitat was considered optimal with a score of 192. The iron, associated with mine drainage, doesn't seem to be precipitating to the point of concretion and the habitat is suitable for sustaining macroinvertebrates. Abundance, Hilsenhoff tolerance indexes, and the habitat score contributed to a majority of stream criteria that indicated no impairment to aquatic life at this station.

Supporting chemical parameters indicated influence from mine drainage:

Water T (C*)	Spec. Cond.	DO T (C*)	Field pH Units	Alka. mg/l	Acid. mg/l	Sulfates mg/l	T Al mg/l	T Fe mg/l	T Mn mg/l	Ca mg/l	Mg mg/l	TDS mg/l	Flow g/min.
13.40	474.00	8.00	7.50	131.00	0.00	95.1	0.30	5.22	0.44	60.60	20.60	414.00	*

* Not available

UT01A

Station UT01A is located on an unnamed tributary to Fox Run, upstream of the Hosack Road bridge. June 19, 2003, a total of 9 taxa and 50 individual macroinvertebrates were counted. Aquatic habitat was considered optimal with a score of 220. Abundance, Hilsenhoff tolerance indexes, and the habitat score contributed to a majority of stream criteria that indicated no impairment to aquatic life at this station.

Supporting chemical parameters indicated no influence from mine drainage:

Water T (C*)	Spec. Cond.	DO T (C*)	Field pH Units	Alka. mg/l	Acid. mg/l	Sulfates mg/l	T Al mg/l	T Fe mg/l	T Mn mg/l	Ca mg/l	Mg mg/l	TDS mg/l	Flow g/min.
14.50	330.00	8.00	7.50	97.00	0.00	35.70	0.21	0.84	0.11	38.60	7.99	258.00	176.90

FR01

Station FR01 is located at the mouth of Fox Run, off of Hosack Road and along a gas well line. June 19, 2003, a total of 12 taxa and 53 individual macroinvertebrates were counted. Aquatic habitat was considered optimal with a score of 215. Like station FR02, the iron, associated with mine drainage, doesn't seem to be precipitating to the point of concretion and the habitat is suitable for sustaining macroinvertebrates. Abundance, Hilsenhoff tolerance indexes, and the habitat score contributed to a majority of stream criteria that represents no impairment to aquatic life at this station.

Supporting chemical parameters indicated influence from mine drainage:

Water T (C*)	Spec. Cond.	DO T (C*)	Field pH Units	Alka. mg/l	Acid. mg/l	Sulfates mg/l	T Al mg/l	T Fe mg/l	T Mn mg/l	Ca mg/l	Mg mg/l	TDS mg/l	Flow g/min.
14.00	434.00	8.00	7.50	119.40	0.00	78.60	0.27	3.18	0.38	55.00	18.00	296.00	2254.82

TABLE 1
BIOASSESSMENT RESULTS

FOX RUN SAMPLING STATIONS

INSECT TAXA	MODIFIED HILSENHOFF INDEX	FR06 6/18/03	UT04 6/18/03	Between FR06 & FR05 9/11/97	FR05 6/18/03	FR04 6/18/03	FR04A 6/18/03	FR03 9/11/97	FR03 6/18/03	FR02 6/19/03	UT01A 6/19/03	FR01 6/19/03
Diptera												
Chironomidae	6	9		10 -> 24		29	18	< 3	24	4		2
Empididae	6						1					
Tabanidae	6			< 3								
Tipulidae	4	1			2	5	8		5	6	4	4
Ephemeroptera												
Baetidae	6									2		11
Ephemeridae	4											1
Heptageniidae	3			3 -> 9	3			< 3				9
Odonata												
Aeshnidae	3			< 3								
Gomphidae	4	1										1
Plecoptera												
Chloroperlidae	0		3		6					1	5	9
Leuctridae	0				1	15			12	8	4	
Nemouridae	2								2			
Perlodidae	2				1				2			
Trichoptera												
Brachycentridae	1						1		6			
Odontoceridae	0										9	
Hydropsychidae	5			> 100				3 -> 9		27		1
Limnephilidae	4									5	12	7
Rhyacophilidae	1						1				1	2
NON-INSECT TAXA												
Amphipoda	6											
Bivalvia												
Sphaeridae	8	2		< 3								
Coleophera												
Elmidae	5	4	2							3	1	
Decapoda												
Cambaridae	6			< 3	6				1	5	12	4
Isopoda												
Asellidae	8	10	3		2	8	8		1	2		
Megaloptera												
Corydalidae	3					2			1	2		
Nigronia	2			10 -> 24				< 3				
Sialidae	6			< 3				< 3	2		2	2
Oligochaeta	10		1	< 3	15		1		1			
Other Worms	9			3 -> 9								
Total # Macroinverterbrate Taxa		6	4	11	8	5	7	5	11	11	9	12
Total # Macroinverterbrate Individuals		27	9	144 -> 195	36	59	38	15 -> 21	57	65	50	53

HABITAT

HABITAT	FR06 6/18/03	UT04 6/18/03	Between FR06 & FR05 9/11/97	FR05 6/18/03	FR04 6/18/03	FR04A 6/18/03	FR03 9/11/97	FR03 6/18/03	FR02 6/19/03	UT01A 6/19/03	FR01 6/19/03
1. Instream Cover	14	8	*	15	18	15	*	17	16	19	19
2. Epifaunal Substrate	12	11	*	16	17	18	*	13	18	17	18
3. Embeddedness-R/R; Pool Substrate-G/P	13	12	*	13	10	10	*	10	14	17	13
4. Flow/Depth Regimes-R/R; Pool Variabilty-G/P	10	10	*	14	18	10	*	14	15	18	19
5. Channel Alterations	20	5	*	20	20	5	*	20	20	20	20
6. Sediment Deposition	12	10	*	15	10	13	*	10	15	19	14
7. Riffle Fequency-R/R; Channel Sinuosity-G/P	16	15	*	17	18	18	*	16	18	17	18
8. Channel Flow Status	17	8	*	13	14	13	*	12	15	18	18
9. Condition of Banks	12	5	*	15	15	15	*	13	17	18	17
10. Bank Vegetation Protection	18	13	*	17	18	18	*	14	18	19	19
11. Grazing or Other Disruptive Pressure	19	19	*	19	19	19	*	19	13	20	20
12. Riparian Vegetation Zone Width	19	18	*	18	14	19	*	18	13	18	20
Total Habitat Score (out of 240)	182	134	*	192	191	173	*	176	192	220	215

240-181: Optimal, 180-121: Sub-optimal, 120-61: Marginal, less or equal to 60: Poor

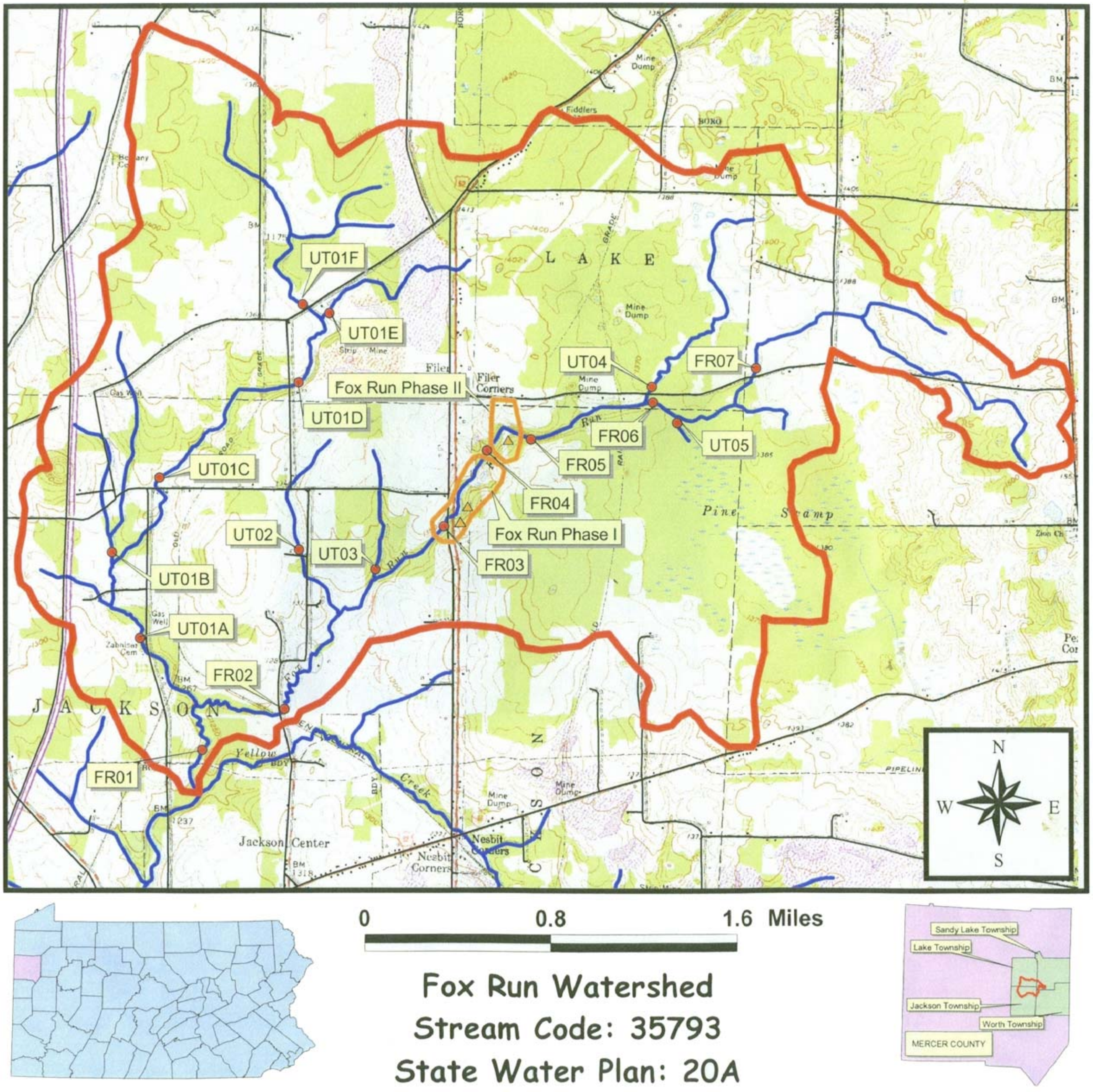
* Not available

STATEWIDE SURFACE WATERS ASSESSMENT PROGRAM CRITERIA

STATEWIDE SURFACE WATERS ASSESSMENT PROGRAM CRITERIA	FR06 6/18/03	UT04 6/18/03	Between FR06 & FR05 9/11/97	FR05 6/18/03	FR04 6/18/03	FR04A 6/18/03	FR03 9/11/97	FR03 6/18/03	FR02 6/19/03	UT01A 6/19/03	FR01 6/19/03
1. Abundance obviously low		I					I				
2. Seven or fewer Families in the collection	I	I			I	I	I				
3. Three or few mayfly individuals	I	I		I	I	I	I	I	I	I	
4. Stoneflies collectively present		N		N	N			N	N	N	N
5. Mayflies/caddisflies collectively abundant			N				N				N
6. 4 EPT Families with Hils. of 4 or less				N				N		N	N
7. 4 or more Families with Hils. of 3 or less				N				N		N	
8. 6 or more Families with Hils. of 4 or less										N	N
9. Dominant Family with Hils. of 4 or less		N								N	
10. Dominant Family with Hils.greater than 5	I	I		I	I	I		I		I	I
11. 7 or more Families with Hils. of 6 or more			I								
12. Dom. by Fam. with mean Hils. of 5 or less		N	N						N	N	N
13. Dom. by Fam. w/ mean Hils. of 6 or more	I			I	I	I		I			
14. Emb. or Sub. Char.+Sed. Dep. <24 for HG		I			I	I		I			
15. Condition of banks+Bank Veg. <24 for HG		I									
16. Habitat score <140 for High Gradient (HG)		I									
Not Impaired? Impaired Biology or Habitat?	**I**	**I**	**N**	**N/I**	**I**	**I**	**I**	**I**	**N**	**N**	**N**

*Excluding Baetidae, Caenidae, Siphlonuridae, Hydropsychidae, and Polycentripodidae

Impaired Criteria (I), Not Impaired Criteria (N)



Fox Run Watershed
Stream Code: 35793
State Water Plan: 20A

Chemical and Biological Analysis of Fox Run Watershed, Mercer County, Pennsylvania

Proceedings of the 2004 National Meeting of the American Society of Mining and Reclamation and the 25th West Virginia Mine Drainage Task Force

Morgantown, West Virginia

April 2004

CHEMICAL AND BIOLOGICAL ANALYSIS OF FOX RUN WATERSHED, MERCER COUNTY, PENNSYLVANIA[1]

Fred J. Brenner[2], Shawn Hedglin, Scott Alexander and Shaun Busler

Abstract: The impact of 5 alkaline iron laden discharges was monitored for their impact on water quality and macroinvertebrate communities in Fox Run, Mercer County Pennsylvania. Water samples were collected monthly and analyzed by an independent laboratory and 6 macroinvertebrate surveys were completed over 9 months using the Pennsylvania Environmental Protection Agency rapid assessment protocol to calculate a Biotic Index. At the completion of the study, a Habitat Evaluation Index (HEI) using the Ohio Environmental Protection Agency Protocols was completed at each stream sampling location. The Biotic indexes and the number of individuals and taxa were inversely correlated with total iron concentrations and positively correlated with the overall HEI. Both water quality macroinvertebrate communities improved 1.3 and 3.5 km downstream from the discharges. The reclamation plan for Fox Run will involve the installation of settling ponds and aerobic wetlands to reduce suspended iron loading into Fox Run.

Additional Key Words: Alkaline discharges, macroinvertebrates, biotic indexes

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Introduction

The Fox Run watershed comprises 21.91 km^2 located approximately 96 km north of Pittsburgh and 8 km east of I79 in Jackson Township, Mercer County, Pennsylvania (Fig. 1). Fox Run is a tributary of Yellow Creek which is classified as a stocked trout fishery. Fox Run has been adversely impacted by suspended and dissolved iron discharges from abandoned deep and surface mines for over 70 years resulting in an impairment of aquatic communities. A previous study by Brenner *et al.* (1977) reported iron concentrations significantly impacted both macroinvertebrate and fish diversities in Fox Run below mine discharges and that the accumulation of iron sediments appeared to be the major factor in reducing community diversity.

Earlier studies reported on the impacts of iron hydroxide compounds on the survival and growth of a variety of macroinvertebrates and fish species (Brenner *et al.*, 1976 1977; Brenner and Cooper, 1978; Smith *et al.* 1973; Sykora ,1970; Sykora *et al.*,1972 a,b) As a tributary of Yellow Creek which is classified as a stocked trout fishery, these iron discharges may not only be adversely impacting macroinvertebrate and fish communities in Fox Run, but portions of Yellow Creek, below the junction with Fox Run as well. The current study was undertaken to re-evaluate the impact of these iron discharges on the composition of the aquatic communities prior to the installation of an aerobic wetland system to remove iron precipitates from Fox Run, thereby restoring the diversity of aquatic communities within the watershed.

Methods

Water samples were collected monthly for 9 months at 5 alkaline mine discharges along Fox Run, 1 location upstream of the discharges, and at 3 locations within the impacted sect ion of the stream (Fig. 1). As a control, samples were also collected from two nonimpacted tributaries of Fox Run and an additional sampling station was located at the junction of Fox Run and Yellow Creek, a stocked trout fishery. These water samples were analyzed by an independent laboratory for pH, alkalinity (mg/l), acidity (mg/l), total iron (mg/l), manganese (mg/l), aluminum (mg/l), conductivity (umhos/cm), sulfate (mg/l), and total dissolved solids (mg/l). Macroinvertebrate communities were assessed using the rapid assessment protocol developed by the Izaak Walton

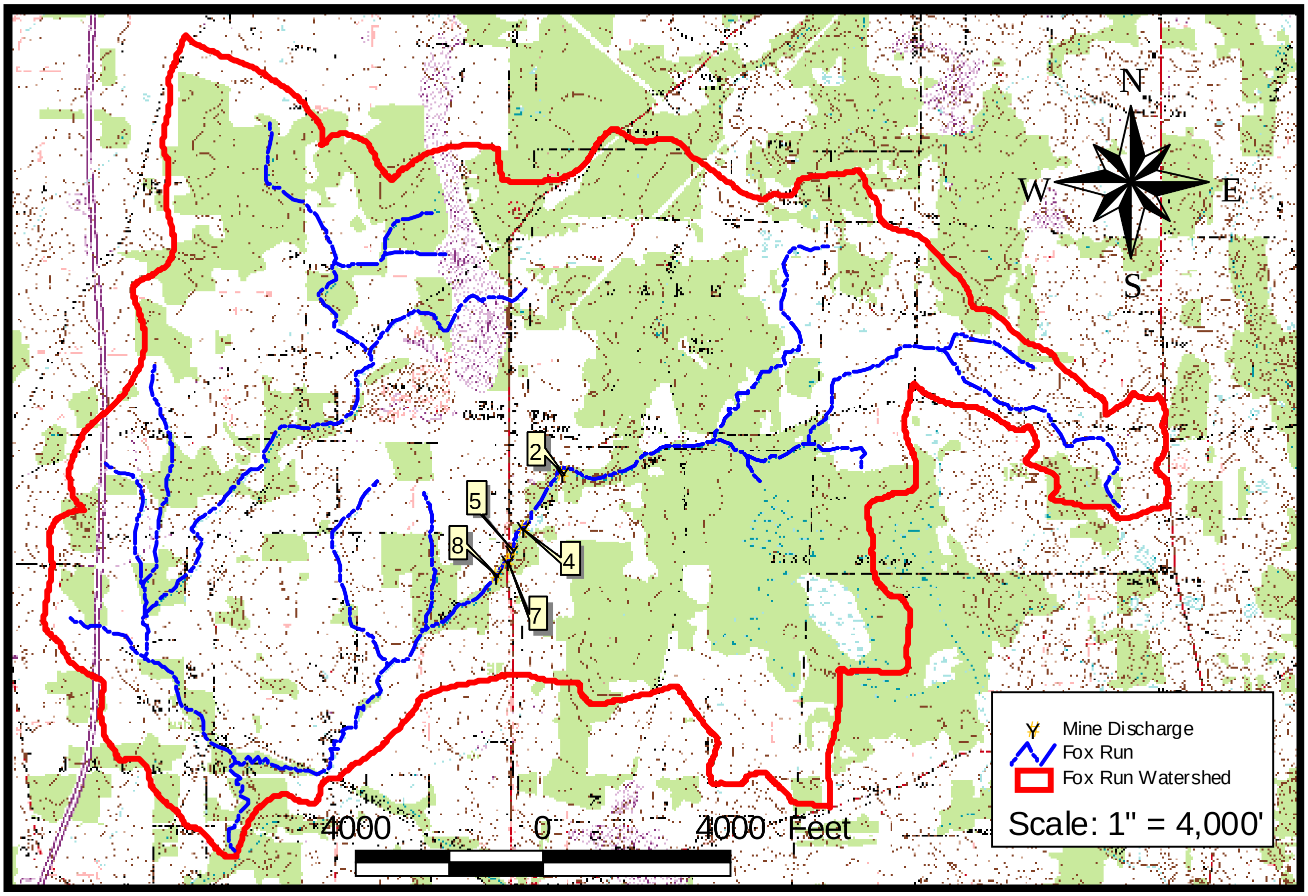
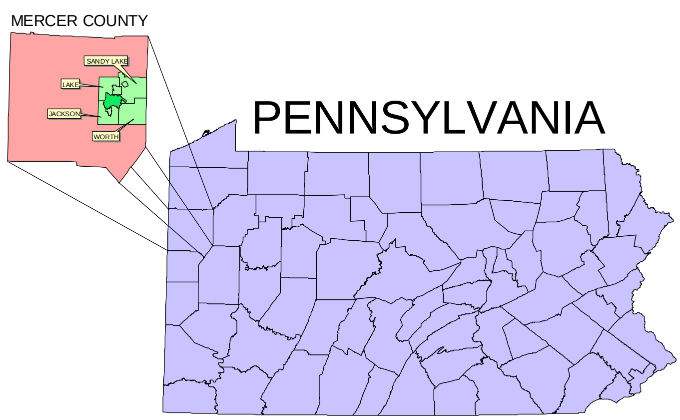


Figure 1: Sample point location map. The 21.91 km^2 Fox Run Watershed is located approximately 96 km north of Pittsburgh in Jackson Township, Mercer County, Pennsylvania.



League's Save our Streams Program and currently being used to develop biotic indices (Beck, 1954; Jones *et al.* 1982; Brenner and Helm, 1991) for streams by state (i.e. Ohio and Pennsylvania) and federal (US EPA) regulatory agencies, as well as other citizen environmental organizations. A Habitat Evaluation Index (HEI) was calculated for each stream station at the completion of the study using the Ohio Environmental Protection Agency Protocols (Rankin, 1989).

Results and Discussion

Water Quality

The mean alkalinity among the 5 discharges varied from 68.8 ± 23.8 to 231.9 ± 9.2 mg/l with a pH of 6.50 ± 0.07 to 7.27 ± 0.23 (Table 1). The dissolved ionic concentrations, as indicated by conductivity of the 5 sampling stations, varied from 751 ± 51.4 uohms/cm to 1237.9 ± 230.3 uohms/cm, which corresponds to the total dissolved solid concentrations of 526.6 ± 36.2 mg/l and 868.1 ± 159.2 mg/l. Sulfate concentrations varied among the 5 discharges from a low of 112.8 ± 23.4 mg/l to a high of 491.3 ± 224.8 mg/l. Iron was the major heavy metal component of the these discharges with concentrations varying from 5.0 ± 1.7 mg/l to 20.9 ± 5.44 mg/l. Whereas, manganese concentrations ranged between 0.73 ± 0.03 mg/l to 1.94 ± 0.34 mg/l and aluminum concentrations averaged from less than 0.02 mg/l to 1 mg/l among the 5 discharges.

The flow rates from the 5 discharges varied from 0.48 ± 0.22 to 3,181 ± 384.0 l/ min. The combined loading from all five discharges into Fox Run was 50.2 kg/day and 5.5 kg/day for iron and manganese, respectively, and the combined aluminum loading was less than 0.05 kg/day. The total combined sulfate loading into Fox Run from these 5 discharges was 1360.2 kg/day. The mean iron concentration in Fox Run above the discharges averaged 0.68 ± 0.29 mg/l with an average loading rate 5.14 kg/day increasing to an average of 3.24 ± 1.86 mg/l and 47.46 kg/day below the discharges. Manganese concentrations averaged 0.12 ± 0.07 mg/l (0.91 kg/day), increasing to 0.48 ± 0.18 mg/l (7.0 kg/ day) below the discharges. Aluminum concentrations decreased from 0.13 ± 0.07 mg/l to 0.09 ± 0.03 mg/l below the discharges, but, because of increased flows, the aluminum load within the stream increased from 0.98 kg/day to 1.32 kg/day. Sulfate concentrations also increased in Fox Run below the discharges from a mean of 42.5 ± 6.9 mg/l to 132.9 ± 21.0 mg/l. Likewise, the conductivity and dissolved solids increased from 203.7 ± 58.8 uohms/cm and 141.7 ± 39.9 mg/l to 514.1 ± 39.9 uohms/cm and 359.6 ± 44.8 mg/l, respectively. Although these discharges increased metal and ionic concentrations in the stream system, the alkalinity increased from 32.33 ± 12.1 mg/l to 132.3 mg/l above and below the 5 discharges, respectively.

Table 1: Water quality analysis of the five mine discharges.

Sample Point	Date	Flow	Ph		Cond.	Temp.	Alk.	Acid.	T. Fe	T. Mn	T. Al	SO4	TDS
		(L/min)	Field	Lab	(umhos/cm)	C	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Mine Discharge 2	12/29/1999	2440.7	6.4	6.6	773	9.6	234.9	0.0	9.1	0.8	0.0	200.9	553
	1/31/2000	2446.7	6.3	6.8	782	9.8	242.8	0.0	10.3	0.8	0.0	211.4	547
	2/28/2000	2446.7	6.4	6.8	757	9.6	234.8	0.0	5.9	0.8	0.0	220.4	530
	3/13/2000	2906.9	6.6	6.7	769	9.7	228.0	0.0	5.9	0.7	0.0	194.3	537
	4/25/2000	5236.3	6.3	6.6	768	10.1	211.1	0.0	5.3	0.7	0.0	221.5	538
	5/25/2000	3893.8	6.4	6.6	761	10.1	225.7	0.0	5.8	0.7	0.0	237.3	533
	6/28/2000	4284.7	6.3	6.6	761	10.1	231.4	0.0	5.4	0.7	0.0	254.7	533
	7/31/2000	2906.9	6.3	6.6	760	9.9	235.3	0.0	5.9	0.7	0.0	235.7	532
	8/28/2000	2335.4	6.4	6.5	783	10.2	243.2	0.0	6.2	0.7	0.0	205.4	549
Mine Discharge 4	12/29/1999	315.9	6.4	6.6	751	10.3	213.2	0.0	7.5	1.3	0.0	201.6	534
	1/31/2000	425.1	6.4	6.8	739	10.4	208.0	0.0	7.0	1.3	0.0	233.7	517
	2/28/2000	425.1	6.3	6.7	686	10.3	189.6	0.0	6.0	1.1	0.0	206.7	481
	3/13/2000	425.1	6.5	6.7	681	10.5	189.3	0.0	6.2	1.2	0.0	175.7	476
	4/25/2000	702.1	6.4	6.6	736	11.3	186.5	0.0	6.3	1.0	0.1	209.9	515
	5/25/2000	368.5	6.4	6.7	842	10.5	232.1	0.0	7.1	1.3	0.0	307.3	590
	6/28/2000	269.5	6.4	6.7	744	10.7	206.5	0.0	6.3	1.2	0.0	304.4	521
	7/31/2000	316.7	6.3	6.7	802	10.7	221.0	0.0	6.7	1.3	0.0	231.2	561
	8/28/2000	316.7	6.5	6.6	778	10.6	225.5	0.0	6.8	1.3	0.0	241.8	544
Mine Discharge 5	12/29/1999	1.0	6.7	7.0	891	0.3	117.1	0.0	14.5	1.9	1.1	26.3	633
	1/31/2000	1.8	6.6	7.1	1016	0.3	127.5	0.0	8.5	1.1	0.4	73.9	711
	2/28/2000	9.9	6.9	7.4	1434	4.8	105.2	0.0	0.8	0.2	0.0	241.4	1005
	3/13/2000	9.9	7.4	7.3	1307	5.1	89.2	0.0	1.4	0.2	0.0	23.7	915
	4/25/2000	1.8	7.1	7.2	1447	10.9	118.0	0.0	4.8	0.8	0.1	297.7	1013
	5/25/2000	4.8	7.1	7.4	1454	14.5	142.3	0.0	2.4	0.5	0.0	254.2	1019
	6/28/2000	4.8	7.2	7.4	1116	17.5	163.7	0.0	2.5	0.6	0.0	13.6	781

Mine Discharge 7	12/29/1999	55.4	6.6	6.8	913	9.0	252.6	0.0	10.8	1.7	0.0	307.2	674
	1/31/2000	56.0	6.6	6.9	916	9.2	247.9	0.0	1.5	1.7	0.0	294.1	641
	2/28/2000	97.8	6.5	6.9	1012	8.5	250.0	0.0	10.4	1.7	0.0	408.3	707
	3/13/2000	56.0	6.9	6.8	920	9.8	245.4	0.0	9.8	1.6	0.0	313.3	643
	4/25/2000	56.0	6.5	6.7	1108	10.4	272.3	0.0	16.3	1.8	0.0	417.4	776
	5/25/2000	97.8	6.3	6.6	1473	11.1	326.0	0.0	23.1	2.3	0.0	795.8	1031
	6/28/2000	56.0	6.2	6.5	1476	11.0	325.3	0.0	26.6	2.5	0.0	926.2	1034
	7/31/2000	226.8	6.3	6.6	1356	11.3	333.6	0.0	20.3	2.3	0.0	530.9	950
	8/28/2000	75.2	6.5	6.6	1080	11.0	285.0	0.0	17.4	1.9	0.0	428.1	756

Mine Discharge 8	12/29/1999	2.0	6.5	6.4	761	0.6	55.8	0.0	23.8	1.4	2.3	92.6	533
	1/31/2000	0.0	6.5	6.5	788	0.9	55.0	0.0	11.8	1.9	0.1	133.5	552
	2/28/2000	0.3	6.2	6.6	825	7.0	57.3	0.0	18.2	1.3	0.1	149.3	578
	3/13/2000	0.3	6.7	6.5	865	3.2	44.9	0.0	24.6	1.2	2.9	126.6	606
	6/28/2000	0.8	6.4	6.6	803	15.8	93.0	0.0	17.3	1.2	0.1	95.6	562
	7/31/2000	0.0	6.3	6.4	847	18.7	65.0	0.0	22.6	1.2	0.1	101.6	593
	8/28/2000	0.3	6.5	6.5	872	17.0	110.4	0.0	27.9	1.5	1.5	90.5	611

The metal loading from these discharges impacted the entire length of Fox Run to the confluence with Yellow Creek. The iron load at two sampling stations, approximately 1 km and 1.3 km downstream from the discharges, averaged 16.7 kg/day and 14.1 kg/day, respectively, and the iron load approximately 3.5 km downstream from the discharges at the confluence with Yellow Creek averaged 18.4 kg/ day. The manganese load averaged 5.0, 4.1 and 5.2 kg/day at sampling points 1 km and 1.3 km and 3.5 km downstream from the sampling points, respectively. Aluminum loads were less than a kg/day at any sampling point downstream from the 5 discharges. By comparison, the heavy metal concentrations in the two unimpacted tributaries to Fox Run was less than 1 mg/ liter for either iron, manganese or aluminum with average loads of less than a kg/ day.

Macroinvertebrate Communities

The number of macroinvertebrate taxa and individuals varied among the different sampling stations. Twenty-seven individual macroinvertebrates representing 6 taxa were collected in the headwaters of Fox Run above the portion of the stream receiving iron discharges. Although the aquatic habitat was considered optimal with a HEI score of 182 (max. 240), the low abundance of macroinvertebrates and a biotic index of 14 indicates an impairment to aquatic life, possibly due to the natural tannins and organic matter in the stream at this point. Although the HEI score increased to 191 approximately 1 km downstream from the headwaters at a point approximately 10 meters above the first mine discharge, the collection of 59 individuals representing 5 taxa along with a biotic index of 13 $\pm$ 0.3 also indicated an impairment to aquatic life. Likewise collections from Fox Run approximately 1 km downstream in the area receiving mine drainage, the HEI of 173 indicated that the stream was suboptimal for aquatic life which was verified by Biotic Index of 9.8 $\pm$ 2.3 indicating impairment to aquatic life. At a sampling point approximately 1.3 km below the discharges, there was an improvement in stream habitat with the HEI of 192, which is considered to be an optimal aquatic habitat. Likewise, the Biotic Index of 19 indicates good water quality and the collection of 65 individuals representing 11 taxa, indicates that the stream was not impacted at this point. At the confluence of Fox Run and Yellow Creek, the HEI score of 215 was considered optimal for aquatic life and the Biotic Index of 19 along with the collection of 53 individuals representing 12 taxa suggesting that stream has recovered 3.5 km below the discharges. In a nonimpacted unnamed tributary to Fox Run, the

HEI score of 220 and the number of macroinvertebrates collected (50) and taxa (9) represented similar stream conditions and aquatic community that occur at the confluence of Fox Run and Yellow Creek.

For over three decades, studies have reported that dissolved and suspended iron adversely impact aquatic communities (Brenner *et al*. 1976, 1977; Brenner and Cooper, 1978; Smith *et al.* 1973; Sykora, 1970; Sykora *et al.* 1972a,b, 1973, 1975). In the current study, the number of individuals ($r = 0.825$, $P < 0.01$, taxa ($r = 0.924$, $P < 0.001$) and the rapid assessment Biotic Indexes ($r = 0.822$, $P < 0.01$) were inversely correlated with total iron concentrations (Fig. 2, 3, and 4). The HEI was positively correlated with both the number of individuals ($r = 0.946$, $P < 0.001$) and taxa ($r = 0.650$, $P < 0.05$), as well as the rapid assessment biotic index ($r = 0.615$, $P = < 0.05$), suggesting that the overall quality of the stream habitat is an important factor in determining the diversity of aquatic communities. Deemer *et al.* (2003) reported that the HEI, especially the substrate, was an important factor that counter acted the adverse impact of nutrient concentrations on the size and diversity of macroinvertebrate communities in a first order stream. These studies suggest that the overall habitat quality can be addressed during the restoration of stream systems receiving mine discharges. The results of this study were similar to those reported by Brenner *et al.* (1977), indicating that there has been little, if any, improvement in water quality or the size and diversity of macroinvertebrate communities over the last 30 years.

Reclamation Plan

The reclamation plan for the Fox Run is divided into two phases. The first phase involves the construction of linear wetland to collect 7 discharges, a settling pond, and an aerobic wetland. The second phase will involve the construction of an aerobic wetland that will treat a discharge of over 3000 liters/min with an iron load of over 30 kg/day. Based on 90% iron removal, these combined systems will prevent over 45 kg/day of suspended iron from entering into Fox Run. Based on the diversity of aquatic communities in a nonimpacted tributary and 3.5 km downstream from the discharges, both the macroinvertebrate and fish communities should recover throughout the stream system.

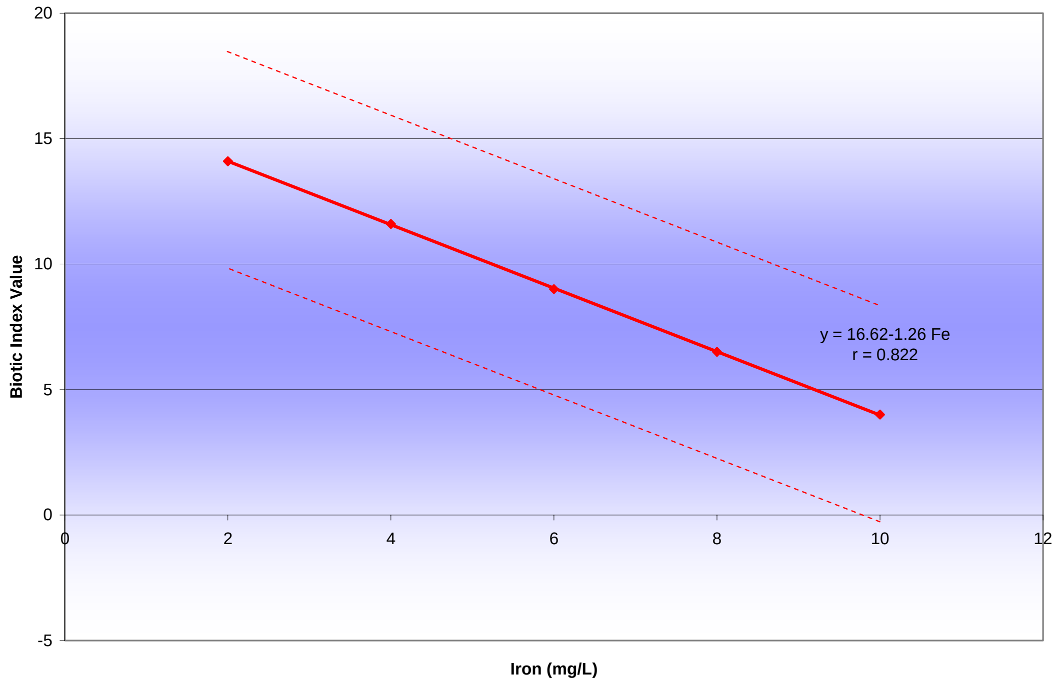


Figure 2: Comparison of Rapid Assessment Biotic Index Value with Total Iron Concentrations within Fox Run

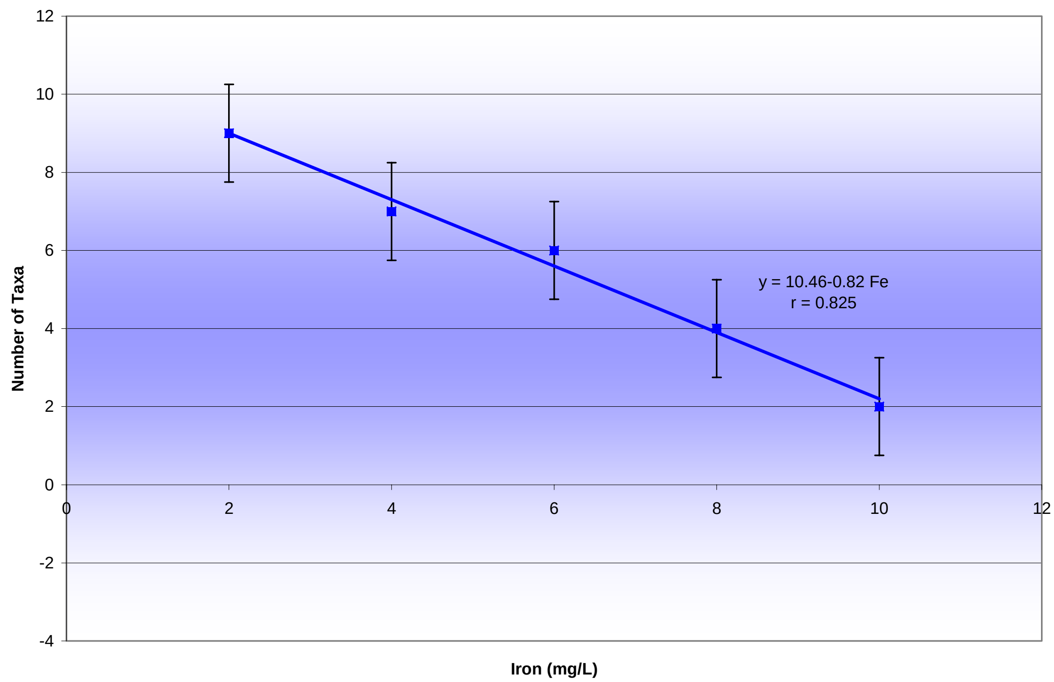


Figure 3: Comparison of the Number of Taxa with Total Iron Concentrations within Fox Run

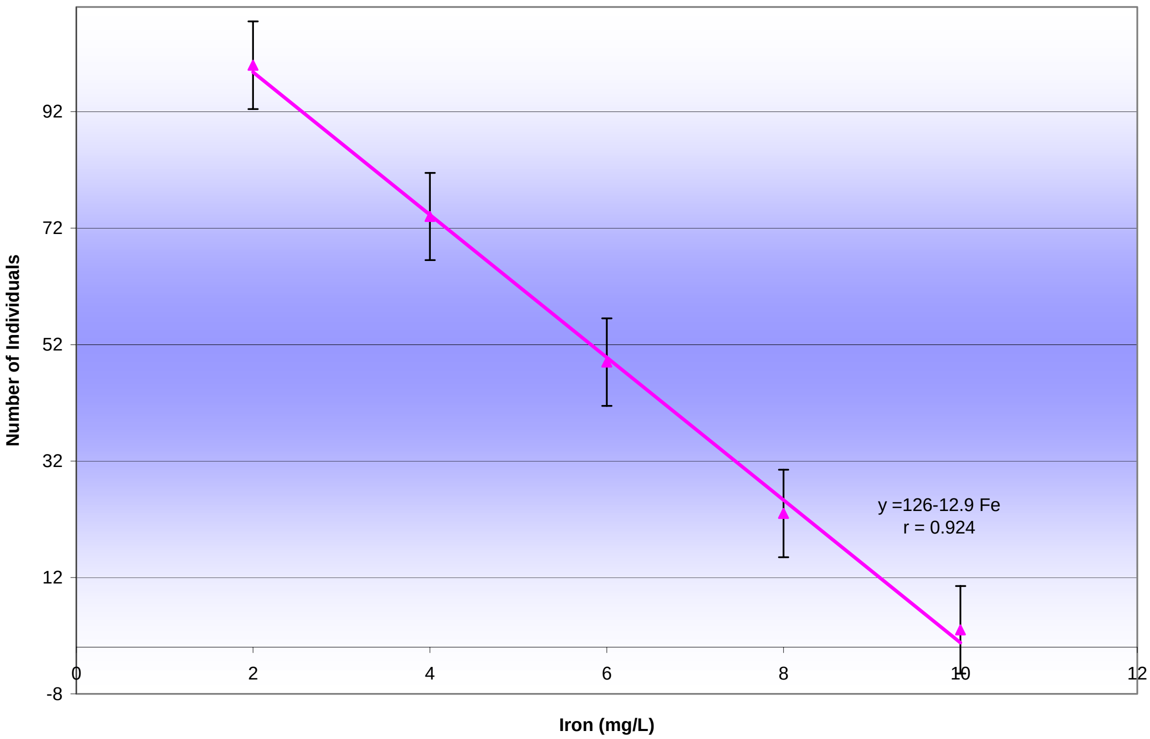


Figure 4: Comparison of the Number of Individuals with Total Iron Concentrations within Fox Run

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Fox Run Restoration Project – Phase I

“A Pennsylvania Growing Greener Initiative”

<u>OPERATION AND MAINTENANCE PLAN</u>

June 2005

Jackson Twp., Mercer Co., PA

“A Public-Private Partnership Effort”

Brenner’s Ecological Service
Grove City College
Urban Wetland Institute
Kish Family
Mercer County Conservation District
Pennsylvania Department of Environmental Protection
Quality Aggregates Inc.
Quality Wetland Products
Kosmic Signs & Designs
BioMost, Inc.
Stream Restoration Inc.

OPERATION AND MAINTENANCE PLAN

This is the Operation and Maintenance Plan for the Fox Run Restoration Project Phase I passive treatment system located on the Kish property in Jackson Township, Mercer County, PA. The passive system was installed along Fox Run, which is a tributary of Yellow Creek. The hydrologic order is Fox Run → Yellow Creek → Cool Spring Creek → Neshannock Creek → Shenango River. The passive treatment system consists of one collection channel, one settling pond, and one aerobic wetland.

The Mercer County Conservation District will be responsible for monitoring and minor maintenance of all structures in order for the passive treatment system to continue to function properly. Quality Aggregates Inc. has pledged a 5-year maintenance agreement for structural integrity of the constructed facility and site vegetation. This will expire in November 2009.

This AMD treatment system was designed, based on the best available knowledge and technology at the time, and implemented through a public-private partnership effort coordinated by the Mercer County Conservation District and Stream Restoration Inc. [non-profit]. Design of all structures focused on minimal operation and maintenance compared to conventional chemical treatment systems. As with any facility, periodic inspections and maintenance will help to guaranty optimum long-term effectiveness. This Operation and Maintenance Plan has been specifically designed and written for this site to be user friendly and easily implemented in order to encourage sustainability of the abandoned mine drainage treatment at Fox Run Phase I. Inspection report forms, site schematic, and location map have been provided in sheet protectors for ease in copying for field use.

CONTENTS

PASSIVE TREATMENT COMPONENT OVERVIEW

Passive systems use no electricity, require limited maintenance, and use environmentally friendly materials for treatment, such as limestone aggregate and spent mushroom compost. This provides a cost-effective alternative to the harsh chemicals typically used for conventional treatment of mine drainage. Passive systems can be designed to neutralize acidity and add alkalinity while providing an environment suitable for beneficial chemical reactions and biological activity to take place. Adding alkalinity encourages the metals dissolved in the mine drainage to form particulates, which are then retained in the channels, settling ponds and/or constructed, naturally functioning, wetlands. In some cases, there is sufficient alkalinity present within the discharge such that only settling ponds and wetlands are required. This is the case at the Fox Run Phase I passive treatment system.

There are several main types of passive treatment components that can be used, often in series, to treat degraded mine drainage. These components are chosen based upon the drainage characteristics (quality and flow rate), chemical or biological reaction preferred, and available construction space. The following is a brief description of the Fox Run Phase I passive treatment components.

Collection Channels serve to collect, intercept, and/or combine discharges and seeps as well as to convey water. These components also collect debris such as sticks and leaves as well as sediment and iron precipitates. There is one Collection Channel (Top Right Photo) at the Fox Run Phase I passive treatment system.

Settling Ponds and Wetlands are typically used in passive treatment systems to allow for the oxidation, precipitation, and accumulation of metal solids that occur when alkaline drainage issues from a minesite or after acidic drainage has passed through an alkalinity-generating treatment component. Although many treatment wetlands are angular-shaped shallow ponds supporting predominantly cattails, the wetlands at Fox Run Phase I have been designed, built, and planted to look and function as a natural wetland with high species diversity that provides not only treatment but also exceptional wildlife habitat. There is one Settling Pond and one aerobic wetland (Bottom Right Photo) at the Fox Run Phase I passive treatment system. (One to two years are generally needed after planting for the wetlands to become well vegetated. The Fox Run Phase I wetlands were planted in June 2005.)

SITE SPECIFIC INSTRUCTIONS

All who will be involved in the operation of the site should have an understanding of, and the ability to perform, basic routine duties, such as site inspections that include evaluating channels, spillways and passive treatment components as well as water sampling and measuring flows.

PASSIVE TREATMENT SYSTEM O&M INSPECTION REPORT

To maintain the passive treatment facility, the site should be inspected periodically and after major precipitation events or other natural/manmade occurrences that may affect the performance or integrity of the structure. Regular site inspections should be conducted on a quarterly basis for the first two years after construction and twice a year thereafter. A qualified person should perform the inspection and complete the appropriate report. (See attached inspection report form.) The inspectors should keep the paper copy of the report in permanent files in chronological order at a specified location. The report data may be posted on-line via the website, www.datashed.org, which is provided by Stream Restoration Inc., a PA Non-Profit. “Datashed” is a GIS-enabled, user-friendly, on-line database that can easily serve as a valuable tool in the Operation and Maintenance of passive treatment systems.

The report should include the inspection date, the inspector’s name, the organization with which the inspector is affiliated, and the start and end time of the actual inspection. The following sections correspond with the attached Passive Treatment System O&M Inspection Report.

A. Site Vegetation

Vegetation (i.e. groundcover) is extremely important to provide wildlife habitat and to prevent erosion. Erosion can carry sediment into streams resulting in turbidity and siltation. Sediment entering the passive treatment components can cause plugging or loss of capacity. During the inspection, overall condition of the site vegetation should be observed and numerically rated from 0 to 5. If significant areas are barren, describe the action needed as well as the location. Normal husbandry practices (such as fertilizing, removing unwanted species, etc.) should be implemented, as necessary, to maintain a stable non-erosive groundcover and viable wildlife habitat on the site.

Rating	Description	Recommended Action
0	Site barren	Revegetate as soon as practicable; temporary seeding, install staked straw/hay bales, filter fabric, etc. until stabilization with permanent seed mix
1	Site mostly barren. Only small isolated areas of vegetation	(Same as for “0” rating)
2	Large area(s) barren	Outline approximate area(s) on Site Schematic; revegetate as described for “0” rating
3	Revegetation spotty; erosion gullies present	Outline approximate area(s) on Site Schematic; on poorly vegetated areas, seed, mulch, apply soil amendments, as necessary; install staked straw/hay bales, rip-rap, etc. in gullies to control erosion
4	Successful vegetation >70% groundcover; few, isolated, minor erosion features or areas with <70% groundcover	Identify potential problem areas; note changes on future Inspection Reports
5	Successful vegetation >70% groundcover	No remedial action required

B. Access

Stabilized access is needed for the maintenance, monitoring, and any educational/outreach programs. **THE FOX RUN PHASE I SITE IS LOCATED ALONG A BUSY AND DANGEROUS HIGHWAY (SR 62). TAKE EXTREME CARE!!!!**

On the inspection sheet:

- Paths passable (Yes or No): Are fallen trees or debris blocking access? Are there significant erosion gullies present?
- Maintenance needed: Do portions need to be stabilized? If so, identify area on Site Schematic. Is machinery required to remove debris?

C. "Housekeeping"

The Fox Run Phase I passive system is located on private property owned by the Kish Family. They have allowed this facility to be constructed on their property in order to help restore Fox Run. Please collect any litter you see during your inspection and dispose of it properly. Do not touch anything that you feel may be dangerous (such as, broken glass) or hazardous. Note these items and their location as a comment in the inspection report. Also report if the project or interpretive signs have been damaged by vandalism or other causes.

D. Vandalism

Please record any type of vandalism and evidence of trespassing on the inspection report. Note any damage to the passive treatment system. Also report any damage to the project sign and interpretative signs and constructed wildlife habitat, such as wood duck boxes.

E. Diversion Ditch and Spillways

All diversion ditches and spillways should be inspected and maintained to minimize erosion and insure proper water handling. The channels should be kept free of obstructions/debris that would restrict water flow. Any debris/obstructions should be removed. Vegetation should also be removed from spillways if it is causing significant water level increase in the component that it drains. If disturbed or eroded areas are present, then these areas should be stabilized as soon as possible with riprap or noninvasive plant species. Channels or ditches that carry mine drainage should be cleaned out when precipitate reduces the capacity by one half. Particular attention should be paid to the stability of rock-lined channels and spillways to assure that the rock lining is intact.

On the inspection sheet**,** for each identified channel or spillway note:

- Significant erosion present (Yes or No): Is the riprap or vegetative lining impaired or absent? Has the berm been overtopped and/or breached? Is there significant sedimentation as a result of erosion?
- Significant debris present (Yes or No): Are there tree limbs, leaves, trash, etc. that would "dam" the water in the diversion ditches and collection channels? Are there vegetation and/or debris in the riprap-lined spillways that would cause the water level to rise in the passive components?
- Maintenance performed: Have the plants been removed from the riprap-lined spillways? (Removal of plants from riprap-lined spillways on a regular basis as part of "general housekeeping" prevents overtopping of berms and loss of function of the facility.) Have tree limbs, leaves, trash, etc. been removed? Has the erosion been addressed (rocks

placed in erosion features; sediment cleaned from ditches, dirt placed and compacted on berms of ditches and channels, etc.)?

- Maintenance Remaining: Describe additional maintenance needed. Indicate areas for additional maintenance on the Site Schematic.

F. Passive Treatment System Components

The Collection Channel, Settling Pond, and Wetland need to be inspected for erosion, berm (slope) stability, vegetation, siltation, leaks, etc. Any problem should be noted and corrected as soon as practicable.

Water inlet areas for all structures should be observed during each site inspection and kept free from sediment, leaves, and any other foreign objects. This is important for the efficient operation of the system. Any debris present in the water inlet areas should be removed. All flow control structures should be maintained to assure that they are free flowing and not restricted.

During inspections, the condition of the vegetation and the presence of any disturbed or eroded areas should be noted. These areas will need to be stabilized as soon as possible with staked straw/hay bales, riprap, plantings with accepted species, etc., whichever is appropriate.

On the inspection sheet for each identified passive treatment component note as applicable:

- Significant erosion present (Yes or No): Are there erosion gullies on the inside and outside berms?
- Features relating to berm condition (Yes or No): Are the berms stable? Is any slumping noted? Are there erosion gullies on the inside or outside of the berms? Are there tension cracks on top of the berms? Are there significant areas on the inside and outside berms that need to be revegetated? Overall does the vegetation appear healthy?
- Successful vegetation (Yes or No): Are there significant areas on the inside and outside berms that need to be revegetated? Overall does the vegetation appear healthy?
- Significant siltation/sedimentation present (Yes or No): Is there significant sediment from erosion of berms or upland areas accumulating in the passive component?
- Significant change in water level: Is the water level rising or lowering in the passive component? Is the water level appropriate? Is there evidence of water overtopping the berm? Is there evidence of water escaping the channels?
- Maintenance required: Do portions of the berms need to be stabilized with riprap and/or reconstructed? Does supplemental reseeding and mulching need to be completed? Do any passive components need to be cleaned of sediment or debris? Is there vandalism?

G. Wildlife Utilization

Wildlife habitat and utilization should be considered. If, however, during inspections, signs of damage are noted, as a result of wildlife, appropriate steps should be taken to continue the function of the passive system and general site restoration. Significant damage needs to be corrected by repairing berms, removing invasive species, replanting, as well as hunting and trapping if necessary (contact PA Game Commission).

On the inspection sheet:

- Animals observed: Although not an inventory, please record whether there were tracks or visual observations of wildlife utilizing the site. Describe any damage observed.

- Invasive plants observed: If invasive or undesirable plants are observed, please note and remove as soon as practicable.

H. Field Water Monitoring and Sample Collection

In order to assess the efficiency and performance of this system and the impact to Fox Run, field tests should be completed including flow rate of passive system final effluent, pH, temperature, alkalinity, and dissolved iron. Water samples, to confirm field analyses, may also be taken and analyzed by the PA State Lab or other approved laboratory using standard chemical testing procedures for pH, alkalinity, acidity, total iron, dissolved iron, total manganese, dissolved manganese, sulfates, and total suspended solids. Field testing is recommended to be completed quarterly or biannually, with confirming lab tests conducted when possible.

Water sampling and field testing at the following locations will enable evaluation of the degree of success of the passive components, individually and combined, in treating the mine drainage:

1. **87-7 (Raw)**
2. **Collection Channel**
3. **Settling Pond (87 SP)**
4. **Wetland (87 WL)**
5. **Fox Up (Fox Run Upstream)**
6. **Fox Dn (Fox Run Downstream)**

The monitoring program should include points other than the final effluent in order to provide a complete description of the water quality through the passive treatment complex at the time of sampling. For instance, the untreated raw mine water (as close to the source as possible), each component (at the effluent), and the stream (above and below the system) should be monitored. Monitoring point locations are identified on the O&M Inspection Sheet and site schematic.

When collecting samples and/or conducting site inspections, flow rates should be measured. Currently there is no method available to monitor flows within the system. It is recommended that a pipe, weir or flume be installed to monitor flow rates and calculate loadings. This plan should then be modified to include specific directions on how to conduct flow measurements.

In order to conduct laboratory analyses for pH, alkalinity, acidity, sulfates, conductivity, and total suspended solids, a 500-ml (or other specified volume), unfiltered, sample should be collected, stored in a cooler, and transported to the laboratory. To differentiate between dissolved and total metal concentrations, the laboratory requires two, 125-ml (or other specified volume) samples that are preserved with trace metal-grade nitric acid to ensure that the pH is <2. The sample for total metals is not filtered. The sample for dissolved metals is filtered using a 0.45-μm filter in the field prior to placing the sample in the bottle. Each bottle should be labeled with a unique number.

A record of every sample taken should be made directly on the inspection sheet. Information such as sampler's name, sample location, sample date, flow rate, field tests, and sample bottle identification will be written on the inspection sheet. Pertinent information is then transferred from the inspection sheets to the laboratory's Record of Sample form or Chain of Custody form.

On the inspection sheet for each Sampling Point complete the following:

- Monitoring point field measurements recorded:

Parameter	Method
Flow	Cross-Section, weir/flume, or bucket & stopwatch, where appropriate
pH	HACH pH kit, pH meter, etc.
Temperature	Field thermometer, pH meter, etc.
Alkalinity	HACH Digital Titrator, etc.
Iron	HACH iron kit, etc.
Dissolved Oxygen (optional)	HACH DO kit, DO meter, etc.

Record readings to nearest whole number, except pH (record to nearest tenth). If the discharge is not piped at the monitoring point, a weir or flume may be installed. Stream flow is generally measured by cross-section. This procedure is to be described by personnel of the Mercer County Conservation District in order to conform with available equipment.

- Sample bottle data: If water samples are collected, assign and record bottle numbers on the inspection sheet. You will need to transfer this information to the laboratory's Record of Sample or Chain of Custody form.
- Comments: Observations such as color of the sample or other information may be recorded in the "Comments" column.

I. Sludge Accumulation

While not necessary to complete an actual sludge accumulation report, one has been provided for use if desired. It is recommended that a sludge accumulation inspection be completed every year or every other year. The primary purpose of this inspection is to assess the type and amount of sludge that is accumulating within the passive treatment components. This can give an indication as to how the system is functioning and when action is needed to remove the sludge from the component.

Items of interest to consider when conducting the inspection could include:

- Color and depth (estimated) of the sludge. Typically, white, red, and black colors indicate precipitate rich in aluminum, iron, and manganese, respectively.
- Has the sludge filled the component to within 2 feet of the total berm height?
- Is there significant organic debris in the sludge?

J. Schematic

A site schematic has been provided to orient the inspector to the site and is keyed to the various sections of the inspection report. The schematic can also be used to identify specific locations where maintenance is needed. This is particularly valuable for locations within the site that do not already have a specific identified name and location. For instance, if a section of the site was not well vegetated and experiencing erosion, that area could be circled on the schematic and then a copy or fax could be provided to the person(s) responsible for addressing the issue.

ANNUAL WETLAND PLANT DIVERSITY REPORT

It is also recommended that an Annual Wetland Plant Diversity Report be completed once a year. The primary purpose of this report is to assess the diversity of plant species within the constructed treatment wetlands in order to determine if species diversity is increasing or decreasing. Species diversity is believed to increase the health, productivity, and treatment capability of the wetland. In addition, increased plant species diversity should result in an increase in wildlife diversity. A secondary purpose is to identify if unwanted invasive plants have become established. These plants should be removed from the wetlands.

On the report provide the common name and/or scientific name for each plant, the plot number, the location of the plot, and the population within that plot.

MISCELLANEOUS MAINTENANCE CONSIDERATIONS

All materials used in repairs should be of equal or better quality and have the same capacity and function as shown on the "As-Built" plans.

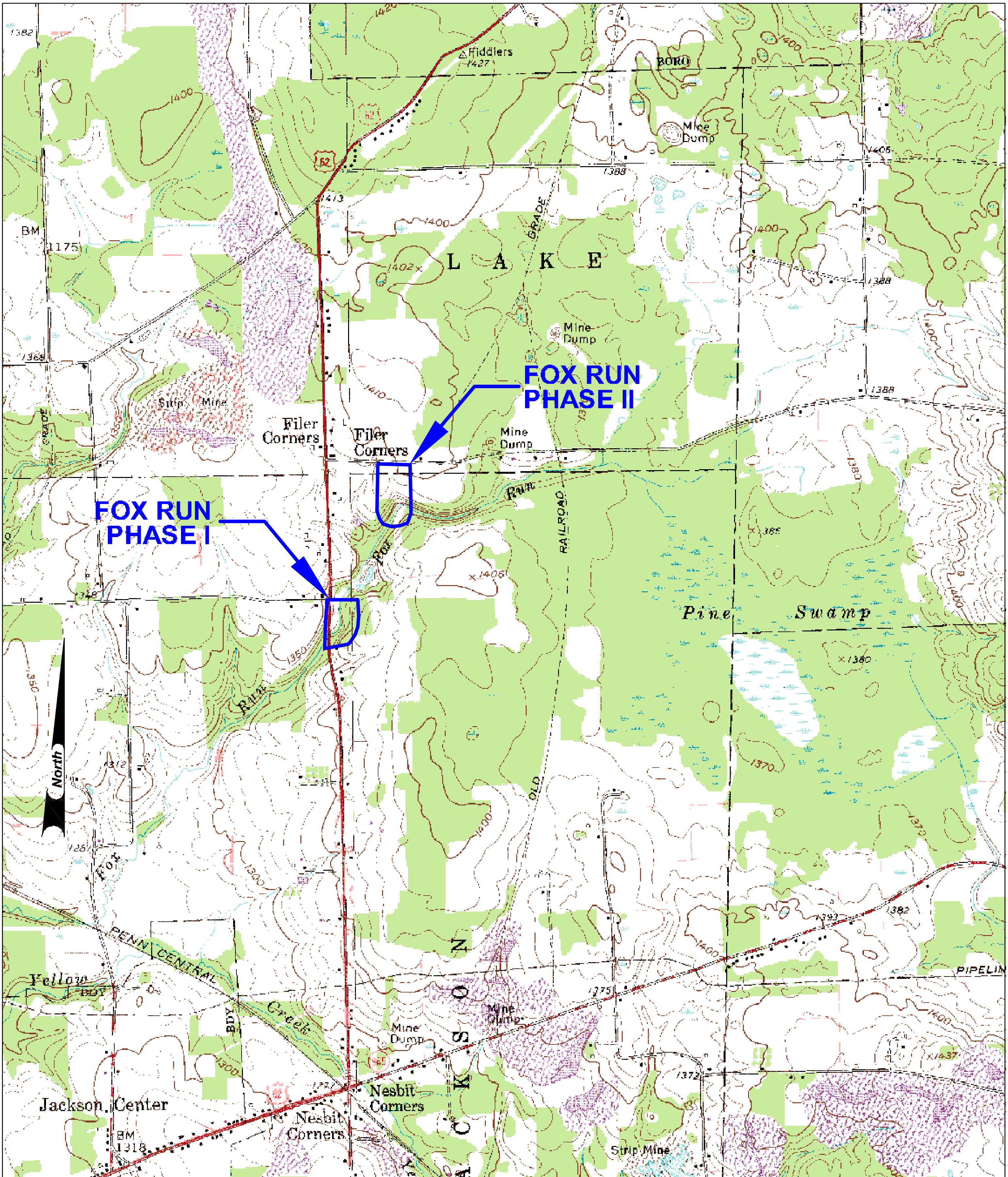
Removal and disposal of accumulated precipitate or sediment

Precipitates from chemical reactions and other solids will be retained within passive treatment components such as the Collection Channel, Settling Pond, and Wetland. This sludge should be removed when the storage volume of the component is reduced by one half. Inlet and outlets should be kept clear of debris and obstructions. Sludge removal is planned for every fifteen years or as desired. Opportunities may be available to utilize the sludge for metal recovery or the sludge may be allowed to drain/dewater for burial on-site. (An Erosion and Sediment Pollution Control Plan should be completed for the placement area.)

REPLACEMENT

Sizing of components and sludge storage capacity for a projected design life of 25 years were based upon data collected by the Mercer County Conservation District Fox Run Watershed Abandoned Mine Drainage Survey. Higher flow rates and poorer water quality can substantially affect the design life. While there is no treatment media that will need to be replaced, accumulated sludge will need to be removed and organic matter may need to be added. Additional plantings may be necessary. At the time of sludge removal, advances in technology and changes in raw drainage quality and quantity should be considered to determine if revisions to the size and/or design of the system would be advantageous. Replacement considerations include:

- Estimating Best Management Practice (BMP) design life;
- Determining replacement responsibility, including a successor, as necessary;
- Determining approximate costs for the following possible needs:
    - removing accumulated sediments;
    - re-sizing the system to accommodate changed water quality or quantity;
    - recharging organic matter in wetlands;



LOCATION MAP - USGS 7.5' JACKSON CENTER, PA (PR1970) AND USGS 7.5' SANDY LAKE, PA (PR1970)

FOX RUN RESTORATION PROJECT - PHASE I

Jackson Township, Butler County, PA

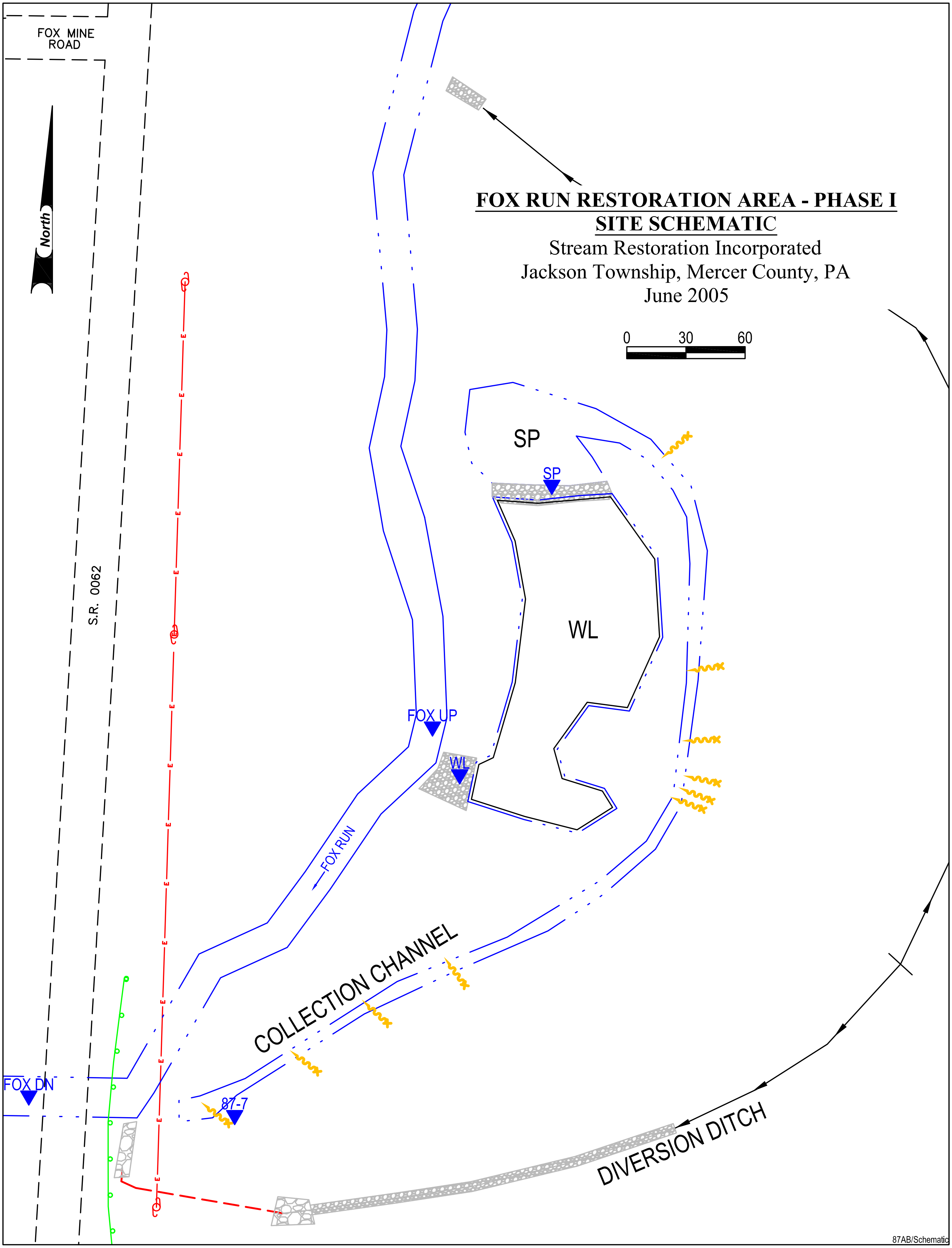
Stream Restoration Incorporated

June 2005, Scale 1" = 2000'

Approximate Center of Project (deg-min-sec)
41-18-03 latitude 80-07-19 longitude

2000 1000 0 2000

BioMost, Inc., Mining and Reclamation Services
Cranberry Twp., PA: loc map


FOX RUN RESTORATION AREA - PHASE I
SITE SCHEMATIC
Stream Restoration Incorporated
Jackson Township, Mercer County, PA
June 2005
0
30
60
FOX MINE ROAD
North
S.R. 0062
SP
SP
WL
WL
FOX UP
FOX RUN
COLLECTION CHANNEL
FOX DN
87-7
DIVERSION DITCH
87AB/Schematic

PASSIVE TREATMENT SYSTEM O&M INSPECTION REPORT

Inspection Date:	______________	Project Name:	Fox Run Restoration Project– Phase I
Inspected by:	______________	Municipality:	Jackson Township
Organization:	______________	County:	Mercer State: PA
Time Start: ________	End: ________	Project Coordinates:	41° 17' 47" Lat 80° 07' 34" Long
Receiving Stream:	Fox Run	Subwatershed:	Yellow Creek Watershed: Cool Spring Creek

Weather (circle one): Snow Heavy Rain Rain Light Rain Overcast Fair/Sunny Temp(°F): #32 33-40 41-50 51-60 60+

Is maintenance required? Yes/No If yes, provide explanation: ____

INSPECTION SUMMARY

A. Site Vegetation (Uplands and Associated Slopes)

Overall condition of vegetation on site: 0 1 2 3 4 5 (0=poor, 5=excellent, circle one) (See instructions.)

Is any reseeding required? Yes/No If yes, describe area size and identify location on Site Schematic:

B. Access

Is the access road accessible for operation and monitoring? Yes ☐ No ☐
Does the access need maintenance? Yes ☐ No ☐
Describe maintenance performed and remaining (Identify location on Site Schematic.): ____________________

C. "Housekeeping"

Is there litter along the road? Yes ☐ No ☐ Is there litter around or in the passive system? Yes ☐ No ☐
Is there litter that may be considered hazardous or dangerous that requires special disposal? Yes ☐ No ☐
Additional comments: ____________________

D. Vandalism

Is there any defacing or damage to signs? Yes ☐ No ☐ Have trees been cut? Yes ☐ No ☐
Additional comments: ____________________

E. Diversion Ditch and Spillways

Channel Identification	Significant Erosion (Y/N)	Debris Present (Y/N)	Maintenance Performed (Y/N)	Maintenance Performed and Remaining (Indicate ditch by number i.e. 2b = Settling Pond Outlet)
1. Upland Diversion Ditch				
2. Rock-Lined Spillways				
a. Level Spreader (SP Outlet)				
b. Wetland Outlet				

F. Passive Treatment System Components

Component	Significant Erosion (Y/N)	Berms Stable (Y/N)	Vegetation Successful (Y/N)	Siltation Significant (Y/N)	Water Level Change (Y/N)	Maintenance Performed and Remaining Indicate which component i.e. Settling Pond
Collection Channel						
Settling Pond						
Wetland						

G. Wildlife Utilization

Animal sighted or tracks observed: ___

Invasive plants observed: ___

Describe any damage caused to treatment system by wildlife (especially muskrats) and required maintenance: ___

___

H. Field Water Monitoring and Sample Collection - Raw water sample locations as marked on plan. For passive components sample effluent.

☐ - Not monitored

Sampling Point	Flow Measurements		Calculated Flow (gpm)	pH	Temp (°C)	Alkalinity (mg/L)	DO (mg/L)	Iron (mg/L)	Comments	Bottle #	Bottle # (total metals)	Bottle # (diss. metals)
	gals	sec.										
Discharge (87-7)												
Collection Channel												
Settling Pond (87 SP)												
Wetland (87 WL)												
Fox Run Up												
Fox Run Down												

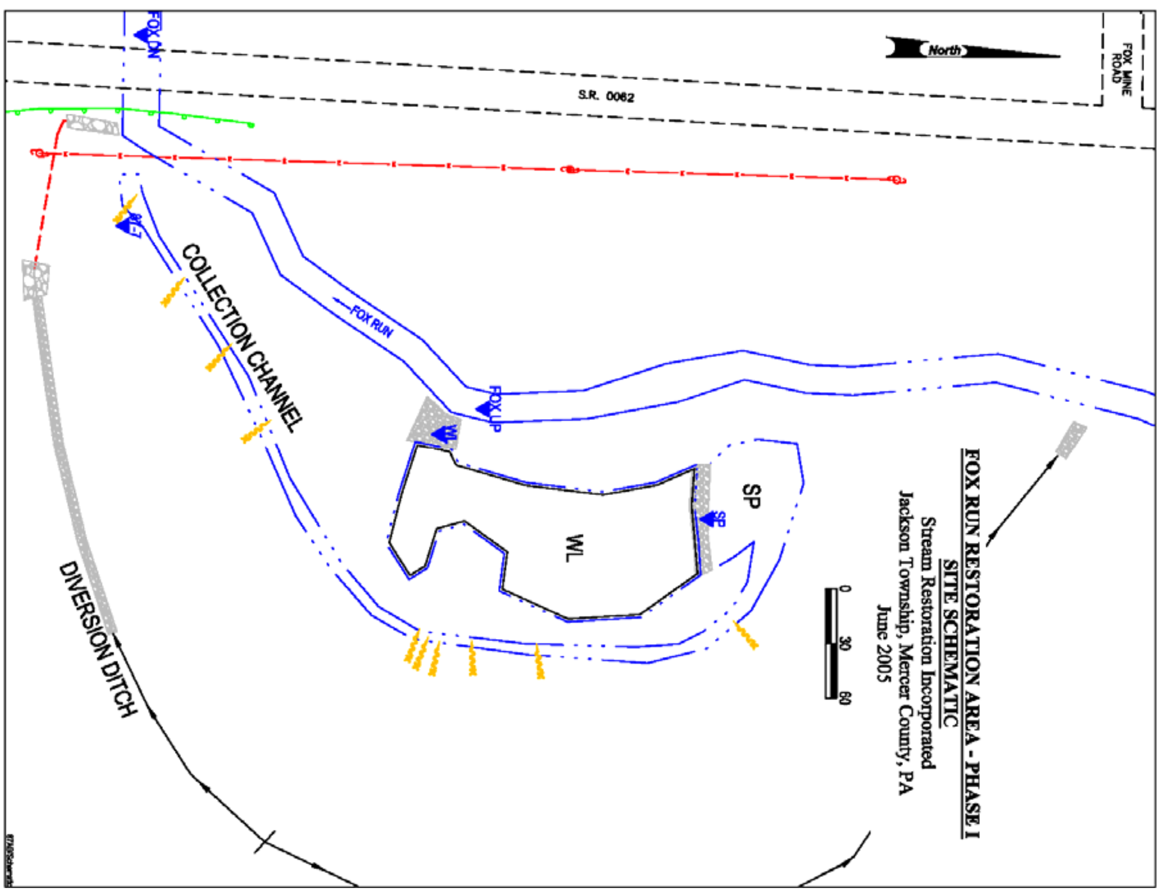
I. Sludge Accumulation

☐ - Not monitored

Component	Sludge Accumulation (within 1-2' of Spillway Y/N*)	Sludge Description	Comments
Collection Channel			
Settling Pond			
Wetland*			

*Note: The sludge accumulation in the Wetland may exceed the crest of the spillway as vegetation continues to grow in accumulated precipitates and helps to stabilize the sludge. In this case the sludge may continue to accumulate to within about 2' of the total berm height.

J.



6/2005

WETLAND PLANT DIVERSITY REPORT

Inspection Date:	______________	Project Name:	Fox Run Restoration Project– Phase I		
Inspected by:	______________	Municipality:	Jackson Township		
Organization:	______________	County:	Mercer	State:	PA
Time Start: ________	End: ________	Project Coordinates:	41° 17’ 47” Lat		80° 07’ 34” Long
Receiving Stream:	Fox Run	Subwatershed:	Yellow Creek	Watershed:	Cool Spring Creek

Weather (circle one): Snow Heavy Rain Rain Light Rain Overcast Fair/Sunny **Temp(°F):** #32 33-40 41-50 51-60 60+

Wetland: ______________________________

Common Name	Scientific Name	Plot #	Plot Location	Number

"The Fox Run Restoration Project"

By Kyle Durrett
BioMost, Inc.

June 30, 2005

(Jackson Center, PA) - The Fox Run Watershed is a subarea of the Shenango River Watershed (subarea 20a in the state water plan.) This watershed is situated in the central eastern portion of the Shenango River Watershed and receives drainage from 5,267 acres of Lake, Sandy Lake, Jackson, and Worth Townships in Mercer County and drains into Yellow Creek, a stocked trout fishery. Fox Run flows through land that was mined for coal by underground methods starting around 1949 by the Fox Mining Co. Surface mining for the Clarion coal seam became present in the watershed soon afterwards in 1954 and continued on into the 1970's and 1980's with the Willowbrook Mining Co and Adobe Coal. (some 608 aces surrounding the stream corridor.)

The Fox Run Watershed has since been identified by the Pennsylvania DEP as a high priority impacted by abandoned mine drainage (AMD) in the 1998 303d List of Waters. This report indicated that the source of pollution was from abandoned mine drainage originating from the section of Fox Run directly upstream and adjacent to the bridge crossing on State Route 62. The main cause of pollution is the amount of iron in the discharges. The abundance of iron precipitate present in this area of Fox Run and downstream from the discharges has had an immense impact on the quality of aquatic habitat. When the site was sampled for aquatic macroinvertebrate life the results were low, yielding less than seven taxa. Based on DEP studies, however, Fox Run has been identified as having the potential to be restored to a high quality of habitat.

In 1999 and 2000 the Mercer County Conservation District received a state grant and conducted an assessment of the abandoned mine drainage and the impacts on the stream. This study identified, monitored, and characterized three perennial discharges (ground water springs and seeps from the old mine) which were responsible for the majority of the degradation to Fox Run. All of the discharges were high alkaline iron-bearing in nature. It was recommended that Aerobic Wetlands be installed adjacent to each discharge to capture the iron before it entered the stream. This type of passive treatment system is a proven, long-term, low-maintenance remediation technique. **The passive treatment system at Fox Run Phase 1 will capture and estimated 4,000 pounds of iron from entering the stream annually!**

RESTORATION OF THE SITE

Stream restoration Incorporated began work on this site when we were contacted by the Mercer County Conservation District. SRI then submitted a Growing Greener grant to the DEP to work on the Fox Run watershed way back in 2002. After the grant was awarded the real work began. It was not until late September 2004 that construction actually began after all design and permitting had been reviewed. Quality Aggregates Inc. construction of the site worked as expected and there is now over a 1/3 acre passive treatment complex including a collection channel, settling pond, and aerobic wetland capturing iron along State Route 62. This new wetland, was planted with a diverse range of native species, providing food and habitat opportunities for wildlife thanks to excellent design by The Urban Wetland Institute and BioMost, Inc. In addition to the plantings two wood duck boxes and an owl box will be installed later this summer to make new homes for birds. As Fox Run returns to a healthy stream, full of the life it once had, it will be an excellent example for future projects in the watershed and a great opportunity for local people to learn about how to keep Pennsylvania clean and majestic.

For General Information or to Contact the Webmaster: sri@streamrestorationinc.org

Website Developed and Maintained by
Stream Restoration Incorporated

THE CATALYST

SLIPPERY ROCK WATERSHED COALITION MONTHLY ACTIVITIES UPDATE

THIS MONTH'S MEETING: Thursday September 11th at 7pm Jennings Environmental Education Center, pizza and pop will be provided. 8/14/03 Attendance: J. Belgredan, F. Brenner, C. Cooper, C. Denholm, M. Dunn, V. Kefeli, B. MacDonald, W. Taylor, J. Uytenbogaart

PHOTO OF THE MONTH

PHOTO OF THE MONTH

Fun in the Mud!
A special thank you to this sizable group of teenagers and chaperones who volunteered at the Erico Bridge treatment wetlands on July 26 as part of a Youth Conference for the North State of the Pittsburgh Ward of The Church of Jesus Christ of Latter Day Saints (SEE ARTICLE BELOW)

What's New at Erico Bridge

Things are looking a lot greener at the **Erico Bridge Restoration Project**, due to the planting efforts of two special groups. One of these groups, **Butler County Juvenile Court Services (BCJCS)**, has been teaming with the SRWC for three years now, while the other, **The Church of Jesus Christ of Latter Day Saints**, is new to the planting game. Each Tuesday throughout the summer, **BCJCS officers Sue McConnell, Bridgette Gigliotti, Mike Deal, Brenda Alter, Jody Mersher**, and as many as ten youth fulfilling their required community service hours have been at the project to help **Maggie Allio, Holly Martinchek, and Greg Holloway from Aquascape Wetland and Environmental Services** vegetate the treatment wetlands. It is a great community service project because it teaches the youth about the environment, and it is bettering watershed. Many of the students live near or along the Slippery Rock Creek and thus appreciate the connection to bettering the water quality near their homes. BCJCS recognized Aquascape's commitment to community service and presented them with the **William DiLuccio Award**.

Despite all of the excellent work of the BCJCS, the Erico Bridge treatment wetlands were still looking more brown than green until Saturday, July 26. On this day, as part of a Youth Conference of the Church of Jesus Christ of Latter Day Saints, approximately 125 enthusiastic teenagers and their chaperones descended on the project and transformed the wetland in a flurry of planting activity. In addition to losing shoes and getting stuck in the mud, they planted about 200 buckets of Pickerel weed and Softstem bulrush, 15 buckets of rice-cut grass, live cuttings from 10 willow wattles, and over 50 buckets of local transplants from the adjacent wetland. Some avoided the water and mud by helping install bluebird boxes in the area. Most ended up very muddy, and all seemed to have fun planting in the wetlands! To volunteer for wetland plantings or bluebird box monitoring (important for the success of nesting birds), contact Aquascape at (724) 458-6610.

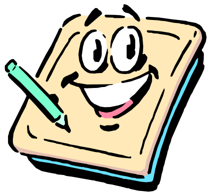
Teacher Workshops at Jennings Environmental Education Center

What was it like to be a coal miner in the early 1900's? How is coal extracted today? How does abandoned mine drainage form and why is it such a problem? On March 29, May 3, and May 24, 2003, twenty-two teachers from area school districts discovered the answers to these questions and much more by participating in an educational workshop designed by the **Jennings Environmental Education Center**. Through innovative hands-on activities, interpretive presentations, and field trips, teachers were not only introduced to a wealth of information, they also discovered how to incorporate this information into their classrooms and address the PA Dept. of Education's academic standards for Environment and Ecology. Some of the activities enjoyed by the teachers included "Cookie Mining" where the financial complications of operating a coal mine are introduced by way of Chips Ahoy; "Mystery Minerals" where mystery samples of minerals were identified during an introduction to geology; and "Construct Your Own Passive Treatment System", an activity developed by **Stream Restoration, Inc**. that provides participants the opportunity to design and construct a simulated passive treatment system. There were field trips to the **Quality Aggregates Limestone Quarry, Tour-Ed Mine & Museum, and Erico Bridge Restoration Project**. Partial funding of this program was through the **DEP Environmental Education Grants Program**. Special thanks to **Tim Danehy** and **Chris and Deanna Treter** from **Stream Restoration** for helping instructors **Will Taylor, Mary Jo Shreffler, Miranda Crotsley, and Eric Best**.

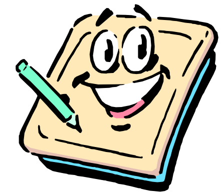
Hooray for herps! On August 6 and 7, Jennings hosted a very popular teacher workshop focusing on reptiles and amphibians. There were twenty-five participants in all: 19 teachers, 4 state park employees, and 2 volunteers from the PA Fish and Boat Commission. Thanks to instructors **Will Taylor** of **Jennings** and **Keith Edwards** and **Laurel Garlicki** of the **Fish and Boat Commission** for leading this interesting and fun workshop! Through enjoyable hands-on indoor and outdoor activities, participants learned about herp habitats and range, how to identify area reptiles and amphibians, snake locomotion, and much more. No doubt the highlight of the two-day workshop was going on an outdoor "Herp Hunt" to search for reptiles and amphibians! Species which were found include the ring neck snake, garter snake, American toad, wood frog, spring peeper, red back salamander, and Jefferson's salamander! And thanks to Jennings' very own "crocodile hunter", **Dave Johnson**, participants were able to see up-close a venomous snake that is also an endangered species: the Massasauga rattlesnake! The snake was a four-year old pregnant female. Dave gave a very enlightening talk on the three venomous snakes native to PA (E. massasauga, N. copperhead, and timber rattler). It was interesting to learn the female massasauga caught by Dave doesn't eat while pregnant (varying slightly from the normal behavior of the typical pregnant human!)

He's the "Trash Man"

Cliff Denholm of the **SRWC** was a one-man trash-picking machine on Friday August 15th! We applaud his solo effort in 90-degree heat and high humidity as he dutifully picked up trash along our stretch of I-79 (between mile marker 100 and 101) At least he had all of the sandwiches to himself! Our next trash pick-up day is scheduled for October 17 and we hope you can come out and join us in our effort to make our little stretch of highway as clean as it can be. We will meet at the "park 'n ride" off exit 99 (west on US 422) at noon for a free quick lunch. Safety vests and gloves will be provided. If you would like more information please call Melissa Busler at 724-776-0161.



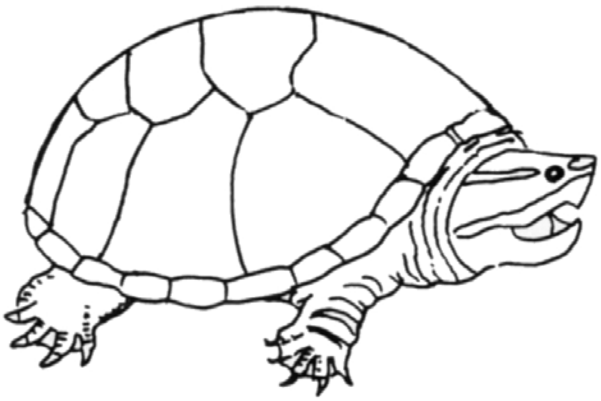
The KIDS Catalyst

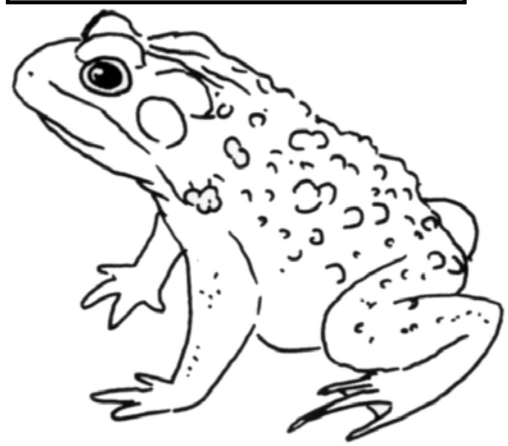


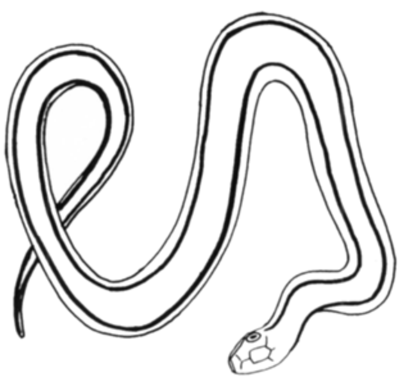
SLIPPERY ROCK WATERSHED COALITION FUN ACTIVITY

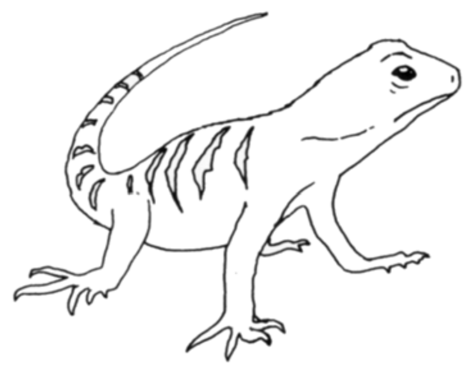
Herp Coloring Activity

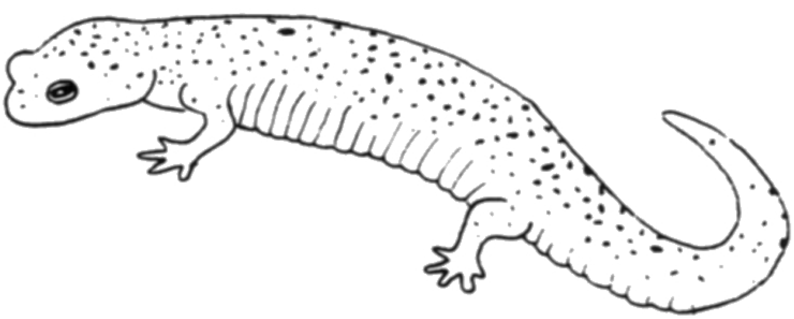
The word “herp” refers to reptiles and amphibians, and includes creatures like snakes, lizards, turtles, salamanders, frogs, and toads. Below is a picture of each of these types of herps. Write the name of the herp kind in each box, color in the picture, and return your coloring to us for a free gift certificate!

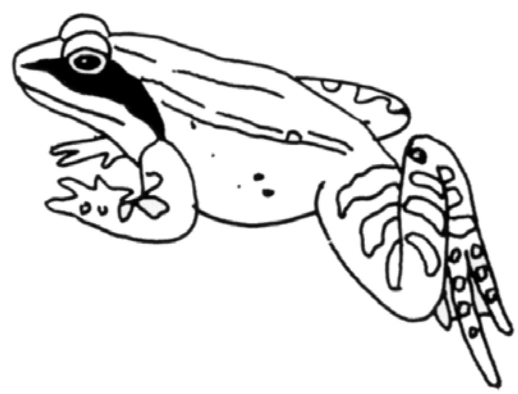












Name ____ **Age** ___________

Address ____

Slippery Rock Watershed Coalition c/o Stream Restoration Incorporated
A PA Non-Profit Organization
3016 Unionville Road
Cranberry Twp., PA 16066

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Thanks to The William & Frances Aloe Charitable Foundation, Environmentally Innovative Solutions, LLC, Dominion Peoples, Amerikohl Mining, Inc., Quality Aggregates Inc., Bio-Most, Inc., Allegheny Mineral Corporation and PA DEP for their support. For more information contact: Slippery Rock Watershed Coalition, c/o Stream Restoration Incorporated (PA non-profit), 3016 Unionville Road, Cranberry Twp., PA 16066, (724)776-0161, fax (724)776-0166, sri@streamrestorationinc.org, www.srwc.org. September Distribution: 1098

Highlighting **O**ther **P**artnership **E**fforts (HOPE!)

Mercer County Conservation District

This month we pay tribute to our neighbors, the good folks of the **Mercer County Conservation District (MCCD)** In 1999, the **MCCD** was awarded grant money which was used to sponsor the **Fox Run Watershed AMD Survey** in Mercer County. This project, which has been successfully completed, involved a survey of the Fox Run Watershed to identify the impact of historic mining activities on the water quality. Discharges existing on previously mined land were located and inventoried, with their physical and chemical attributes and effects quantified. Based on this initial assessment, **Stream Restoration, Inc.** is partnering with the MCCD to address one of the major discharges on Fox Run. Located along Route 62, the site is clearly visible from the road. Participants in this partnership are hoping for community support and involvement with the project. **Dr. Fred Brenner**, board member of the district and professor at **Grove City College**, and several students from **Grove City College** are already involved in the work, and educational outreach events are being planned. We are enjoying working with the MCCD on this project, and would like to acknowledge the good work of **Jim Mondock, District Manager, Shawn Hedgelin, Nutrient Manager Specialist, Jill Shankel, Watershed Specialist, and Bob McDonald, Technician.** If you would like to get involved with us in this project, please contact Shaun Busler at (724) 776-0161.

The 2nd Annual Ohio River Watershed Cruise

We hope you have registered and will be joining us in our celebration of the Ohio River Watershed for the 2nd Annual Riverboat Cruise! Remember to come early on Sept. 17 to enjoy the pre-cruise activities which begin at 10:00 a.m. Thank you to all of the cruise partners and sponsors to date; we will be acknowledging all partners and sponsors in a comprehensive list in next month's issue of The Catalyst.

November 2004

THE CATALYST

SLIPPERY ROCK WATERSHED COALITION MONTHLY ACTIVITIES UPDATE

<u>THIS MONTH'S MEETING:</u> Thursday November 11 at 7pm Jennings Environmental Education Center, pizza and pop will be provided. 10/14/04 Meeting Attendance: J. Belgredan, C. Cooper, C. Denholm, D. Johnson, S. Smith.

The SRWC Travels to D.C. for "Take Pride Award"

Several participants in the Slippery Rock Watershed Coalition traveled to our nation's capital, Washington, D.C., for the **Take Pride in America** national awards ceremony! The SRWC was honored to receive a national award from Take Pride in the category of Public/Private Partnership. The award was presented to the SRWC on Sept. 21 by **Secretary Gale Norton** of the Department of the Interior and **Marti Allbright**, the Executive Director of Take Pride in America. Awards were handed out to the winners from an unusual location: the roof of the Interior Building! It offered a bird's-eye-view of the nation's capital, a beautiful setting. Also part of the evening's festivities were the presentation of colors by the US Park Police Honor Guard, taped remarks from **Clint Eastwood** (Take Pride's National Spokesman), and remarks from **Desiree Sayle** from the USA Freedom Corps.

Representing the SRWC at the Take Pride awards were **Margaret Dunn, Annette Danehy, Tim Danehy, Cliff Denholm, Valentine Kefeli, Galina Kefeli, and Dave Johnson**. Dave, the park manager at Jennings Environmental Education Center, was the individual responsible for nominating the SRWC for the award. Thanks, Dave! Also on hand for the awards ceremony was **Jeff Jarrett**, former Deputy Secretary for Mineral Resources for the PA DEP, now the current Director of the OSM, Dept. of the Interior. The SRWC thanks Jeff for his support of numerous watershed reclamation projects throughout the United States over the years!

While the awards were presented on the 21st, the 20th was also a busy day for the SRWC. They were given a special tour of Washington, D.C., which included a wonderful banquet and reception in the evening.

There were 26 National Award Winners this year. The SRWC was recognized in the Public/Private Partnership category, with more than 500 volunteers contributing 2000 hours of time this year. Over 63 public and private partners are working together in the SRWC to make the Slippery Rock Watershed healthy and productive. This is being done, in part, by the SRWC's 15 treatment systems that handle and treat 750 million gallons of AMD annually.

New Book on Wildlife Diseases

A new book on wildlife diseases will be released in November, edited by **Dr. Fred Brenner** of the SRWC and Biology professor at Grove City College. Entitled "Wildlife Diseases: Landscape Epidemiology, Spatial Distribution and Utilization of Remote Sensing Technology", the book is edited by **S.K. Majumdar, J.E. Huffman, F.J. Brenner, and A.I. Panah**. It is published by the Pennsylvania Academy of Science. In addition to being a coeditor, Dr. Brenner and 12 former **Grove City College** students are the co-authors of three chapters in the book. This is the 10th book edited by Dr. Brenner.

PHOTO OF THE MONTH

"Take Pride in America" Ceremony (09/21/04): Jeff Jarrett, Director, US Office of Surface Mining with Cliff Denholm, Dave Johnson, Margaret Dunn, Valentine and Galena Kefeli, and Annette Danehy (Photo by Tim Danehy)

PHOTO OF THE MONTH

Will Taylor of Jennings stands with several papyrus plants used in Dr. Kefeli's water purification research project.

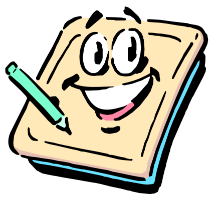
Water Purification Project

Dr. Valentine Kefeli, soil scientist of the SRWC, conducted research June through September of this year at **Jennings Environmental Education Center** to examine the ability of plants to purify water. Several volunteers, including students at **Slippery Rock University**, worked with Dr. Kefeli at Jennings. He was interested in developing a system of wastewater purification which could respond to several demands, with the understanding that in houses the peak of wastewater production occurs during the fall and winter seasons. Some of these demands include: developing plant disks for containers with polluted water with well-developed root systems; finding plants with active rooting and minimal dormant periods; proposing the indoor cycle of wastewater for its further recycling in green houses, atriums, and cold frames; choosing the proper pattern of plants for summer and winter water cleaning.

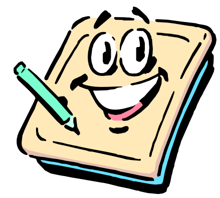
During the summer-fall season of this year, Valentine and his volunteers investigated the intensity of willow and poplar growth on fabricated soil and the rooting process of cuttings of these plants. Some species of willow and poplar were applied as tools for the plant disk constructions (summer type). A special focus was the propagation of tropical plants, which do not go dormant and could be used for water cleaning during the winter. Cloning of this type of plant was also an element of Valentine's project.

SRWC's Shaun Busler Gains GISP Certification

Congratulations to **Shaun Busler** of the SRWC and Stream Restoration Inc. for his recent certification in Geographic Information Systems (GIS)! Shaun was awarded professional certification in GIS this month and is now a certified member of the **GIS Certification Institute** (GISCI). Shaun met the standards and requirements established by GISCI for a Certified **GIS Professional** (GISP). He was certified under guidelines established by leaders within his field and his portfolio was also reviewed by a cross-section of his peers representing various disciplines. Fewer than 500 professionals with the GISP certification exist nation-wide. Shaun looks forward to developing relationships with fellow GISCI members and expects the future GIS-related training and materials he will receive as a GISP will help further advance his expertise in this growing field and its application to his work in the watershed.



The KIDS Catalyst

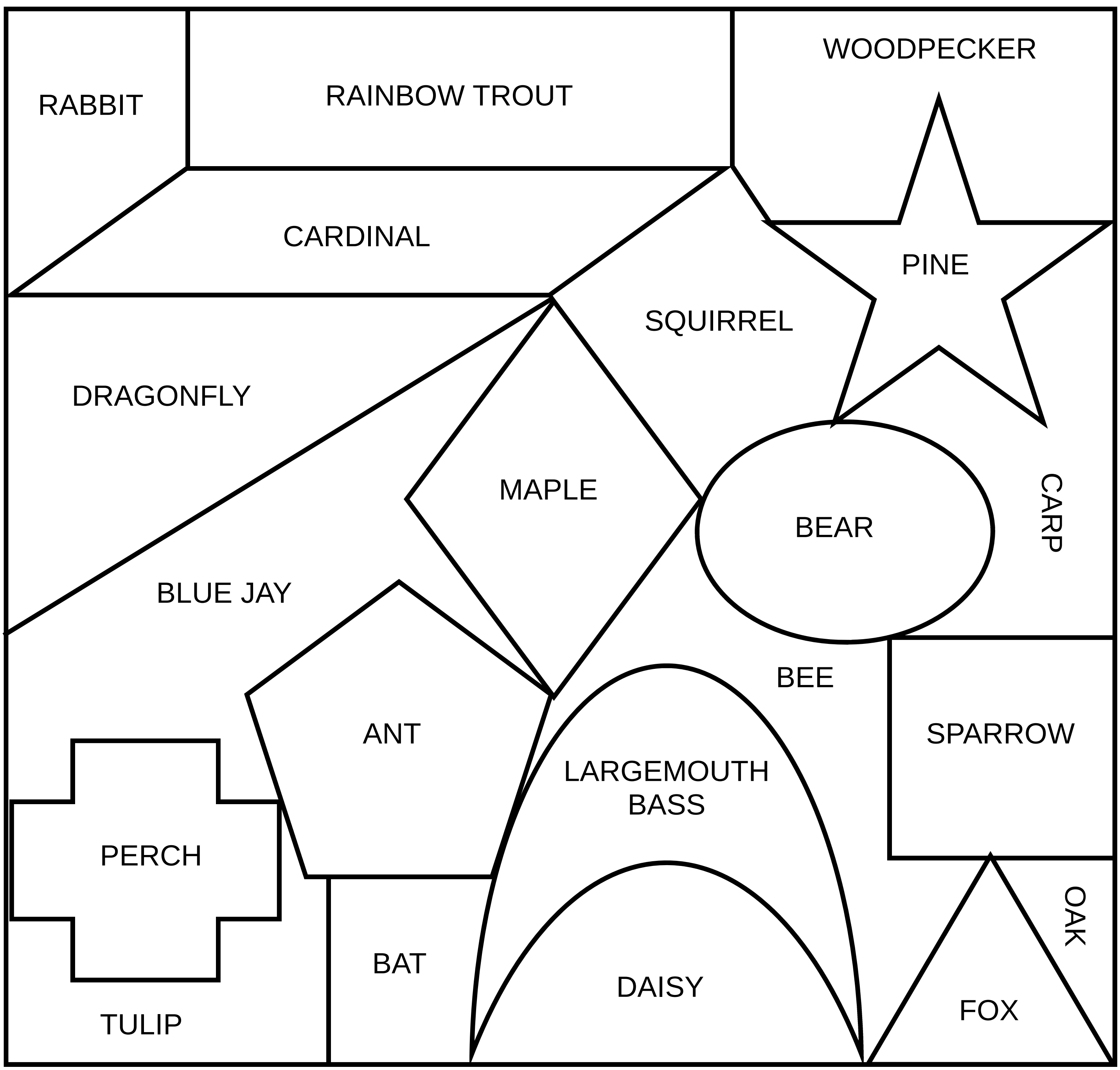


SLIPPERY ROCK WATERSHED COALITION FUN ACTIVITY

Wildlife Coloring Puzzle

How well do you know your Pennsylvania wildlife? The names of several different kinds of wild-life are found in the shapes in the game below. Your job is to color each shape according to the key in the following box. If you mail us your colored paper, we'll send you a free gift certificate!

Insect = purple	Mammal = orange
Bird = yellow	Flower = red
Tree = green	Fish = blue



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Thanks to The William & Frances Aloe Charitable Foundation, Environmentally Innovative Solutions, LLC, Dominion Peoples, Amerikohl Mining, Inc., Quality Aggregates Inc., BioMost, Inc., Allegheny Mineral Corporation and PA DEP for their support. For more information contact: Slippery Rock Watershed Coalition, c/o Stream Restoration Incorporated (PA non-profit), 3016 Unionville Road, Cranberry Twp., PA 16066, (724)776-0161, fax (724)776-0166, sri@streamrestorationinc.org, www.srwc.org. Nov. Distribution: 1230 copies

Highlighting Other Partnership Efforts (HOPE!)

Fox Run Watershed

This month we take a closer look at a neighbor of the SRWC—the **Fox Run Watershed**, located to the northwest of Slippery Rock Creek Watershed, in Mercer County. Fox Run flows into the Shenango River and is on the DEP's 303D List indicating it has been impacted. Fox Run, about 8 square miles in size, is on the list for elevated metals. Several alkaline discharges containing iron impact this waterway. One large discharge in particular, located in the headwaters area, essentially makes up the entire stream in times of seasonal low flow. The **PA DEP "Growing Greener," Mercer County Conservation District, Western PA Watershed Program, local land owners, Quality Aggregates Inc., Grove City College, Urban Wetland Institute, BioMost, Inc., and Stream Restoration Inc.** have partnered to clean this watershed with the goal of returning it to a healthy ecosystem for wildlife and lovers of the outdoors.

Construction of the first phase in what has been deemed the Fox Run Restoration Area was started in mid-September of this year. The installation of a bioswale, settling pond, and aerobic wetland by **Quality Aggregates Inc**. and their equipment operators, **Kevin Steiner** and **Mike Hjorten**, will treat several alkaline, iron discharges. Thanks to the landowner, **The Kish Family**, for allowing us to construct this system! This project is highly visible to the east of Route 62 and is close to completion. The wetland will be planted in the spring of 2005. Anyone interested in volunteering in the wetland planting may contact Shawn Hedglin of the Mercer County Conservation District at (724) 662-2242 or Dr. Fred Brenner of the Urban Wetland Institute at (724) 458-2113.

Fox Run Water Quality Database

Sample Point	Date	Method of Flow Meas.	Flow (gpm)	Field pH	Lab pH	Spec. cond. (umhos/cm)	Field Temp (C)	Alk. (F) (mg/L)	Alk. (L) (mg/L)	Acid. (mg/L)	T. Fe (mg/L)	D. Fe (mg/L)	T. Mn (mg/L)	D. Mn (mg/L)	T. Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
87-6	12/29/1999	Weir	976	7.0	7.4	594	5		141	0	6.9		0.6		0.1		107	5
87-6	1/28/2000	Cross-section	933															
87-6	1/31/2000	Cross-section	904	6.9	7.6	689	6		194	0	4.7		0.7		0.0		192	14
87-6	2/16/2000	Cross-section	4217															
87-6	2/28/2000	Cross-section	6680	6.9	6.9	242	4		35	0	0.9		0.2		0.2		64	5
87-6	3/13/2000	Cross-section	3109	7.1	7.2	408	6		82	0	4.8		0.4		0.2		87	5
87-6	3/27/2000	Cross-section	2041															
87-6	4/25/2000	Cross-section	2410	7.0	7.1	563	11		137	0	2.6		0.5		0.0		152	7
87-6	4/28/2000	Cross-section	2176															
87-6	5/25/2000	Cross-section	4712	6.9	7.1	350	13		80	0	2.1		0.3		0.1		98	14
87-6	5/30/2000	Cross-section	1285															
87-6	6/20/2000	Cross-section	3200															
87-6	6/28/2000	Cross-section	4374	6.9	7.1	305	16		80	0	2.8		0.4		0.2		63	6
87-6	7/25/2000	Cross-section	1185															
87-6	7/31/2000	Cross-section	900	7.3	7.5	738	12		216	0	2.3		0.7		0.0		227	4
87-6	8/24/2000	Cross-section	985															
87-6	8/28/2000	Cross-section	742	7.6	7.5	738	13		228	0	2.2		0.7		0.0		207	4
87-6	9/6/2000	Cross-section	792															
Min			742	6.9	6.9	242	4		35	0	0.9		0.2		0.0		63	4
Max			6680	7.6	7.6	738	16		228	0	6.9		0.7		0.2		227	14
Avg			2312	7.1	7.3	514	10		132	0	3.2		0.5		0.1		133	7
Range			5939	0.7	0.6	496	12		193	0	6.0		0.5		0.2		164	10

Description: Fox Run 1/4 mile downstream of Phase II upstream of Phase I

Fox Run Water Quality Database

Sample Point	Date	Method of Flow Meas.	Flow (gpm)	Field pH	Lab pH	Spec. cond. (umhos/cm)	Field Temp (C)	Alk. (F) (mg/L)	Alk. (L) (mg/L)	Acid. (mg/L)	T. Fe (mg/L)	D. Fe (mg/L)	T. Mn (mg/L)	D. Mn (mg/L)	T. Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
87-7	12/29/1999	Weir	13	6.6	6.8	913	9		253	0	10.8		1.7		0.0		307	7
87-7	1/28/2000	Weir	20															
87-7	1/31/2000	Weir	13	6.6	6.9	916	9		248	0	1.5		1.7		0.0		294	20
87-7	2/16/2000	Weir	13															
87-7	2/28/2000	Weir	22	6.5	6.9	1012	9		250	0	10.4		1.7		0.0		408	25
87-7	3/13/2000	Weir	13	6.9	6.8	920	10		245	0	9.8		1.6		0.0		313	6
87-7	3/27/2000	Weir	13															
87-7	4/25/2000	Weir	13	6.5	6.7	1108	10		272	0	16.3		1.8		0.0		417	7
87-7	4/28/2000	Weir	17															
87-7	5/25/2000	Weir	22	6.3	6.6	1473	11		326	0	23.1		2.3		0.0		796	21
87-7	5/30/2000	Weir	22															
87-7	6/20/2000	Weir	22															
87-7	6/28/2000	Weir	13	6.2	6.5	1476	11		325	0	26.6		2.5		0.0		926	16
87-7	7/25/2000	Weir	35															
87-7	7/31/2000	Weir	52	6.3	6.6	1356	11		334	0	20.3		2.3		0.0		531	6
87-7	8/24/2000	Weir	28															
87-7	8/28/2000	Weir	17	6.5	6.6	1080	11		285	0	17.4		1.9		0.0		428	8
87-7	9/26/2000	Weir	17															
87-7	2/9/2001	Weir	20	6.3	7.0	961	12		252	0	15.6	13.4	1.8	1.7	0.1	0.0	360	1
87-7	10/1/2002			6.0	6.8	1256			260	-252	16.0		2.0		0.1		472	11
87-7	6/18/2003			6.5	6.7	1072	10	260	264	-214	14.3	11.5	2.0	2.0	0.1	0.0	433	8
87-7	12/14/2004			6.0	6.4	2074	9	361	407	-254	27.1	26.3	2.2	2.2	0.1	0.1	992	10
87-7	2/7/2005			6.5	6.7	2116	6	459	428	-245	30.8	30.0	3.1	3.0	0.0	0.0	3127	13
87-7	3/17/2005			6.0	6.7	2265	6	438	425	-284	39.4	31.2	3.0	3.0	0.0	0.0	1234	14
87-7	4/13/2005			6.0	6.9	2181	10	456	412	-296	26.2	25.9	3.3	3.2	0.0	0.0	894	14
87-7	5/9/2005			6.0	6.5	2242		458	460	-315	26.0	25.7	2.5	3.3	0.2	0.2	849	14
87-7	6/1/2005			6.0	6.6	2350		481	456	-372	24.1	24.0	3.8	3.6	0.0	0.0	1489	10

Fox Run Water Quality Database

Sample Point	Date	Method of Flow Meas.	Flow (gpm)	Field pH	Lab pH	Spec. cond. (umhos/cm)	Field Temp (C)	Alk. (F) (mg/L)	Alk. (L) (mg/L)	Acid. (mg/L)	T. Fe (mg/L)	D. Fe (mg/L)	T. Mn (mg/L)	D. Mn (mg/L)	T. Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
Min			13	6.0	6.4	913	6	260	245	-372	1.5	11.5	1.6	1.7	0.0	0.0	294	1
Max			52	6.9	7.0	2350	12	481	460	0	39.4	31.2	3.8	3.6	0.2	0.2	3127	25
Avg			20	6.3	6.7	1487	10	416	328	-124	19.7	23.5	2.3	2.8	0.0	0.0	793	12
Range			39	0.9	0.5	1437	6	221	214	372	37.9	19.7	2.2	1.9	0.2	0.2	2833	24

Description: Abandoned underground mine discharge to Fox Run near SR62

Fox Run Water Quality Database

Sample Point	Date	Method of Flow Meas.	Flow (gpm)	Field pH	Lab pH	Spec. cond. (umhos/cm)	Field Temp (C)	Alk. (F) (mg/L)	Alk. (L) (mg/L)	Acid. (mg/L)	T. Fe (mg/L)	D. Fe (mg/L)	T. Mn (mg/L)	D. Mn (mg/L)	T. Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
87-9	12/29/1999	Weir	810	7.4	7.9	580	4		141	0	0.8		0.4		0.0		77	4
87-9	1/28/2000	Weir	810															
87-9	1/31/2000	Weir	810	7.7	8.1	721	4		188	0	0.4		0.6		0.0		174	15
87-9	2/16/2000	Weir	3544															
87-9	2/28/2000	Weir	6400	6.0	7.1	226	4		33	0	0.6		0.2		0.1		61	6
87-9	3/13/2000	Weir	2720	6.9	7.6	401	4		83	0	1.2		0.3		0.0		118	4
87-9	3/27/2000	Weir	1870															
87-9	4/25/2000	Weir	2282	7.6	7.6	556	10		137	0	2.0		0.4		0.0		138	6
87-9	4/28/2000	Weir	1870															
87-9	5/25/2000	Weir	3182	7.4	7.5	346	13		81	0	2.2		0.3		0.2		83	5
87-9	5/30/2000	Weir	2072															
87-9	6/20/2000	Weir	2389															
87-9	6/28/2000	Weir	3918	7.3	7.4	312	16		80	0	2.5		0.3		0.1		64	4
87-9	7/25/2000	Weir	810															
87-9	7/31/2000	Weir	810	8.0	8.1	722	13		220	0	1.2		0.5		0.0		231	5
87-9	8/24/2000	Weir	810															
87-9	8/28/2000	Weir	736	8.2	8.1	758	13		226	0	0.8		0.5		0.0		217	4
87-9	9/6/2000	Weir	527															
Min			527	6.0	7.1	226	4		33	0	0.4		0.2		0.0		61	4
Max			6400	8.2	8.1	758	16		226	0	2.5		0.6		0.2		231	15
Avg			2020	7.4	7.7	514	9		132	0	1.3		0.4		0.1		129	6
Range			5873	2.2	1.0	532	12		194	0	2.2		0.4		0.2		171	11

Description: Fox Run ~2/3 mile downstream of 87-7

Fox Run Water Quality Database

Sample Point	Date	Method of Flow Meas.	Flow (gpm)	Field pH	Lab pH	Spec. cond. (umhos/cm)	Field Temp (C)	Alk. (F) (mg/L)	Alk. (L) (mg/L)	Acid. (mg/L)	T. Fe (mg/L)	D. Fe (mg/L)	T. Mn (mg/L)	D. Mn (mg/L)	T. Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
SP	12/14/2004			7.0	7.2	1600	4	328	323	-235	8.8	4.8	2.3	2.2	0.1	0.1	630	6
SP	2/7/2005			6.5	7.0	1638	4	330	326	-255	11.3	10.0	3.1	3.1	0.0	0.4	1394	4
SP	3/17/2005			6.5	7.1	1706	4	338	340	-291	11.7	7.6	3.0	2.7	0.0	0.0	809	3
SP	4/13/2005			6.5	7.4	1715	12	350	336	-243	13.2	6.1	3.2	3.2	0.0	0.0	765	10
SP	5/9/2005			6.5	6.9	1803		355	379	-361	10.0	6.4	3.3	3.2	0.3	0.2	771	10
SP	6/1/2005			6.5	7.1	1932		372	1150	-166	9.5	6.6	3.8	3.8	0.1	0.0	1124	15
Min				6.5	6.9	1600	4	328	323	-361	8.8	4.8	2.3	2.2	0.0	0.0	630	3
Max				7.0	7.4	1932	12	372	1150	-166	13.2	10.0	3.8	3.8	0.3	0.4	1394	15
Avg				6.6	7.1	1732	6	346	476	-258	10.7	6.9	3.1	3.0	0.1	0.1	916	8
Range				0.5	0.5	332	8	44	827	194	4.4	5.2	1.5	1.5	0.2	0.4	763	12

Description: Settling Pond; Sampled at level spreader; Lab alkalinity on 6-1-05 is spurious although clarified by lab to be correct result. Sample may have been contaminated. Field alkalinity was 372.

Fox Run Water Quality Database

Sample Point	Date	Method of Flow Meas.	Flow (gpm)	Field pH	Lab pH	Spec. cond. (umhos/cm)	Field Temp (C)	Alk. (F) (mg/L)	Alk. (L) (mg/L)	Acid. (mg/L)	T. Fe (mg/L)	D. Fe (mg/L)	T. Mn (mg/L)	D. Mn (mg/L)	T. Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
WL	12/14/2004			7.5	7.5	1548	2	321	330	-233	1.7	0.8	2.1	1.7	0.1	0.0	630	1
WL	2/7/2005			6.5	7.2	1637	3	340	324	-197	7.8	6.5	3.1	3.0	0.0	0.0	1947	20
WL	3/17/2005			7.0	7.4	1723	3	345	348	-286	9.1	6.0	3.1	2.9	0.0	0.0	728	10
WL	4/13/2005			6.5	7.6	1657	11	348	339	-260	5.6	3.0	2.8	2.8	0.0	0.0	795	9
WL	5/9/2005			6.5	7.2	1827		360	383	-326	3.7	1.9	2.7	2.7	0.1	0.1	717	5
WL	6/1/2005			6.9	7.3	1886		347	377	-321	6.0	1.7	3.8	3.8	0.0	0.0	892	4
Min				6.5	7.2	1548	2	321	324	-326	1.7	0.8	2.1	1.7	0.0	0.0	630	1
Max				7.5	7.6	1886	11	360	383	-197	9.1	6.5	3.8	3.8	0.1	0.1	1947	20
Avg				6.8	7.4	1713	5	344	350	-270	5.7	3.3	2.9	2.8	0.1	0.0	952	8
Range				1.0	0.4	338	9	39	59	129	7.4	5.8	1.7	2.1	0.1	0.1	1317	19

Description: Wetland; Final Effluent of Fox Run Phase 1 passive treatment system; Sampled at spillway

Fox Run Water Quality Database

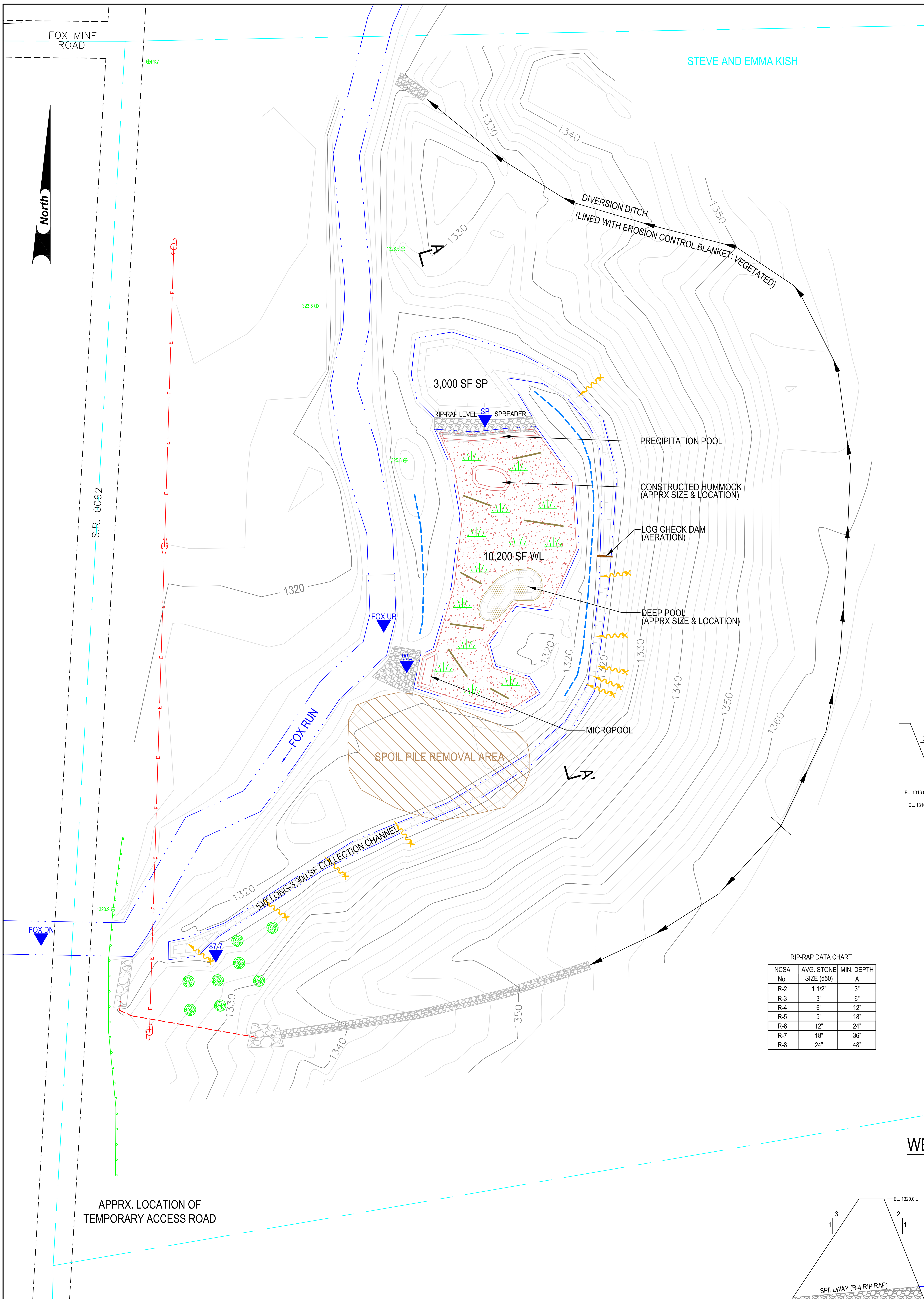
Sample Point	Date	Method of Flow Meas.	Flow (gpm)	Field pH	Lab pH	Spec. cond. (umhos/cm)	Field Temp (C)	Alk. (F) (mg/L)	Alk. (L) (mg/L)	Acid. (mg/L)	T. Fe (mg/L)	D. Fe (mg/L)	T. Mn (mg/L)	D. Mn (mg/L)	T. Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
FOX DN	12/14/2004			6.9	6.7	297	2		65	-41	1.2	0.7	0.2	0.2	0.1	0.1	85	4
FOX DN	2/7/2005			6.8	7.3	600	3	132	139	-108	3.2	1.6	0.6	0.6	0.0	0.0	149	8
FOX DN	3/17/2005			7.0	7.3	509	1	120	118	-99	2.3	1.7	0.5	0.5	0.0	0.0	131	7
FOX DN	4/13/2005			7.0	7.5	6	10	159	163	-135	3.0	2.0	0.6	0.6	0.0	0.0	192	9
FOX DN	5/9/2005			7.0	7.2	637		161	168	-154	2.9	1.8	0.7	0.7	0.3	0.1	152	6
FOX DN	6/1/2005			7.0	7.4	888		271	191	-186	3.0	2.5	0.9	0.8	0.0	0.0	287	7
Min				6.8	6.7	6	1	120	65	-186	1.2	0.7	0.2	0.2	0.0	0.0	85	4
Max				7.0	7.5	888	10	271	191	-41	3.2	2.5	0.9	0.8	0.3	0.1	287	9
Avg				6.9	7.2	490	4	169	141	-121	2.6	1.7	0.6	0.6	0.1	0.0	166	7
Range				0.3	0.8	882	9	151	126	145	2.0	1.8	0.7	0.6	0.2	0.1	202	5

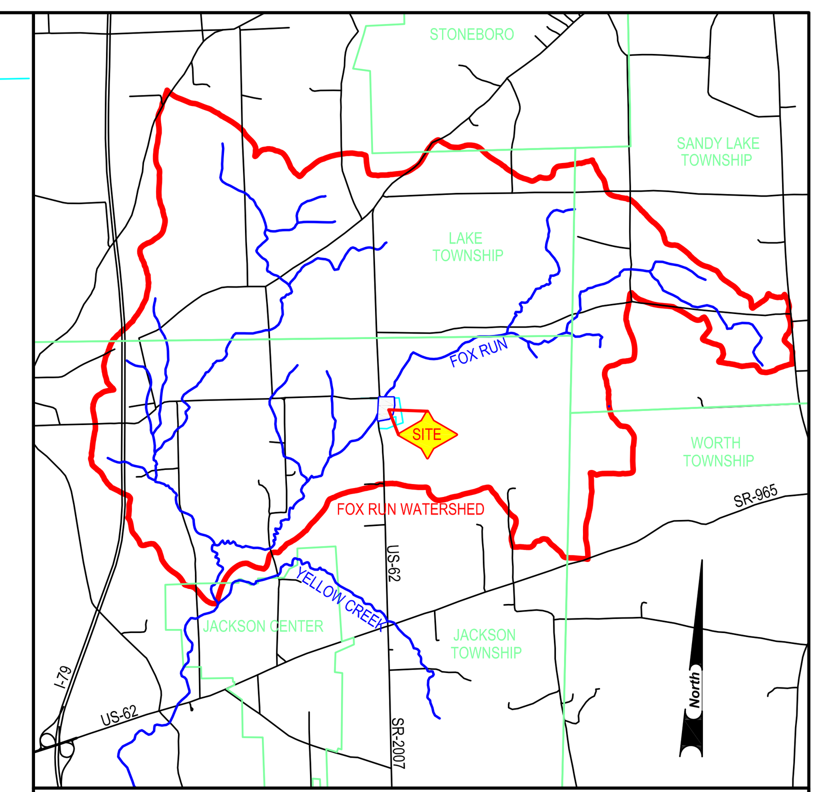
Description: Fox Run; Downstream of Phase 1 passive treatment system

Fox Run Water Quality Database

Sample Point	Date	Method of Flow Meas.	Flow (gpm)	Field pH	Lab pH	Spec. cond. (umhos/cm)	Field Temp (C)	Alk. (F) (mg/L)	Alk. (L) (mg/L)	Acid. (mg/L)	T. Fe (mg/L)	D. Fe (mg/L)	T. Mn (mg/L)	D. Mn (mg/L)	T. Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
FOX UP	12/14/2004			6.9	6.7	288	2		62	-43	1.2	0.7	0.2	0.2	0.1	0.1	80	1
FOX UP	2/7/2005			6.8	7.4	589	1	138	143	-97	3.0	1.7	0.5	0.5	0.1	0.0	184	4
FOX UP	3/17/2005			6.5	7.3	485	0	113	120	-103	2.4	1.7	0.4	0.4	0.0	0.0	116	6
FOX UP	4/13/2005			7.0	7.5	605	11	153	149	-116	3.1	2.0	0.6	0.6	0.0	0.0	173	8
FOX UP	5/9/2005			7.0	7.2	604		171	160	-143	3.1	1.8	0.7	0.6	0.3	0.2	136	6
FOX UP	6/1/2005			7.0	7.6	860		183	196	-164	1.3	1.0	0.9	0.8	0.0	0.0	199	6
Min				6.5	6.7	288	0	113	62	-164	1.2	0.7	0.2	0.2	0.0	0.0	80	1
Max				7.0	7.6	860	11	183	196	-43	3.1	2.0	0.9	0.8	0.3	0.2	199	8
Avg				6.9	7.3	572	4	152	138	-111	2.4	1.5	0.5	0.5	0.1	0.1	148	5
Range				0.5	0.9	572	11	70	134	121	1.9	1.3	0.7	0.7	0.3	0.2	119	7

Description: Fox Run; Sampled upstream of Phase 1 passive treatment system





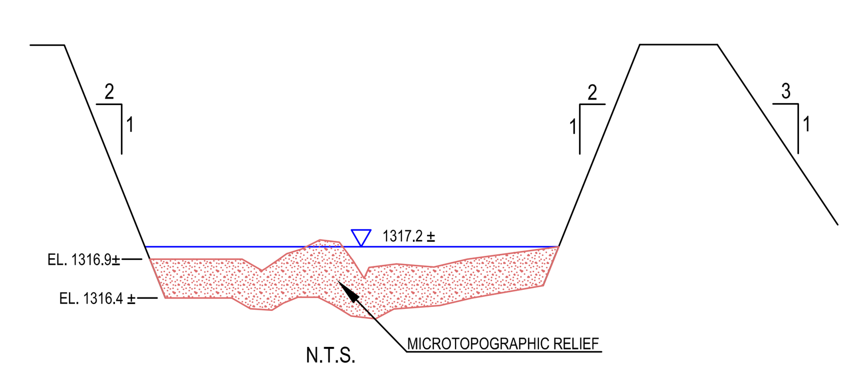
LOCATION MAP

1" = 1 MILE

LEGEND

- CONTOUR - INDEX
- CONTOUR - INTERMEDIATE
- PROPERTY LINE
- STREAM
- UTILITY POLE
- POWER LINE
- GUARDRAIL
- PAVED/IMPROVED ROAD
- WETLAND
- HIGH MARSH
- DEEP POOL
- WETLAND SUBSTRATE
- WOODY DEBRIS (REPRESENTATIVE)
- R-4 LIMESTONE RIP-RAP
- R-6 LIMESTONE RIP-RAP
- 36" PLASTIC COATED WIRE MESH (BURIED; LOCATION APPRX)
- 18" N-12 PIPE
- WATER SAMPLE POINT
- ABANDONED MINE DISCHARGE
- TEMPORARY BENCHMARK W/ ELEVATIONS
- 2' PINE TREE SAPLING (LOCATION APPRX)
- AS-BUILT CROSS SECTION

HIGH MARSH DETAIL

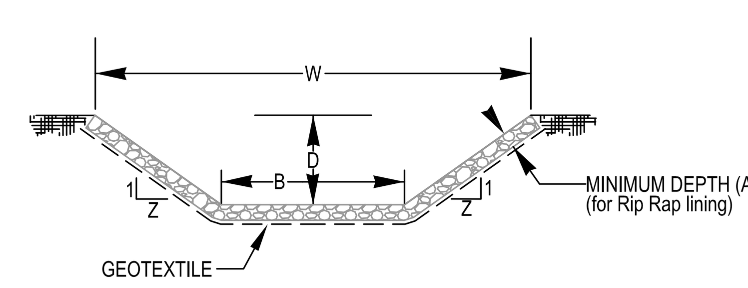


N.T.S.

RIP RAP CHANNEL DETAIL

RIP-RAP DATA CHART

NCSA No.	AVG. STONE SIZE (d50)	MIN. DEPTH A
R-2	1 1/2"	3"
R-3	3"	6"
R-4	6"	12"
R-5	9"	18"
R-6	12"	24"
R-7	18"	36"
R-8	24"	48"

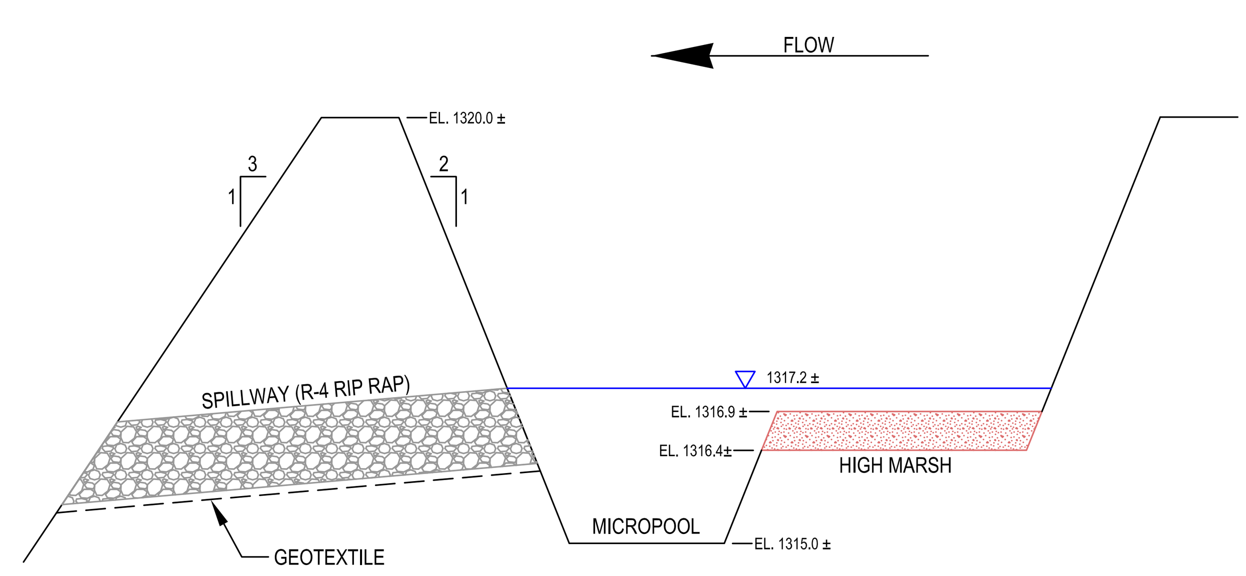


RIP-RAPPED CHANNELS

CHANNEL TYPE	W	B	D	Z	LINING
SPILLWAY	27	19	2	2	R-4

N.T.S.

WETLAND OUTLET DETAIL

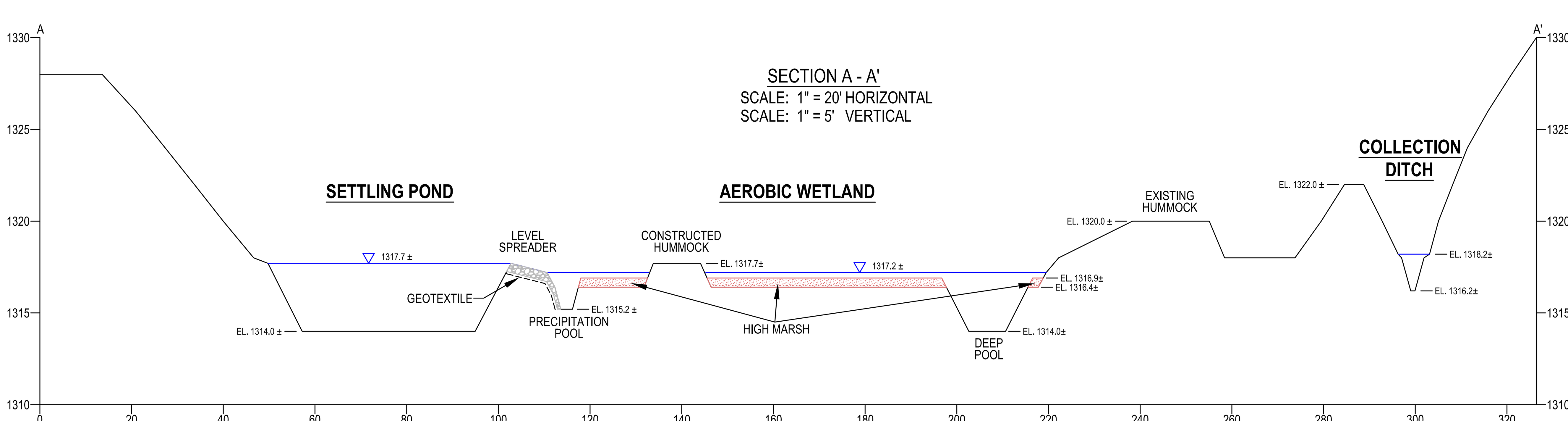


N.T.S.

SECTION A - A'

SCALE: 1" = 20' HORIZONTAL

SCALE: 1" = 5' VERTICAL



Notes:

Base map prepared by EDM survey by Earthtech, Inc. with additional information from site inspections provided by BioMost, Inc.

Surface areas calculated at approximate water elevation.

Bottom elevation of wetlands varies due to microtopographic relief.

Property owner of area: Steve and Emma Kish

PLAN VIEW AND DETAILS

AS-BUILT DRAWING

FOX RUN RESTORATION PROJECT - PHASE I

STREAM RESTORATION INCORPORATED

situate in

Jackson Township, Mercer County, PA

Scale: 1" = 30' Date: 6/2005

BioMost, Inc., Cranberry Township, Pennsylvania

Mining and Reclamation Services

87AB/AB Plan