JB1 Passive Treatment System
Phase 1
Technical Report

BioMost, Inc.
Stream Restoration Incorporated

June 2007

RACCOON CREEK WATERSHED RESTORATION - JB1 (PHASE 1)

TECHNICAL REPORT

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

Grants

PA Department of Environmental Protection Growing Greener Program

Ronald Horansky, Project Advisor

US Office of Surface Mining Appalachian Clean Streams Initiative

David Hamilton, Project Advisor

Support and In-Kind Contributors

Landowners: Margaret Pallus (Vincent T. Pallus); Robert & Louise McFall; Saundra Edmond; James Joseph, Daniel, & Ruth Petricca

Non-profits/Businesses: Independence Conservancy (Vicki Michaels, President); Raccoon Creek Watershed Assn. (Wayne Culmer, President); Quality Aggregates Inc. (Joe Aloe, Pres.); WOPEC (Tiff Hilton, Owner); G and C Coal Analysis Lab., Inc. (Michael J. Chestnut, Water Lab Director); McClymonds Supply & Transit Co., Inc. (Mark McClymonds, President); BioMost, Inc. (Tim Danehy, Sec./Treas.); Aquascape Wetland and Environmental Services (David Jessloski, Director); Environmentally Innovative Solutions, LLC (Jeff Ankrom, VP); Stream Restoration Inc.

Government Representatives: Washington Co. Conservation District (Gary Stokum, District Manager); Smith Twp. Supervisors (Thomas A. Schilinski, RJ Diaz, Joseph T. Murray); State Senator J. Barry Stout; Washington Co. Planning Commission (Jeffrey W. Leithauser, Env. Mgr.); Washington Co. Board of Commissioners [John P. Bevic (Chairman), Diana L. Irey, J. Bracken Burns Sr.]

Brief Description of Project Work through Grant and Partnership Contributions

- Completed applications/notifications/permits; delineated wetlands;
- Identified underground utilities and installed Erosion and Sediment Controls;
- Installed **4 piezometers** (10 exploratory boreholes) to monitor potentiometric surface of confined water-bearing zones associated with underground workings in the Pittsburgh coalbed;
- Conducted water sampling events;
- Developed/reviewed and interpreted geologic maps, cross-sections, isopleth maps, etc.;
- Compiled available water monitoring data from 1973 to date [sources: Operation Scarlift report; PA DEP (provided by John Davidson, former MCI); etc.];
- Identified dramatic change in site water quality and quantity;
- Compiled and reviewed precipitation data from 1836 to 2006 to assist in evaluation of recent dramatic change in discharge characteristics;
- Redesigned passive system relating to wetland impacts;
- Constructed innovative passive system to partially treat JB1; installed stream intake and distribution piping system along perimeter of existing impacted wetlands; enhanced wetlands and installed wildlife habitat features; [raw discharge (avg. values; n = 117): 950 gpm; 4.8 pH; 151 mg/l acidity; 50 mg/l total Fe; 2 mg/l total Mn; 5 mg/l total Al];
- Estimated current average neutralization of **~3000 lbs/day of acidity** and retention of **~700 lbs/day of metals** by passive system;
- Developed addendum to existing, watershed-wide, Operation & Maintenance Plan; utilized **"Datashed"** (www.datashed.org) to enable ready access to forms, data, etc.;
- Compiled **pictorial log** of site conditions including "before, during, and after" restoration;
- Submitted quarterly status reports and final report; administered contract.

Public-Private Partnership Effort

Project Advisor

PA Dept. of Environmental Protection, Greensburg District Mining Office,
Armbrust Professional Center, 8205 Route 819, Greensburg, PA 15601
HORANSKY, Ron, Watershed Mgr./Proj. Advisor; PONTORERO, Joel, District Mining Manager (724) 925-5500

US Office of Surface Mining
Harrisburg Field Office, 415 Market Street, Suite 3C, Harrisburg, PA 17101
HAMILTON, David, State Coordinator, Appalachian Clean Streams Initiative (717) 782-4871

Landowners

Edmond Family; McFall Family; Pallus Family; Petricca Family

Passive Treatment System Construction

Quality Aggregates Inc., 200 Neville Rd., Neville Island, PA 15225
ALOE, Joseph, Pres.; ANKROM, Jeff, VP; FUCHS Wayne, Foreman (412) 777-6717

Passive Treatment System Design, Water Monitoring, Operation & Maintenance

BioMost, Inc., 3016 Unionville Rd., Cranberry Twp., PA 16066
DANEHY, Timothy, QEP; DUNN, Margaret, PG; BUSLER, Shaun, GISP; DENHOLM, Clifford, Env. Sci.; DURRETT, Kyle, GeoTech.; GROTE, Tom, Facilitator; DANEHY, Sylvia, Office Mgr. (724) 776-0161

Bruce Leavitt, PE, PG; Consulting Hydrogeologist
2776 S-Bridge Rd., Washington, PA 15301 (724) 228-7385

Wetland Plantings

Aquascape, 200 Neville Rd., Neville Island, PA 15225
JESSLOSKI, Dave, Director; REIDENBAUGH, Jeff, Env. Eng. (412) 777-6717

Operation & Maintenance and Education & Public Outreach

Raccoon Creek Watershed Association, P.O. Box 251, Clinton, PA 15026
CUMER, Wayne , President; MICHAELS, Vicky, Vice-President; VERBANIC, Evan, Recording Secretary; KRESS, Mark, Treasurer (724) 947-3859

Washington County Conservation District
Suite 105 Courthouse Square, 100 W. Beau Street, Washington, PA 15301
STOKUM, Gary, District Manager; CARMICHAEL, Susie, Watershed Specialist (724) 228-6774

Grant Administration, Education and Public Outreach, Volunteer Effort

Stream Restoration Inc. (Non-Profit) 3016 Unionville Rd., Cranberry Twp., PA 16066
DANEHY, Timothy, QEP; DUNN, Margaret, PG; BUSLER, Shaun, GISP; DENHOLM, Clifford, Env. Sci.; DURRETT, Kyle, GeoTech.; GROTE, Tom, Facilitator; DANEHY, Sylvia, Office Mgr. (724) 776-0161

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PA Environment Digest, 12/19/06, Video Blog - BioMost, Inc.
PA Environment Digest, 12/19/06, Video Blog - Quality Aggregates Inc.
Raccoon Creek Watershed Restoration JB1 Project (handout 5/22/07)

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Pittsburgh Historical Precipitation Totals 1836 to 2007
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DRILL LOGS

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RACCOON CREEK WATERSHED RESTORATION - JB1 (PHASE 1)

TECHNICAL REPORT

submitted to

Pennsylvania Department of Environmental Protection
and
US Department of Interior Office of Surface Mining

EXECUTIVE SUMMARY

The Raccoon Creek Watershed, which covers portions of Allegheny, Beaver, and Washington Counties in southwest Pennsylvania, is severely impacted by historic coal mining activities. The main stem of Raccoon Creek is often degraded for 26 miles to the confluence with the Ohio River. In 2003, with support of numerous partners, a design-build team was developed and funding was received from the PA DEP Growing Greener Program and the US Office of Surface Mining Appalachian Clean Streams Initiative to implement partial treatment (Phase 1) for the abandoned mine discharge (JB1) which issues from the Pittsburgh & Eastern Coal Co. No. 2 Mine (ca. 1925) through an abandoned slope entry. Criteria used in the conceptual design for the grant applications were based on 90 PA DEP sampling events from 01/1995 through 04/2003 with confirming samples from the design team. Average values for JB1 were 833 gpm, 5.1 pH, 22 mg/l alkalinity, 117 mg/l acidity, 47 mg/l total iron, and 5 mg/l total aluminum. Possibly due to significant increases in precipitation starting in May 2003 with 2004 being not only the wettest year in recorded history (171 years) but also having the two largest storm events, JB1 characteristics changed dramatically, with average values of 1380 gpm, 4.6 pH, 6 mg/l alkalinity, 223 mg/l acidity, 89 mg/l total iron, and 12 mg/l total aluminum. With increases in average acidity, total iron and aluminum concentrations of 191%, 189%, and 240%, respectively, and in flow rate by 166%, **average acidity, total iron, and total aluminum loadings increased by 384% (from 1166 to 4474 lbs/day), 355% (from 476 to 1691 lbs/day), 555% (from 47 to 261 lbs/day), respectively.** In addition, due to the conditions by the US Army Corps of Engineers relating to disturbance of the existing AMD-impacted wetland, an innovative approach was needed and Phase 1 was redesigned. A piping system was installed along the outside perimeter of the existing wetland to disturb <1 acre and to more evenly distribute both the JB1 discharge as well as a portion of stream water from Raccoon Creek. Wetland plantings and installation of bluebird, duck, and bat boxes improved species diversity and wildlife habitat with over 30 species of animals being observed post-construction. While accurate flow measurements are difficult, estimated loading reductions indicates that currently **~3000 lbs/day of acidity are being neutralized and ~700 lbs/day of metals are no longer entering Raccoon Creek**. Implementation of Phase 2 is needed, however, to more fully address the impacts of the JB1 discharge to Raccoon Creek. Future restoration may consist of a second passive treatment system or the conveyance of mine water associated with the abandoned underground Erie, Langeloth, and Francis Mines ("ELF") to a single location for treatment or for use by the Beech Hollow Power Plant (Champion, PA). If the "ELF" project is determined to be feasible and if successfully implemented, the need for Phase 2 treatment may be eliminated.

COMPREHENSIVE TIMELINE

Abbreviations:
BMI - BioMost; **EPA** - US Environmental Protection Agency; **E&S** - Erosion and Sedimentation; **GG** - Growing Greener; **MOU** - Memorandum of Understanding; **OSM** - US Dept. of Interior Office of Surface Mining; **PA DEP** - PA Dept. of Environmental Protection; **PHMC** - PA Historic & Museum Comm.; **PLS** - Professional Land Surveyor; **QAI** - Quality Aggregates Inc.; **RCW** - Raccoon Creek Watershed; **RCWA** - Raccoon Creek Watershed Assn.; **RCWR** - Raccoon Creek Watershed Restoration -JB1; **SRI** - Stream Restoration Inc.; **USFWS** - US Fish & Wildlife Service; **WCCD** - Washington Co. Conservation District; **WCPC** – Washington Co. Planning Comm.; **WOPEC** - Working on People Environmental Concerns; **WPCAMR** - Western PA Coalition for Abandoned Mine Reclamation

DATE	DESCRIPTION
02/22/2001	Preliminary site investigation: T. Danehy, M. Hall, M. Dunn, J. Davidson, J. Ankrom, B. Beran
10/29/2002	PA DEP - RCW macroinvertebrate surveys - 4/30/2001, 10/28/2002,10/12/2003 received
11/29/2002	Raccoon Creek macroinvertebrate count by WCCD received
01/10/2003	Letter of Support/Access from Petricca family
01/16/2003	GG 2002A announced JB1 project to WCCD
01/17/2003	Water sampling and site investigation
01/17/2003	Site evaluation: Ankrom, Jessloski, Stokum, Davidson, Petricca, Dunn, Danehy, Beran
01/18/2003	Upstream - downstream data for the JB1 area requested from PA DEP
01/21/2003	Photos of JB1 area received from WCCD
01/24/2003	Letter of Acknowledgement from WPCAMR
01/28/2003	Letter of Commitment G & C Coal Analysis Lab., Inc.
01/28/2003	Letter of Support/In-Kind McClymonds Supply & Transit Co., Inc.
04/04/2006	Letter of Support/Access Margret Pallus
01/29/2003	Bucket tests of JBI discharge, stream and discharge mix
01/29/2003	Letter of Support/In-Kind Quality Aggregates
01/29/2003	Letter of Support Senator J. Barry Stout
01/29/2003	Letter of Support Washington County Board of Commissioners
01/29/2003	Site inspection, field tests, water sample collection, photos of potential future Phase 2
01/30/2003	Bucket tests of JBI discharge, stream and discharge mix
01/30/2003	Letters of Support from WCCD and WCPC
01/30/2003	Letter of Support from BMI
01/30/2003	Letter of Commitment from SRI
01/31/2003	Bucket tests of JBI discharge, stream and discharge mix
01/31/2003	Letter of Support Smith Township Supervisors
01/31/2003	Letter of Support/In-Kind Aquascape Wetland and Environmental Services
02/01/2003	Bucket tests of JBI discharge, stream and discharge mix
02/---/2003	Conceptual Passive Treatment System Design for JB1 (Phase 1)
02/01/2003	Letter of Support/Access Saundra Edmond
02/02/2003	GG Grant application submitted to DEP for JB1 (Phase 1)
02/02/2003	Letter of Support/Access McFall family
02/03/2003	Letter of Support Tiff Hilton (WOPEC)
07/16/2003	Grant application submitted for JB1 to OSM
07/22/2003	SRI provides OSM with Directors and Officers information
08/15/2003	Landowner info sent to PA DEP
08/19/2003	PHMC letter to OSM stated JB1 site has high probability of archaeological significance
08/28/2003	PHMC letter to SRI stated JB1 site has high probability of archaeological significance
09/11/2003	PHMC preliminary field meeting and review of site with PHMC (Mark McConaughy)
09/15/2003	PHMC letter to SRI - JB1 site has low archaeological potential - proceed with project
09/18/2003	Official notification DEP to SRI of GG Grant for RCWR- JB1 (Phase 1)

11/20/2003	Application to OSM for JB1 Watershed Cooperative Agreement
12/03/2003	Contract, SOW, Budgets, Support/Access Letters, Goals Worksheet submitted to DEP
12/19/2003	OSM Watershed Cooperative Agreement awarded
12/29/2003	SRI signs Watershed Cooperative Agreement for JB1 effective December 19, 2003
01/19/2004	Technical Transfer Evaluation CA 470306 submitted
03/01/2004	PA DEP completes processing of Growing Greener Grant Agreement
03/09/2004	Working capitol request to PA DEP for 20% of total grant ($80,000.00)
03/09/2004	Compliance Review for Grants/County Governments Form STD-21B submitted to PA DEP
04/01/2004	PA DEP Jan. - Mar. Quarterly Report 2004 submitted
04/01/2004	PA DEP Grants Center completes processing GG Grant Agreement
05/19/2004	OSM Performance Report for 12/19/2003 -3/19/2003 submitted
07/12/2004	PA DEP Apr. - June Quarterly Report 2004 submitted
07/12/2004	OSM Performance Report for 3/19/2004 -7/12/2004 submitted
10/08/2004	PA DEP July - Sept. Quarterly Report 2004 submitted
10/08/2004	OSM Performance Report for 7/13/2004 - 10/7/2004 submitted
01/06/2005	PA DEP Oct. - Dec. Quarterly Report 2004 submitted
01/06/2005	OSM Performance Report for 10/7/2004 -12/31/2004 submitted
04/22/2005	PA DEP Jan.- Mar. Quarterly Report 2005 submitted
04/22/2005	OSM Performance Report for 1/1/2005 -3/31/2005 submitted
07/12/2005	PA DEP Apr.- June Quarterly Report 2005 submitted
07/12/2005	OSM Performance Report for 3/31/2005 - 6/30/2005 submitted
10/14/2005	PA DEP July - Sept. Quarterly Report 2005 submitted
10/14/2005	OSM Performance Report for 7/1/2005 -9/30/2005 submitted
11/01/2005	GCCD provides hydric soil list for Greene and Washington Counties
11/01/2005	BMI and AQ site investigation and wetland delineation
11/10/2005	OSM Environmental Assessment - Clean Streams Program Project received
11/14/2005	Burgettstown-Smith Twp. Joint Sewer Auth. GIS Sewer Mapping requested
11/14/2005	Gannett-Fleming provided GIS and BCM Sewer Mapping
11/18/2005	Topographic site map forwarded to Jack Chamberlain
11/25/2005	Aerial photos by Aerocon Photo Services Inc. requested
12/01/2005	E & S Plan submitted to WCCD
12/---/2005	Preliminary site plan
12/07/2005	Pre-const. field evaluation, elevations, floodways, culverts, potential intake locations, etc
12/14/2005	McKay & Gould Drilling Co. request for drilling
12/16/2005	PA One Call System, Inc. notified
12/19/2005	McKay & Gould Drilling Co. & BMI BH 94-1, -2, -3, -4, -5, -6, -7, -8, -9, -10; 4 piezometers
12/20/2006	Piezometer water elevation monitoring
12/26/2005	OSM Eligibility Determination received
01/05/2006	Site investigation and stream flow
01/08/2006	Request for wetland waiver submitted to PA DEP
01/12/2006	Tax maps provided by Jack Chamberlain
01/20/2006	PA DEP Oct.- Dec. Quarterly Report 2005 submitted
01/20/2006	OSM Performance Report for 9/30/2005 -12/31/2005 submitted
01/24/2006	OSM Grant extension submitted
01/27/2006	OSM Hbg 1st Amend. to Watershed Coop. Agmt. Performance Period 1/1/2004 - 12/31/2006
02/---/2006	"Drilling in Raccoon Creek Watershed" H.O.P.E. article in *The Catalyst*
02/13/2006	Jack Chamberlain, PLS, provided coordinate & elevation data for survey refs & mon. wells
02/14/2006	Jack R. Chamberlain, PLS, requested map with survey refs. & monitoring wells
02/21/2006	Water elevation monitoring and water sampling

02/27/2006	PA DEP grants request of waiver of permitting requirements for the JB1 wetland
03/08/2006	Rough preliminary site elevation schematic completed
03/08/2006	SRI notifies USACE regarding need to use 1.2 acres of existing NP#27 wetland
03/09/2006	SRI sent Christina Schroeder (USACE) site plan with wetland delineation boundaries
03/13/2006	SRI provides USACE with updated property information and wetlands description
03/16/2006	Water sampling and site investigation
03/16/2006	BMI, SRI, and AQ field meeting with USACE to review site and project
04/03/2006	SRI sends five requested documents to USACE related to JB1 Project
04/07/2006	PA DEP Jan - Mar. Quarterly Report 2006 submitted
04/12/2006	USACE posts public notice of SRI request for AMD wetlands for mitigation
04/14/2006	OSM Performance Report for 1/1/2006 -3/31/2006 submitted
05/12/2006	Field meeting with USACE and USFWS to review site and project
05/15/2006	USFWS notifies USACE - compensatory mitigation of all wetland impacts recommended
05/15/2006	Jeff Reidenbaugh provides MOA between EPA and USACE
05/24/2006	Measured JB1 discharge for construction of flume
05/26/2006	Installed flume for JB1 discharge
05/31/2006	Site investigation and flow measurement
06/01/2006	Bruce Leavitt measured flow rate of JB1 discharge
06/07/2006	Bruce Leavitt measured flow rate of JB1 discharge
06/15/2006	USACE concurs with USFWS; requires 4.5 acres of mitigation (non-treatment) wetlands (3:1)
07/05/2006	PA DEP Apr.- June Quarterly Report 2006 submitted
07/05/2006	OSM Performance Report for 3/31/2006 -6/30/2006 submitted
08/02/2006	Water sampling and site investigation
10/11/2006	PA DEP July-Sept. Quarterly Report 2006 submitted
10/11/2006	OSM Performance Report for 7/1/2006 - 9/30/2006 submitted
11/03/2006	SRI withdraws the request to USACOE for wetland mitigation
11/21/2006	SRI submits revised design plan for JB1 Phase 1
12/01/2006	Copies of E & S Plan sent to Quality Aggregates
12/08/2006	Design calculations for JB1 passive treatment system completed
12/12/2006	Water sampling and site investigation
12/12/2006	Former PA DEP Sec. Dave Hess & RCWA tour site at beginning of construction
12/15/2006	Concrete Box Design sent to Quality Aggregates
12/15/2006	Bruce Leavitt sent Design Plan for RCWR-JB1
12/19/2006	Video Blogs of Tim Danehy (BMI) & Wayne Fuchs (QAI) in PA Environment Digest
12/21/2006	Field meeting, water monitoring, and site inspection
12/21/2006	Request to OSM to extend RCWR JB1 Watershed Cooperative Agmt. through 12/31/2007
12/29/2006	Extension request submitted to PA DEP
12/29/2006	OSM granted extension to 12/31/2007
01/02/2007	Field meeting/inspection
01/15/2007	Oct.- Dec. Quarterly Report 2006 submitted
01/15/2007	Field meeting/inspection
01/16/2007	OSM Performance Report for 10/1/2006-12/31/2006 submitted
01/17/2007	Plans & profiles of collection system submitted to Sub-Technical & B. Leavitt for review
01/19/2007	Field meeting/inspection
01/25/2007	Field meeting/inspection
02/01/2007	Field meeting/inspection
02/09/2007	Upgrades and repairs to cross-vane
02/13/2007	Field meeting/inspection
02/15/2007	Field meeting/inspection

02/16/2007	Field meeting/inspection
02/20/2007	Foam grouting plug for slope entry
02/20/2007	Field meeting/inspection
02/23/2007	Field adjustments
02/24/2007	Field adjustments
02/28/2007	Field meeting/inspection
03/16/2007	Site inspection
03/22/2007	Distribution system for JB1 discharge and stream intake online; post-construction inspection
04/02/2007	Reimbursement information sent by PA DEP
04/04/2007	Site inspection; adjusted pipe elevations
04/05/2007	Site inspection; adjusted pipe elevations
04/13/2007	Planting
04/13/2007	JB-1 Info Sheet - Education outreach document
04/25/2007	Water sampling and site inspection
04/27/2007	PA DEP Jan.- Mar. Quarterly Report 2007 submitted
04/27/2007	OSM Performance Report for 1/1/2007-3/31/2007 submitted
05/18/2007	Jeff Reidenbaugh ordered trees
05/22/2007	Picnic, “Get Together”, site tours: Independence Cons., RCWA, MRWA
05/29/2007	Site inspection for cross-vane reconstruction and other site const.
05/31/2007	Access road repairs
06/07/2007	Water sampling and site inspection
06/11/2007	Jeff Reidenbaugh finished planting at JB1
06/13/2007	Delivery of stone supplies for cross-vane upgrade
06/14/2007	Cross-vane upgrade begins
06/21/2007	Wildlife inventory of JB1 project identified 34 species of birds
06/25/2007	GG Funding Transfer Request to Presto-Sygan site AMD Remediation Project # GD040325
06/26/2007	Cross-vane upgrade completed
06/27/2007	Water sampling and site inspection
06/29/2007	Dissolved oxygen and pH measurements for isopleth map
06/29/2007	Elevation measurements for "As-Built" surveys
06/30/2007	Elevation measurements for "As-Built" surveys

PROJECT DESCRIPTION

Introduction

The approximately 184-square mile Raccoon Creek Watershed covers portions of sixteen municipalities in Allegheny, Beaver, and Washington Counties in southwestern Pennsylvania. Historical mining activities have substantially impacted major streams within the watershed, including the main stem of Raccoon Creek, which is degraded at times for 26 miles to the confluence with the Ohio River. The Commonwealth of Pennsylvania recognized the severity of the impacts to the watershed and, through Operation Scarlift, the abandoned mine discharges were inventoried and prioritized in the mid-1970s. Since that time, selected restoration activities have been completed, periodic monitoring has been conducted, and preliminary restoration plans have been proposed. The current project is the implementation of Phase 1 to partially treat the largest contributor of AMD in the watershed, known as Joffre Basin 1 (JB1).

Site Location

The JB1 discharge is located on the 7½' USGS Midway topographic map (PI1977) at latitude 40° 21' 40" and longitude 80° 21' 33". Phase 1 lies between Slak Lane and Bonnymeade Drive and is west of Joffre-Cherry Valley Road (SR4015) near the town of Bonnymeade (~1 mile northwest of Cherry Valley) in Smith Township, Washington County, PA. (See Location Map in O&M section of appendix.) Phase 1 is on properties of Margaret Pallus (Vincent T. Pallus); Robert & Louise McFall; Saundra Edmond; and James, Joseph, Daniel, & Ruth Petricca. (See "As-Built" plan view.)

Geologic Setting and Mining History

Within the Raccoon Creek Watershed, the Pittsburgh coalbed (Pittsburgh Fm.; Monongahela Gp.) has been extensively mined, with the earliest reported operation in 1781. The geologic setting (attitude, jointing, elevation, depth, etc.) of the Pittsburgh coalbed was instrumental in determining the mining method, location, direction, and extent. For instance, where the Pittsburgh coalbed crops, drift entries were driven directly into the coal from the surface, whereas in areas where the coal was deeper and at distance from the crop, slopes or shafts were used to access the coal.

According to Operation Scarlift Report SL 130-7 (Ackenheil, 1976), the JB1 discharge emanates from the Pittsburgh and Eastern Coal Company No. 2 Mine, locally referred to as the Cherry Valley Mine, through an abandoned open slope entry.

[Aside: Pittsburgh and Eastern Mines No.1, 2, 3 opened ca. 1903 along the Pittsburgh, Cincinnati, Chicago, and St. Louis (P.C.C. & St. L.) Railroad Company's Hickory Branch Line and had a combined production capacity of ~3000 tons/day. (Washlaski, retrieved online 2007)]

The Scarlift Report further stated that a 1925 mine map indicated a haulage-way beneath Raccoon Creek connecting the No. 2 Mine with the No. 3 Mine; therefore, providing a conduit for the two mines to contribute to the drainage at the abandoned open slope. The slope entry with the JB1 discharge (SE: ~1001') is about 20 feet above the base of the Pittsburgh coalbed and is located on the eastern flank of the north-south trending West Middletown Syncline which is coincident with the northern flank of the east-west trending Cross Creek Syncline. (Strike: N30-40W; Dip: ~1%SW) (Note mining areas on the attached generalized schematic for the "ELF" project.)

Major Discharges and Restoration Efforts

General Description of Underground Mine Pools

As noted in the 06/2006 report, "Raccoon Creek Restoration Project", (See references.), underground mines are described as being either above drainage (the coal is above the level of the local creek) or below drainage (the coal is below the level of the local creek). Water, that seeps into mines, flows down the dip of the coalbed until finding a discharge point or flowing into a below-drainage mine. Water that seeps or flows into a below-drainage mine causes the mine to fill with water like a swimming pool with the water level "backing up" in the mine until encountering a way to discharge to the surface. This discharge point can be an old mine entry, a borehole, or fracture in the rock. The water level continues to rise until the volume of water flowing out of the mine is equal to the volume of water flowing into the mine. As the amount of water flowing into the mines changes with the seasons, the water level in the mines also fluctuates.

Although discharging from perennially flooded mine workings, the JB1 discharge is located in the vicinity of a "beach" which may help to explain the extremely variable flow rates and water quality as described later in the report. (See West Virginia Water Research Institute map.)

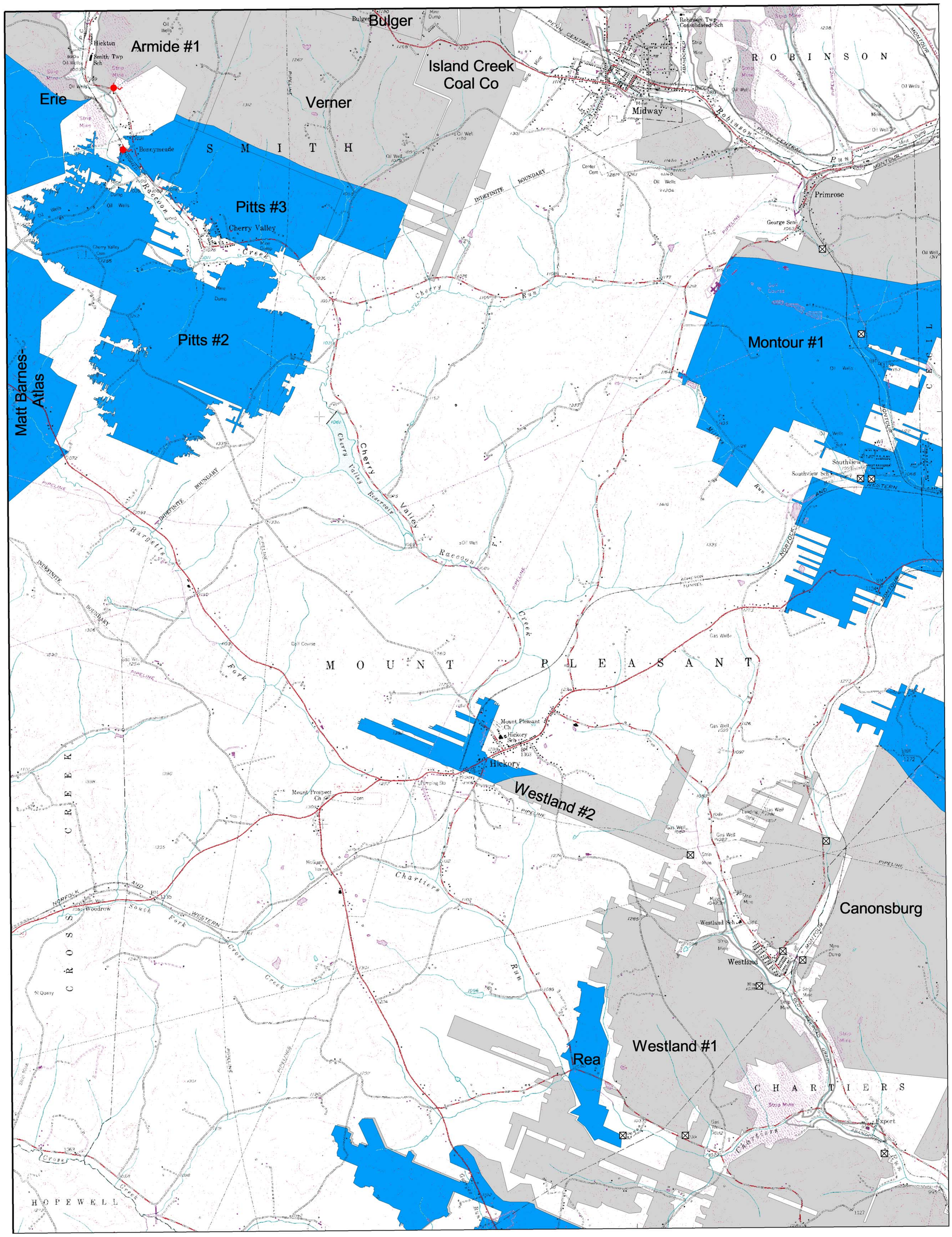
Abandoned Mine Discharges in the Raccoon Creek Watershed

According to a recent watershed-wide survey (Skelly & Loy, 2000), the historical mining activities left a legacy of least 175 to 200 degraded abandoned mine discharges. Many are considered insignificant; however, the restoration plan identified 7 primary and 17 secondary AMD sites with substantial stream impacts. According to the report, remediation of the primary sites would significantly improve the general water quality of the entire watershed. The primary sites were identified as:

- Langeloth Borehole (L2)
- East Plum Run (P6)
- West Plum Run (P7)
- Erie Mine (E1)
- Joffre Borehole 1 [*a.k.a.* Joffre Basin 1] (JB1)
- Joffre Borehole 2 [*a.k.a.* Joffre Basin 2] (JB2)
- Hamilton (H3)

Selected AMD Treatment Projects

Through efforts of the Raccoon Creek Watershed Association, Washington County Conservation District, Independence Conservancy, PA Department of Environmental Protection, and other stakeholders, passive treatment systems were installed to address discharges L2, H3, JB2, and drainage from the Solar Mine in 1999, 2003, 2004, and 2005, respectively. (Upgrades and renovations were completed on the JB2 system in 2006.) In 2003, with the support of numerous partners, a design-build team was developed and grants were received from the PA DEP Growing Greener program (SW30426; Doc# 4100020678) and the US Office of Surface Mining Appalachian Clean Streams Initiative (Watershed CA 470306) to implement Phase 1 for the JB1 discharge. Major construction of JB1 Phase 1 was completed in June 2007.



Flooding status in the Pittsburgh Seam - Midway, PA, Quadrangle

West Virginia University
West Virginia Water Research Institute
Hydrology Research Center

December 2003

Legend:

- mine drainage
- sealed shaft
- Pittsburgh coal outcrop

Colored areas are underground mining indicated on company maps; uncolored areas are unmined areas (including pillars and barriers), except that the areas between the indicated mines and the surface outcrop are probably mined.

Base map is derived from the U. S. Geological Survey Midway, PA, 7.5 minute topographic quadrangle map

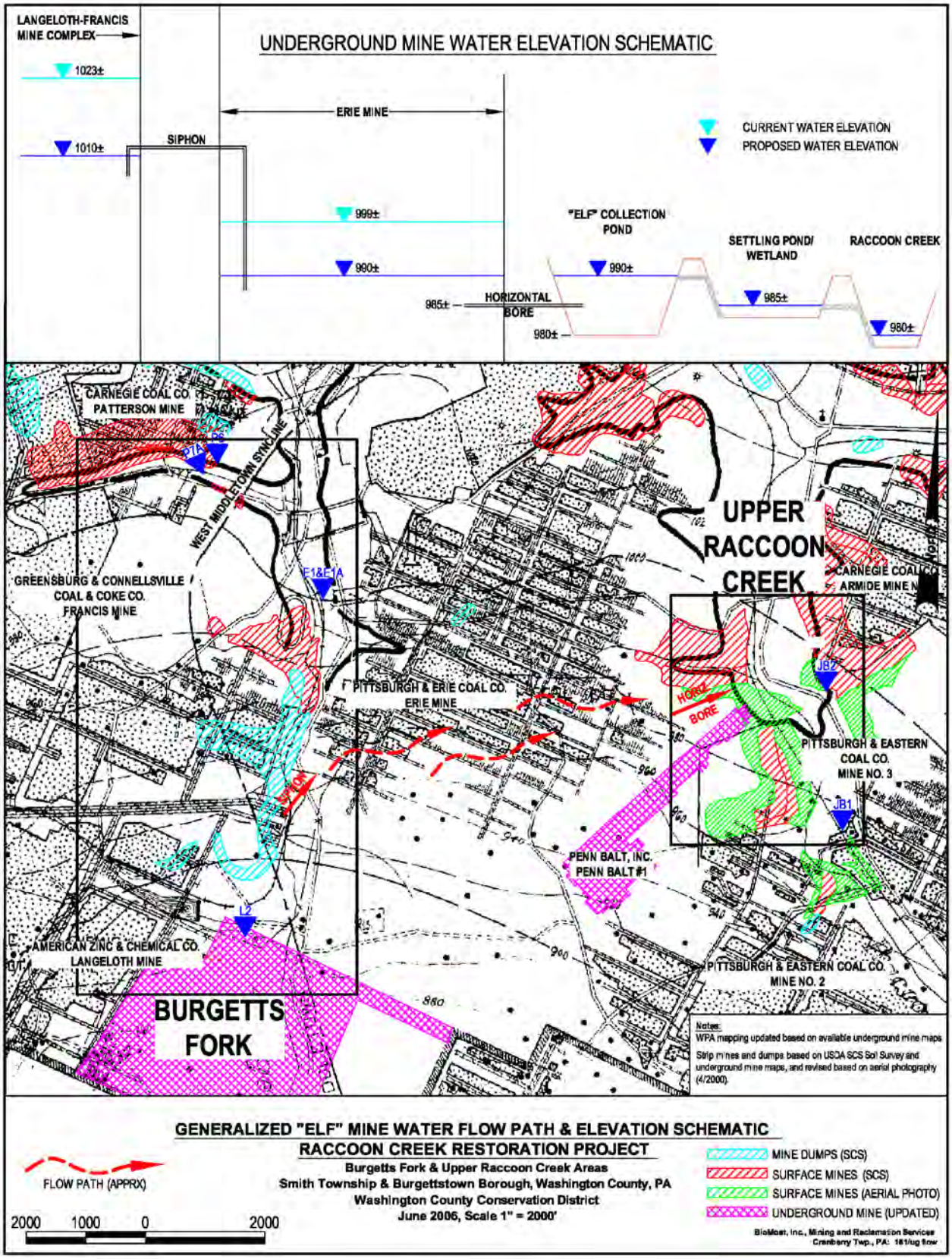
flooding status:

- not flooded or unknown
- active mine
- flooded or flooding

This mapping is a reasonable, but not exact, facsimile of the distribution of underground mined areas. Mine map outlines were compiled from a variety of original and secondary sources of varying accuracy. While the absolute accuracy of specific barrier locations, mine outlines, and unmined coal blocks may not easily be estimated, it may be considered to typically range from 30-100 meters. Mine features have been generalized; individual mains, longwall panels, and pillars are not explicitly shown. Unmined coal blocks within mines were mapped only if their total area was greater than about 40 acres.

Selected Future Restoration Efforts

Through a Growing Greener Grant to the Washington County Conservation District, an assessment and evaluation of abandoned mine discharges (L2, P7, E1, and others) has been recently completed (BioMost, 2006). Based on the recommendations, a grant from the PA DEP Bureau of Abandoned Mine Reclamation was received in 2007 to determine the feasibility of combining and conveying mine water associated with the abandoned underground Erie, Langeloth, and Francis Mines ("ELF") to a single location [DEP File No. OSM PA(AMD-06) Mine Pool Transfer]. Treatment of the combined discharges is projected to be more cost effective at one facility, rather than at four, with relocation of the discharges alone restoring ~6 miles of major streams in the Raccoon Creek Watershed. In addition, designers of the 300-megawatt Beech Hollow Power Plant, which is under construction ~5 miles east of the Cherry Valley area in Champion, PA (Washington County), are reviewing the feasibility of utilizing the mine water in the electricity-generation process. If feasible, the need for non-profits and/or the Commonwealth to build and maintain facilities to treat P7, E1, and L2 is essentially eliminated. (Phase 2 for JB1 may also be significantly decreased.) If the "ELF" project is successfully implemented, the only major discharge remaining in the Raccoon Creek Watershed would be East Plum Run (P6). (See attached Generalized "ELF" Mine Water Flow Path & Elevation Schematic.)


UNDERGROUND MINE WATER ELEVATION SCHEMATIC
LANGELOTH-FRANCIS MINE COMPLEX
1023±
1010±
SIPHON
ERIE MINE
999±
990±
985±
HORIZONTAL BORE
980±
"ELF" COLLECTION POND
990±
SETTLING POND/ WETLAND
985±
RACCOON CREEK
980±
CURRENT WATER ELEVATION
PROPOSED WATER ELEVATION
CARNEGIE COAL CO. PATTERSON MINE
P6
P1A
WEST MIDDLETOWN SYNCLINE
GREENSBURG & CONNELLSVILLE COAL & COKE CO. FRANCIS MINE
E1&E1A
UPPER RACCOON CREEK
CARNEGIE COAL CO. ARMIDE MINE
PITTSBURGH & ERIE COAL CO. ERIE MINE
HORIZ. BORE
JB2
PITTSBURGH & EASTERN COAL CO. MINE NO. 3
JB1
PENN BALT, INC. PENN BALT #1
L2
AMERICAN ZINC & CHEMICAL CO. LANGELOTH MINE
PITTSBURGH & EASTERN COAL CO. MINE NO. 2
BURGETTS FORK
Notes:
WPA mapping updated based on available underground mine maps
Strip mines and dumps based on USDA SCS Soil Survey and underground mine maps, and revised based on aerial photography (4/2000).
GENERALIZED "ELF" MINE WATER FLOW PATH & ELEVATION SCHEMATIC
RACCOON CREEK RESTORATION PROJECT
Burgetts Fork & Upper Raccoon Creek Areas
Smith Township & Burgettstown Borough, Washington County, PA
Washington County Conservation District
June 2006, Scale 1" = 2000'
FLOW PATH (APPRX)
2000 1000 0 2000
MINE DUMPS (SCS)
SURFACE MINES (SCS)
SURFACE MINES (AERIAL PHOTO)
UNDERGROUND MINE (UPDATED)
BioMost, Inc., Mining and Reclamation Services
Cranberry Twp., PA: 161/ug flow

JB1 Discharge Characteristics and Impact to Raccoon Creek

Table I describes both the JB1 discharge for various time periods and the overall average and median characteristics. Comparing recent monitoring (May 2003-June 2007) with the 90 sampling events conducted between January 1995 and April 2003, illustrates the recent dramatic increase in iron, aluminum, acidity and flow rates. In fact, monitoring from April and June 2007 identified the highest known flow rates as well as the highest known iron and aluminum concentrations.

Table I. JB1 Discharge Characteristics

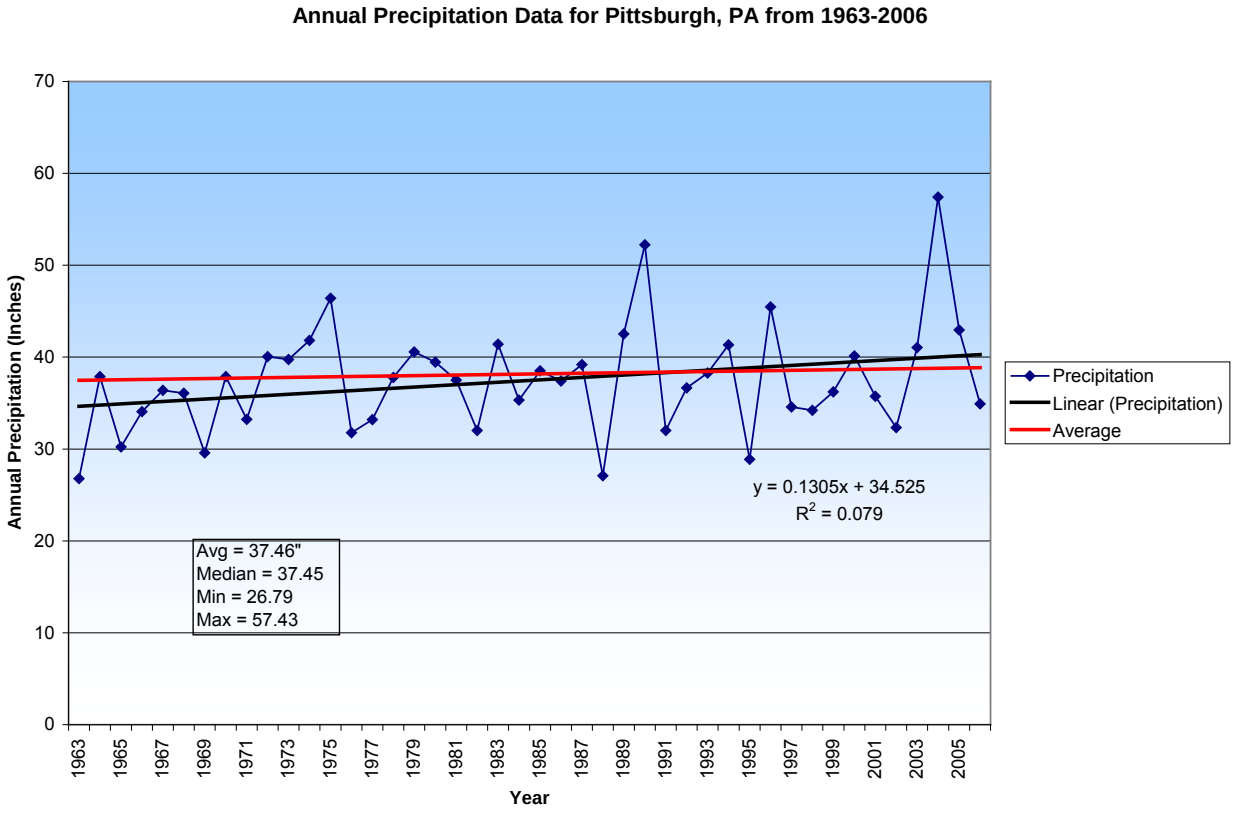
(average values - water quality parameters and flow rates)

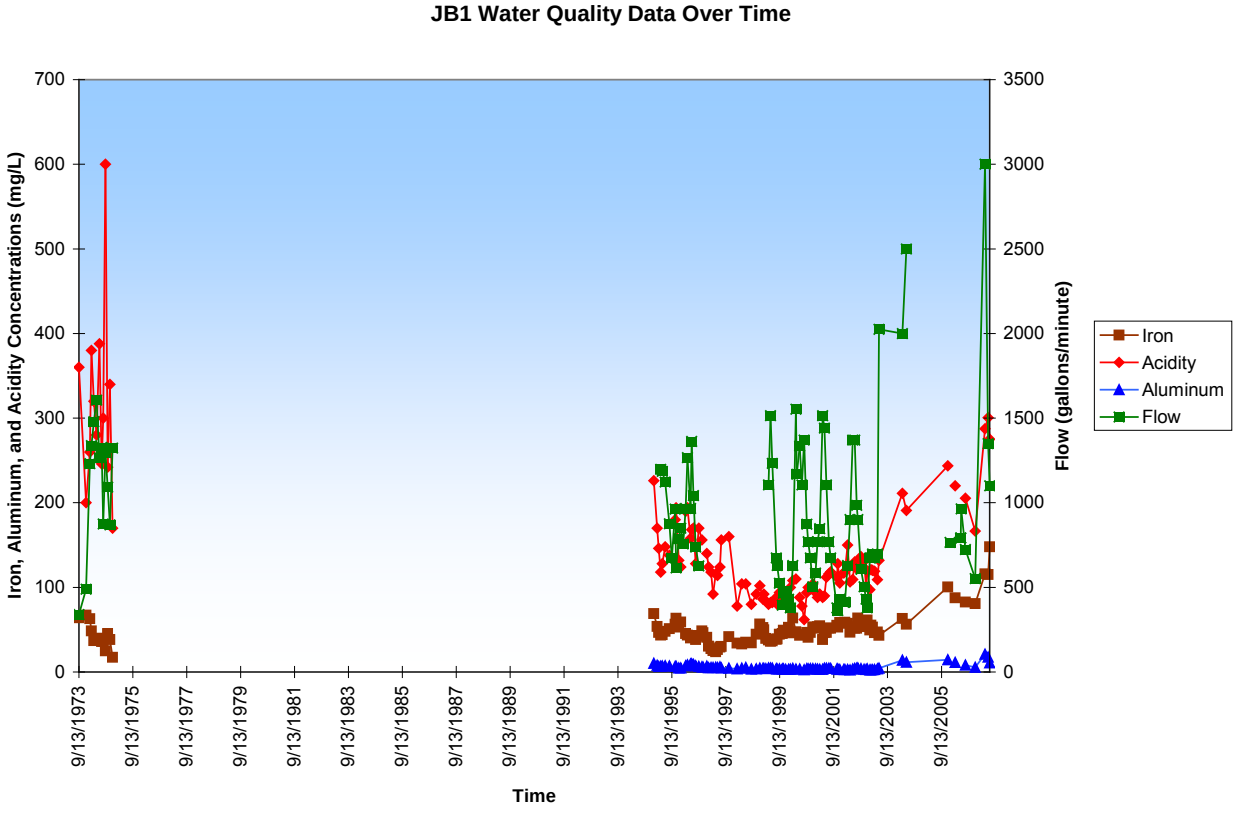
Monitoring Period	N	Flow	pH		Alk	Acd	Fe	Mn	Al	SO_4^{-2}
			field	lab	lab					
09/73-12/74	13	1100	-	3.0	0	314	43	-	-	830
01/95-04/03	90	830	5.5	5.0	22	117	47	1	5	650
05/03-06/07	14	1380	4.6	4.6	6	223	89	2	12	830
Average (all samples)	117	950	4.6	4.8	18	150	50	2	5	690
Median (all samples)	117	850	4.8	5.0	18	120	47	2	4	670

n - number of sampling events, may vary for individual parameters; flow in gallons per minute (gpm); pH in standard units not averaged from H-ion concentration; alkalinity and acidity mg/L as $CaCO_3$; total iron (Fe), manganese (Mn), aluminum (Al), and sulfate (SO_4^{-2}) in mg/L

The reason(s) for the changes is uncertain; however, a correlation with increased precipitation is expected. Of the 32 months from May 2003 through Dec 2005, 25 had above average precipitation. In addition, 2004 was the wettest year since record keeping began in 1836 with a total precipitation of 57.43" compared to the average of 37.85". (11 months in that calendar year had higher than average precipitation.) There were also two record-breaking precipitation events, Hurricanes Francis (3.60"; 9/8/04) and Ivan (5.95"; 9/17/04). The period of excessive precipitation followed a ~2-year period of drought conditions with annual precipitation 12-15" below average. (See attached Pittsburgh Historical Precipitation Totals: 1836 to Current.) Figure 1 further illustrates the relationship between annual precipitation and changes in flow and in selected water quality parameters over time for the JB1 discharge. Other mine discharges in the region are reported to have experienced similar changes in water quality (Rich Beam, PADEP BAMR, personal comm., 2007). Also note that samples collected over 30 years ago (1973-1974) had a low lab pH and high acidity. Again, the reason for the difference is unknown; however, sampling at a location farther from the source may be responsible for the discrepancy in pH values, and, dissolved aluminum (untested) may account for the higher acidity. Note that the 3/03-06/07 monitoring period reflects two sampling events in June 2007, which may slightly skew the data.

Figure 1. Relationship of Precipitation and JB1 Water Quality Over Time





The pollutant loading associated with the JB1 discharge (Table II) varies for **acidity and total iron by ~2000% (20x), total manganese by ~1500% (15x), and total aluminum by ~5000% (50x).** Due to the widely variable characteristics, this type of discharge is often referred to as a "slugger". Note that the average pollutant loading (considering all monitoring) for acidity is nearly 2000 lbs/day (~365 tons/yr) with a combined metal (Fe, Mn, Al) loading of almost 700 lbs/day (~125 tons/yr).

Table II. JB1 Discharge Loadings (1973 to date)

Values	Acidity	Iron	Manganese	Aluminum
Minimum	437	210	6	14
Maximum	10,361	4,183	90	760
Average	1,961	603	18	71

*loadings in lbs/day; total values; based on **all** samples with both flow rate and concentrations; n varies for individual parameters*

Prior to construction, the JB1 discharge flowed in a channel through a present-day wetland area which supported, and was reconfigured by, historical mining activities. Abandoned mine drainage from the impacted wetland is intercepted by a side channel of Raccoon Creek, which "cuts through" the wetland. (The side channel re-enters Raccoon Creek ~500 feet from the inlet.) [(See aerial photo depicting iron (orange color) precipitates in the wetland channel and aluminum (white color) precipitates in the side channel.] The impact of the JB1 discharge on Raccoon Creek is depicted in Table III. Upstream (monitoring point SL-1) of the discharge, Raccoon Creek is consistently a net alkaline, good quality, stream with low metal content. After mixing with the JB1 discharge, Raccoon Creek, at downstream sampling points SR8 and Keys Road, generally contains some alkalinity, but was, on average, net acidic with elevated concentrations of iron, aluminum, and sulfates. (Note sampling periods and dates for individual parameters do not necessarily coincide.)

The degree of impact from JB1 to Raccoon Creek varies seasonally. In reviewing the monitoring data, during low flow periods, JB1 appears to have a greater impact on Raccoon Creek than during higher flow periods due to the decreased alkalinity loading in Raccoon Creek during low flow as well as a decreased ability to dilute the discharge. During high flow periods, Raccoon Creek tends to remain net alkaline with the primary pollutant of concern being iron. (See Appendix.)

Table III. JB1 Impact on Raccoon Creek Pre-Phase 1 Implementation

(average values; laboratory measurements)

Sampling Point	Relationship To JB1	n	pH	Alk	Acd	Fe	Mn	Al	SO_4^{-2}
SL-1	directly upstream	13	7.7	177	-10	<1	<1	1	86
SR8	directly downstream	14	6.2	112	40	16	1	4	297
Keys Road	~¾ mile downstream	7	6.5	77	15	21	1	1	448

n - number of sampling events (may vary for individual parameters); flow in gallons per minute (gpm); pH in standard units not averaged from H-ion concentration; alkalinity and acidity in mg/L as $CaCO_3$; total iron (Fe), manganese (Mn), aluminum (Al) and sulfate (SO_4^{-2}) in mg/L

The Raccoon Creek Watershed Association, Washington County Conservation District, and others have also monitored the macro-invertebrates (See Table IV) at various stations within the watershed. The rating criteria, as used in a watershed-wide report (Skelly & Loy, 2000), indicates that Raccoon Creek at Location A [Keys Road] has poor water quality. The monitoring point is also impacted by the JB2 and JB25 abandoned mine discharges.

Table IV. Raccoon Creek Macro-Invertebrate Monitoring Data at Keys Road
(Source: PA DEP files provided by John Davidson, former MCI; Skelly & Loy, 2000)

Macroinvertebrate			Dates Sampled					
Order	Family	Common Name	10/---/99	04/---/00	10/---/00	04/30/01	10/29/02	10/12/03
Megaloptera	Sialidae	Alderfly	2	1		"no organisms collected"	2	3
Megaloptera	Corydalidae	Dobsonfly/hellgrammite			1			
Diptera	Chironomidea	Midges		2				
Diptera	Tipulidae							1
Amphipoda		Scud		1				4
(Phylum) Annelida	(Class) Oligochaeta			1				

Proposed Passive System and Pre-Construction Site Evaluation

Bench-Scale Testing

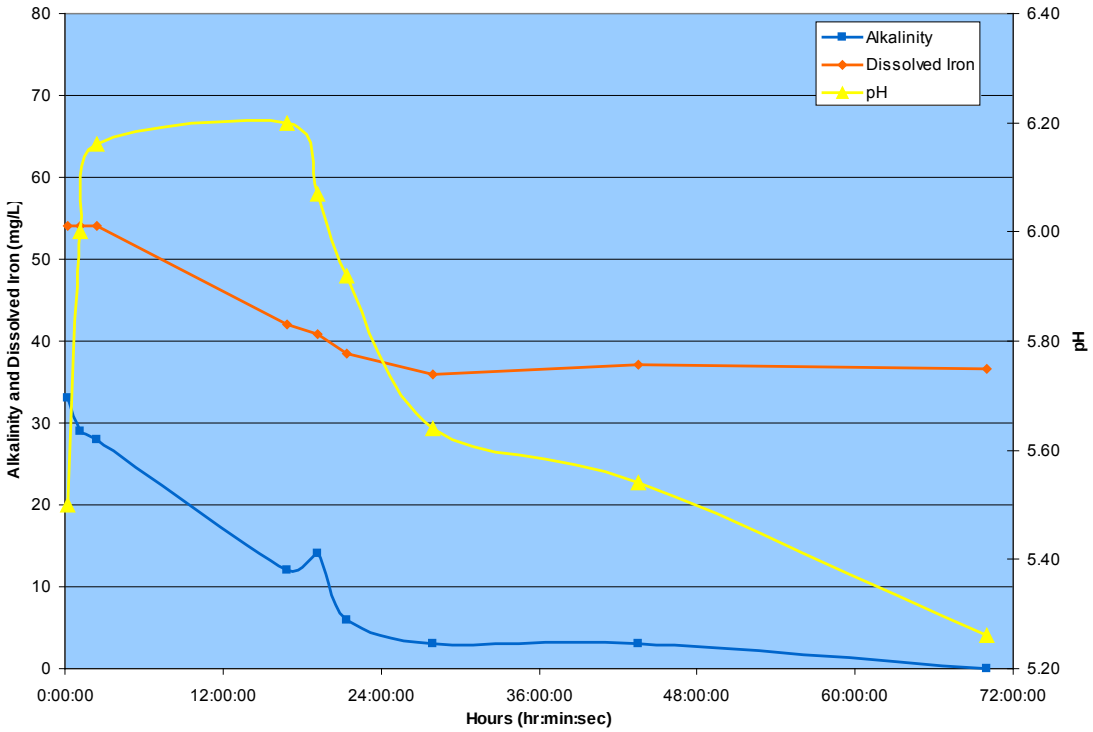
In order to evaluate design criteria and to develop and to validate, on a preliminary basis, a conceptual design for the JB1 Phase 1 passive system, bench-scale testing was conducted prior to submitting the grant application. (See photos.) Four tests were performed that included non-agitation and agitation of both JB1 only and JB1 mixed with stream water. The experiments were used to illustrate change in the iron removal rate associated with agitation and with the introduction of a small amount of the well-oxygenated, substantially net alkaline, stream water to the JB1 discharge.

The results indicated that mixing the discharge with the stream water and agitating (degassing CO_2/oxygenating) increased the reaction rate relating to iron oxidation/hydrolysis; therefore, providing the fastest (best) treatment while the discharge alone with no agitation and without the addition of stream water was slowest in forming iron particulates (least) treatment.

Figure 2 provides a comparison of the pH, alkalinity, and dissolved iron of the agitated discharge verses the agitated discharge (3 parts) and stream (1 part) mixture. Of particular note is that while the final alkalinity values and pH of the two are similar, the final iron concentrations of the discharge mixed with the stream are much lower. The initial difference in iron content is due to stream dilution; however, the greater change realized for the mixture is most likely due to the higher pH, dissolved oxygen levels, and alkalinity loading provided by the stream, and, with degassing of carbon dioxide during agitation. [Ferrous iron oxidation rates are faster at higher pH and alkalinity maintains (buffers) the pH as acidity is generated from hydrolysis of the ferric iron.] (See photos.)

Figure 2: Agitated Samples With and Without Stream Contribution

DISCHARGE ONLY



STREAM AND DISCHARGE

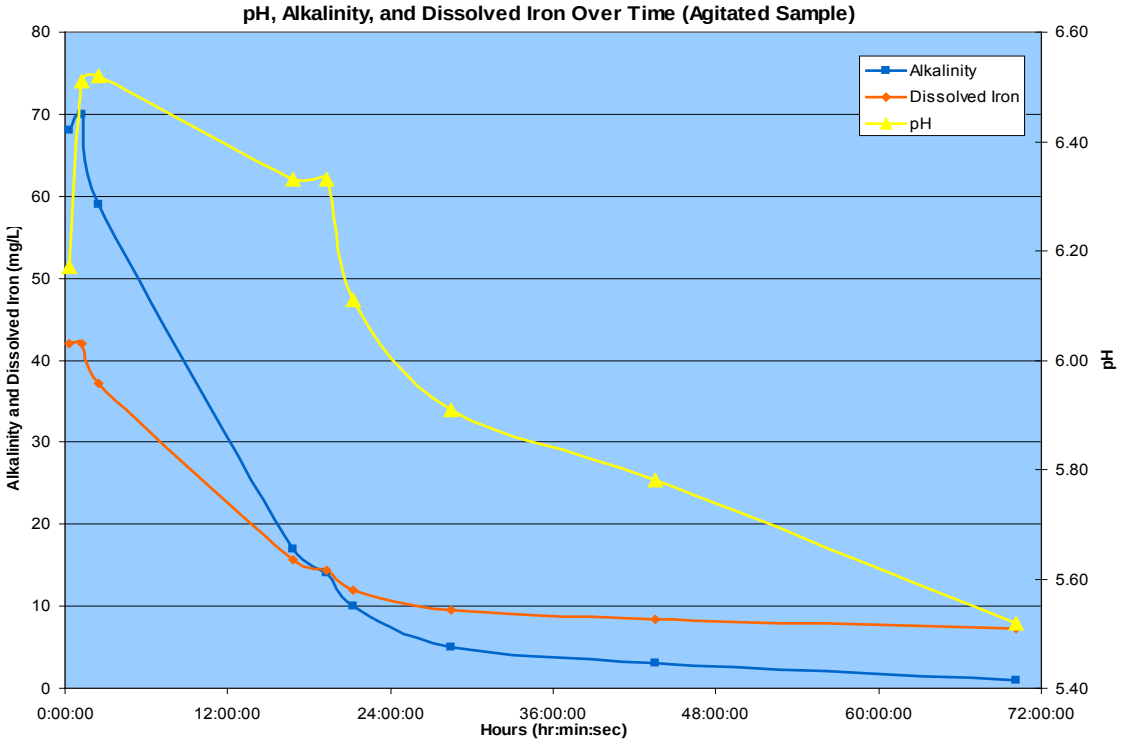
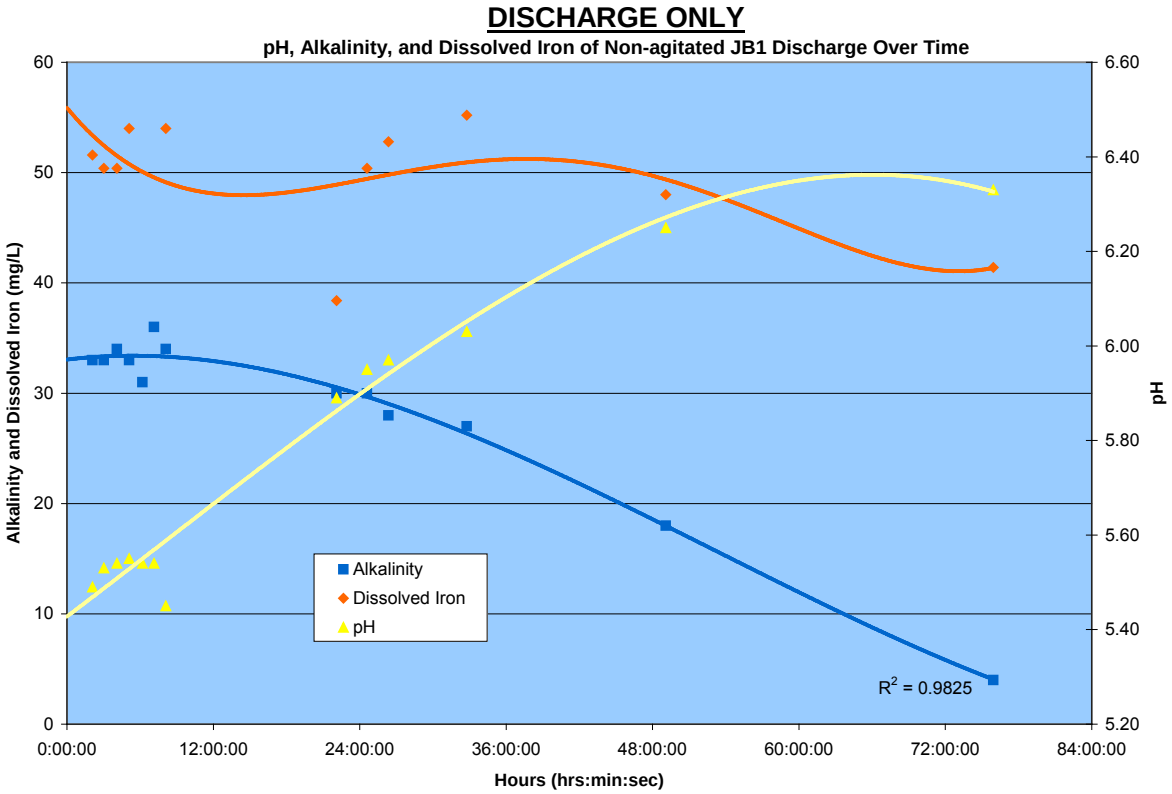


Figure 3: Nonagitated Samples With and Without Stream Contribution



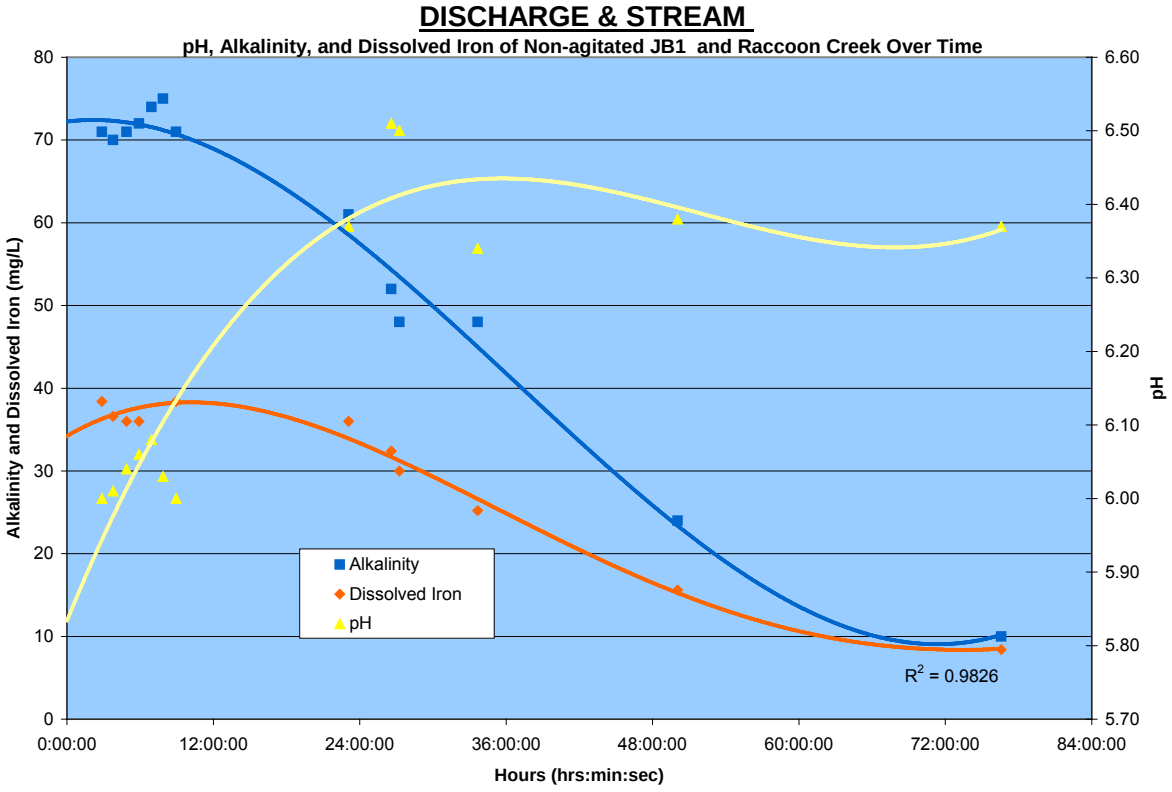
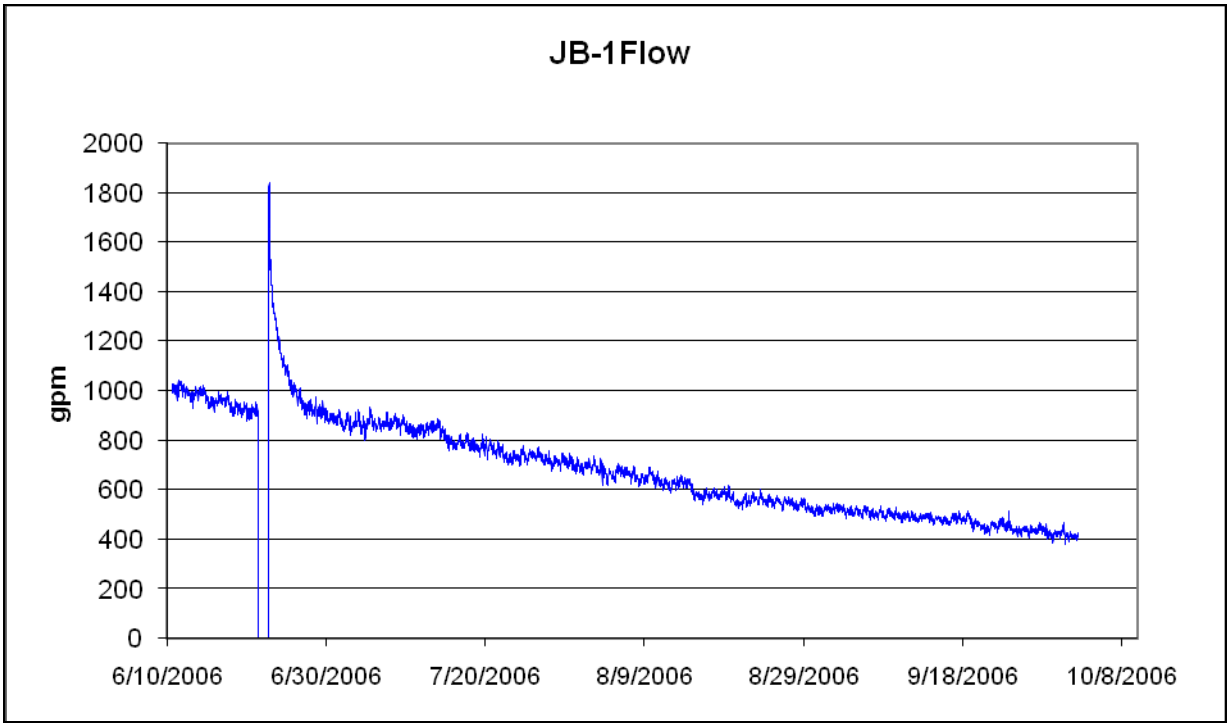


Figure 3 provides a comparison of the pH, alkalinity, and dissolved iron of the non-agitated discharge verses the non-agitated discharge (3 parts) and stream (1 part) mixture. The test indicates that even without agitation, adding a minimal amount of alkaline stream water increased the rate of iron removal. As the system had to be redesigned relating to potential wetland impacts and as the change in elevation at the site is minimal, the non-agitated tests appear to be more applicable for Phase 1 as constructed. Note that specific features, other than the initial "drop" realized at the JB1 discharge outlet pipes, were not able to be included in the redesigned system. (Gravel bars placed in the channels may have helped, in some instances, to aerate the water.) (See photos.)

Flume Installation at JB1

A V-notch weir was installed and used by the PA DEP for JB1 flow measurements. As the weir needed to be replaced, in May 2006, an H-Flume was temporarily installed to measure the flow rate of JB1. A datalogger was used to provide measurements at 30-minute intervals between June 2006 and Oct. 2006, primarily as part of the aforementioned "ELF" feasibility study. The following graph depicts the continuous flow rate measurements obtained from the datalogger. The flow rates physically measured [engineer's rule with conversion to gpm from the Discharge Table for 2.0' H Flume (Wachter, 04/06/00)] during sampling events or site inspections are identified in the monitoring reports and used for the site evaluation. During construction of the passive system, the flume was removed. Currently, research is being conducted by Bruce Leavitt, PE, PG to evaluate measurement of the JB1 flow rate from a single port into each of the JB1 discharge distribution pipes.



Piezometer Installation

In order to characterize the groundwater conditions as well as the geology of the site, ten boreholes (94-1 through 94-10) were drilled and logged. Of the ten boreholes, four (94-1, 94-8, 94-9, 94-10) were developed into piezometers. Drilling was completed by McKay and Gould Drilling, Inc. (Darlington, PA) and BioMost, Inc. on 12/19/05. Water levels were measured and water samples collected. See the Geologic Drill Hole Logs/Piezometer As-Builts (Drill Logs) and Water Quality Database in the Appendix. The information gained enabled interpretation of the local attitude of the Pittsburgh coalbed, location of mine workings, and a "glimpse" as to the local hydrology and mine pool characteristics.

Permits and Notifications

A review of the site completed by the US Fish & Wildlife Service (USFWS) determined that there were no threatened or endangered species within the impact of the project area. A search conducted by the PA Historical & Museum Commission (PHMC), however, indicated that significant archaeological sites were located near the project area. A Phase I archaeological survey was conducted which determined that the actual project site had no potential effect upon significant archaeological resources.

The wetland delineation was prepared by Aquascape Wetland & Environmental Services (Pittsburgh, PA) in December 2005. As the original design proposed to impact greater than 1 acre of wetlands, Stream Restoration Inc. requested a waiver of permit requirements from the PA DEP for restoration activities under the provisions of Section 105.12(a)(16) in January 2006. The PA DEP waived the requirement to obtain State 401 Water Quality Certification by determining that the project met the Category 1 waiver criteria as published in the Pennsylvania Bulletin on 12/14/96. A pre-construction notification for Nationwide Permit #27 was submitted to the US Army Corps of Engineers (ACE). According to the ACE and the USFWS, the proposed wetlands to be impacted were not degraded or impaired by AMD; therefore, a mitigation plan was required to create a minimum of 4.5 acres of replacement wetlands. In addition, the ACE would not accept AMD treatment wetlands as mitigation. Due to the excessive cost associated with the design, construction, and monitoring of 4.5 acres of mitigation wetlands, Stream Restoration Inc. withdrew the request to the ACE to receive the Nationwide Permit #27. A revised design was then developed to impact less than 1 acre of wetlands which was resubmitted to the PA DEP on 11/21/06.

While an approved Erosion and Sedimentation Control Plan was not required, a written E&S Plan was developed and maintained on site during construction.

PA One Call (Serial # 3476486) was notified to determine the location of underground utilities. The sewer line was subsequently flagged by the Burgettstown - Smith Twp. Joint Sewer Authority. An abandoned, overhead electric service line through the wetland was observed in the field.

Site Preparation

Prior to system installation, the site was cleared, grubbed, and E&S Controls installed. An existing access road was upgraded and extended for construction activities.

Passive Treatment System Installation

Due to the conditions set forth by the ACE relating to disturbance of the existing AMD-impacted wetland, an innovative approach was needed. The passive system had to be redesigned to utilize the existing wetland with limited enhancements and with <1 acre of wetland impacts. To do this, separate piping systems for the JB1 discharge and the stream water were installed to distribute flow along the perimeter of the existing wetland. The passive system may be described as three separate components.

The first component consists of a distribution system for the JB1 discharge. Two, uncapped, 18-inch, Schedule 40, PVC pipes were inserted ~15 feet into the open mine entry. The first ~11 feet were custom perforated with 8, 1½-inch, holes every 6 inches. Polyurethane foam was then injected by Sub-Technical, Inc. (Mars, PA) to seal the existing mine entry. The piping was then extended to a custom-fabricated, pre-cast concrete structure with a manhole entry. Two discharge pipes were then extended from the concrete structure for a total length of ~1050 feet along the perimeter of the wetland. Twenty-one adjustable outlet risers were installed at ~50-foot intervals to distribute the flow. In order to measure the water level associated with the abandoned mine, an 8-inch hole was hand-bored into the existing concrete mine roof and an 8-inch, Schedule 40, PVC riser installed. A data logger was then inserted in the riser. A pre-existing, 15-inch, terra cotta riser also appears to reflect the water level associated with the mine.

The second component is a stream intake and distribution system. An existing, breached, beaver dam (See attached photo.) which had been previously stabilized by others for fishing/swimming was replaced in Raccoon Creek with a rock cross-vane to maintain a water level at ~1001.5 feet. (The elevation at the top of the existing streambank was ~1002.6 feet and the water level above the breached beaver dam was ~1000.2 feet on 12/07/05.) Upstream of the cross-vane, a 12-inch, Schedule 40, PVC pipe with ½-inch perforations spaced every 4 inches was installed to convey the stream flow to a prefabricated concrete stream intake structure. A pipeline was then installed along the perimeter of the wetland in parallel with the discharge piping. Twenty-one adjustable outlet risers were installed at the same locations as the discharge risers to encourage mixing of the AMD and the stream water prior to entering the wetland.

The third component of the system consisted of actual enhancements to the AMD-impacted wetland. The enhancements consisted of the strategic placement of small gravel bars within existing incised channels of the wetland to try to disrupt preferential pathways and to encourage more complete utilization of the wetland. Wildlife habitat structures installed included boxes for bluebirds (4), mallards (1), wood ducks (1), and bats (1).

The following seed mix was used on the inner banks of the wetlands: Canada Wild Rye (2 lbs); Virginia Wild Rye (2 lbs); Black-Eyed Susan (1 lb); Little Bluestem (2.5 lbs); Annual Ryegrass (4 lbs); Switch Grass (2 lbs).

In addition, wetland plantings were conducted to improve species diversity and wildlife habitat. The following (Table V) is a planting list (quantity and common name) for the project:

Table V. 2007 Planting List for JB1

Bare Root	Container	Tree Band
25 Scotch Pine	25 Silky Dogwood	25 Buttonbush
25 Eastern White Pine	25 Red Osier Dogwood	
25 Poplar	25 Green Ash	
25 Swamp White Oak	25 Ninebark	
50 Sycamore	25 Smooth Sumac	
50 Black Willow		
50 Silky Dogwood		

PASSIVE TREATMENT PERFORMANCE AND ENVIRONMENTAL RESULTS

The evaluation provided below is for illustration purposes and is limited in scope. Major construction was completed in March 2007; however, minor elements were being implemented through June 2007. An accurate and representative performance evaluation of the JB1 Phase 1 passive treatment system is tenuous at best.

Pre-Construction Wetland Treatment

Prior to installation of Phase 1, iron was precipitating and being retained within the existing wetland. (See attached aerial photo.) Channelization had developed in the wetland, including a watercourse from the abandoned slope entry to a side channel of Raccoon Creek. Water samples were collected on 12/7/05 (Table VI) after the dramatic increase in pollutant loadings and before construction. JB1 is the AMD discharge and JB1B is the wetland channel outlet below JB1.

Table VI. 12/7/05 Pre-Construction AMD Treatment by Existing Wetland

Point	Desc.	pH		Alkalinity		Acidity	T. Fe	T. Mn	T. Al	SO_4^{-2}
		Field	Lab	Field	Lab					
JB1	AMD raw	4.8	4.6	0	3	244	100.5	2.4	14.4	1080
JB1B	Wetland effluent	4.8	4.6	1	2	240	91.0	2.4	14.6	1063

Concentrations in mg/l; alkalinity and acidity in mg/l as $CaCO_3$

On 12/7/05, the pre-existing wetland provided no significant improvement in pH, acidity, sulfate, total manganese, and total aluminum. [The minor (2%) decrease in acidity and sulfates may represent a dilution, formation of iron minerals at low pH, or measurement precision.] The alkalinity of the discharge appears to have been decreased by ~1 mg/l. At this pH, hydrolysis of the dissolved aluminum in the JB1 discharge is expected to consume the available bicarbonate. [A decrease of ~1 mg/l alkalinity represents the hydrolysis of <<1 mg/l (~0.2 mg/l) of dissolved aluminum.] The decrease in total iron of ~9 mg/l may be primarily attributed to settling of the particulate iron observed to be in the raw discharge. (Raw AMD, collected in 2006-2007, had a total iron of <1 mg/l to 22 mg/l greater than the dissolved iron content.) As the precipitation total for the month of November 2005 was ~1" above normal which is similar to that recorded for March 2004, the flow rate of JB1 was assumed to be ~2000 gpm. Assuming no other flow contributions, a decrease in total iron loading of ~294 lbs/day was being realized prior to Phase 1 construction or a decrease of 12%.

Phase 1 Post-Construction Treatment

Due to permitting issues, a single outlet could not be constructed for the wetland; instead, there are multiple, naturally-occurring, channels with discharges of varying quality and flow. As the flow from JB1 has been distributed along the perimeter of the wetland and as gravel bars have been placed to try to disrupt channelized flow, the contribution of flow to JB1B from JB1 is less. To very generally compare pre- with post-construction treatment, JB1B (wetland effluent point with greatest flow rate) was sampled on 4/25/07, 6/7/07, and 6/27/07. SL1 depicts both the upstream quality of Raccoon Creek and the stream water distributed along the outside wetland perimeter.

At JB1 on 4/25/07 (Table VII), the 111 mg/l dissolved iron and 21 mg/l dissolved aluminum represent an increase of 160% and 210%, respectively, in relation to the maximum 69 mg/l total iron and 10 mg/l total aluminum, measured 1/11/95 prior to the period of above normal precipitation beginning May 2003.

Table VII. 4/25/07 Post-Construction AMD Treatment by Enhanced Wetland

Point	Desc.	Flow	pH		Alkalinity		Acidity	D. Fe	D. Mn	D. Al	SO_4^{-2}
			Field	Lab	Field	Lab					
SL1	Raccoon Ck./intake	635	8.1	8.1	183	169	-159	0.1	0.0	0.1	80
JB1	AMD raw	3125	4.6	3.9	1	0	287	111.0	2.4	20.8	1133
JB1B	Wetland effluent	3760	5.0	4.5	7	0	178	82.7	2.0	9.0	706

Flow in gpm based on limited measurements and adjusted assuming D. Mn conservative; concentrations in mg/l; alkalinity and acidity in mg/l as $CaCO_3$

The 17% decrease in dissolved manganese is thought to reflect dilution as dissolved manganese is considered conservative (does not form solids) in the presence of dissolved ferrous. Note also there was essentially no dissolved manganese in the stream sample. The flow rate of JB1 and of the stream contribution were very roughly estimated at ~3000 gpm and ~760 gpm, respectively, by measuring the flow at a selected riser along each distribution piping system. [Corrected slightly to conform to the 17% decrease in dissolved manganese, refines the JB1 discharge flow rate to 3125 gpm and the stream contribution to 635 gpm. (See photos.)] As observed in the above table, the dissolved iron concentration is decreased by 28 mg/l (25%). At 3125 gpm, the dissolved iron loading at JB1 is 4163 lbs/day. Assuming that JB1B represents the aggregate quality of the drainage from the wetland, the dissolved iron loading in the wetland effluent at 3760 gpm would be 3731 lbs/day; therefore, 432 lbs/day of dissolved ferrous are forming particulates representing a 10% decrease in dissolved iron loading due to treatment processes. (Note the 25% decrease in concentration reflects the impact of both dilution and chemical change.) The orange-colored precipitates observed in the field also indicate the removal of iron particulates. Most remarkable, the dissolved aluminum concentration decreases by ~12 mg/l (57%). Estimating a dissolved aluminum loading of 780 lbs/day in the raw AMD and 406 lbs/day remaining in the wetland effluent, 374 lbs/day of aluminum is being removed by the enhanced wetland or there is a 52% decrease due to treatment processes. White-colored precipitates observed in the field validate the removal of aluminum. (See photos.)

On 6/7/07 (Table VIII), the flow rate from each of the 21 risers along the JB1 distribution piping was measured. Flow rates ranged, in 20 of the 21 pipes, from 31 to 120 gpm. Discharge Riser #5 was not flowing. The total flow rate of JB1 was 1347 gpm. Along the stream distribution piping, 15 of the 21 risers were not flowing or the flow was not discernable. The flow rate was measurable in 2 of the risers at 5 gpm (Stream Riser #21) and 15 gpm (Stream Riser #12). For the remaining risers, flow rate was not measurable due to the proximity of the outlet to the ground surface. In addition, the flow contribution from the stream intake appeared to be minimal based on visual observations.

Table VIII. 6/7/07 Post-Construction AMD Treatment by Enhanced Wetland

Point	Desc.	Flow	pH		Alkalinity		Acidity	D. Fe	D. Mn	D. Al	SO_4^{-2}
			Field	Lab	Field	Lab					
SL1	Raccoon Ck./intake	<50	8.0	7.0	NM	201	-180	0.4	0.2	0.5	107
JB1	AMD raw	~1350	4.6	4.2	0	0	301	107.0	2.3	15.8	839
JB1B	Wetland effluent	~1400	4.1	3.7	0	0	281	102.1	2.4	14.0	860

Concentrations in mg/l; alkalinity and acidity in mg/l as $CaCO_3$

Interestingly, as the sulfates appear to increase at JB1B, this may indicate a poorer water quality at JB1 in the recent past than what was identified at the time of sampling. In other words, the water quality of JB1 appears to have been significantly worse just prior to sampling, as there is a "lag" (travel) time from the raw water discharge point to the wetland outlet. In addition, there is no evidence of dilution reflected in the dissolved manganese concentration, which is slightly higher than that of the raw AMD. Even so, there appears to be decreases of 5% and 11% in the dissolved iron and aluminum concentrations, respectively. There is also a decrease in dissolved iron and aluminum loading by ~20 lbs/day each. The pipes were adjusted and additional sampling was scheduled for later that month.

On 6/27/07 (Table IX), the flow rate was measured from each of the 21 risers along the JB1 discharge distribution piping. Flow rates ranged from 21 to 100 gpm. Discharge Riser #5 was not flowing. The total flow rate of JB1 was 1089 gpm. For the stream distribution piping, 10 of the 21 risers were not flowing or the flow was not discernable.

Table IX. 6/27/07 Post-Construction AMD Treatment by Enhanced Wetland

Point	Desc.	Flow	pH		Alkalinity		Acidity	D. Fe	D. Mn	D. Al	SO_4^{-2}
			Field	Lab	Field	Lab					
SL1	Raccoon Ck./intake	227*	7.8	7.7	204	172	-120	0.5	0.3	0.4	78
JB1	AMD raw	1089	4.6	5.1**	NM	3	275	126.0	2.3	7.9	842
JB1B	Wetland effluent	1316*	4.8	4.7	7	2	144	71.4	1.9	2.5	600

Concentrations in mg/l; alkalinity and acidity in mg/l as $CaCO_3$; *SL1 and JB1B flow rate calculated assuming dilution only contributor to D. Mn decrease; **JB1 lab pH appears spurious

As previously noted, dissolved manganese is considered conservative; therefore, the decrease observed is attributed to dilution; i.e., the dissolved manganese loading does not change. An algebraic equation was used to estimate the stream intake flow rate.

Where,

Q_{JB1} = flow rate of the JB1 discharge in liters per minute;
C = dissolved manganese at JB1, SL1, and JB1B in milligrams per liter;

The following equation was then solved for X to estimate the flow rate of the intake:

$$(Q_{JB1} * C_{JB1}) + (X * C_{SL1}) = (Q_{JB1} + X) * C_{JB1B}$$

Similar to the 4/25/07 sampling, the decrease in the dissolved manganese concentration on 6/27/07 is 17%. The dissolved iron content is decreased by 55 mg/l (43%). With a dissolved iron loading of 1647 lbs/day in the JB1 raw water compared to 1128 lbs/day at JB1B, a decrease in 519 lbs/day (32%) of dissolved iron is attributed to treatment processes. The dissolved aluminum concentration decreases by ~5 mg/l (32%). With a dissolved aluminum loading of 103 lbs/day in the raw AMD and 40 lbs/day remaining in the wetland effluent, 63 lbs/day of aluminum is being removed by the enhanced wetland or there is a 39% decrease due to treatment processes (not dilution). (See photos of white and orange precipitates.) Please note that the decreases in loadings assume that the quality of all the drainage from the wetland is represented by JB1B. On 6/27/07, short-circuiting was noted along the northern end of the site (along Slak Lane extension) and Stream Risers #13 thru 21 were not flowing.

On 6/29/07, a field survey was conducted in order to assist in adjusting the risers to provide optimum treatment. At 17 points (located by GPS with submeter accuracy) within the wetland, dissolved oxygen and pH were measured (See Table X). The survey illustrated areas of adequate and inadequate treatment. Based on a preliminary interpretation of data, the risers have since been adjusted and additional monitoring is planned. (See attached map showing survey points.)

Table X. 6/29/07 Wetland DO and pH Field Survey

ID	DO	PH	Latitude	Longitude
1	6.79	6.22	40.36004718	-80.36046900
2	3.70	5.16	40.36035630	-80.36044312
3	4.87	4.86	40.36060453	-80.36044662
4	0.23	7.01	40.36090952	-80.36041152
5	6.73	5.93	40.36094282	-80.36028499
6	6.51	5.29	40.36097351	-80.36005531
7	6.51	6.07	40.36112132	-80.35970642
8	6.47	4.05	40.36126572	-80.35936720
9	6.38	4.53	40.36136520	-80.35947556
10	7.22	3.17	40.36154465	-80.35952454
11	3.52	4.61	40.36157492	-80.35985890
12	6.25	3.34	40.36132356	-80.35989520
13	7.63	4.85	40.36120666	-80.36004817
14	5.76	3.72	40.36106088	-80.36049513
15	5.87	3.92	40.36081867	-80.36075218
16	5.00	5.23	40.36067428	-80.36083470
17	4.81	4.39	40.36047155	-80.36077673
18	DRY		40.36036467	-80.36068960

Wildlife Utilization

During inspections and improvements, wildlife utilization of the wetland was noted.

Wildlife Identified at the Site Post-Construction

American Crow	Eastern Phoebe	Pileated Woodpecker
American Goldfinch	European Starling	Red Wing Black Bird
Baltimore Oriole	Great Blue Heron	Red-tailed Hawk
Bank Swallow	Green Heron	Robin
Barn Swallow	Killdeer	Snapping Turtle
Belted Kingfisher	Mallard Duck	Tufted Titmouse
Black-capped Chickadee	Mocking Bird	Turkey Vulture
Blue Jay	Mourning Dove	Wild Turkey
Canada Geese (14 goslings)	Northern Bobwhite	Wood Duck
Cardinal	Northern Flicker	

In addition to the list above, other unidentified Vireos, Flycatchers, Warblers, Sparrows, Meadowlarks, and a large owl have also been observed at the site. The bluebird boxes were also inhabited in Summer 2007.

Summary

The Phase 1 system is successfully providing partial treatment of the "worst" AMD discharge in the Raccoon Creek Watershed. In the original design, the estimated decrease in iron loading needed to substantially improve Raccoon Creek was 180 to 480 lbs/day. The construction of Phase 1 appears to be able to meet or exceed the targeted removal rate; however, with the dramatic increase in pollutant loadings (increases in both pollutant concentrations and flow rate at JB1), the additional degradation needs to be addressed in Phase 2.

A promising option under consideration as part of Phase 2 is the "ELF" system. As previously discussed, a grant has been received from the PA DEP Bureau of Abandoned Mine Reclamation in 2007 to determine the feasibility of combining and conveying mine water associated with the abandoned underground Erie, Langeloth, and Francis Mines ("ELF") to a single location. The combined flow may then be treated at one facility or may be used by the Beech Hollow Power Plant. If the project is successful, the pollutant loadings at JB1 may be significantly decreased. Completion of the "ELF" feasibility project, also allows for further water monitoring and maturity of the wetland plantings at Phase 1. Phase 1 has been designed and installed to be readily adjusted as experience is gained to optimize function and the additional time will enable a more accurate evaluation of the projected long-term performance of Phase 1.

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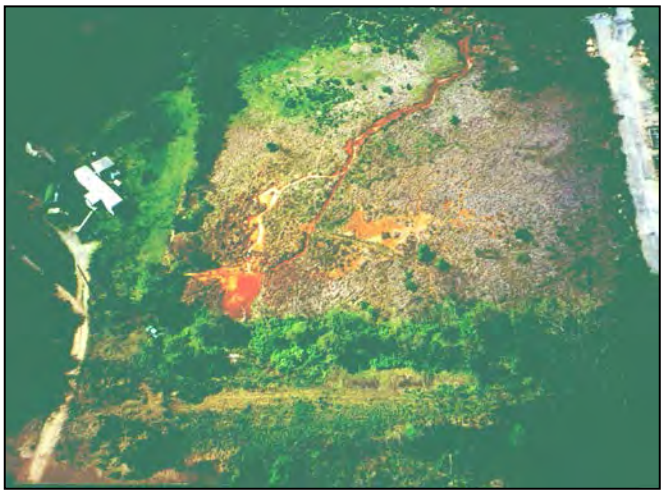
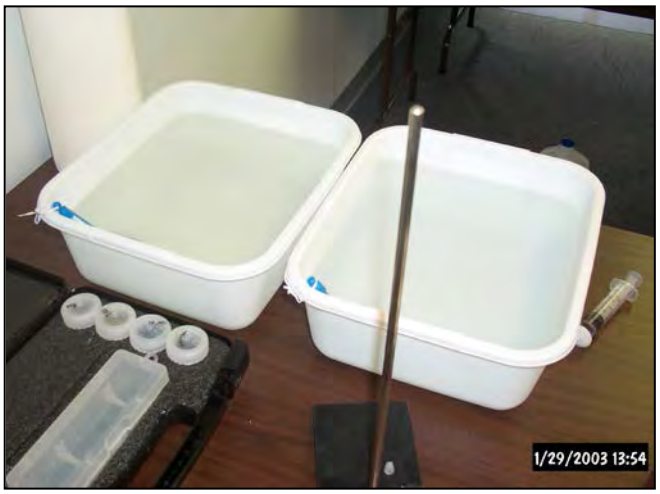
W.P.A. Project No. 4483, undated, Burgettstown Sheet No. 5, Pittsburgh Seam [1 sheet; 1" = 2000']



The acidic, metal-laden, JB1 discharge (Upper Left) located in Smith Township, Washington County, which at times flows over 2000 gpm, emanates from an abandoned slope entry of the Pittsburgh and Eastern Coal Company #2 and #3 mines. The AMD flows through a large degraded wetland prior to entering Raccoon Creek. An “aerial” photo (Upper Right) as well as the remaining photographs on this page depicts the extent of the impact of the JB1 discharge to the wetland. Note the proximity of a home to the discharge (Upper Right and Lower Left).

Upstream of the JB1 discharge, Raccoon Creek (Upper Left) is a good quality stream. A portion of Raccoon Creek splits from the main branch as a side channel and intercepts the JB1 discharge (Upper Right and Center Left). After mixing with JB1, the side channel then re-enters Raccoon Creek (Center Right). The sever impact of JB1 to Raccoon Creek can easily be seen at downstream sampling points SR8 (Lower Left) and Keys Road (Lower Right).



Prior to submitting the grant proposal, a bench-scale experiment utilizing plastic tubs to mimic a settling pond or wetland was conducted, where the discharge without addition of alkaline stream water (Right Tub) was compared to a mixture of 1 part Raccoon Creek to 3 parts of JB1 discharge (Left Tub). The photos depict the experiment from beginning to end. As can be seen from the photos, the mixture resulted in faster iron precipitation than the discharge alone. The initial conceptual design of the passive treatment system was to install a stream intake in order to mix the JB1 discharge with the highly-alkaline and well-oxygenated Raccoon Creek in a treatment wetland.

In order to complete the design and permitting for the passive treatment system, water monitoring and site investigations were conducted. An Environmental Assessment (Upper Left and Right) was completed with Jeff Reidenbaugh (Aquascape). Piezometers were installed by McKay & Gould Drilling (Center Left) and monitored by BioMost, Inc. and Bruce Leavitt (Center Right). A flume was installed (Lower Left and Right) at the JB1 discharge to monitor flow rates prior to completion of the design.

An innovative approach was taken to enhance the naturally-occurring, AMD-impacted, wetland. These enhancements began in December 2006 with stabilization of an existing, abandoned, railroad grade/access road. On 12/12/06, former PA DEP Secretary Dave Hess toured the JB1 site and other restoration projects in the Raccoon Creek Watershed. Video blogs of Tim Danehy of BioMost, Inc (Upper Right) and equipment operator Wayne Fuchs (Center Left) of Quality Aggregates were included in the *PA Environment Digest*. Members of the Raccoon Creek Watershed Association and Stream Restoration Incorporated (Center Right) were also on hand to conduct the tour.

Two separate distribution systems were installed to evenly disperse the JB1 discharge and a small portion of Raccoon Creek around the outer perimeter of the wetland. Each distribution line has twenty-one outlet risers (Center Right and Lower Right) to spread the flow in order to more completely utilize the pre-existing, AMD-impacted, wetland. The lower outlet riser closer to the wetland is for the Raccoon Creek distribution line while the higher outlet riser closer to the berm is for the JB1 discharge distribution line.

An intake structure and rock vane (Upper Left and Right) were installed in the same location as a previously existing beaver dam (local fishing and swimming “hole”). A distribution line from the intake was installed along the perimeter of the existing wetland in order to mix a small portion of the high alkalinity, well-oxygenated, Raccoon Creek with the JB1 discharge. To capture and distribute the JB1 discharge, two, 18”, perforated pipes were placed in an excavated channel (Center Left), inserted into the old mine entry, and connected to a concrete, flow-splitter box (Center Right). The flow-splitter box was then connected to the distribution line. The mine entry was then sealed with a polyurethane grout by contractor Sub-Technical, Inc. (Lower Left and Right).

As the JB1 discharge and stream water from Raccoon Creek mix, chemical reactions begin to occur resulting in the precipitation of aluminum (white precipitates) and iron (red and orange precipitates). These reactions continue within the wetland. Gravel bars (Lower Left) were placed within existing channels in the wetland to disrupt preferential flow paths and encourage better distribution and mixing of the discharge with the stream water. Wetland plantings were conducted to increase species diversity, to enhance wildlife habitat, and to further water treatment.

The flow rate as the well as iron, aluminum, and acidity concentrations of the JB1 discharge has on average increased significantly compared to pre-construction monitoring that was conducted between January 1995 and April 2003. As most of the JB1 discharge pipes were flowing similarly, based on the flow measurement of this pipe, the flow rate of JB1 on 4/25/07 was estimated to be around 3000 gpm.

A picnic and “get-together” was held by Independence Conservancy, the Montour Run Watershed Association, and the Raccoon Creek Watershed Association on May 22, 2007 at the JB2 pavilion (Upper Left). As part of the event, a tour of the JB2 (Center Left and Right) and JB1 (Lower Left) passive treatment systems as well as Raccoon Creek Watershed Association member Evan Verbanic’s Cherry Valley Organics Farm (Lower Right).

The pre-existing beaver dam (fishing and swimming “hole”) was removed and replaced with the cross vane shown here.

Several habitat structures were installed including four blue bird boxes (Upper Left and Right), a bat box (Lower Left), a wood duck box (Lower Right), and a mallard duck box (not pictured).

OPERATION AND MAINTENANCE PLAN

The comprehensive Raccoon Creek Operation and Maintenance Plan was completed in March 2007 under a PA DEP Growing Greener Technical Assistance Grant awarded to Stream Restoration Incorporated. The Plan was designed to allow for the incorporation of future passive treatment system and land reclamation projects. Copies of the plan were distributed to the PA DEP Grants Center, Ron Horansky (PA DEP Greensburg District Mining Office), Washington County Conservation District, Raccoon Creek Watershed Association, Independence Conservancy, BioMost, Inc., and Stream Restoration Incorporated. The O&M Plan is also available via the internet at the Datashed website.

Datashed, www.datashed.org, is a fully-featured, GIS-enabled, internet database designed to assist watershed groups, academia, private industry, and government agencies. Powered by open source software, this database provides a cost-effective and reliable solution to the management of data associated with environmental efforts. The GIS capability allows users to easily view geographic data and directs users to additional content. Anyone with internet access can view the site and download information. This allows the website to function not only as a data management tool but also as part of the education/outreach effort associated with the project. Datashed was developed by Stream Restoration Incorporated, 241 Computer Services, and WPCAMR using the PHP programming language and open source software such as APACHE HTTP Server, MySQL database, and Map Server.

Datashed was incorporated as an essential component of the Raccoon Creek Watershed Coalition's comprehensive O&M Plan. Each restoration project has a dedicated page within the website where users can not only view data but also download and print information needed to conduct O&M efforts such as site inspection forms, site schematics, topographic maps, aerial photos, etc. In addition, passwords are provided to designated watershed personnel in order to allow direct online upload of collected field and laboratory data.

The following pages represent an addendum to the Raccoon Creek Operation and Maintenance Plan. Additional project specific information including "As-Builts" and water quality data have also been uploaded to Datashed.

JB1 Phase I

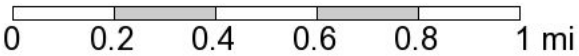
Site Type: Passive Treatment System
Latitude: 40 21 40
Longitude: -80 21 33
Determined by GPS: No
Elevation: 1000
Quad: Midway
Stream: Raccoon Creek
Watershed: Raccoon Creek
Municipality: Smith Township
County: Washington
Year Constructed: 2006
Primary Funding Partners: DEP Growing Greener
DEP Title IV, Appalachian Clean Streams
Treatment Technologies: Aerobic Wetland
Contact: Stream Restoration Inc.
Responsible Organization: Stream Restoration Inc.
Source of AMD: Underground
Links: **http://www.streamrestorationinc.org**
http://www.independencemarsh.org/RCWA.html

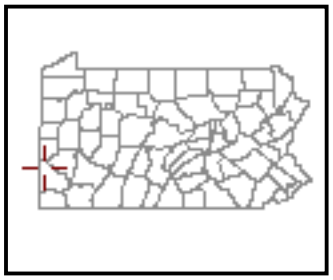
Loadings

Water Treated 0 (gal/yr)

No water quality information is available.

Datashed iMap





Legend

Boundaries

Counties

Projects

Projects

WMS

USGSTopo

Project Name

JB1 Phase I

Organization

Stream Restoration Inc.

Project Location

Quadrangle: Midway
Municipality: Smith Township
County: Washington
State: Pennsylvania

Map Details

latitude: 40 21 40
longitude: -80 21 33
scale: 1" = 2000'

PASSIVE TREATMENT SYSTEM O&M INSPECTION REPORT

6/2007

Inspection Date:		Project Name:	JB1 Phase I
Inspected by:		Municipality:	Smith Township
Organization:		County:	Washington State: PA
Time Start:	End:	Project Coordinates:	40° 21' 40" Lat 80° 21' 33" Long
Receiving Stream:	Raccoon Creek	Subwatershed:	Raccoon Creek Watershed: Ohio River

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

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.)
Does the site have any areas that need to be stabilized? ***Yes / No*** If yes, explain maintenance performed or needed:

B. Site Access

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

C. Wildlife Utilization

Animals sighted or tracks observed_____
Invasive plants observed _____
Describe any damage caused to treatment system by wildlife (especially muskrats) and required maintenance:

D. Raccoon Creek @ SR8, Raccoon Creek Side Channel @ JB1A (CULV2), Raccoon Creek @ CULV 1,

Enter effluent pH, temp, alkalinity, flow and other field data as applicable in Section K.

E. Culverts 1 & 2

Does Culvert 1 need maintenance? Yes / No Does Culvert 2 need maintenance? Yes / No
Describe Maintenance needed/performed?_____
Additional comments:_____

F. JB1 Wetland & Sampling Points 94-20, 94-21, JB1B, 94-23, and JB1C

Enter effluent pH, temp, alkalinity, flow and other field data as applicable in Section K.
Is any Maintenance needed? ***Yes / No*** If Yes, Check which elements of the Wetland require maintenance and provide further detail below

Element	√ if need	Maintenance needed
Vegetation		
Sediment and/or Sludge removal		
Short Circuiting		

Describe Maintenance performed?_____
Additional comments:_____

G. JB1 Abandoned Mine Discharge (JB1)

Sample closest Peri-Pipe to mine entry. Enter effluent pH, temp, alkalinity, flow and other field data as applicable in Section K.
Enter flow measurements from distribution Peri-Pipe risers below. Total calculated flows and enter for JB1 in Section K.

Pipe #	Volume	Time	Calculated Flow	Pipe #	Volume	Time	Calculated Flow	Pipe #	Volume	Time	Calculated Flow
1				8				15			
2				9				16			
3				10				17			
4				11				18			
5				12				19			
6				13				20			
7				14				21			

H. JB1 Abandoned Mine Discharge (JB1) Distribution System

Is any Maintenance needed? ***Yes / No*** If Yes, Check which elements of the System require maintenance and provide further detail below

Element	√ if need	Maintenance needed
Concrete Structure		
Distribution Line		
Peri-Pipe risers (include pipe #)		
Valves		

Is water flowing out of the manhole ***Yes / No*** What is the depth to water from the top of the manhole? _____

Describe Maintenance performed?_____

_____

Additional comments:_____

_____

I. Raccoon Creek Upstream (SL1)

Enter effluent pH, temp, alkalinity, flow and other field data as applicable in Section K.

Enter flow measurements from distribution Peri-Pipe risers below.

Pipe #	Volume	Time	Calculated Flow	Pipe #	Volume	Time	Calculated Flow	Pipe #	Volume	Time	Calculated Flow
1				8				15			
2				9				16			
3				10				17			
4				11				18			
5				12				19			
6				13				20			
7				14				21			

J. Raccoon Creek Cross Vane, Intake, and Distribution System

Is any Maintenance needed? ***Yes / No*** If Yes, Check which elements of the System require maintenance and provide further detail below

Element	√ if need	Maintenance needed
Cross Vane (stable, debris, sedimentation, etc)		
Concrete Intake Structure		
Distribution Line		
Peri-Pipe risers (include pipe #)		
Valves		

Does the intake system appear to be functioning properly? ***Yes / No*** Is there sufficient amount of stream water going through the system ***Yes / No***

Does the Intake Structure or Distribution Line need to be cleaned out? ***Yes / No*** If Yes, was it cleaned out ***Yes / No***

Describe Maintenance performed?_____

_____

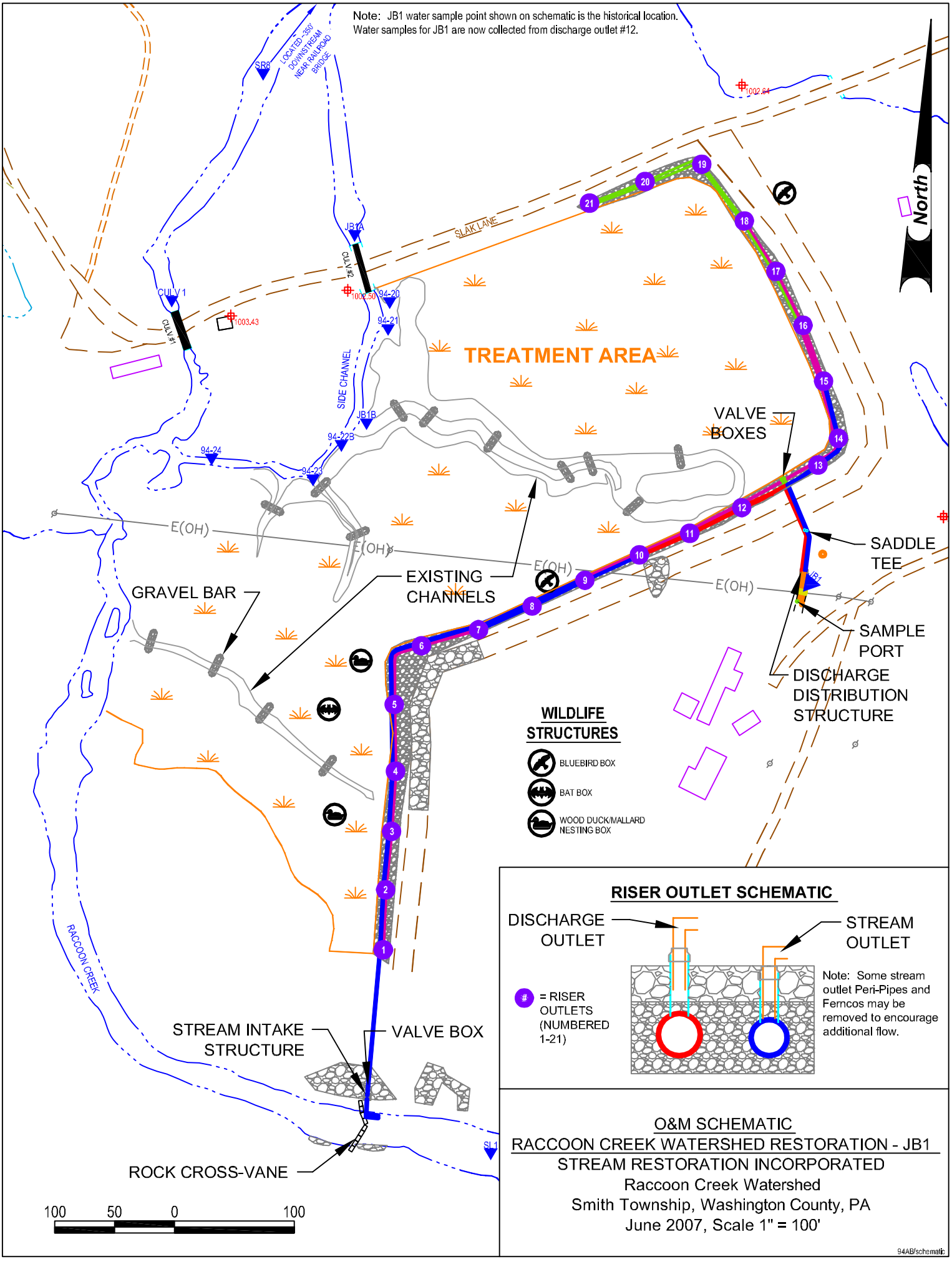
Additional comments:_____

_____

K. Field Water Monitoring and Sample Collection

Water sample locations as marked on plan.

Sampling Point	Flow Measurements		Calculated Flow (gpm)	pH	ORP	Temp (°C)	Alkalinity (mg/L)	DO (mg/L)	Iron (mg/L)	Comments	Bottle #	Bottle # (total metals)	Bottle # (diss. metals)
	gals	sec.											
SR8													
JB1A													
CULV1													
94-20													
94-21													
JB1B													
94-23													
JB1C													
JB1													
SL1													


Note: JB1 water sample point shown on schematic is the historical location.
Water samples for JB1 are now collected from discharge outlet #12.
SB8
LOCATED ~300' DOWNSTREAM NEAR RAILROAD BRIDGE
1002.64
North
SLAK LANE
JB1A
CULV #2
1002.50
94-20
94-21
CULV 1
CULV #1
1003.43
TREATMENT AREA
SIDE CHANNEL
JB1B
94-22B
94-24
94-23
VALVE BOXES
E(OH)
EXISTING CHANNELS
GRAVEL BAR
SADDLE TEE
JB1
SAMPLE PORT
DISCHARGE DISTRIBUTION STRUCTURE
WILDLIFE STRUCTURES
BLUEBIRD BOX
BAT BOX
WOOD DUCK/MALLARD NESTING BOX
RISER OUTLET SCHEMATIC
DISCHARGE OUTLET
STREAM OUTLET
= RISER OUTLETS (NUMBERED 1-21)
Note: Some stream outlet Peri-Pipes and Ferncos may be removed to encourage additional flow.
RACCOON CREEK
STREAM INTAKE STRUCTURE
VALVE BOX
ROCK CROSS-VANE
SL1
100 50 0 100
O&M SCHEMATIC
RACCOON CREEK WATERSHED RESTORATION - JB1
STREAM RESTORATION INCORPORATED
Raccoon Creek Watershed
Smith Township, Washington County, PA
June 2007, Scale 1" = 100'
94AB/schematic

February 2006

THE CATALYST

SLIPPERY ROCK WATERSHED COALITION MONTHLY ACTIVITIES UPDATE

THIS MONTH'S MEETING: Thursday 2/9 at 7 pm at Jennings Environmental Education Center, pizza and pop provided. 1/12/06 Meeting Attendance: C. Cooper, T. Danehy, C. Denholm, M. Dunn, K. Durrett, D. Johnson, V. Kefeli, J. Rankin

2005 Year in Review:

A Time of Partnerships and Progress

Education/Outreach Activities

- Annual Prairie Improvement Day at Jennings Environmental Education Center - 2/5
- Community Tree/Shrub Planting with Grove City Borough, Pine Township, and Beran Environmental Services, Inc. in Grove City, PA - 4/23
- Wolf Creek Upper Dam Tree & Shrub volunteer planting - April
- 10th Annual Earth Day Celebration at EDCO Park in Evans City, PA - 4/30
- 4th Annual Ohio River Watershed Celebration, Pittsburgh, PA - 7/27
- Citgo Bassmaster Classic "Family Fun Fest", Pittsburgh, PA - 7/28
- Ribbon-Cutting Ceremony for John Jay Center, Robert Morris University - 9/12
- Slippery Rock Heritage Festival - 9/18
- "Garden Talk" WPTT radio Valentin Kefeli interview with Jane Nugent - 12/10
- "Adopt-a-Highway" program, Interstate 79 mile markers 100-101

Restoration Projects

- Improvements to DeSale I passive treatment system, Venango Township, Butler Co., PA
- Wolf Creek dam removal, clean-up, and restoration, Grove City, PA - Grove City College, Beran Environmental
- Slippery Rock Creek Watershed Assessment - ongoing

Conferences

- Slippery Rock Watershed Coalition Student Symposium at Westminster College - 4/14
- 26th Annual West Virginia Surface Mine Drainage Task Force Symposium in Morgantown, WV - 4/19-20 - presented paper on Erico Restoration, Venango Twp., Butler Co., PA
- Pennsylvania GIS Conference at Camp Hill, PA - 5/18 - presentation on "Datashed"
- Slippery Rock Watershed Coalition 10th Annual Symposium at Boyers Sportsmen Club and Jennings Environmental Education Center - 6/11
- 22nd Annual American Society of Mining and Reclamation National Meeting in Breckenridge, CO - 6/18-24 - M. Dunn, 2005 ASMR President
- OSM Technology Transfer 2005 Mine Water Treatment Conference in Pittsburgh, PA - 8/16-18
- Pennsylvania GIS Day in Harrisburg, PA - 11/15
- Pennsylvania Association of Environmental Professionals Western Section Meeting in Coraopolis, PA - 12/7

Recognition

- 9th Annual Carnegie Science Center Award for Excellence in Environmental category awarded to Margaret Dunn - 4/27
- Slippery Rock Watershed Coalition featured in 2005 International Affiliation of Land Reclamationists newsletter
- Dr. Fred Brenner elected to serve as District Governor of Rotary International

Kids have fun making "fish prints" at the 4th Annual Ohio River Watershed Celebration.

Beautiful sites in Breckenridge and surrounding towns added to the enjoyment of the ASMR Conference.

PHOTO OF THE MONTH

Ninety-one volunteers turned out for the 5th annual prairie improvement day held at Jennings Environmental Education Center on Saturday, January 21. Volunteers dedicated 270 hours of their time, and 8 restaurants donated hot, delicious soup.

PHOTO OF THE MONTH

Escape the Winter Blues with Fun Programs at Jennings

Who says you have to stay cooped up this winter? Take a break from your winter hibernation to join the knowledgeable staff at Jennings Environmental Education Center (JEEC) for some interesting environmental education programs! JEEC, a state park dedicated to providing environmental education and interpretation to the community, is located in Slippery Rock 12 miles north of Butler on PA Route 528. JEEC offers a diverse array of environmental education programs year-round. Check out 3 of their fun upcoming events! These programs are offered at no cost, but interested individuals should call JEEC to sign up.

Program Title: Owl Prowl

Date: February 12, 2006

Time: 7:00 PM

Contact Info.: Will Taylor, Program Coordinator, 724-794-6011

Program Description: Princes of darkness and lords of the night time sky, owls are superb, highly specialized predators. Their nocturnal habits, silent flight and ghostly appearances have fascinated people for centuries. Come owling for the evening and explore the folklore, natural history and adaptations of the mysterious creatures of the night. Following a brief indoor presentation, prowl among owls and other nightlife on a guided walk along Jennings' darkened forest trails.

Program Title: Winter Tree Identification Hike

Date: February 26, 2006

Time: 2:00 PM

Contact Info.: Will Taylor, Program Coordinator, 724-794-6011

Program Description: During the leafless winter months many familiar trees seem to conceal their identities. However, true tree detectives notice clues in the bark, buds, and branches that remain during this frosty season. In fact, these distinctive characteristics are often easier to observe after the leaves have disappeared. Solve the mystery and learn to distinguish our common trees in their dormant state on a one and one half hour guided walk with the Jennings staff.

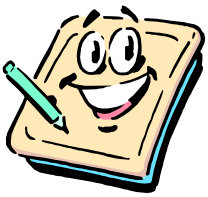
Program Title: The Fur Trade: Its Origin and Importance

Date: March 12, 2006

Time: 2:00 PM

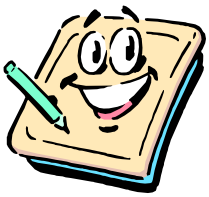
Contact Info.: Will Taylor, Program Coordinator

Program Description: With the arrival of Europeans the Iroquois and Algonquin tribes in North America turned from using natural resources for survival to depending on imported manufactured goods. This provided France and England with an economic source of power and put thousands to work to meet the demands of the Indians in North America. Dressed as an early trader with an intriguing supply of furs and 18th century artifacts, artist and historian Fred Threlfall will make this historical period come alive with his fascinating presentation.



The KIDS Catalyst

SLIPPERY ROCK WATERSHED COALITION FUN ACTIVITY



Groundhog's Day Phun with Phil

Groundhog's Day is February 2! On this day, lots of people will be tuning in to hear the news of the famous groundhog, Phil, who lives in Punxsutawney, Pennsylvania. According to tradition, if it is sunny on Groundhog's Day then Punxsutawney Phil will come out of his burrow and cast a shadow, meaning there will be 6 more weeks of winter. If Phil comes out of his hole and doesn't see his shadow, tradition says there will be an early spring! Phil has been used to predict the weather since 1887! Most of the time, Phil has seen his shadow.

Groundhogs and woodchucks are common names for the same animal, a rodent that can actually climb trees and swim! During the winter, groundhogs go into a deep hibernation that lasts until early February. It is believed that growing amounts of sunlight trigger the groundhogs to wake up from their hibernation time. Groundhogs in the wild eat succulent green plants, such as dandelion greens, clover, plantain, grasses, and are tempted by nearby garden vegetables. Adult groundhogs weigh about 10 pounds and are about 2 feet long.

Below are several words related to Groundhog's Day that are hidden in the word search. Try to locate and circle all of the words. If you mail us your completed paper, we will send you a free gift certificate!

Groundhog	Punxsutawney	Tradition	Winter	Predict
February	Pennsylvania	Forecast	Phil	Hibernate
Spring	Shadow	Burrow	Woodchuck	Sunny

B	U	S	O	Q	A	N	T	R	A	W	O	O	D	C	H	U	C	K	W	O	K	S
F	E	H	M	P	H	C	V	N	O	J	Z	Q	F	B	Y	J	U	N	A	S	I	P
S	R	I	M	S	H	J	O	A	E	C	H	V	E	E	I	L	P	I	O	U	H	R
Z	G	B	R	B	Q	I	J	C	H	E	R	T	S	K	M	L	E	N	P	N	U	E
Y	R	E	R	N	T	P	L	E	N	N	S	Y	P	L	V	A	I	W	Q	N	Z	D
E	X	R	L	I	M	W	N	Y	F	K	F	O	R	E	C	A	S	T	E	Y	P	I
N	P	N	D	D	I	C	M	O	O	Q	D	N	I	N	N	O	W	S	H	Z	A	C
W	O	A	C	R	B	S	C	U	O	P	L	J	N	C	K	W	N	T	E	S	R	T
A	R	T	Z	C	G	O	H	D	N	U	O	R	G	Q	F	U	H	M	R	Y	W	O
T	O	E	N	N	A	V	T	A	D	R	E	G	H	U	P	I	O	D	R	S	A	B
U	Q	T	Y	B	H	D	C	W	D	P	K	Y	B	F	R	T	H	A	M	V	U	E
S	I	W	I	N	T	E	R	W	A	O	I	C	B	W	W	O	U	C	H	R	C	K
X	P	U	N	X	T	Q	U	N	X	E	W	U	K	L	O	R	B	E	R	A	E	P
N	E	N	N	S	Y	B	Q	W	P	Y	I	V	C	X	B	Z	U	O	S	T	R	E
U	T	H	Y	A	I	N	A	V	L	Y	S	N	N	E	P	Q	W	E	N	T	I	L
P	E	C	B	Q	S	A	T	F	J	C	N	O	F	O	S	A	F	E	B	M	S	W

Name _____ Age _____

Address _____

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

Thanks to The William & Frances Aloe Charitable Foundation, Environmentally Innovative Solutions, LLC, Dominion Peoples, Amerikohl Mining, Inc., Quality Aggregates Inc., Drs. Ron & Kathy Falk Family, 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. Feb. Distribution: 1276

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

Drilling in Raccoon Creek Watershed

To help help restore the degraded waters of Raccoon Creek, preliminary site investigations are being conducted to install a new passive system to treat an 800-gpm discharge from an abandoned underground coal mine site in northern Washington County near the small town of Joffre on property owned by the **Petricia Family**. **McKay & Gould Drilling, BioMost, Inc., and Quality Aggregates** braved a blustery January day to install test boreholes and establish water monitoring wells. The wells will help to define the characteristic of the mine pool that surfaces a few hundred yards away from Raccoon Creek. This restoration project will reinforce progress that the **Washington County Conservation District** and the **Raccoon Creek Watershed Association** have been making upon this impaired watershed already. Funding has been provided by the **PA Department of Environmental Protection's Growing Greener** program, the **Office of Surface Mining**, and in-kind contributions from project partners. Thanks **Mike Hollabaugh** and **Steve Doyle**, McKay & Gould Drilling (pictured below)!!!

Video Blog - Raccoon Creek Watershed Cleanup Guided by Ingenuity, Volunteers


JB#1 Under Construction

Raccoon Creek is home to 32,000 people in 15 municipalities in parts of Beaver Washington and Allegheny counties. But it is also the home of over 175 sources of abandoned mine drainage.

Thanks to the Raccoon Creek Watershed Association, Independence Marsh Foundation, the Department of Environmental Protection, the federal Office of Surface Mining and lots of local volunteers, the watershed is now being cleaned up to again be a source of pride for the community.

This week's Video Blog features highlight two of the nine projects the Association has developed in the watershed to clean up mine drainage, educate the community about its problems and enjoy the natural features of the watershed.

Phase I of the JB#1 Project is located in the headwaters of the Raccoon Creek Watershed in Washington County and is designed to treat a 1,100 gallon per minute mine discharge.

The unique design of this project will mix clean water from Raccoon Creek with the contaminated mine water to increase the effectiveness of a pond and wetland treatment system to reduce the iron content of the water by about 45 tons a year.

Tim Danehy from Biomost, Inc. talks about the objectives of the project and its design, while equipment operator Wayne Fuchs from Quality Aggregates discusses its construction.

Sometimes mine drainage treatment projects do not work like the designers thought. And that's what happened in the case of the JB#2 Project in the Raccoon Creek Watershed, Washington County.

Originally designed to filter water through spent mushroom compost, it was discovered the lower pH of the mine water made the iron cling to the compost and clog up the system.

Now, with the help of the federal Office of Surface Mining, the Raccoon Creek Watershed Association and Independence Marsh Foundation are renovating the project to restore its treatment capacity.

John Davidson, local volunteer and a former DEP mine inspector, talks about the challenges of renovating the treatment system.

For more information, visit the Raccoon Creek Watershed Association website.

1/19/2007

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PA Environment Digest Video Blog

This is the video companion to the online newsletter www.PaEnvironmentDigest.com dedicated to "Active Environmentalists" using education, collaboration and positive action to improve the environment.

Tuesday, December 19, 2006

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Raccoon Creek Watershed Association

Biomost, Inc.- Project Designer

posted by David E. Hess @ ***8:59 AM***

0 COMMENTS:

Post a Comment

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About Me

Name: David E. Hess
Location: Harrisburg, Pennsylvania,

I edit the www.PaEnvironmentDigest.com online newsletter which is published by Crisci Associates, Harrisburg, PA. I can be contacted at 717-234-1716 or by sending email to: DHess@CrisciAssociates.com. I served as Secretary of the Pennsylvania Department of Environmental Protection from 2001 to 2003, as staff in the Pennsylvania Senate and in the former Department of Environmental Resources for over 30 years.

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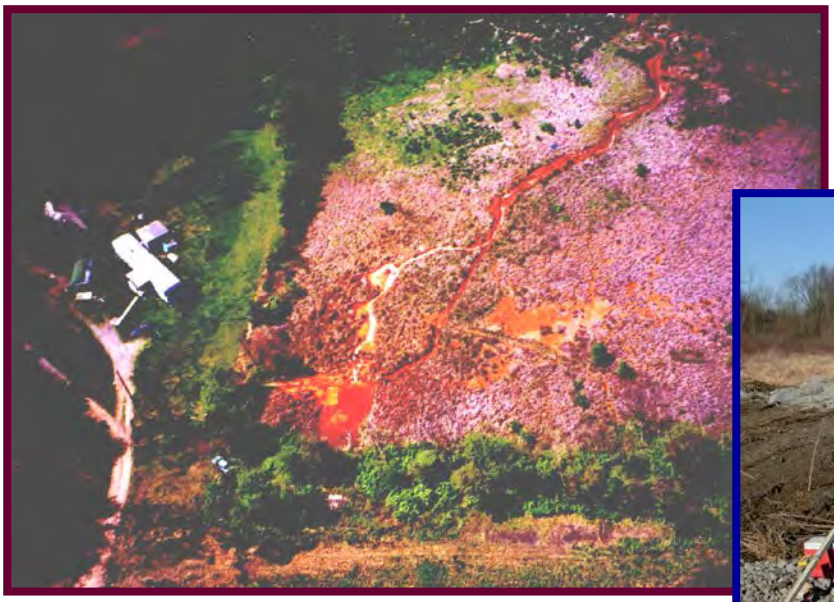
Handout given to Raccoon Creek Watershed Association and Montour Run Watershed Association during 5/22/07 celebration and tour.

RACCOON CREEK WATERSHED RESTORATION

JB1 PROJECT



Left: Before Construction - Aerial view of the JB1 discharge. With an average flow rate of 800 gallons/minute, JB1 is the greatest source of AMD pollution to the Raccoon Creek Watershed. Note the channelized flow in the existing wetland.

Right: Quality Aggregates Inc. installing an innovative manifold distribution system to utilize available wetland area to treat JB1.

Location: Petricca, Edmond, Pallus, and McFall properties, Smith Township, Washington County, PA

Environmental Need: The JB1 discharge is the largest contributor of abandoned mine drainage (AMD) pollution in the Raccoon Creek Watershed. Acidic, iron- and aluminum-laden, drainage enter Raccoon Creek at maximum flow rates in excess of 1,500 gallons per minute. In addition, water samples collected from 12/2005 through 4/2007 indicate that the quality of the drainage has deteriorated substantially when compared to earlier monitoring. [Average total values: 1995-2003 Fe ~50 mg/L, Al ~4 mg/L; 2005-2007 Fe ~94 mg/L, Al ~12 mg/L]

Environmental Benefit: About 26 miles of Raccoon Creek to the confluence with the Ohio River are expected to be improved through this effort. The passive treatment system is currently under construction and is expected to eliminate ~33 to ~88 tons/year of iron from entering Raccoon Creek.

Project Description: For Phase 1, innovative mine discharge and stream distribution manifolds have been installed in parallel. Mixing a small portion of water from Raccoon Creek, containing significant alkalinity (~170 mg/L), dissolved oxygen, and low metals with the heavily polluted mine discharge, is expected to increase pH, neutralize acidity, and encourage the precipitation of metals. In Phase 1, ~4 acres of existing, previously impacted, wetland area are utilized to remove pollutants before entering Raccoon Creek. The options for Phase 2 include the use and treatment of the mine drainage by the power industry or additional passive treatment.

Partnership: Petricca, Edmond, McFall, and Pallus families (landowners); PADEP Greensburg DMO; US Office of Surface Mining; Quality Aggregates Inc.; Aquascape; volunteers; Washington County Conservation District; Raccoon Creek Watershed Association; Independence Conservancy; Environmentally Innovative Solutions, LLC; BioMost, Inc.; Stream Restoration Inc.

For more information contact:
Stream Restoration Incorporated, A PA Non-Profit Organization 501(c)(3)
3016 Unionville Rd., Cranberry Twp., PA 16066
PH: 724-776-0161; FX: 724-776-0166; sri@streamrestorationinc.org; www.streamrestorationinc.org

Pittsburgh Historical Precipitation Totals 1836 to Current

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1836	----	----	----	----	----	----	----	3.28	1.55	2.04	1.59	2.18	-----
1837	2.66	2.27	1.27	1.00	4.64	7.50	1.70	2.52	1.77	3.93	3.71	2.69	35.66
1838	1.29	1.94	1.59	----	----	----	----	----	----	----	----	----	-----
1939	1.40	1.80	1.76	1.80	2.08	2.25	2.40	1.50	3.75	0.60	2.70	3.28	25.32
1840	1.33	1.33	3.47	2.18	2.93	3.70	1.57	3.89	2.12	2.68	1.71	1.73	28.64
1841	2.74	0.07	4.77	3.82	2.40	4.97	1.73	4.01	1.85	2.31	2.77	3.41	34.85
1842	2.75	2.88	3.75	4.64	2.86	4.96	4.90	3.91	2.20	2.09	1.72	3.79	40.45
1843	2.70	3.31	3.27	2.33	4.05	3.83	1.87	2.32	6.44	3.46	2.87	2.26	38.71
1844	2.20	0.93	3.04	1.79	4.89	4.02	2.44	4.47	2.57	2.85	1.85	1.50	32.55
1845	2.85	1.50	3.04	2.51	1.18	4.04	3.74	3.06	3.39	3.37	2.02	1.19	31.89
1846	2.92	2.73	2.02	3.76	4.62	4.05	7.15	6.05	1.95	4.78	2.60	5.16	47.79
1847	3.01	2.86	3.47	2.55	3.64	5.32	4.18	3.26	3.92	4.76	4.27	4.98	46.22
1848	1.31	0.50	3.20	2.45	5.51	3.03	3.69	2.27	2.08	2.11	3.11	4.88	34.14
1849	2.43	1.31	3.85	0.83	5.83	2.84	1.26	3.26	1.26	3.86	3.97	4.11	34.81
1850	3.76	3.45	2.74	2.59	3.30	2.62	2.82	1.27	3.62	4.29	2.19	4.76	37.41
1851	0.35	3.01	1.43	2.83	3.57	2.04	4.30	2.66	2.62	1.45	3.67	1.71	29.64
1852	1.80	3.34	2.03	9.27	3.84	2.76	2.55	2.76	3.09	2.24	2.67	5.01	41.36
1853	1.56	3.53	1.11	4.16	3.27	1.32	2.74	6.56	2.34	2.04	2.90	2.10	33.63
1854	2.23	2.33	2.82	4.21	2.24	2.06	1.45	1.13	1.76	2.89	1.88	1.67	26.67
1855	2.15	1.77	3.08	2.60	2.33	7.58	5.57	3.57	4.79	1.54	5.07	3.28	43.33
1856	2.64	1.80	1.73	2.29	2.52	3.99	2.71	1.60	1.95	2.05	1.97	1.34	26.59
1857	1.86	1.56	1.03	2.50	6.34	5.14	2.89	4.65	2.20	3.66	3.52	3.61	38.96
1858	1.15	2.78	0.99	4.29	6.60	4.30	3.60	1.90	1.03	2.40	2.37	4.77	36.18
1859	0.43	2.67	3.83	4.79	2.00	3.02	1.87	5.00	2.74	3.00	1.69	4.67	35.71
1860	1.75	1.25	1.19	6.56	3.69	2.17	3.09	3.82	1.81	4.45	3.96	2.04	35.78
1861	1.96	2.65	1.80	3.48	2.70	1.75	4.69	3.00	5.70	2.72	1.81	0.44	32.70
1862	3.60	1.20	2.87	2.79	2.49	4.00	2.60	1.20	1.51	3.45	2.10	1.57	29.38
1863	3.91	2.33	2.69	2.17	2.11	3.38	1.42	2.26	2.72	3.43	2.45	2.75	31.62
1864	1.48	1.77	4.82	2.24	4.46	2.10	2.55	8.29	8.25	2.36	3.93	2.75	45.00
1865	2.75	1.37	4.83	3.20	5.36	5.48	6.26	5.54	7.56	3.21	1.48	3.46	50.50
1866	----	----	----	----	----	----	----	----	7.50	4.90	4.46	2.75	-----
1867	2.58	4.11	4.30	2.90	----	----	----	----	----	----	----	----	-----
1868	----	----	----	----	----	----	----	----	----	----	----	----	-----
1869	----	----	----	----	----	----	----	----	----	----	----	----	-----
1870	----	----	----	----	----	----	----	----	----	----	----	----	-----
1871	----	----	----	----	----	----	----	----	----	----	----	----	-----
1872	1.85	1.03	1.38	1.09	2.66	2.69	7.77	2.81	2.57	4.37	0.83	2.86	31.91
1873	3.16	3.08	3.87	3.06	3.42	2.15	3.44	5.19	1.94	6.21	2.13	3.77	41.42
1874	2.92	3.15	2.94	7.20	2.43	1.84	7.68	1.98	2.56	0.06	3.36	3.30	39.42
1875	2.17	1.57	3.45	2.09	2.79	2.85	5.27	2.19	2.56	2.36	2.96	3.79	34.05
1876	3.59	2.83	3.80	2.04	3.35	1.47	5.86	2.72	7.35	1.14	2.03	0.83	37.01
1877	2.99	1.43	5.31	2.88	1.66	3.54	3.98	2.10	1.90	2.76	4.48	1.69	34.72
1878	2.52	1.14	2.42	2.60	1.76	5.18	5.15	1.29	5.55	2.99	4.20	3.96	38.76
1879	1.54	1.74	2.99	1.63	1.20	4.56	7.78	5.56	1.01	0.65	3.36	5.00	37.02
1880	3.02	2.63	2.77	2.41	1.25	3.52	2.15	3.62	3.12	2.80	1.73	2.95	31.97
1881	3.55	3.45	3.35	1.81	2.34	6.95	3.86	0.88	0.76	3.75	2.66	3.94	37.30
1882	4.58	3.14	3.78	1.39	5.80	4.14	1.99	4.50	4.08	1.74	2.07	1.42	38.63
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1884	4.82	4.57	3.71	1.11	3.48	1.71	4.04	2.94	1.17	2.02	1.18	4.07	34.82
1885	4.03	1.90	1.14	2.79	3.26	2.68	2.49	5.64	1.69	4.29	2.57	1.64	34.12
1886	3.21	1.39	2.85	4.03	3.51	5.17	5.56	2.85	2.86	1.06	4.91	1.81	39.21
1887	1.92	6.52	1.49	4.29	5.78	4.50	9.51	2.16	2.03	0.39	1.37	1.99	41.95
1888	6.17	1.74	2.51	1.04	4.13	2.22	4.36	7.26	1.77	3.46	3.57	1.66	39.89
1889	2.50	1.58	2.32	3.62	6.45	4.93	5.48	1.88	2.87	2.06	4.61	3.07	41.37
1890	4.18	5.52	3.86	4.87	5.85	3.37	2.22	4.06	4.24	5.66	1.14	5.64	50.61
1891	2.43	6.09	3.11	1.18	3.23	3.90	7.65	1.60	1.90	1.53	2.61	3.05	38.28
1892	3.29	1.85	2.29	2.93	3.77	4.15	5.88	2.22	2.04	0.51	1.81	1.92	32.66
1893	2.36	4.74	1.17	4.94	4.50	2.87	5.08	2.94	1.86	3.22	1.46	2.70	37.84
1894	2.02	2.98	2.41	3.63	4.63	0.61	1.16	0.43	3.68	1.72	1.80	3.10	28.17
1895	4.16	0.77	1.73	1.83	1.97	2.26	2.11	4.29	1.83	1.11	2.24	3.20	27.50
1896	1.63	2.89	4.13	3.39	3.91	4.79	8.96	4.09	4.17	2.26	2.76	1.37	44.35
1897	1.34	4.30	3.50	3.34	2.70	2.97	4.52	2.08	1.65	0.13	5.11	3.44	35.08
1898	3.40	1.60	5.45	1.60	3.99	3.98	2.56	4.01	1.06	3.85	2.34	1.92	35.76

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL

1899	3.41	2.68	3.37	2.59	3.26	3.72	3.13	2.57	2.66	2.10	2.12	2.24	33.85
1900	1.54	2.86	2.35	1.25	1.34	3.25	3.42	0.84	1.01	2.24	3.64	1.99	25.73
1901	1.98	0.91	3.69	8.11	5.80	4.41	2.84	4.04	1.96	0.38	1.80	4.84	40.76
1902	1.49	1.45	4.15	2.70	2.30	5.79	2.94	1.61	2.21	2.79	1.08	3.71	32.22
1903	2.33	3.99	4.29	2.82	1.67	5.27	5.66	4.71	1.04	2.88	2.60	1.55	38.81
1904	2.31	2.00	5.11	3.02	3.48	5.76	2.72	2.36	2.35	2.09	0.22	2.34	33.76
1905	2.36	1.41	3.03	2.07	2.79	6.64	3.01	3.11	2.41	3.54	1.80	3.02	35.19
1906	1.84	1.09	3.85	1.70	2.08	4.08	4.18	2.96	3.10	2.94	0.95	2.52	31.29
1907	5.58	0.74	5.24	1.99	1.79	3.17	4.95	1.89	3.25	1.64	1.59	3.03	34.86
1908	1.65	2.89	5.22	3.59	3.84	1.14	5.07	2.48	0.71	0.95	0.69	1.94	30.17
1909	3.10	4.47	3.14	5.23	1.51	4.92	1.22	3.33	0.76	2.36	0.84	2.30	33.18
1910	5.33	3.60	0.37	2.21	3.24	1.94	1.26	2.47	5.50	1.69	1.32	2.87	31.80
1911	3.30	1.98	1.90	5.42	0.42	2.63	2.17	6.30	6.36	4.94	2.02	3.79	41.23
1912	1.90	1.81	4.83	4.32	1.56	5.67	6.61	2.39	2.89	2.67	0.80	2.86	38.31
1913	5.28	2.11	4.37	2.53	3.11	1.04	4.86	2.81	2.86	4.26	2.66	2.60	38.49
1914	2.41	3.13	2.12	3.98	2.64	3.31	1.89	4.52	0.69	3.07	1.35	4.37	33.48
1915	4.66	2.24	1.26	1.27	3.84	5.36	3.37	2.73	1.71	2.84	2.37	3.85	35.50
1916	3.51	2.61	3.63	2.54	2.33	3.82	3.88	4.73	1.63	2.31	1.86	2.01	34.86
1917	4.33	0.99	3.36	2.20	2.65	3.65	2.33	4.75	1.90	5.27	0.28	1.19	32.90
1918	2.82	1.87	1.25	2.73	3.89	2.40	2.22	4.84	2.22	3.08	1.79	3.50	32.61
1919	1.42	1.58	1.89	3.07	4.89	3.58	6.20	7.15	1.64	5.37	3.82	2.88	43.49
1920	2.80	1.62	1.77	4.42	1.03	6.74	3.29	2.53	3.48	1.48	2.57	1.94	33.67
1921	3.35	1.80	3.36	1.66	2.49	5.33	2.81	3.03	5.07	2.25	5.06	2.36	38.57
1922	1.56	1.57	5.84	3.56	2.59	3.12	2.80	2.35	1.54	1.62	1.31	1.98	29.84
1923	3.49	2.18	2.15	3.82	3.34	4.28	6.74	4.24	1.62	1.05	2.39	6.22	41.52
1924	3.53	2.59	4.15	3.09	4.54	4.39	3.10	3.46	5.39	0.12	1.39	1.95	37.70
1925	3.16	1.91	1.61	1.43	3.42	2.11	3.81	0.96	1.58	4.09	2.70	1.40	28.18
1926	2.85	3.47	1.73	1.46	2.10	1.20	1.72	2.95	7.45	4.12	3.27	3.12	35.44
1927	3.52	3.97	3.20	3.15	3.74	2.77	6.34	1.86	2.18	4.09	5.18	3.16	43.16
1928	1.30	3.07	4.25	4.05	1.09	7.73	4.93	3.10	1.02	1.22	1.91	1.18	34.85
1929	3.33	2.62	2.15	4.29	5.38	2.21	3.50	1.79	1.05	5.07	3.38	2.15	36.92
1930	1.67	3.12	2.82	2.60	1.95	3.41	1.33	1.10	0.74	1.17	1.02	1.72	22.65
1931	1.16	1.93	2.48	3.61	5.46	5.72	5.36	3.50	3.81	1.21	1.80	2.94	38.98
1932	4.80	0.82	3.24	1.16	3.03	0.78	2.01	1.72	0.59	2.79	3.22	1.73	25.89
1933	2.39	1.67	5.77	4.25	6.55	1.16	3.21	5.51	4.20	0.46	1.68	3.42	40.27
1934	2.02	0.85	2.15	2.41	0.66	4.45	3.25	7.47	3.78	0.67	2.63	1.33	31.67
1935	2.41	3.00	3.04	1.91	4.07	3.35	2.00	4.44	2.13	2.01	2.15	2.74	33.25
1936	3.50	2.30	5.88	2.11	1.01	1.61	3.07	3.97	4.93	4.05	2.65	3.39	38.47
1937	7.15	1.40	2.09	5.62	2.21	2.65	5.63	2.52	0.57	3.73	1.10	2.99	37.66
1938	1.98	2.82	3.21	3.27	4.10	3.99	2.06	2.86	4.30	1.10	2.64	0.89	33.22
1939	2.89	4.32	2.86	3.16	1.48	4.99	2.73	1.25	2.58	3.14	0.53	1.66	31.59
1940	0.88	3.31	4.18	5.26	4.14	6.23	4.16	4.44	2.59	0.88	2.92	2.62	41.61
1941	2.98	0.80	1.97	1.36	3.52	4.42	4.22	6.55	1.00	3.55	2.27	1.73	34.37
1942	1.54	2.18	4.31	3.08	4.41	3.99	4.15	2.77	3.40	3.91	2.55	5.61	41.90
1943	2.93	1.72	3.26	2.38	5.63	1.89	7.99	1.89	0.71	3.58	1.58	1.14	34.70
1944	1.26	2.26	5.50	3.24	2.97	4.60	3.70	4.32	1.21	2.96	2.35	6.16	40.53
1945	3.02	2.78	5.97	3.81	5.06	3.65	2.74	2.50	10.08	2.39	3.79	2.41	48.20
1946	1.12	2.43	2.53	1.15	4.10	4.93	2.70	2.11	1.27	3.47	0.99	2.45	29.25
1947	3.54	1.32	1.51	2.51	3.78	4.04	4.89	1.42	1.52	1.19	3.09	1.19	30.00
1948	2.04	1.90	3.69	6.03	3.17	6.05	2.83	2.90	1.27	3.14	2.60	3.25	38.87
1949	3.95	2.62	3.14	2.57	2.26	3.04	5.04	2.22	1.80	1.79	1.92	3.43	33.78
1950	5.67	3.74	3.88	2.29	4.61	5.86	4.09	2.63	3.53	1.53	7.29	3.26	48.38
1951	4.90	2.77	4.54	4.86	2.06	10.25	3.48	0.55	2.71	1.45	3.75	3.83	45.15
1952	4.69	2.82	4.64	3.96	5.35	3.79	2.04	4.08	1.45	0.98	1.73	2.19	37.72
1953	3.07	1.14	3.03	3.91	5.89	3.68	2.18	3.00	1.66	0.89	1.33	1.43	31.21
1954	2.34	1.55	4.28	3.11	1.88	3.79	2.43	2.92	1.80	8.20	1.00	2.70	36.00
1955	1.34	3.24	3.69	2.61	2.59	3.20	3.61	6.77	1.75	2.79	2.89	0.40	34.88
1956	1.90	5.98	5.28	4.31	5.90	4.19	4.25	5.07	1.93	1.50	1.03	3.35	44.69
1957	1.65	1.35	2.02	4.58	2.73	4.07	3.97	0.78	4.06	1.74	2.50	4.22	33.67
1958	3.17	1.11	1.87	3.42	4.82	2.74	7.43	3.71	4.52	0.97	2.47	1.10	37.33
1959	3.99	2.15	2.11	3.33	2.56	3.70	4.25	4.04	1.34	5.94	2.43	2.78	38.62
1960	3.01	3.16	2.06	1.37	5.62	2.72	3.46	3.55	1.84	1.64	1.22	1.64	31.29
1961	1.95	3.13	3.48	5.21	2.80	4.21	5.53	2.11	1.98	2.58	3.41	1.71	38.10
1962	2.33	3.55	3.85	3.03	1.87	1.82	2.44	2.57	4.69	2.11	1.53	1.83	31.62

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1963	1.96	2.09	5.28	2.39	1.57	2.40	3.45	2.31	1.40	0.16	2.54	1.24	26.79
1964	2.55	1.73	4.96	7.61	1.77	3.84	4.48	1.79	0.74	1.42	2.74	4.26	37.89

1965	3.84	2.98	3.16	1.79	1.21	2.31	1.82	3.26	4.07	2.82	2.35	0.63	30.24
1966	4.52	3.23	1.88	3.73	2.76	1.72	2.70	5.13	1.92	1.38	3.39	1.70	34.06
1967	1.06	2.54	6.10	4.41	5.21	0.90	4.54	2.67	1.61	2.05	3.07	2.22	36.38
1968	2.83	0.79	4.53	2.33	6.36	2.38	2.36	3.97	3.08	2.13	2.07	3.24	36.07
1969	2.02	0.51	1.14	2.91	1.89	3.74	4.52	2.96	0.91	2.59	2.44	3.95	29.58
1970	1.61	1.92	3.35	3.09	4.36	4.61	3.89	1.55	2.77	4.80	2.64	3.29	37.88
1971	2.29	4.04	3.20	0.48	3.87	1.41	6.82	1.23	3.86	0.84	1.94	3.24	33.22
1972	1.84	3.64	3.68	4.37	1.38	5.08	2.98	1.79	5.42	2.15	4.70	3.04	40.07
1973	2.03	1.80	3.86	4.69	5.87	3.12	2.16	3.40	3.56	4.45	2.65	2.15	39.74
1974	3.47	2.10	3.72	3.26	5.35	5.08	3.30	2.93	4.42	1.12	3.06	4.02	41.83
1975	3.34	4.64	4.62	2.27	1.84	4.58	4.38	7.56	5.06	3.46	1.77	2.90	46.42
1976	3.25	1.74	4.45	1.24	1.99	3.37	4.72	1.25	3.30	3.76	0.90	1.81	31.78
1977	2.06	0.87	4.12	3.26	2.57	2.85	3.38	2.66	3.13	2.44	2.59	3.27	33.20
1978	6.25	0.54	1.65	2.25	4.26	4.11	2.15	3.65	2.64	3.42	1.62	5.24	37.78
1979	4.80	3.12	1.32	3.17	4.49	1.73	4.31	6.84	3.60	2.46	2.43	2.29	40.56
1980	1.56	1.32	5.65	2.94	4.32	4.34	6.76	5.10	1.29	2.42	2.38	1.38	39.46
1981	0.77	4.20	2.12	4.92	2.04	8.20	3.82	0.98	4.13	1.82	1.50	3.00	37.50
1982	4.44	1.93	3.52	1.44	3.98	3.05	2.36	1.97	2.80	0.40	3.33	2.79	32.01
1983	1.19	1.58	3.50	4.33	5.24	4.82	3.32	3.13	2.42	3.67	3.94	4.27	41.41
1984	1.40	2.05	2.32	3.72	5.22	1.98	3.01	5.15	0.84	3.45	3.14	3.04	35.32
1985	1.43	1.45	3.37	1.64	5.80	2.26	4.06	2.64	0.28	2.27	11.05	2.26	38.51
1986	2.49	3.43	1.38	1.94	1.67	5.24	5.66	3.04	2.33	2.83	3.92	3.47	37.40
1987	2.23	0.71	2.65	5.30	2.41	6.30	2.42	7.86	3.97	0.92	2.02	2.41	39.20
1988	1.49	3.46	2.56	1.97	2.78	1.26	2.82	2.04	2.34	1.40	2.80	2.17	27.09
1989	1.99	3.42	5.52	1.43	6.56	10.29	1.62	1.12	4.57	2.04	1.56	2.39	42.51
1990	3.30	3.31	1.47	3.48	6.19	4.24	6.59	3.59	6.00	3.51	2.05	8.51	52.24
1991	2.55	1.88	2.92	2.56	3.29	3.82	3.74	1.63	3.45	0.55	1.97	3.66	32.02
1992	2.13	1.73	3.54	2.30	2.31	0.64	8.71	4.77	2.91	1.47	3.31	2.83	36.65
1993	2.99	2.92	4.14	3.66	2.85	3.35	2.85	2.44	3.87	2.77	4.30	2.12	38.26
1994	3.90	2.13	5.00	3.72	2.54	2.91	3.27	7.75	3.59	0.88	3.64	2.01	41.34
1995	2.23	1.73	1.56	1.70	3.72	3.74	3.06	1.75	1.80	3.24	2.74	1.62	28.89
1996	3.68	2.54	4.54	4.42	2.95	7.95	4.01	1.99	5.63	2.96	2.82	1.98	45.47
1997	1.58	1.15	3.22	1.57	6.33	3.95	1.82	3.80	2.92	0.95	5.99	1.29	34.57
1998	3.63	2.56	1.91	5.00	2.39	6.71	2.02	3.32	1.09	2.27	1.50	1.81	34.21
1999	4.88	2.43	1.24	4.19	4.12	1.67	6.25	2.21	1.97	1.55	3.46	2.24	36.21
2000	1.70	2.53	2.26	3.15	5.69	5.64	6.28	3.66	3.10	2.09	1.38	2.64	40.12
2001	1.34	1.09	3.28	3.75	2.11	3.43	3.15	7.12	2.23	2.33	3.47	2.43	35.73
2002	1.76	1.17	3.67	3.05	4.70	2.63	1.66	2.89	3.24	2.99	2.00	2.57	32.33
2003	2.18	2.86	1.55	2.45	6.14	3.88	6.01	3.18	3.48	2.57	3.42	3.34	41.06
2004	4.78	2.44	3.60	4.49	6.09	5.01	5.67	6.13	10.06	3.36	3.19	2.61	57.43
2005	6.12	3.02	2.31	3.72	4.09	3.35	4.33	3.72	1.32	3.47	4.05	1.73	42.96
2006	3.74	1.74	2.12	3.02	2.96	4.37	3.87	1.60	3.26	4.84	1.40	2.01	34.92
2007	3.28	1.97	5.28	4.31	1.93	2.53							
30 yr	2.70	2.37	3.17	3.01	3.80	4.12	3.96	3.38	3.21	2.25	3.02	2.86	37.85
mean	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
(1971-2000)													

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
CULV 1	4/25/2007			8.1	8.0	555	11	192	177	-163	0.4	0.1	0.1	0.1	0.3	0.1	87	6
CULV 1	6/7/2007			7.4	6.8	737	20	197	187	-174	2.9	0.7	0.5	0.5	0.6	0.1	153	3
CULV 1	6/27/2007			7.1	7.1	920	25	199	171	-149	5.7	2.0	1.3	1.3	0.2	0.0	264	6
Min				7.1	6.8	555	11	192	171	-174	0.4	0.1	0.1	0.1	0.2	0.0	87	3
Max				8.1	8.0	920	25	199	187	-149	5.7	2.0	1.3	1.3	0.6	0.1	264	6
Avg				7.6	7.3	737	19	196	178	-162	3.0	1.0	0.7	0.6	0.3	0.1	168	5
Range				1.0	1.2	365	14	7	16	24	5.4	1.9	1.2	1.2	0.4	0.1	177	3

Description: Raccoon Creek; at 7' SS culvert (culv#1) for access road (Slak Lane extension); ~155' W of CULV #2 (JB1A) for side channel

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
JB1	9/13/1973	Measured	340		3.2				0	360	64.0						1100	
JB1	12/17/1973	Measured	489		2.9				0	200	67.2						875	
JB1	2/8/1974	Measured	1232		2.8				0	260	62.9						325	
JB1	3/1/1974	Measured	1337		3.0				0	380	48.6						600	
JB1	4/3/1974	Measured	1479		2.8				0	320	37.1						575	
JB1	5/8/1974	Measured	1607		3.1				0	280	38.1						950	
JB1	6/18/1974	Measured	1266		2.9				0	388	39.9						625	
JB1	7/16/1974	Measured	1327		3.2				0	246	35.8						800	
JB1	8/8/1974	Measured	875		2.8				0	300	36.1						875	
JB1	9/6/1974	Measured	1297		2.9				0	600	25.0						1225	
JB1	10/7/1974	Measured	1093		3.2				0	242	45.3						850	
JB1	11/7/1974	Measured	870		2.9				0	340	38.4						1025	
JB1	12/11/1974	Measured	1323		3.3				0	170	17.2						925	
JB1	1/11/1995				4.6				14	226	69.1		1.8		10.2		830	1
JB1	2/24/1995				4.5				11	170	53.7		1.6		7.8		737	2
JB1	3/17/1995				4.7				15	146	46.7		1.4		6.6		618	2
JB1	4/13/1995	Measured	1197		4.6				13	118	43.5		1.5		6.8		571	2
JB1	5/4/1995	Measured	1186		4.6				12	128	44.0		1.5		7.0		611	2
JB1	6/13/1995	Measured	1122		4.7				14	148	48.0		1.7		7.2		603	8
JB1	8/8/1995	Measured	876		4.8				16	138	51.1		1.6		7.0		633	4
JB1	9/11/1995	Measured	672															
JB1	10/26/1995	Measured	963		4.9				18	180	56.4		1.7		6.5		747	14
JB1	11/8/1995	Measured	615		4.8				15	194	63.5		1.9		6.5		722	15
JB1	12/13/1995	Measured	788		5.1				26	132	53.0		1.5		4.6		715	2
JB1	1/11/1996	Measured	850		5.3				24	124	59.1		1.6		4.7		780	8
JB1	2/12/1996	Measured	756															
JB1	3/18/1996	Measured	967		4.6				11	190	45.3		1.4		7.4		667	2
JB1	4/9/1996	Measured	1267		4.3				7	194	43.6		1.4		8.5		653	2
JB1	5/21/1996	Measured	966		4.4				9	158	40.2		1.5		9.5		682	2

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
JB1	6/6/1996	Measured	1362		4.5				10	168	42.9		1.6		9.7		658	2
JB1	7/1/1996	Measured	1043		4.6				12	170	41.4		1.5		9.0		612	12
JB1	8/1/1996	Measured	738		4.6				12	128	38.4		1.4		7.4		616	2
JB1	9/10/1996	Measured	627		4.7				13	170	42.1		1.4		6.5		696	16
JB1	10/24/1996				4.7				14	156	48.6		1.6		6.0		751	34
JB1	11/8/1996				4.8				16		46.4		1.4		5.8		662	12
JB1	12/30/1996				4.7				14	140	40.8		1.5		6.8		670	2
JB1	1/23/1997				4.7				14	124	30.4		1.2		5.1		730	2
JB1	2/25/1997				4.6				12	118	27.6		1.3		5.1		626	2
JB1	3/24/1997				4.5				11	92	25.3		1.2		5.3		496	10
JB1	4/28/1997				4.6				12	116	23.9		1.2		5.5		586	2
JB1	5/21/1997				4.7				15	114	26.4		1.3		5.2		753	2
JB1	6/24/1997				4.6				10	124	29.4		1.3		6.0		523	10
JB1	7/14/1997				4.9				17	156	30.1		1.3		4.8		486	6
JB1	10/23/1997				5.1				18	160	41.8		1.4		4.6		626	4
JB1	2/11/1998				4.9				17	78	34.2		1.2		3.8		575	36
JB1	4/16/1998				4.9				18	104	33.0		1.3		4.5		574	2
JB1	6/10/1998				4.7				12	104	35.2		1.3		5.3		588	10
JB1	8/24/1998				5.0				22	80	34.3		1.1		3.4		639	12
JB1	10/29/1998				5.2				24	92	44.7		1.4		3.8		685	6
JB1	12/16/1998				5.3				2	102	56.7		1.6		4.5		747	2
JB1	1/27/1999				5.3				28	86	52.4		1.5		4.1		629	2
JB1	2/8/1999				5.2				26	92	49.9		1.5		4.3		695	2
JB1	3/9/1999				5.0				19	84	39.7		1.3		3.9		514	6
JB1	4/14/1999	Measured	1105		4.8				16	80	37.7		1.4		4.7		582	8
JB1	5/12/1999	Measured	1515		4.9				16	82	36.2		1.3		4.7		558	4
JB1	6/3/1999	Measured	1233		4.9				17	82	36.6		1.4		4.5		552	6
JB1	7/28/1999	Measured	674		5.1				20	88	38.5		1.3		3.9		641	2
JB1	8/9/1999	Measured	629		5.2				22	80	39.0		1.3		3.5		601	2

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
JB1	9/9/1999	Measured	524		5.2				24	94	44.5		1.4		3.6		811	2
JB1	10/19/1999	Measured	395		5.2				26	92	45.3		1.4		3.6		706	2
JB1	11/2/1999	Measured	466		5.3				24	84	49.3		1.5		3.8		687	2
JB1	12/2/1999	Measured	480		5.5				34	88	47.2		1.4		3.1		822	6
JB1	1/11/2000	Measured	430		5.6				40	88	52.6		1.4		3.1		701	10
JB1	2/2/2000	Measured	379		5.5				34	100	46.1		1.2		3.4		786	2
JB1	3/6/2000	Measured	629		5.3				32	108	63.8		1.7		4.3		680	10
JB1	4/20/2000	Measured	1552		5.2				24	110	47.6		1.4		3.4		624	2
JB1	5/2/2000	Measured	1168															
JB1	6/8/2000	Measured	1335		5.2				24	88	43.2		1.4		3.5		663	6
JB1	7/10/2000	Measured	1105		5.2				22	78							577	2
JB1	8/9/2000	Measured	1370		5.5				38	62	44.3		1.3		2.7		609	4
JB1	9/14/2000	Measured	874		5.0				19	94	46.7		1.6		3.9		646	2
JB1	10/3/2000	Measured	770		5.1				22	100	40.9		1.5		3.7		676	4
JB1	11/1/2000	Measured	674		5.2				24	98	46.6		1.5		3.8		638	22
JB1	12/4/2000	Measured	504		5.3				24	104	53.2		1.6		3.9		761	10
JB1	1/8/2001	Measured	585		5.4				34	94	51.6		1.5		3.7		760	17
JB1	2/5/2001	Measured	770		5.5				34	88	53.6		1.6		3.5		754	8
JB1	3/7/2001	Measured	847		5.4				30	92	54.6		1.4		3.3		708	26
JB1	4/16/2001	Measured	1515		5.2				18	88	38.2		1.2		3.1		595	6
JB1	5/9/2001	Measured	1441		4.9				17	90	46.3		1.4		4.5		643	6
JB1	6/5/2001	Measured	1105		5.0				18	112	46.7		1.6		4.6		581	6
JB1	7/10/2001	Measured	770		5.1				19	116	51.8		1.7		4.5		606	14
JB1	8/2/2001	Measured	674		5.1				22	118	51.7		1.6		4.2		606	10
JB1	10/25/2001	Measured	379		5.2				28	112	55.1		1.6		3.5		875	8
JB1	11/7/2001	Measured	363		5.3				28	128	53.0		1.5		3.6		793	6
JB1	12/3/2001	Measured	430		5.3				34	105	58.6		1.6		3.0		691	20
JB1	1/29/2002	Measured	412		5.6				42	117	58.2		1.5		2.8		757	2
JB1	2/11/2002	Measured	412		5.5				44	119	58.8		1.6		2.9		592	2

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
JB1	3/20/2002	Measured	629		5.6				40	150	57.4		1.5		2.8		503	12
JB1	4/22/2002	Measured	901		5.5				36	107	47.0		1.3		2.5		587	4
JB1	5/28/2002	Measured	1370		5.2				22	109	53.2		1.5		3.5		552	14
JB1	6/24/2002	Measured	1370		5.0				22	130	51.6		1.6		4.1		550	16
JB1	7/22/2002	Measured	985		5.1				20	122	51.6		1.7		4.5		660	8
JB1	8/7/2002	Measured	901		5.2				19	131	63.8		1.9		4.8		749	4
JB1	9/16/2002	Measured	607		5.2				26	136	56.7		1.6		3.8		849	10
JB1	10/28/2002	Measured	504		5.5				32	131	54.7		1.5		3.2		111	28
JB1	11/25/2002	Measured	430		5.5				42	102	53.6		1.5		2.8		808	28
JB1	12/11/2002	Measured	379		5.3				32	120	61.3		1.7		3.7		427	14
JB1	1/17/2003	Weir	674	5.5	5.7	1481	10		30	97	49.6	40.1	1.6	1.2	2.4	1.7	768	10
JB1	1/29/2003			5.5			11	33										
JB1	1/30/2003	Weir	674	5.4	5.4				41	121	55.4		1.5		2.7		747	3
JB1	2/20/2003	Weir	697	5.4	5.6				40	120	52.9		1.4		2.5		713	3
JB1	3/20/2003	Weir	674	5.5	5.2				28	119	46.3		1.3		3.0		654	4
JB1	4/29/2003	Weir	697	5.5	5.2				22	109	47.2		1.5		3.8		629	12
JB1	5/21/2003	Weir	2025	5.0	4.7				12	132	43.4		1.4		4.4		562	6
JB1	3/31/2004	Estimated	2000	3.9	4.5				12	211	63.1		2.2		13.9		704	48
JB1	5/26/2004	Weir	2500	4.5	4.6				13	191	56.4		2.0		11.6		720	6
JB1	12/7/2005			4.8	4.6	1713	11	0	3	244	100.5		2.4		14.4		1080	8
JB1	3/16/2006				4.6	1518			2	220	87.7	83.5	2.0	1.9	11.2	8.7	858	20
JB1	5/31/2006	Flume	792															
JB1	6/1/2006	Flume	792															
JB1	6/7/2006	Flume	964															
JB1	8/2/2006	Flume	724	4.8	4.5	1516	12	0	0	205	82.7	82.3	1.8	1.8	8.2	8.0	734	9
JB1	12/12/2006	Flume	552	5.0	5.1	1582	12	18	5	166	80.9	80.6	2.2	2.1	5.5	5.0	829	
JB1	1/5/2007	Flume	766															
JB1	4/25/2007	Estimated	3000	4.6	3.9	1717	12	1	0	287	116.0	111.0	2.5	2.4	21.1	20.8	1133	15
JB1	6/7/2007	Measured	1347	4.6	4.2	1627	14	0	0	301	115.1	107.0	2.3	2.3	17.6	15.8	839	5

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
JB1	6/27/2007	Measured	1100	4.6		1616	13		3	275	148.0	126.0	2.3	2.3	10.8	7.9	842	17
Min			340	3.9	2.8	1481	10	0	0	62	17.2	40.1	1.1	1.2	2.4	1.7	111	1
Max			3000	5.5	5.7	1717	14	33	44	600	148.0	126.0	2.5	2.4	21.1	20.8	1225	48
Avg			946	5.0	4.8	1596	12	9	18	151	50.2	90.1	1.5	2.0	5.4	9.7	691	8
Range			2660	1.6	2.9	236	4	33	44	538	130.8	85.9	1.4	1.2	18.7	19.1	1114	47

Description: Abandoned mine discharge; PADEP CV 103; Pittsburgh & Eastern Coal Co. Mines No. 2 & 3; monitored for Penn Balt, Inc. Mine# 3, SMP63860104 (1/12/89); 5.1 lab pH on 6/27/07 appears spurious

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
JB1A	1/17/2003			6.0	6.4	1440	6		73	44	35.5	34.0	1.2	1.1	2.0	0.8	424	11
JB1A	4/25/2007			6.3	6.0	1099	11	44	22	49	54.5	51.6	1.5	1.5	9.1	1.3	544	12
JB1A	6/7/2007			4.5	3.7	1583	20	0	0	238	95.9	90.0	2.9	2.8	12.5	11.2	849	7
JB1A	6/27/2007			4.8	4.5	1398	21	6	0	162	77.6	73.2	2.4	2.3	5.7	3.3	590	30
Min				4.5	3.7	1099	6	0	0	44	35.5	34.0	1.2	1.1	2.0	0.8	424	7
Max				6.3	6.4	1583	21	44	73	238	95.9	90.0	2.9	2.8	12.5	11.2	849	30
Avg				5.4	5.1	1380	15	17	24	123	65.9	62.2	2.0	1.9	7.3	4.2	602	15
Range				1.8	2.7	484	15	44	73	194	60.4	56.0	1.7	1.7	10.5	10.4	425	23

Description: Side Channel Raccoon Creek; downstream of JB1 drainage; at 6' SS culvert (CULV 2) for access road (Slak Lane extension]

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
JB1B	12/7/2005			4.8	4.6	1708	12	1	2	240	91.0		2.4		14.6		1063	3
JB1B	4/25/2007			5.0	4.5	1403	12	7	0	178	100.8	82.7	2.1	2.0	14.5	9.0	706	6
JB1B	6/7/2007			4.1	3.7	1772	24		0	281	103.5	102.1	2.4	2.4	15.8	14.0	860	3
JB1B	6/27/2007			4.8	4.7	1303	24	7	2	144	75.1	71.4	2.0	1.9	5.6	2.5	600	42
Min				4.1	3.7	1303	12	1	0	144	75.1	71.4	2.0	1.9	5.6	2.5	600	3
Max				5.0	4.7	1772	24	7	2	281	103.5	102.1	2.4	2.4	15.8	14.0	1063	42
Avg				4.7	4.4	1547	18	5	1	211	92.6	85.4	2.2	2.1	12.6	8.5	807	14
Range				0.9	1.0	469	12	6	2	137	28.4	30.7	0.5	0.5	10.2	11.4	463	39

Description: Abandoned Mine Discharge; channelized JB1 flow just prior to confluence with side channel of Raccoon Creek

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
JB1C	4/25/2007			8.0	7.8	517	11	165	154	-120	1.1	0.6	0.2	0.1	0.7	0.5	80	9
JB1C	6/7/2007			6.4	6.0	1606	17		98	-84	38.5	17.1	3.6	3.5	0.7	0.6	828	20
JB1C	6/27/2007			6.4	6.4	1504	28	125	82	-68	32.2	21.0	3.4	3.4	0.6	0.3	650	16
Min				6.4	6.0	517	11	125	82	-120	1.1	0.6	0.2	0.1	0.6	0.3	80	9
Max				8.0	7.8	1606	28	165	154	-68	38.5	21.0	3.6	3.5	0.7	0.6	828	20
Avg				6.9	6.7	1209	19	145	112	-91	23.9	12.9	2.4	2.3	0.7	0.5	520	15
Range				1.5	1.8	1089	17	40	72	53	37.3	20.4	3.4	3.4	0.1	0.3	748	11

Description: Side Channel Raccoon Creek; near inlet

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
JB25	12/18/1973	Measured	352		3.0				0	300	70.0						875	
JB25	1/16/1974	Measured	221		3.1				0	282	54.4						950	
JB25	2/8/1974	Measured	145	3.0					0	280	67.2						600	
JB25	3/1/1974	Measured	163		3.0				0	280	50.0						550	
JB25	4/3/1974	Measured	163		3.1				0	240	25.8						650	
JB25	5/8/1974	Measured	145		3.1				0	320	36.8						900	
JB25	6/18/1974	Measured	145		3.0				0	280	37.7						675	
JB25	7/16/1974	Measured	130		3.1				0	266	32.3						675	
JB25	8/9/1974	Measured	130		2.8				0	500	35.3						625	
JB25	9/9/1974	Measured	163		3.0				0	500	25.5						875	
JB25	10/18/1974	Measured	145		3.5				0	394	40.8						975	
JB25	11/13/1974	Measured	163		3.1				0	288	43.1						950	
JB25	12/13/1974	Measured	101		3.1				0	214	45.0						800	
JB25	5/2/2000	Measured	78															
JB25	6/8/2000	Measured	84		5.6				42	50	38.0		1.4		1.8		577	4
JB25	7/10/2000	Measured	72		5.4				32	64	37.3		1.3		2.2		562	2
JB25	8/9/2000	Measured	98		6.1				94	0	27.1		1.0		0.9		416	2
JB25	9/14/2000	Measured	66		5.1				20	88	45.1		1.6		2.3		667	2
JB25	10/3/2000	Measured	66		5.2				22	90	39.1		1.5		2.0		622	2
JB25	11/1/2000	Measured	66		5.3				26	88	47.9		1.5		2.0		631	18
JB25	12/4/2000	Measured	66		5.4				32	88	51.6		1.6		1.5		677	4
JB25	1/8/2001	Measured	60		5.6				40	80	48.4		1.5		1.2		713	3
JB25	2/5/2001	Measured	65		5.9				60	38	43.6		1.4		0.9		593	8
JB25	3/7/2001	Measured	66		5.7				42	68	48.2		1.3		1.1		657	8
JB25	4/16/2001	Measured	65		5.7				38	54	33.7		1.2		1.6		484	2
JB25	5/9/2001	Measured	78		5.1				19	82	46.2		1.5		3.4		610	10
JB25	6/5/2001	Measured	55		5.2				22	96	43.9		1.6		3.1		520	8
JB25	7/10/2001	Measured	66		5.1				18	116	50.1		1.7		2.6		521	8
JB25	8/2/2001	Measured	55		5.3				24	193	48.3		1.6		2.0		641	6

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
JB25	10/25/2001	Measured	55		5.4				32	108	53.0		1.5		1.1		740	2
JB25	11/7/2001	Measured	45		5.5				34	114	50.0		1.4		1.1		692	4
JB25	12/3/2001	Measured	66		5.6				48	78	51.0		1.5		0.9		611	24
JB25	1/29/2002	Measured	55		5.8				64	79	53.1		1.5		0.7		700	2
JB25	2/11/2002	Measured	55		6.0				70	77	51.8		1.4		0.6		613	2
JB25	3/20/2002	Measured	106		6.4				108	0	27.2		0.8		1.4		328	20
JB25	4/22/2002	Measured	60		6.0				72	50	39.7		1.2		0.8		436	12
JB25	5/28/2002	Measured	60		5.9				62	52	44.8		1.4		1.4		476	8
JB25	6/24/2002	Measured	55		5.3				30	117	50.1		1.6		2.4		573	8
JB25	7/22/2002	Measured	66		5.2				22	118	50.7		1.7		2.6		730	6
JB25	8/7/2002	Measured	40		5.2				20	127	62.3		1.9		2.7		761	6
JB25	9/16/2002	Measured	45		5.3				5	130	51.9		1.5		1.5		699	6
JB25	10/28/2002	Measured	40		5.7				44	102	53.4		1.5		0.9		714	8
Min			40	3.0	2.8				0	0	25.5		0.8		0.6		328	2
Max			352	3.0	6.4				108	500	70.0		1.9		3.4		975	24
Avg			96	3.0	4.8				28	158	45.2		1.4		1.7		660	7
Range			312	0.0	3.6				108	500	44.5		1.1		2.7		648	22

Description: JB25 abandoned mine discharge; to be intercepted and included in Phase II passive system for JB1

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
Keys Road	10/16/2000			6.5	6.6				76	0	18.3		1.3		0.7		522	22
Keys Road	4/29/2001			7.3	7.1				154	0	7.5		0.5		1.0		263	30
Keys Road	10/14/2001			6.4	6.2				40	34	22.4		1.9		0.7		345	20
Keys Road	8/6/2002			6.5	6.2				26	77	42.1		2.3		2.7		866	24
Keys Road	4/27/2003			7.2	6.9				140	0	10.0		0.6		0.9		239	3
Keys Road	10/12/2003			6.6	6.7				87	0	18.7		1.1		0.3		356	20
Keys Road	8/2/2006			6.4	6.0	1011	28	36	18	-3	26.2	19.1	1.3	1.3	0.6	0.1	544	3
Keys Road	4/25/2007			6.8	7.1	785	12	137	114	-106	16.1	12.8	0.7	0.7	3.2	0.2	294	7
Keys Road	6/7/2007			6.7	5.7	1215	16	66	24	8	44.6	38.5	2.0	1.9	2.5	0.2	588	57
Keys Road	6/27/2007			6.3	5.7	1334	19	69	9	58	57.0	53.6	2.4	2.4	2.1	0.2	630	43
Min				6.3	5.7	785	12	36	9	-106	7.5	12.8	0.5	0.7	0.3	0.1	239	3
Max				7.3	7.1	1334	28	137	154	77	57.0	53.6	2.4	2.4	3.2	0.2	866	57
Avg				6.7	6.4	1086	19	77	69	7	26.3	31.0	1.4	1.6	1.5	0.2	465	23
Range				1.0	1.4	549	16	101	145	183	49.5	40.8	1.9	1.7	3.0	0.1	627	54

Description: Raccoon Creek; at Keys Road (T-821) ~ 3/4 mile downstream of JB1 confluence; also downstream of JB2, JB21, JB25

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
SL1	8/9/1999				7.3				160	0	0.5		0.5		0.5		75	
SL1	10/18/1999				7.7				200	0	0.3		0.1		0.5		85	
SL1	11/15/1999				7.4				180	0	0.4		0.1		0.5		141	
SL1	12/1/1999				7.4				166	0	0.3		0.1		0.5		135	
SL1	1/10/2000			7.4	7.9				162	0	0.3		0.1		0.5		58	3
SL1	2/16/2000			7.1	7.5				118	0	1.3		0.1		1.0		51	4
SL1	3/7/2000			7.1	8.3				168	0	0.3		0.1		0.5		71	3
SL1	4/2/2000			8.0	7.9				188	0	0.3		0.1		0.5		121	3
SL1	5/15/2000			7.8	8.1				192	0	0.3		0.1		0.5		86	3
SL1	6/27/2000			7.9	7.8				210	0	0.8		0.1		0.5		129	4
SL1	7/24/2000			7.9	7.7				200	0	0.3		0.1		0.5		53	3
SL1	8/28/2000			8.0	7.9				200	0	0.3		0.1		0.5		67	3
SL1	8/2/2006			7.4	7.2	486	27	168	163	-133	0.9	0.4	0.1	0.1	0.4	0.3	42	3
SL1	12/12/2006			7.8	8.1	529	8	179	172	-159	0.4	0.1	0.2	0.1	1.2	0.1	66	2
SL1	4/25/2007			8.1	8.1	536	11	183	169	-159	0.4	0.1	0.1	0.0	0.4	0.1	80	7
SL1	6/7/2007			8.0	7.0	600	23		201	-180	0.7	0.4	0.2	0.2	0.7	0.5	107	4
SL1	6/27/2007			7.8	7.7	586	27	204	172	-120	0.9	0.5	0.3	0.3	0.4	0.4	78	10
Min				7.1	7.0	486	8	168	118	-180	0.3	0.1	0.1	0.0	0.4	0.1	42	2
Max				8.1	8.3	600	27	204	210	0	1.3	0.5	0.5	0.3	1.2	0.5	141	10
Avg				7.7	7.7	547	19	184	178	-44	0.5	0.3	0.1	0.1	0.6	0.3	85	4
Range				1.0	1.3	114	19	36	92	180	1.0	0.4	0.4	0.3	0.8	0.4	100	8

Description: Raccoon Creek; above stream intake for JB1 passive system near private driveway; same (?) as SL-1 in Watershed Survey (Skelly & Loy, Inc., 2000)

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
SR5	9/13/1973		138		7.7				140	0	0.2						100	
SR5	12/18/1973		1311		7.6				362	0	0.0						87	
SR5	2/7/1974		20209		7.2				230	0	0.6						70	
SR5	3/1/1974		6872		8.0				270	0	0.2						156	
SR5	4/3/1974		13251		7.0				260	0	0.7						175	
SR5	5/8/1974		2537		7.5				306	0	0.2						100	
SR5	6/11/1974		1488		7.8				368	0	0.0						200	
SR5	7/15/1974		5556		7.6				244	0	0.1						150	
SR5	8/7/1974		700		6.8				336	0	0.8						150	
SR5	9/5/1974		10320		6.7				152	20	0.1						250	
SR5	10/3/1974		2342		7.1				184	0	0.0						225	
SR5	11/5/1974		1255		7.5				220	0	0.9						300	
SR5	12/4/1974		5383		7.9				196	0	0.4						150	
Min			138		6.7				140	0	0.0						70	
Max			20209		8.0				368	20	0.9						300	
Avg			5489		7.4				251	2	0.3						163	
Range			20071		1.3				228	20	0.9						230	

Description: Raccoon Creek; ~ 1 mi. upstream of JB1; upstream of SL-1

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
SR8	9/13/1973		571		3.3				0	290	57.0						930	
SR8	12/18/1973		2394		6.4				246	22	6.5						170	
SR8	2/13/1974		7836		6.9				176	38	10.3						150	
SR8	3/1/1974		9076		7.0				194	0	4.9						185	
SR8	4/3/1974		16998		7.1				196	0	0.1						175	
SR8	5/9/1974		3979		6.7				84	40	10.4						275	
SR8	6/11/1974		2878		5.8				44	24	15.2						275	
SR8	7/15/1974		8344		7.0				166	10	0.0						25	
SR8	8/7/1974		1525		4.2				0	56	21.6						200	
SR8	9/5/1974		13520		6.1				106	20	3.7						300	
SR8	10/3/1974		3575		6.5				86	16	14.8						425	
SR8	11/5/1974		5684		6.1				88	18	14.0						400	
SR8	12/4/1974		8348		7.3				164	0	17.8						200	
SR8	8/2/2006			6.3	5.9	1019	22	47	22	25	40.8	39.9	1.0	1.0	3.8	0.3	448	4
SR8	12/12/2006			6.9	6.8	741	6	142	114	-98	15.0	14.9	0.6	0.6	1.2	0.3	224	27
SR8	4/25/2007			7.3	7.1	759	11	140	103	-96	17.9	17.1	0.7	0.7	3.8	0.3	239	5
SR8	6/7/2007			6.3	5.7	1162	20	67	30	34	49.7	46.7	1.8	1.8	4.1	0.4	570	58
SR8	6/27/2007			5.7	5.6	1345	20	26	10	103	64.9	61.1	2.2	2.2	4.6	0.7	600	38
Min			571	5.7	3.3	741	6	26	0	-98	0.0	14.9	0.6	0.6	1.2	0.3	25	4
Max			16998	7.3	7.3	1345	22	142	246	290	64.9	61.1	2.2	2.2	4.6	0.7	930	58
Avg			6518	6.5	6.2	1005	16	84	102	28	20.3	35.9	1.3	1.3	3.5	0.4	322	26
Range			16427	1.7	4.0	604	16	116	246	388	64.9	46.2	1.7	1.7	3.4	0.4	905	54

Description: Raccoon Creek; east of abandoned railroad bridge; downstream of JB1; upstream of JB25 and JB2; Scarlift point SR8(?)

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
94-1	2/21/2006			6.3	6.4	1275		140	80	-54	21.5	18.1	5.9	5.9	0.9	0.1	264	63
Min				6.3	6.4	1275		140	80	-54	21.5	18.1	5.9	5.9	0.9	0.1	264	63
Max				6.3	6.4	1275		140	80	-54	21.5	18.1	5.9	5.9	0.9	0.1	264	63
Avg				6.3	6.4	1275		140	80	-54	21.5	18.1	5.9	5.9	0.9	0.1	264	63
Range				0.0	0.0	0		0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0

Description: Piezometer 94-1 (See As-Built for water level measurements, etc.)

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
94-8	2/21/2006			7.2	7.1	1698		318	217	-216	22.5	7.9	3.8	2.7	2.9	0.1	131	26
Min				7.2	7.1	1698		318	217	-216	22.5	7.9	3.8	2.7	2.9	0.1	131	26
Max				7.2	7.1	1698		318	217	-216	22.5	7.9	3.8	2.7	2.9	0.1	131	26
Avg				7.2	7.1	1698		318	217	-216	22.5	7.9	3.8	2.7	2.9	0.1	131	26
Range				0.0	0.0	0		0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0

Description: Piezometer 94-8 (See As-Built for water level measurements, etc.)

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
94-9	2/21/2006			7.2	7.1	2550		281	236	-198	4.8	0.3	1.5	1.4	1.7	0.2		31
Min				7.2	7.1	2550		281	236	-198	4.8	0.3	1.5	1.4	1.7	0.2		31
Max				7.2	7.1	2550		281	236	-198	4.8	0.3	1.5	1.4	1.7	0.2		31
Avg				7.2	7.1	2550		281	236	-198	4.8	0.3	1.5	1.4	1.7	0.2		31
Range				0.0	0.0	0		0	0	0	0.0	0.0	0.0	0.0	0.0	0.0		0

Description: Piezometer 94-9 (See as-built for water level measurements, etc.) 2/21/06 sulfate reading of 28.5 mg/l appears spurious

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
94-10	2/21/2006			6.9	6.6	984		231	139	-111	7.6	5.7	19.3	18.9	0.9	0.1	217	120
Min				6.9	6.6	984		231	139	-111	7.6	5.7	19.3	18.9	0.9	0.1	217	120
Max				6.9	6.6	984		231	139	-111	7.6	5.7	19.3	18.9	0.9	0.1	217	120
Avg				6.9	6.6	984		231	139	-111	7.6	5.7	19.3	18.9	0.9	0.1	217	120
Range				0.0	0.0	0		0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0

Description: Piezometer 94-10 (See As-Built for water level measurements, etc.)

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
94-20	4/25/2007			4.9	4.4	1537	12	4		213	107.5	102.2	2.2	2.1	13.9	8.7	793	8
94-20	6/7/2007			4.4	3.7	1650	20	0	0	310	108.6	107.1	2.4	2.3	17.4	15.6	902	5
94-20	6/27/2007			4.2	3.3	1699	18	0	0	274	122.0	115.0	2.4	2.3	9.8	7.6	842	19
Min				4.2	3.3	1537	12	0	0	213	107.5	102.2	2.2	2.1	9.8	7.6	793	5
Max				4.9	4.4	1699	20	4	0	310	122.0	115.0	2.4	2.3	17.4	15.6	902	19
Avg				4.5	3.8	1629	17	1	0	266	112.7	108.1	2.3	2.3	13.7	10.6	845	11
Range				0.7	1.2	162	8	4	0	98	14.5	12.8	0.2	0.2	7.6	8.0	109	14

Description: JB1 wetland effluent to side channel of Raccoon Creek ~ 40' South of Slak Lane Center Line

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
94-21	4/25/2007			4.9	4.4	1437	12	5		178	90.2	85.6	2.1	2.0	13.0	8.9	714	6
94-21	6/7/2007			4.1	3.9	1645	23		0	270	101.5	99.6	2.4	2.3	16.2	14.8	860	3
94-21	6/27/2007			3.9	3.5	1489	25	0	0	212	83.8	82.8	2.2	2.2	7.2	6.0	721	31
Min				3.9	3.5	1437	12	0	0	178	83.8	82.8	2.1	2.0	7.2	6.0	714	3
Max				4.9	4.4	1645	25	5	0	270	101.5	99.6	2.4	2.3	16.2	14.8	860	31
Avg				4.3	4.0	1524	20	3	0	220	91.9	89.3	2.2	2.2	12.1	9.9	765	13
Range				1.0	0.9	208	13	5	0	91	17.7	16.8	0.3	0.3	9.1	8.8	145	28

Description: JB1 wetland effluent to side channel of Raccoon Creek ~55' South of Slak Lane Center Line

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
94-22B	6/27/2007			5.3	5.2	1235	26	10	4	111	64.2	63.0	1.8	1.8	4.1	1.1	570	37
Min				5.3	5.2	1235	26	10	4	111	64.2	63.0	1.8	1.8	4.1	1.1	570	37
Max				5.3	5.2	1235	26	10	4	111	64.2	63.0	1.8	1.8	4.1	1.1	570	37
Avg				5.3	5.2	1235	26	10	4	111	64.2	63.0	1.8	1.8	4.1	1.1	570	37
Range				0.0	0.0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	0

Description: JB1 wetland effluent to side channel of Raccoon Creek ~120' South of Slak Lane Center Line

Raccoon Creek 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)	Fe (mg/L)	D. Fe (mg/L)	Mn (mg/L)	D. Mn (mg/L)	Al (mg/L)	D. Al (mg/L)	Sulfate (mg/L)	Susp. Solids (mg/L)
94-23	4/25/2007			5.0	4.3	1404	12	8		163	78.6	76.0	2.1	2.0	13.2	8.7	662	6
94-23	6/7/2007			3.9	3.4	1730	22		0	265	99.4	98.3	2.4	2.4	16.5	16.3	902	18
94-23	6/27/2007			4.6	4.3	1396	22	0	0	168	76.8	69.9	2.0	1.9	6.0	4.1	640	30
Min				3.9	3.4	1396	12	0	0	163	76.8	69.9	2.0	1.9	6.0	4.1	640	6
Max				5.0	4.3	1730	22	8	0	265	99.4	98.3	2.4	2.4	16.5	16.3	902	30
Avg				4.5	4.0	1510	19	4	0	198	84.9	81.4	2.1	2.1	11.9	9.7	735	18
Range				1.1	0.9	334	10	8	0	102	22.6	28.4	0.5	0.4	10.5	12.2	261	24

Description: JB1 wetland effluent to side channel Raccoon Creek ~ 175' South of Slak Lane Center Line

Geologic Drill Hole Log & Piezometer As-Built

Hole No.	94-1	Operation Name	JB1
Road Name	Slak Lane (private)	G. G. Contract #	SW 30426
Sfc. Elev.	1002.40	Drilling Method(Date)	air-rotary; 4 3/4" carbide button bit (12/19/05)
Surveyed by	Jack Chamberlin Surveying	Driller(License#)	McKay & Gould Drilling Co. (PA-0592); Mike Hollabaugh (driller)
Client	PA DEP	Municipality/County	Smith Township / Washington County
Remarks	all dimensions in feet, unless noted	Quadrangle	7½' Midway (PI1977)
Logged by	Margaret H. Dunn, PG (PA-000771)	Latitude	40.361702 Longitude -80.360237

Depth	Thick-ness	Scale	Lithology	Graphic Log	"As-Built"		Water Level Data DTW	WE	Date	Time	Comments
		0			(1)						
0			Road fill; LS agg; md-gy				6.6	996.6	12/20/05		"Stick-Up": 0.83; elev. @ top: 1003.23
					~x~x	~x~x	6.4	996.8	02/21/06		(DTW reported from top of "Stick-Up")
					x~x~	x~x~	6.4	996.8	05/24/06		WE - rounding discrepancies
	3½		@1½ SH frags (½) ; blk, dk-gy, org		~x~x	~x~x	7.0	996.3	08/02/06		
			@2 red dog (1½)		x~x~	x~x~					
					x(2)~	~x~x					(2) Riser: 0 - 8
					~x~x	x~x~					
3½			coal & bony		x~x~	~x~x					
	1½		@4-5 (poor air return)		~x~x	x~x~					
		5			x~x~	~x~x					
5			CS; dk-org; damp		~(3)x	WL ~x~x					(3) Backfill: 0 - 5½
					~~	~~~~					
					~~	WL ~~~~					
	3½				~~~~	~~~~					
					~(4)~	~~~~					(4) Grout: 5½ - 8
					~~	~~~~					
					..(5)..	.....					(5) Sand: 8 - 14
8½			Coal		.....	.....					
					..(6)..	------					(6) Screen: 9 - 14
		10			.....	------					
	4½		@10½ SH (1½) ; carb; (Binder); dry	-.-.-.-.-.-.-.-.-.-	.....	------					
				IIII- - -IIIII - - -III	.....	------					
				- - - III - - III - - -	.....	------					
			@12 Bony (1)	IIIIIIIIIIIIIIIIIIIIII	.....	------					
			[Pgh coalbed; elev. 989.41]	IIIIIIIIIIIIIIIIIIIIII		------					
13	1		SH; dk-gy & bk (1)		.....	------					
			[Pgh seatearth?]	- - - - - - - - - -	.....	------					
14			SH/CS; md- gy; (some	-- ~-- ~ -- ~ --	...(1)...	----------					
	1½	15	(@15 add rod)	~ -- ~ -- ~ -- ~	~~~~	TD 14 ~~~~					
			(making water)	-- ~ -- ~ -- ~ --	~~~~	~~~~~~~ ~~~~					
15½			STS; md-gy	-- -- -- -- -- --	~~~~	~~~~~~~ ~~~~					
				- - - - - - - - - -	~~~~	~~~~~~~ ~~~~					
	3			-- -- -- -- -- --	~~~~	~~~~~~~ ~~~~					
				- - - - - - - - - -	~~~~	~~~~~~~ ~~~~					
				-- -- -- -- -- --	~~~~	~~~~~~~ ~~~~					
				- - - - - - - - - -	~~~~	~~~~~~~ ~~~~					
18½			CS; lt-to md-gy	~~~~~~~~~~	~~~~	~~~~~~~ ~~~~					
			(~ 1 gpm)	~~~~~~~~~~	~(4)~	~~~~~~~ ~~~~					(4) Grout: 14 - 25
	3	20		~~~~~~~~~~	~~~~	~~~~~~~ ~~~~					
				~~	~~~~	~~~~~~~ ~~~~					
				~~	~~~~	~~~~~~~ ~~~~					
				~~	~~~~	~~~~~~~ ~~~~					
21½			STS; md-gy	-- -- -- -- -- --	~~~~	~~~~~~~ ~~~~					
	1½			- - - - - - - - - -	~~~~	~~~~~~~ ~~~~					
				-- -- -- -- -- --	~~~~	~~~~~~~ ~~~~					
23			SS; lt- to md-gy; fn-gn	. .. .	~~~~	~~~~~~~ ~~~~					
			(@23 water 25-30 gpm)	.. . .	~~~~	~~~~~~~ ~~~~					
				. .. .	~~~~	~~~~~~~ ~~~~					
		25		.. . .	~~~~	~~~~~~~ ~~~~					
				TD 25							

WELL CONSTRUCTION
(1) Slip cap: 2" PVC
(2) Riser: 2", Sch. 40, PVC, threaded
(3) Backfill: drill chips
(4) Grout: bentonite (chips) & drill chips
(5) Sand: #420
(6) Screen: 20,000th slot, Sch. 40 PVC

Scale: 1" = 5 '

Geologic Drill Hole Log & Piezometer As-Built

Hole No.	94-2	Operation Name	JB1
Road Name	Slak Lane (private)	G. G. Contract #	SW 30426
Sfc. Elev.	1005.5	Drilling Method(Date)	air-rotary; 4 3/4" carbide button bit (12/19/05)
Surveyed by	Jack Chamberlin Surveying	Driller(License#)	McKay & Gould Drilling Co. (PA-0592); Mike Hollabaugh (driller)
Client	PA DEP	Municipality/County	Smith Township / Washington County
Remarks	all dimensions in feet, unless noted	Quadrangle	7½' Midway (PI1977)
Logged by	Margaret H. Dunn, PG (PA-000771)	Latitude	40.361971 Longitude -80.359434

Depth	Thickness	Scale	Lithology	Graphic Log	"As-Built" (1)			Water Level Data DTW	WE	Date	Time	Comments
		0										
0			Road fill; LS agg; md-gy)	/ / / / / / / / / / /	~x~x	x~x~x~x	~x~x					Backfill with drill chips 0 - 21
	1			/ / / / / / / / / / /	~x~x	x~x~x~x	~x~x					
			@1SH frag; blk; coal frags (½)	/ / IIII/ / / / / IIII/ /	x~x~	~x~x~x~	x~x~					
1½			Clay; org; dry	~~~~~~~~~~~	~x~x	x~x~x~x	~x~x					
	1½			~~~~~~~~~~~	x~x~	~x~x~x~	x~x~					
				~~	~x~x	x~x~x~x	~x~x					
3			(Poor air return)		x~x~	~x~x~x~	x~x~					
					~x~x	x~x~x~x	~x~x					
	2½				x~x~	~x~x~x~	x~x~					
		5			~x~x	x~x~x~x	~x~x					
					x~x~	~x~x~x~	x~x~					
5½			CS; OD; damp	~~~~~~~~~~~	~x~x	x~x~x~x	~x~x					
	2			~~~~~~~~~~~	x~x~	~x~x~x~	x~x~					
				~~	~x~x	x~x~x~x	~x~x					
				~~	x~x~	~x~x~x~	x~x~					
7½			SS/CS; interlayered; wx	.....	~x~x	x~x~x~x	~x~x					
				~~	x~x~	~x~x~x~	x~x~					
	2½			.....	~x~x	x~x~x~x	~x~x					
				.....	~x~x	x~x~x~x	~x~x					
		10		~~~~~~~~~~~	x~x~	~x~x~x~	x~x~					
10			(Very poor air return; "squeeze")		~x~x	x~x~x~x	~x~x					
	2		(Muddy)		x~x~	~x~x~x~	x~x~					
					~x~x	x~x~x~x	~x~x					
					x~x~	~x~x~x~	x~x~					
12			MS; md-gy; wx; damp	.-.-.-.-.-.-.-.-.-.-.	~x~x	x~x~x~x	~x~x					
	2			.-.-.-.-.-.-.-.-.-.-.	x~x~	~x~x~x~	x~x~					
				.-.-.-.-.-.-.-.-.-.-.	~x~x	x~x~x~x	~x~x					
			@14 CS; lt-gy (<0.1)	.-.-.-.-.-.-.-.-.-.-.	x~x~	~x~x~x~	x~x~					
14			Coal		~x~x	x~x~x~x	~x~x					
		15	(@15 add rod)		x~x~	~x~x~x~	x~x~					
					~x~x	x~x~x~x	~x~x					
					x~x~	~x~x~x~	x~x~					
	4½				~x~x	x~x~x~x	~x~x					
			@16½ SH; dk-gy; (1) (binder)	- - - - - - - - - -	x~x~	~x~x~x~	x~x~					
				-- -- -- -- -- -- --	~x~x	x~x~x~x	~x~x					
			@17½ Coal (1)		x~x~	~x~x~x~	x~x~					
			[Pgh coalbed; elev. 987.5]		~x~x	x~x~x~x	~x~x					
18½			CS; md- to dk-gy	~~~~~~~~~~~	x~x~	~x~x~x~	x~x~					
	1½			~~~~~~~~~~~	~x~x	x~x~x~x	~x~x					
		20	[Pgh seatearth]	~~~~~~~~~~~	x~x~	~x~x~x~	x~x~					
20			LS; lt- to md-gy; arg.; dry		~x~x	x~x~x~x	~x~x					
					x~x~	~x~x~x~	x~x~					
			TD 21									

Scale: 1" = 5 '

Geologic Drill Hole Log & Piezometer As-Built

Hole No.	94-3	Operation Name	JB1
Road Name	Slak Lane (private)	G. G. Contract #	SW 30426
Sfc. Elev.	1005.7	Drilling Method(Date)	air-rotary; 4 3/4" carbide button bit (12/19/05)
Surveyed by	Jack Chamberlin Surveying	Driller(License#)	McKay & Gould Drilling Co. (PA-0592); Mike Hollabaugh
Client	PA DEP	Municipality/County	Smith Township / Washington County
Remarks	all dimensions in feet, unless noted	Quadrangle	7½' Midway (PI1977)
Logged by	Margaret H. Dunn, PG (PA-000771)	Latitude	40.362057 Longitude -80.358930

Depth	Thick-ness	Scale	Lithology	Graphic Log	"As-Built"	Water Level Data DTW	WE	Date	Time	Comments
		0			(1)					
0			Road fill; (LS agg; md-gy) coal frags.							Backfill with drill chips & bentonite: 0 - 12
			@2 Red dog (½)							
			@2½ Coal frags (1)							
	7									
			@3½ Red dog (3½)							
		5								
7			Clay; lt-gy; damp							
	4									
		10								
			damp							
11			SS; md-gy; fn-gn; muddy							(Hole caving @12)
	3									
			@13 water ~ 5 gpm							
14			SS; md- to dk-gy; fn-gn; shaley;							
		15	some coal frags							
			(@15 add rod; water ~10 gpm)							
	3									
17			SH; md-gy							
	1½									
18½			coal; some SH; carb							
		20								
	5½									
			[Pgh coalbed; elev. ~981.7]							
24			CS							
		25	[Pgh seatearth]							
				TD 25						

Scale: 1" = 5 '

Geologic Drill Hole Log & Piezometer As-Built

Hole No.	94-4	Operation Name	JB1
Road Name	(old RR grade)	G. G. Contract #	SW 30426
Sfc. Elev.	1006.7	Drilling Method(Date)	air-rotary; 4 3/4" carbide button bit (12/19/05)
Surveyed by	Jack Chamberlin Surveying	Driller(License#)	McKay & Gould Drilling Co. (PA-0592); Mike Hollabaugh (driller)
Client	PA DEP	Municipality/County	Smith Township / Washington County
Remarks	all dimensions in feet, unless noted	Quadrangle	7½' Midway (PI1977)
Logged by	Margaret H. Dunn, PG (PA-000771)	Latitude	40.361091 Longitude -80.358848

Depth	Thick-ness	Scale	Lithology	Graphic Log	"As-Built"	Water Level Data DTW	WE	Date	Time	Comments
		0			(1)					
0			Old railroad grade fill (coal frags; clay; org)							Backfill with drill chips & bentonite: 0 - 11
	4									
			(@3 Poor air return)							
4	1		SH; md-gy							
		5								
5			(Poor air return)							
	8									
		10								
			(@10 lost air)							
										(Hole caving @11)
13			SH; carb; blk; with bony & coal							
		15								
	5		(@15 add rod)							
			@15 Bony (1); some coal							
			@16 SH (1); carb; some bony							
			@17 Coal & bony (½)							
			@17½ SH (½); carb & bony							
18			Coal							
		20								
	5									
			[Pgh coalbed; elev. 983.7]							
23	1		CS; lt-gy							
			[Pgh seatearth]							
24			LS; arg; lt- to md-gy; dry							
		25								
				TD 25						

Scale: 1" = 5 '

Geologic Drill Hole Log & Piezometer As-Built

Hole No.	94-5	Operation Name	JB1
Road Name	(old RR grade)	G. G. Contract #	SW 30426
Sfc. Elev.	1006.4	Drilling Method(Date)	air-rotary; 4 3/4" carbide button bit (12/19/05)
Surveyed by	Jack Chamberlin Surveying	Driller(License#)	McKay & Gould Drilling Co. (PA-0592); Mike Hollabaugh (driller)
Client	PA DEP	Municipality/County	Smith Township / Washington County
Remarks	all dimensions in feet, unless noted	Quadrangle	7½' Midway (PI1977)
Logged by	Kyle Durrett, GeoTech	Latitude	40.361161 Longitude -80.358891

Depth	Thick-ness	Scale	Lithology	Graphic Log	"As-Built"	Water Level Data DTW	WE	Date	Time	Comments
		__0__			(1)					
0			Old railroad grade fill (coal frags; clay; org)							Backfill with drill chips & bentonite: 0 - 26
	6									
		__5__								
6			MS; silty; dk-bn dk-gy							
	4									
		__10__								
10			SS; fn- to md-gn; org staining							
	3									
13	1		SH; lt-gy							
14	1		CS/MS;							
		__15__	(@15 add rod)							
15	1		SH; carb; dk-gy; dry							
			@15½ bony (½)							
16			SH; lt- to dk-gy							
			@16 lt-gy (1)							
			@17 md-gy (6)							
	9½	__20__								
			(Pgh coalbed horizon?; replaced?)							
			@23 dk-gy (2½)							
		__25__								
25½			LS; arg.; lt - to md-gy; dry							
				TD 26						

Scale: 1" = 5 '

Geologic Drill Hole Log & Piezometer As-Built

Hole No.	94-6	Operation Name	JB1
Road Name	(old RR grade)	G. G. Contract #	SW 30426
Sfc. Elev.	1006.6	Drilling Method(Date)	air-rotary; 4 3/4" carbide button bit (12/19/05)
Surveyed by	Jack Chamberlin Surveying	Driller(License#)	McKay & Gould Drilling Co. (PA-0592); Mike Hollabaugh (driller)
Client	PA DEP	Municipality/County	Smith Township / Washington County
Remarks	all dimensions in feet, unless noted	Quadrangle	7½' Midway (PI1977)
Logged by	Margaret H. Dunn, PG (PA-000771)	Latitude	40.361238 Longitude -80.358945

Depth	Thick-ness	Scale	Lithology	Graphic Log	"As-Built"	Water Level Data DTW	WE	Date	Time	Comments
		0			(1)					
0			Old railroad grade fill							Backfill with drill chips & bentonite: 0 - 25
	2		ballast & clay; org							
2	1		CS; dk-gy							
3	½		Coal frags							
3½			CS; lt-org							
		5								
			(@6 Poor air return)							
	9½									
		10								(Hole caving @ 11)
13	1		STS; sandy; OD							
14			SH; carb; black							
	2	15	(@15 add rod; water)							
16			Coal; some bony							
	1									
18	½		SH; carb; blk							
18½			Coal							
		20								
	5									
			[Pgh coalbed; elev. 983.1]							
23½	½		SH; carb							
24			CS; lt-gy & LS; arg; lt - to md-gy							
		25	[Pgh seatearth]							
				TD 25						

Scale: 1" = 5 '

Geologic Drill Hole Log & Piezometer As-Built

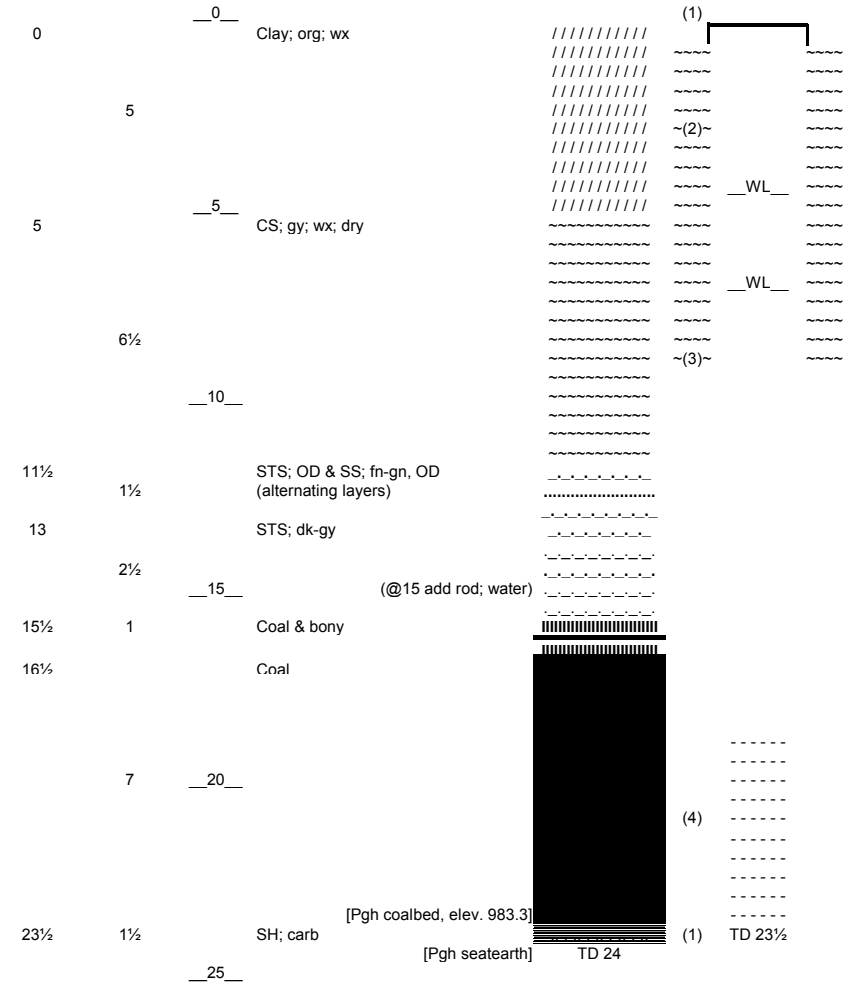
Hole No.	94-7	Operation Name	JB1
Road Name	(old RR grade near Bonnymeade Lane)	G. G. Contract #	SW 30426
Sfc. Elev.	1007.1	Drilling Method(Date)	air-rotary; 4 3/4" carbide button bit (12/19/05)
Surveyed by	Jack Chamberlin Surveying	Driller(License#)	McKay & Gould Drilling Co. (PA-0592); Mike Hollabaugh (driller)
Client	PA DEP	Municipality/County	Smith Township / Washington County
Remarks	all dimensions in feet, unless noted	Quadrangle	7½' Midway (PI1977)
Logged by	Margaret H. Dunn, PG (PA-000771)	Latitude	40.361050 Longitude -80.358818

Depth	Thick-ness	Scale	Lithology	Graphic Log	"As-Built"	Water Level Data DTW	WE	Date	Time	Comments
		0								
0			Soil & regolith							Hole collapsed as second rod was added
	4									Backfill with drill chips & bentonite
4			CS; dk-bn; wx; damp							
		5								
			@7 CS; org							
		10	(@10 lost air)							
			(Log as per drill response)							
			(Squeezing; caving)							
		15	(@15 add rod)							
				TD 15						
		20								
		25								

Scale: 1" = 5 '

Geologic Drill Hole Log & Piezometer As-Built

Hole No.	94-8	Operation Name	JB1
Road Name	(old RR grade; Petricca prop.)	G. G. Contract #	SW 30426
Sfc. Elev.	1006.83	Drilling Method(Date)	air-rotary; 4 3/4" carbide button bit (12/19/05)
Surveyed by	Jack Chamberlin Surveying	Driller(License#)	McKay & Gould Drilling Co. (PA-0592); Mike Hollabaugh (driller)
Client	PA DEP	Municipality/County	Smith Township / Washington County
Remarks	all dimensions in feet, unless noted	Quadrangle	7½' Midway (PI1977)
Logged by	Kyle Durrett, GeoTech	Latitude	40.361363 Longitude -80.359025



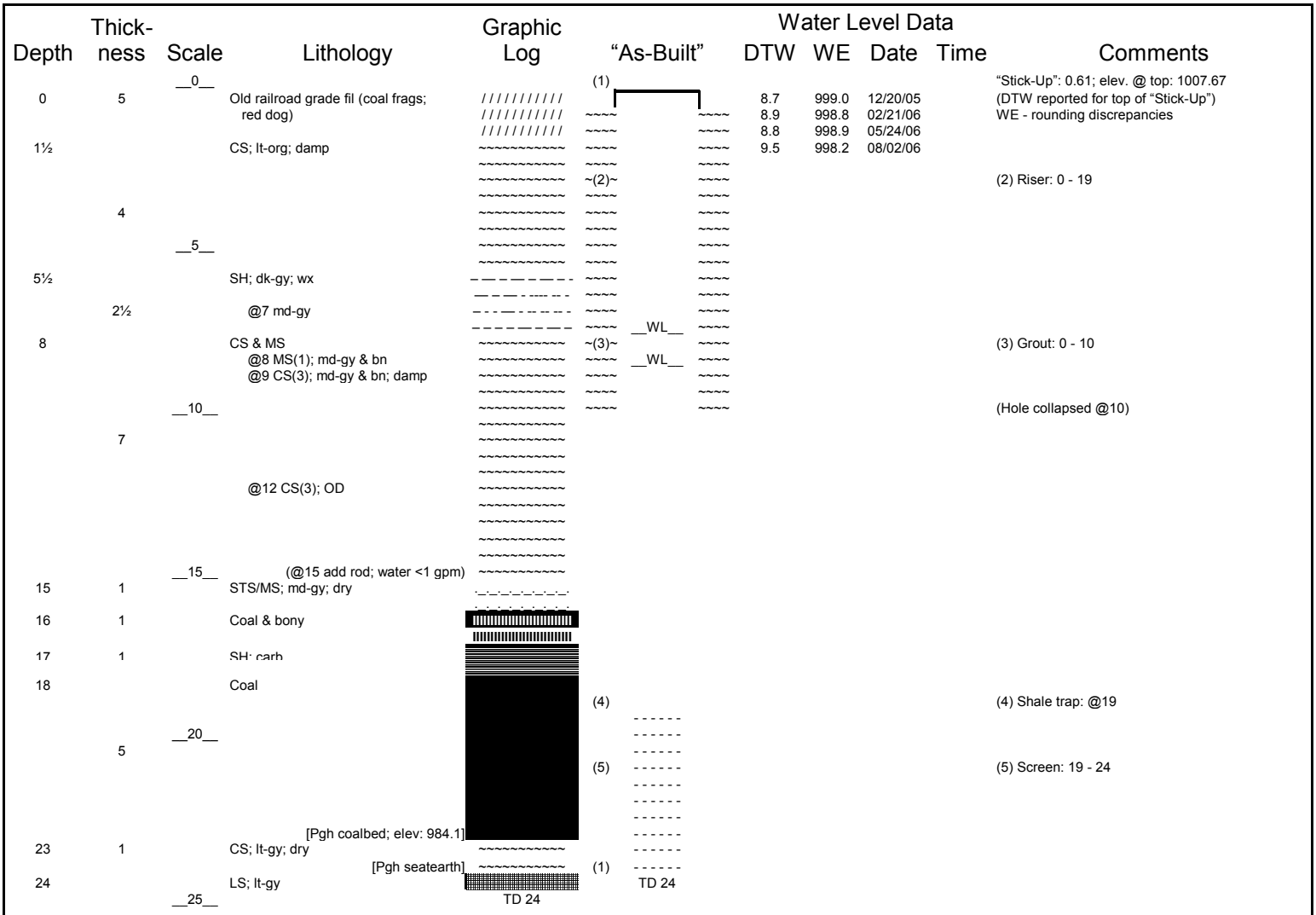
Depth	DTW	WE	Date	Time	Comments
					"Stick-Up": 1.90; elev. @ top: 1008.73
0	9.0	999.7	12/20/05		(DTW reported for top of "Stick-Up")
	9.0	999.7	02/21/06		WE - rounding discrepancies
	9.1	999.6	05/24/06		
	6.6	1002.1	08/02/06		
					(2) Riser: 0 - 18½
					(3) Grout: 0 - 9
					(Hole squeezed @ 9)
					(4) Screen: 18½ - 23½

WELL CONSTRUCTION
(1) Slip cap: 2" PVC
(2) Riser: 2", Sch. 40, PVC, threaded
(3) Grout: bentonite chips
(4) Screen: 20,000th slot, Sch. 40 PVC

Scale: 1" = 5 '

Geologic Drill Hole Log & Piezometer As-Built

Hole No.	94-9	Operation Name	JB1
Road Name	(old RR grade; Petricca prop.)	G. G. Contract #	SW 30426
Sfc. Elev.	1007.06	Drilling Method(Date)	air-rotary; 4 3/4" carbide button bit (12/19/05)
Surveyed by	Jack Chamberlin Surveying	Driller(License#)	McKay & Gould Drilling Co. (PA-0592); Mike Hollabaugh (driller)
Client	PA DEP	Municipality/County	Smith Township / Washington County
Remarks	all dimensions in feet, unless noted	Quadrangle	7½' Midway (PI1977)
Logged by	Margaret H. Dunn, PG (PA-000771)	Latitude	40.361638 Longitude -80.359186



WELL CONSTRUCTION
(1) Slip cap: 2" PVC
(2) Riser: 2", Sch. 40, PVC, threaded
(3) Grout: bentonite chips
(4) Shale trap: 2"x5", bell-shaped, rubber
(5) Screen: 20,000th slot, Sch. 40 PVC

Scale: 1" = 5 '

Geologic Drill Hole Log & Piezometer As-Built

Hole No.	94-10	Operation Name	JB1
Road Name	Slak Lane (private)	G. G. Contract #	SW 30426
Sfc. Elev.	1002.07	Drilling Method(Date)	air-rotary; 4 3/4" carbide button bit (12/19/05)
Surveyed by	Jack Chamberlin Surveying	Driller(License#)	McKay & Gould Drilling Co. (PA-0592); Mike Hollabaugh (driller)
Client	PA DEP	Municipality/County	Smith Township / Washington County
Remarks	all dimensions in feet, unless noted	Quadrangle	7½' Midway (PI1977)
Logged by	Margaret H. Dunn, PG (PA-000771)	Latitude	40.361835 Longitude -80.359757

Depth	Thickness	Scale	Lithology	Graphic Log	"As-Built"	Water Level Data DTW	WE	Date	Time	Comments
		0			(1)					"Stick-Up": 2.60; elev. @ top: 1004.67
0			Road fill; LS agg; md-gy; coal frags			7.8	996.9	12/20/05		(DTW reported from top of "Stick-Up")
						7.5	997.2	02/21/06		WE - rounding discrepancies
						7.5	997.2	05/24/06		
	3½					8.4	996.3	08/02/06		
					(2) Riser: 0 - 10					
3½			CS; org; damp							
		5			WL					
					WL					
	6½									
					(3) Grout: 0 - 10					
		10			(4) Shale trap: @10					
10	1		Coal & bony							
11			Coal							
	3		@12 some bony		(5)					(5) Screen: 10 - 15
			[Pgh coalbed; elev. 988.1]							
14	1		CS & LS; arg; lt-gy; dry							
		15	[Pgh seatearth]							
				TD 15	(1) TD 15					
		20								

WELL CONSTRUCTION
(1) Slip cap: 2" PVC
(2) Riser: 2", Sch. 40, PVC, threaded
(3) Grout: bentonite chips
(4) Shale trap: 2"x5", bell-shaped, rubber
(5) Screen: 20,000th slot, Sch. 40 PVC

Scale: 1" = 5 '

KEYES ROAD (KEYES ROAD MONITORING POINT ~3/4 MILE DOWNSTREAM)

JB25 (~200' NORTH)

KORAIDO, Louis

KORAIDO, Joseph L. & Nancy

PETRICCA, D. et.al.

PETRICCA, J. et.al.

EDMOND, S.

PALLUS, George & Margaret

PALLUS, George & Margaret

MCFALL, Louise & Robert E.

SR8 LOCATED ~350' DOWNSTREAM NEAR RAILROAD BRIDGE

SR5 LOCATED ~3/4 MILE UPSTREAM

SLAK LANE

RACCOON CREEK

POOL

DECK

94-1 1002.40

94-2 1005.50

94-3 1005.70

94-4 1006.70

94-5 1006.40

94-6 1006.60

94-7 1007.10

94-8 1006.83

94-9 1007.06

94-10 1002.07

94-20

94-21

94-22B

94-23

1002.64

1002.50

1003.43

1009.10

JB1A

JB1B

JB1C SIDE CHANNEL

JB1

SL1

CULV 1
INV. 995.2
7' SS
INV. 995.4
CULV #1

CULV #2
5' SS
INV. 993.7
6' SS
INV. 993.3

ROCKS

45° & 22.5° ELBOW

R-4 RIPRAP DRAIN

R-4 RIPRAP TO STABILIZE ROAD DURING HIGH FLOWS

DISCHARGE COLLECTION INSET

R-6 BANKFULL BENCH

PRE-CAST CONCRETE STREAM INTAKE STRUCTURE

12" AGRI-DRAIN VALVE

PERMANENT ROCK CROSS-VANE

2-10' PERFORATED 12" PIPE CAPPED AT END

E(OH)

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

40 20 0 40 80

LEGEND

- CONTOUR - INDEX
- CONTOUR - INTERMEDIATE
- WATER
- ROAD - PAVED
- ROAD - UNPAVED
- TRAIL
- PROPERTY LINE (VERY APPROXIMATE)
- UTILITY POLE
- BUILDING/STRUCTURE
- E(OH) OVERHEAD UTILITY LINE
- SANITARY SEWER LINE
- WETLAND AREA (EXISTING)
- WETLAND AREA (EXPANDED)
- R-4 LIMESTONE RIPRAP
- R-6 LIMESTONE RIPRAP

(NOTE: ALL PIPE IS PRESSURE RATED SCHEDULE 40 PVC)

- WATER DISTRIBUTION PIPE 14"
- WATER DISTRIBUTION PIPE 12"
- PERFORATED 12" 40 PIPE
- WATER DISTRIBUTION PIPE 10"
- WATER DISTRIBUTION PIPE 8"
- WATER DISTRIBUTION PIPE 6"
- WATER DISTRIBUTION PIPE 4"
- VALVE AND VALVE BOX (MATCH PIPE SIZE)
- DISTRIBUTION OUTLETS (1 OUTLET PER DISTRIBUTION PIPE)
- GRAVEL BAR
- JB1B WATER SAMPLE POINT
- 94-1 1006.7 BOREHOLE (PIEZOMETERS 94-1, -8, -9, -10)
- 1009.10 SURVEY REFERENCE POINT (WITH ELEVATION)
- 16 WETLAND MONITORING POINT (DO/pH)

WILDLIFE STRUCTURES

- BLUEBIRD BOX
- BAT BOX
- WOOD DUCK/MALLARD NESTING BOX

Notes:

Topographic mapping by Aerocon Photogrammetric Services, Inc., Willoughby, OH from aerial photographs exposed 12/08/05 and EDM survey by Chamberlin Surveying and Consulting, Brookville, PA.

As-Built information provided by BioMost, Inc. using post-processed positions from a sub-meter GPS unit collected on 6-29-07.

Property line information from Washington County tax maps 57-24 & 57-25 (reviewed 01/12/06). Locations of lines adjusted using aerial photographs from the Southwestern Pennsylvania Commission (SPC) taken 4/2000 and limited field investigation by BioMost, Inc. This is not a survey.

Location map based on USGS 7.5' Midway, PA (PI1977), SPC aerial photography, and from vector data downloaded from Pennsylvnaia Spatial Data Access (PASDA).

Overhead utility line over wetland no longer in use.

Boreholes 94-2,4,5,6, & 7 backfilled. Elevations of boreholes represent pre-existing conditions.

Dimensions of gravel bars vary due to the width and depth of the existing channel.

Sewer line owned by Burgettstown Smith Twp. Joint Sewer Authority.

JB1 water sample point shown on plan is the historical location. Water samples for JB1 are now collected from discharge outlet #12.

DISCHARGE COLLECTION INSET

SCALE 1" = 10'

10 5 0 10

14" VALTERRA VALVE

BY-PASS CROSSOVER (SEE DETAIL)

90° ELBOW

8" VALTERRA VALVE

12" VALTERRA VALVE

22.5° ELBOW

SADDLE TEE

UNDERGROUND MINE SLOPE ENTRY

SAMPLE PORT

DISCHARGE DISTRIBUTION STRUCTURE (SEE DETAIL)

DISCHARGE COLLECTION SYSTEM (SEE DETAIL)

CAPPED 15" TERRACOTTA PIPE

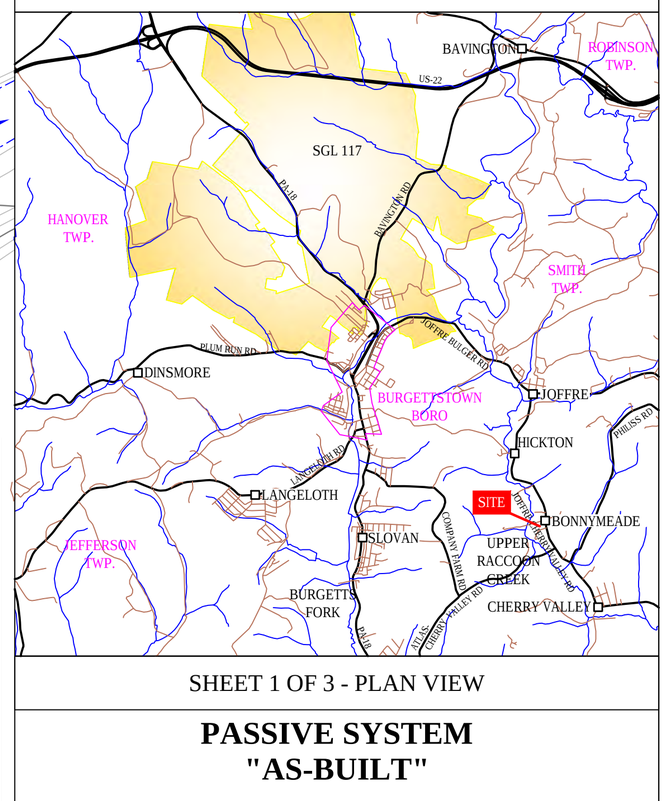
North

DISCHARGE COLLECTION INSET

LOCAL ROADS
STATE ROADS
STREAM
MUNICIPAL BOUNDARY

LOCATION MAP

1" = 1 MILE



SHEET 1 OF 3 - PLAN VIEW

PASSIVE SYSTEM "AS-BUILT"

RACCOON CREEK WATERSHED RESTORATION - JB1 (PHASE 1)

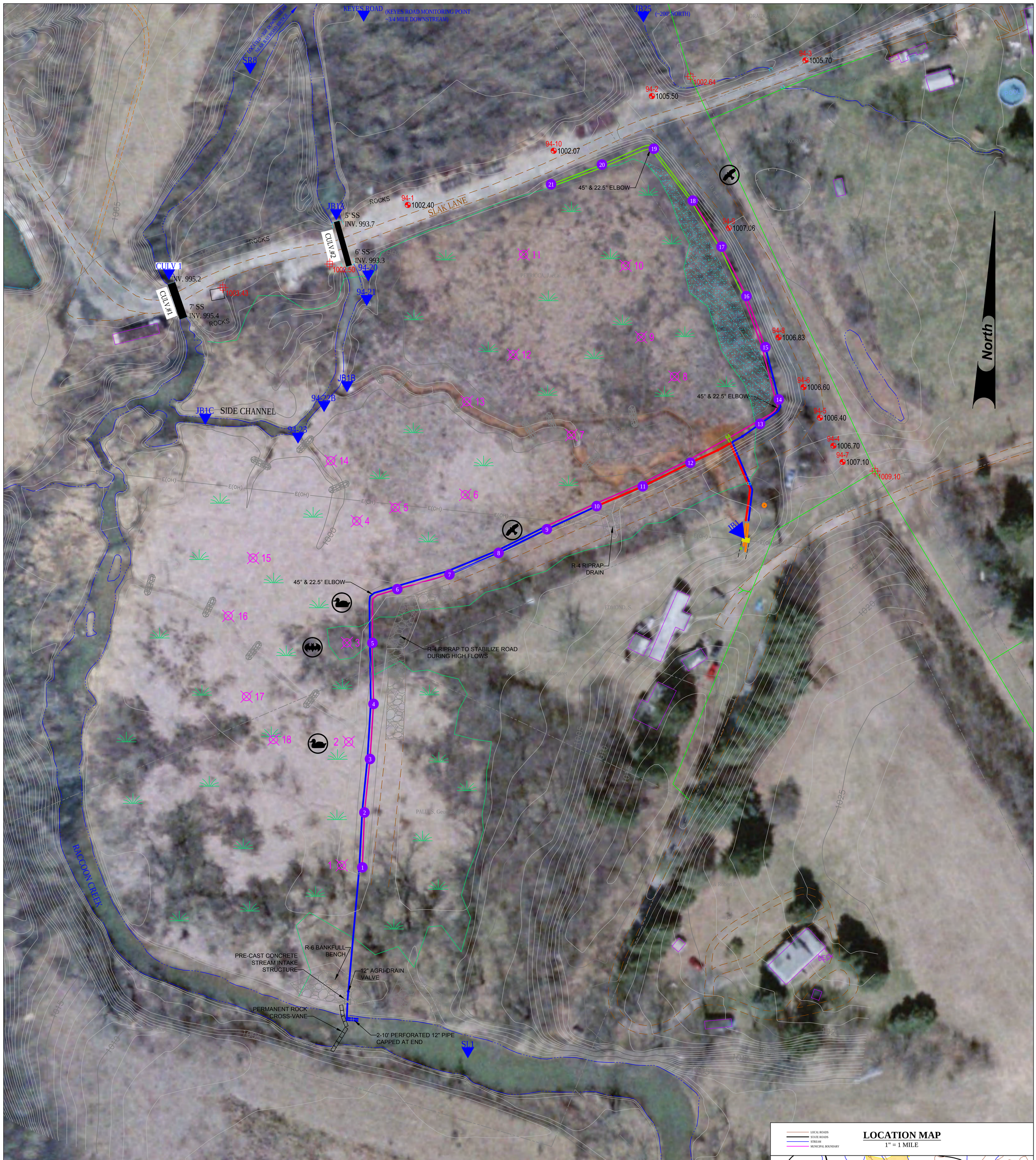
Stream Restoration Incorporated

Smith Township, Washington County, Pennsylvania

Scale: 1" = 40' June 2007

BioMost, Inc., Mining and Reclamation Services
Cranberry Township, PA

94AB/AB1 (final)



LEGEND

(NOTE: ALL PIPE IS PRESSURE RATED SCHEDULE 40 PVC)

- CONTOUR - INDEX
- CONTOUR - INTERMEDIATE
- WATER
- ROAD - PAVED
- ROAD - UNPAVED
- TRAIL
- PROPERTY LINE (VERY APPROXIMATE)
- UTILITY POLE
- BUILDING/STRUCTURE
- OVERHEAD UTILITY LINE (E(OH))
- SANITARY SEWER LINE
- WETLAND AREA (EXISTING)
- WETLAND AREA (EXPANDED)
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- R-6 LIMESTONE RIPRAP

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- WATER DISTRIBUTION PIPE 6"
- WATER DISTRIBUTION PIPE 4"
- VALVE AND VALVE BOX (MATCH PIPE SIZE)
- DISTRIBUTION OUTLETS (1 OUTLET PER DISTRIBUTION PIPE)
- GRAVEL BAR
- WATER SAMPLE POINT (JB1B)
- BOREHOLE (PIEZOMETERS 94-1, -8, -9, -10) (94-1 / 1006.7)
- SURVEY REFERENCE POINT (WITH ELEVATION) (1009.10)
- WETLAND MONITORING POINT (DO/pH) (16)

WILDLIFE STRUCTURES

- BLUEBIRD BOX
- BAT BOX
- WOOD DUCK/MALLARD NESTING BOX

Notes:

Topographic mapping by Aerocon Photogrammetric Services, Inc., Willoughby, OH from aerial photographs exposed 12/08/05 and EDM survey by Chamberlin Surveying and Consulting, Brookville, PA.

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Location map based on USGS 7.5' Midway, PA (PI1977), SPC aerial photography, and from vector data downloaded from Pennsylvnaia Spatial Data Access (PASDA).

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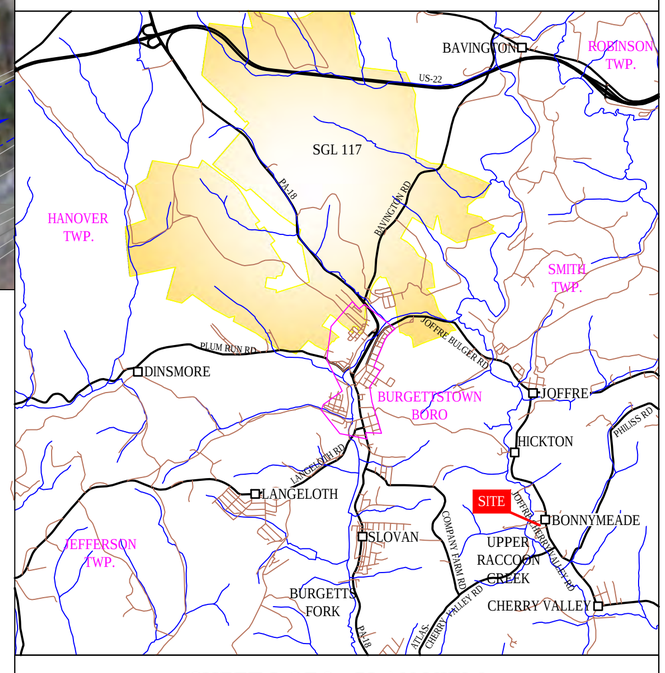
Dimensions of gravel bars vary due to the width and depth of the existing channel.

Sewer line owned by Burgettstown Smith Twp. Joint Sewer Authority.

JB1 water sample point shown on plan is the historical location. Water samples for JB1 are now collected from discharge outlet #12.

LOCATION MAP

1" = 1 MILE



SHEET 2 OF 3 - PLAN VIEW

PASSIVE SYSTEM "AS-BUILT"

(WITH PRE-CONSTRUCTION AERIAL PHOTO)

RACCOON CREEK WATERSHED RESTORATION - JB1 (PHASE 1)

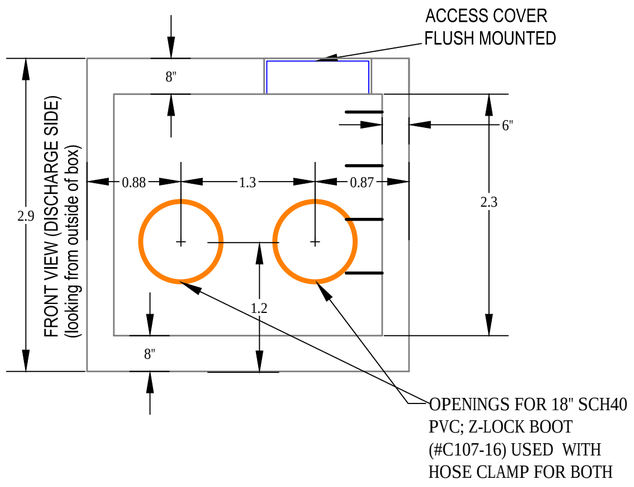
Stream Restoration Incorporated

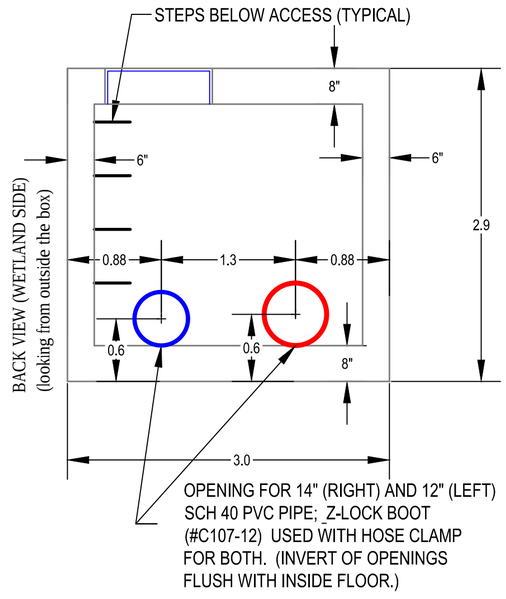
Smith Township, Washington County, Pennsylvania

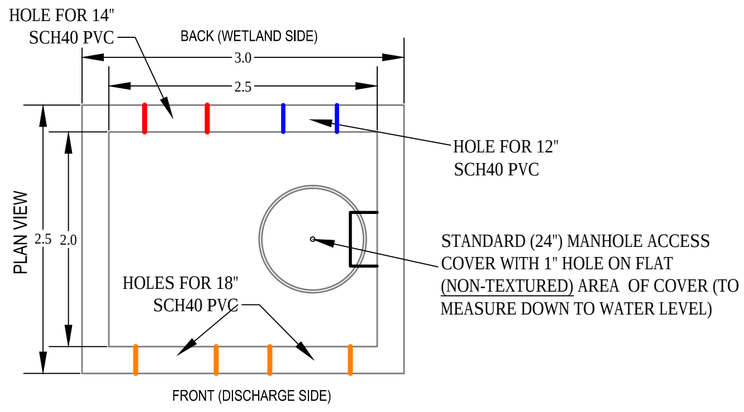
Scale: 1" = 40' June 2007

BioMost, Inc., Mining and Reclamation Services
Cranberry Township, PA

94AB/AB2 (final)

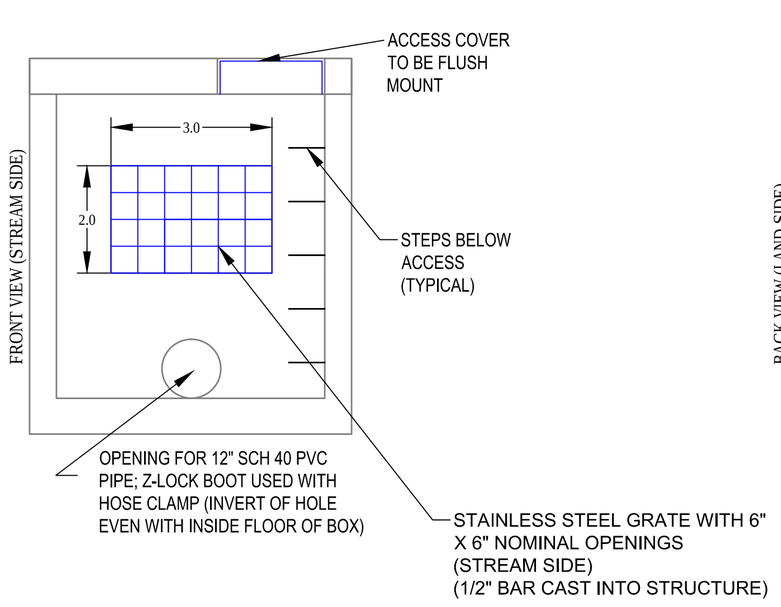


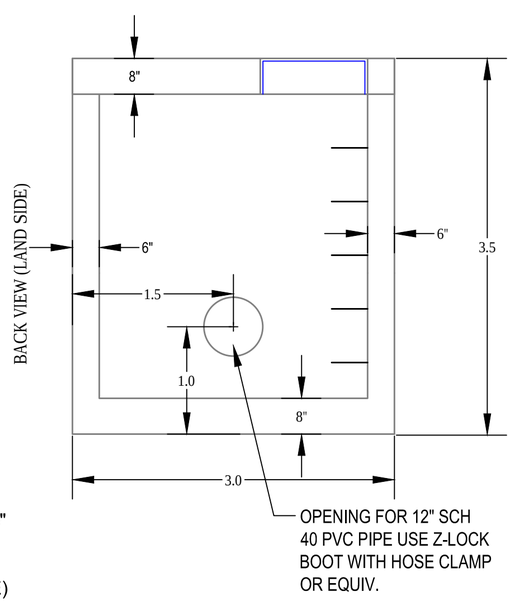


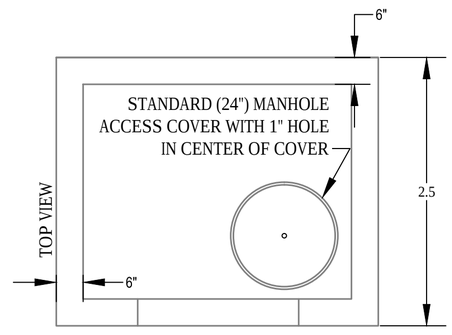


PRE-CAST CONCRETE DISCHARGE DISTRIBUTION STRUCTURE

SCALE 1" = 2'

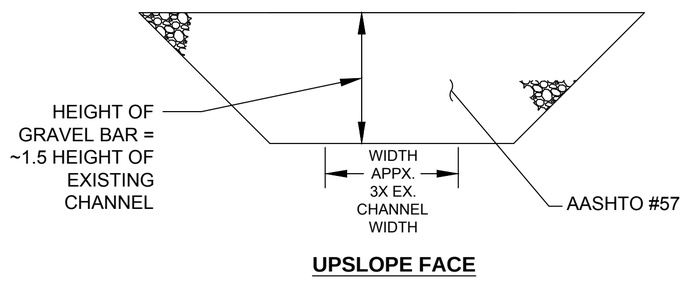




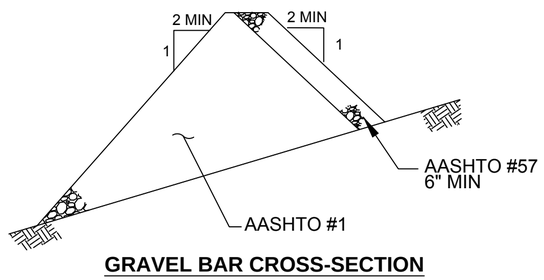


PRE-CAST CONCRETE STREAM INTAKE STRUCTURE

SCALE 1" = 2'



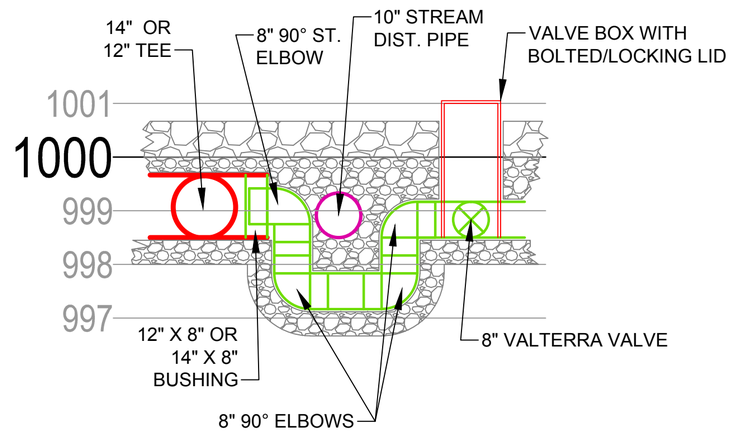
UPSLOPE FACE



GRAVEL BAR CROSS-SECTION

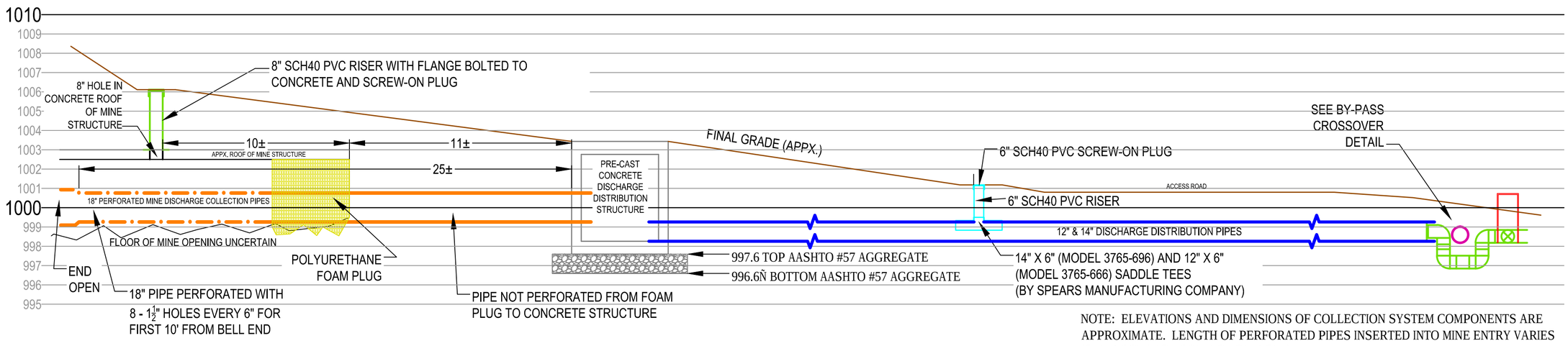
GRAVEL BAR DETAIL

N.T.S.



BY-PASS CROSSOVER DETAIL

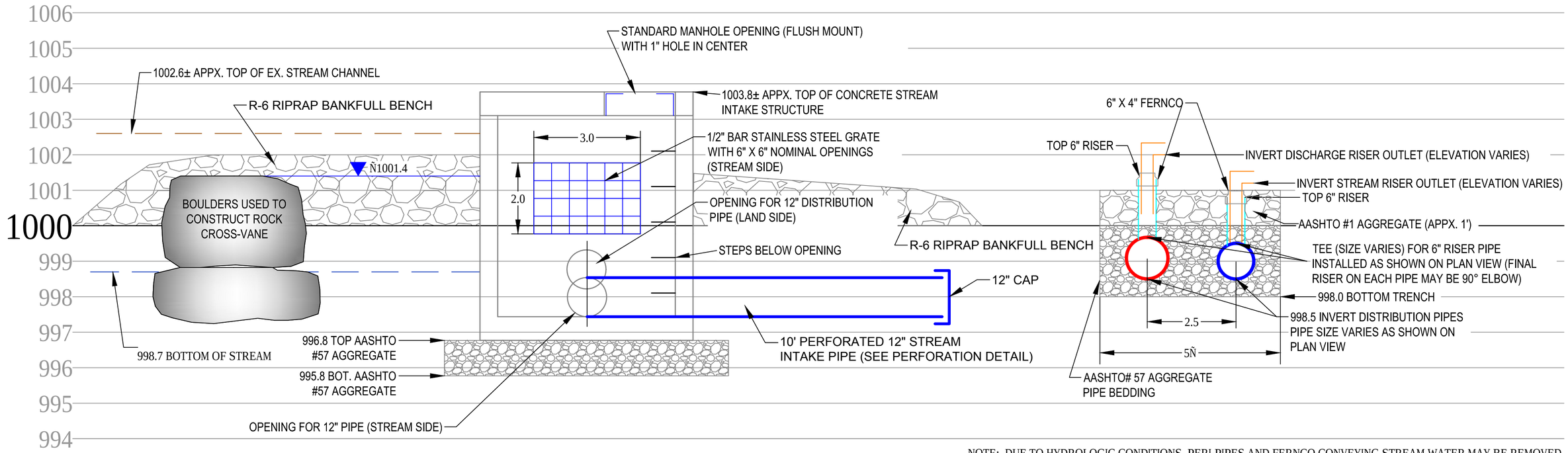
SCALE 1" = 2'



NOTE: ELEVATIONS AND DIMENSIONS OF COLLECTION SYSTEM COMPONENTS ARE APPROXIMATE. LENGTH OF PERFORATED PIPES INSERTED INTO MINE ENTRY VARIES (SEE DISCHARGE COLLECTION INSET).

DISCHARGE COLLECTION SCHEMATIC

SCALE 1" = 4'

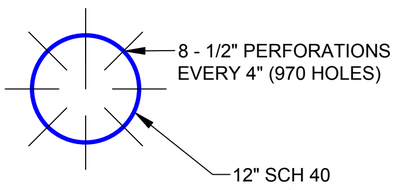


STREAM INTAKE SCHEMATIC

SCALE 1" = 2'

NOTE: DUE TO HYDROLOGIC CONDITIONS, PERI-PIPES AND FERNCO CONVEYING STREAM WATER MAY BE REMOVED FROM RISERS TO ENCOURAGE ADDITIONAL STREAM FLOW FOR IMPROVED TREATMENT OF MINE DRAINAGE.

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"	30"
R-8	24"	36"



STREAM INTAKE PIPE PERFORATION DETAIL

SCALE 1" = 2'

SHEET 3 OF 3 - DETAILS

PASSIVE SYSTEM "AS-BUILT"

RACCOON CREEK WATERSHED RESTORATION - JB1 (PHASE 1)

Stream Restoration Incorporated

Smith Township, Washington County, Pennsylvania

Scale: 1" = 40' June 2007

BioMost, Inc., Mining and Reclamation Services
Cranberry Township, PA

94AB/AB3 (final)