Erico Bridge Restoration Area

A Public Private Partnership Effort

Venango Township, Butler County

Slippery Rock Watershed Coalition

December 2004

SLIPPERY ROCK WATERSHED COALITION

ERICO BRIDGE RESTORATION AREA FINAL REPORT

Seaton Creek Watershed, Slippery Rock Creek Headwaters
Venango Township, Butler County, PA

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

A Pennsylvania Growing Greener Watershed Restoration Project

Brief Description of Project Work through Grant and Partnership Contributions

- Completed applications/notifications and received permits/approvals necessary for the **~24-acre restoration site** from US Army Corps of Engineers, US Fish & Wildlife Service, Venango Twp. Supervisors, PA Historical & Museum Commission, PA Fish & Boat Comm., PA Dept. of Environmental Protection, Butler Co. Conservation District, PA One Call;

- Identified underground utilities and installed approved Erosion and Sediment Controls;

- Designed passive system complex (25-year design life) for **five abandoned mine discharges** (63A, 63B, 63C, 63D, 63E) significantly impacting Seaton Creek, a major tributary to Slippery Rock Creek. Design basis (raw water monitoring by PA DEP and other project partners): >300 gpm avg. (>700 gpm max.), 5.7 pH, 62 mg/l (total/dissolved 166 mg/l max.) iron, and **31 mg/l manganese**; [post-construction **average flow rates ~500 gpm** and **avg. iron ~70 mg/l**];

- Installed **17 piezometers** (22 exploratory boreholes) to monitor potentiometric surface of confined water-bearing zones associated with underground mine in Brookville coalbed and with surficial material replacing Brookville coalbed (subcrop); monitored water levels and quality;

- Developed interpretive geologic maps and cross-sections including isopach maps, potentiometric maps, bed map, etc.;

- Developed and implemented plan addressing underground mine pool prior to construction of passive system;

- Expanded proposed 4-component system to a **16-component passive treatment complex** consisting of Anoxic Collection Systems (3); Anoxic Limestone Drains (3) (12,000 tons limestone aggregate); Plunge Pools (2); Settling Ponds (5); **Created Wetlands with wildlife habitat enhancements (2) (>2½ acres total)**; Horizontal Flow Limestone Bed (1) (9,000 tons limestone aggregate);

- **Analyzed (Acid-Base Accounting) abandoned coal refuse** to identify potential acidity production and neutralization required;

- Removed **~40,000 cubic yards of abandoned coal refuse** (Scarlift pre-construction estimate 15,000 CY) neutralized material with alkaline, circulating fluidized-bed coal ash from Scrubgrass Generating Plant (Kennerdell, PA) and placed coal refuse within the backfill to **assist in the reclamation of** the nearby (<1 mile from site) Tiche **abandoned surface mine pit** on the Brookville coalbed;

- Installed **innovative in-stream water elevation control structure across Seaton Creek** in accordance with US Dept. of the Army permit to create **~1-acre of wetlands in the footprint of previously existing gob piles** and enhance >3.5 acres of existing, degraded, wetlands with treated effluent from passive complex; planted associated ~1/5-acre upland area;

- **Developed wetland substrate** from mixture of spent mushroom compost, alkaline pond fines (by-product from limestone quarry), and onsite soil material;

- Demonstrated neutralization of **~900 lbs/day of acidity** (~30% higher than 620 lbs/day pre-construction estimate) and retention of **~500 lbs/day of metals** (~30% higher than 340 lbs/day pre-construction estimate) by passive complex and return of fish in Seaton Creek through continued monitoring by project partners;

- **Treated site drainage** (combined final effluents) to **average values of 7.0 pH, 111 mg/l alkalinity, negative acidity, 2 mg/l total iron, and 3 mg/l total manganese; removing ~100% of acidity, 97% of iron, and 81% of manganese**;

- Utilized **"Datashed"** (www.datashed.org) to post Operation & Maintenance Form;

- Conducted **education and outreach activities** including wetland and upland plantings, construction and installation of wildlife habitat structures with service groups and children at-risk, and site tours (visitors from Peru, Korea, Brazil, Venezuela, OK, OH, MT, WV, community groups, watershed education programs, etc.);

- Compiled **mining history** of the site and the region spurred by the interest of nearby residents to encourage expansion of local interest in watershed stewardship;

- Compiled **pictorial log** of site conditions including historical and "before, during, and after" restoration;

- Developed **permanent project sign** and three interpretative signs;

- Received **5-year post-construction warranty by Quality Aggregates Inc.** for site revegetation and structural integrity of the passive system components;

- Submitted electronic updates, quarterly status reports, and a final report; administered contract.

Support

In-Kind/Matching: Butler County Commissioners; Western PA Watershed Program; Beran Environmental Inc.; Butler Co. Environmental Quality Board; Urban Wetland Institute; Grove City College; Venango Twp. Supervisors; Butler Co. Planning Comm.; Scrubgrass Generating Plant; Jennings Environmental Education Center; Karns City Elementary School; Americorps; Jack & John Foreman; Homeschool students; Church of Jesus Christ of Latterday Saints volunteers; Butler Co. Juvenile Court Services; Butcherine Distributor; Grove City Cub Scout Pack 76; George Jr. Republic; BioMost, Inc.; WOPEC; Quality Aggregates Inc.; PA Game Commission; Environmentally Innovative Solutions, LLC; Northwest Sanitary Landfill; Slippery Rock Watershed Coalition; Stream Restoration Inc.

Legislators/Government: PA Senator Mary Jo White; PA Rep. Dick Stevenson; Butler Co. Comm.: Glenn Anderson, James Kennedy, Joan Chew; Venango Twp. Supervisors: Norman Link, Jim Shaffer, John Wells

Landowners: Bessemer and Lake Erie Railroad Company; The Flick Family; The Tiche Family

Local Residents: Support letter with over 150 signatures

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O&M Form

Water Monitoring Data

Education/Outreach

News Articles (newspapers and websites)

- "Group works to clean up Seaton Creek", Pittsburgh Tribune Review, 8/9/01
- "Growing Greener Project Gets Boost from Butler Co. Commissioners", PADEP Update, 9/14/01
- "Water reclamation set to begin", Butler Eagle, 10/4/01
- "Coalition Dedicates Growing Greener Project in Butler County", PA DEP Update, 10/5/01
- "Tour group visits…and Erico Bridge…Areas", Watershed Weekly, Vol 3, #5, 2/01/02
- "Water Cleaner, Fish Return", Pittsburgh Post-Gazette, 9/22/02
- "DEP Conducts First Watershed Academy for Local Governmnet", PA DEP Update, 5/16/03
- "Erico Bridge Abandoned Mine Project", Watersheds.TV, 9/9/03
- "Acid free, crystal clear", Pittsburgh Post-Gazette, 10/24/04

The Catalyst (SRWC newsletter) Articles

- "Fish Get Buzzed On Electrical Current", 9/01
- "Butler County Commissioners Donate$180,000 to…Restoration Projects", 10/01
- "SRWC in the Pittsburgh Tribune", 10/01
- "Erico Bridge Groundbreaking", 11/01
- "PASDA Visits SRWC", 11/01
- " Erico Bridge – Gob Getting' Gone!!!", 3/02
- "7th Annual Slippery Rock Watershed Coalition Symposium – Yet Another Success", 5/02
- "The Peruvian Connection", 6/02
- "Erico Bridge Wetland Planting", 6/02
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- "The Watershed Academy Visits Our Watershed", 7/02
- "Erico Bridge Drilling", 8/02
- "Home-School Students Tour SRWC Sites", 10/02
- "Dominion Tour of Slippery Rock Creek Watershed", 3/03
- "8th Annual SRWC Symposium Has Largest Attendance Yet", 5/03
- "Watershed Academy Visits SRWC Sites", 6/03
- "What's New at Erico Bridge", 9/03
- "Teacher Workshops at Jennings Environmental Education Center", 9/03
- "Scout Pack Assists Restoration Effort at Erico Bridge", 1/04
- "Helpful Cub Scouts Volunteer at Erico Bridge", 4/04
- "9th Annual SRWC Symposium an International Flare", 5/04

"As-Builts"

ERICO BRIDGE RESTORATION AREA FINAL REPORT
VENANGO TOWNSHIP, BUTLER COUNTY, PA
Slippery Rock Creek Watershed

submitted to the

Pennsylvania Department of Environmental Protection

EXECUTIVE SUMMARY

For 1½ years, a passive treatment complex at the Erico Bridge Restoration Area has successfully removed essentially 100% of the acidity, 97% of the iron, and 81% of the manganese from ~500 gpm of abandoned mine drainage. The ~24-acre restoration effort described in this final report is for a site, which was the largest contributor of acidity and iron to Seaton Creek, the most heavily impacted major tributary in the Slippery Rock Creek Watershed. [1998 *Comprehensive Mine Reclamation Strategy,* PA Dept. of Environmental Protection (PADEP) Knox District Mining Office]

With broad-based public and private support (including >150 local residents by letter), Slippery Rock Watershed Coalition participants received funding through PADEP Growing Greener to install a passive system to treat five, net acid, metal-bearing, discharges and to remove coal refuse. With funding from the Butler County Commissioners, Western PA Watershed Program, and generous donations and in-kind from numerous partners, sixteen passive components were installed instead of the four proposed.

Federal, state, and local permitting, site characterization that addressed an abandoned underground mine pool, innovative passive system design that included the largest known Anoxic Limestone Drain within PA, and system installation that utilized innovative techniques were completed without an increase in the original contract costs. This economic, efficient, and effective implementation was made possible by a coordinated team approach developed prior to submission of funding requests. This public-private partnership effort included government agencies, private industry, nonprofits, a local college, and volunteers.

The 16-component passive treatment complex includes 3 Anoxic Collection Systems, 3 Anoxic Limestone Drains, 2 Plunge Pools, 5 Settling Ponds, 2 Aerobic Wetlands with fabricated substrate, and a Horizontal Flow Limestone Bed. The main passive treatment complex was completed in June 2003. (Components for a small discharge were completed in May 2004.) The complex is neutralizing ~900 lbs/day of acidity and preventing ~500 lbs/day of metals from entering Seaton Creek. Pre-construction raw water averaged ~320 gpm with a 5.7 pH, 50 mg/l alkalinity, 62 mg/l total Fe, and 31 mg/l total Mn. With a post-construction average flow of ~500 gpm, the effluent quality averages 7.0 pH, 111 mg/l alkalinity, 2 mg/l total Fe, and 3 mg/l total Mn.

The ~40,000 CY of abandoned coal refuse were removed, transported, mixed with alkaline coal ash, and placed within a nearby abandoned strip cut, reclaiming two sites concurrently without additional costs to the Commonwealth. This would not have been possible without project partners Quality Aggregates and Scrubgrass Generating. Within the gob pile footprint, created wetlands were planted with over 40 species for ecological function and high-value wildlife habitat. With approval from the US Army Corps of Engineers, an innovative in-stream water elevation control structure was installed across Seaton Creek to establish the necessary hydrology for the 1-acre wetlands and to enable >3.5 acres of severely-impacted wetlands along the banks of Seaton Creek to receive good quality water from the passive system.

Widely used for education and outreach activities including numerous tours, presentations, and newspaper, magazine and website articles, church youth groups, homeschool students, boy scouts, and children at-risk participated in planting wetlands and uplands, and building and installing wildlife habitat structures such as bluebird, kestrel, and wood duck boxes, and osprey nesting platforms. Encouraged by local residents, site history was also compiled. An online management tool, "Datashed", was utilized to enable access to information that will assist long-term system performance monitoring.

Complementing the recent De Sale, Goff Station, and Chernicky restoration efforts, the entire length (~5 miles) of Seaton Creek has been dramatically improved, resulting in Seaton Creek, probably devoid of fish for a century, supporting a reproducing fish population (spawning beds observed).

COMPREHENSIVE TIMELINE

DEP Inspection
Tour/Site Visit
News Item

Date	Description
06/26/00	Site investigation and water monitoring
01/15/01	Site investigation and water monitoring
01/22/01	Meeting with PA DEP, Stream Restoration Inc., BioMost, Inc., Quality Aggregates, Aquascape
02/02/01	Site investigation and water monitoring
02/05/01	Site investigation and water monitoring
02/28/01	Cubitainer Test on 63E1 and 63B discharges
03/02/01	Meeting with PA DEP, Stream Restoration Inc., BioMost, Inc., Aquascape
03/07/01	Site investigation water sampling
03/09/01	Growing Greener grant applications submitted for mine drainage abatement, gob pile removal and wetland construction
07/25/01	Site visit with Jennifer Hill of PA DEP NWRO
07/25/01	PNDI search request submitted to PA DEP
07/30/01	PA Historical and Museum Commission review requested for project area
08/01/01	PA DEP Official letters of Grant Approval; county and township notifications submitted; one PNDI potential conflict identified
08/03/01	Request for restoration waiver submitted to PA DEP NWRO
08/03/01	Electro-fishing survey of Seaton Creek; reported in 9/01 “Catalyst”
08/06/01	PNDI potential conflict and project information submitted to PA Fish & Boat Commission and US Fish & Wildlife Service; Fish Survey conducted; Photo shoot with Pittsburgh Tribune-Review
08/09/01	PNDI potential conflict cleared by US Fish & Wildlife Service; “Group Works to Clean Up Seaton Creek” article appears in Pittsburgh Tribune Review
08/15/01	Submission of US Fish & Wildlife Potential Conflict Response to PA DEP
08/22/01	PHMC clearance issued
08/29/01	PNDI potential conflict cleared by PA Fish & Boat Commission
08/31/01	PA DEP Grants Center sends Growing Greener Grant Agreement packets
09/06/01	Butler Co. Commissioners approve $100,000 matching funds
09/07/01	Meeting with PA DEP, Stream Restoration Inc., BioMost, Inc., Quality Aggregates, Aquascape
09/14/01	PA DEP Update article “Growing Greener Project Gets Boost from Butler County Commissioners”
09/18/01	Waiver of permit requirements (EA10-017NW) received from PA DEP
09/25/01	Growing Greener Training
09/26/01	Butler County Environmental Quality Board tours Flick gob pile at Erico Bridge; reported in 11/01 “Catalyst”
10/03/01	Groundbreaking Ceremony; reported in 11/01 “Catalyst”; reported in 10/5/01 PA DEP Update
10/11/01	Butler Eagle newspaper article entitled “Water Reclamation set to begin”
11/08/01	Water sampling and site investigation; Erico Bridge Gob Removal executed

	contract submitted to PA DEP Grants Center; Revised grant agreement for Discharge Abatement sent by PA DEP Grants Center
11/15/01	Preliminary construction meeting with Quality Aggregates, BioMost, Aquascape, and Chamberlin Survey; Technical Deficiencies for E&S Control Plan sent by Butler County Conservation District
11/20/01	Waiver of Permit Requirements, Environmental Assessment, PNDI, PHMC and other notifications/reviews submitted to US Army Corps of Engineers; Erico Bridge Discharge Abatement executed contract submitted to PA DEP Grants Center
11/27/01	First Phase of E&S control plan (NPDS Permit PAR10E173) approved by Butler County Conservation District
12/04/01	Scope of Work Revision for Gob Removal and Discharge Abatement grant
12/10/01	Clarifications to US Army Corp of Engineers 404 permit
12/13/01	Field Meeting with US Army Corp of Engineers to review project
12/18/01	Working Capital request submitted to PA DEP Knox DMO
12/21/01	Tour of Goff Station & Erico Bridge; Reported in 2/1/02 Watershed Weekly
12/26/01	Working Capital request approved by PA DEP Knox DMO
01/08/02	US Army Corp of Engineers Public Notice for application of 404 permit
01/10/02	PA DEP Grants Center completes Processing of Erico Bridge Gob Removal Growing Greener Grant Agreement
01/14/02	GP8 permit submitted to Butler County Conservation District
01/15/02	Compliance Review Form STD-21B submitted to PA DEP
01/16/02	GP8 permit (#GP081002601) approved by Butler Co. Conservation District
01/25/02	PA DEP Grants Center completes Processing of Erico Bridge Discharge Abatement Growing Greener Grant Agreement
01/30/02	Roads constructed to haul gob Tiche Brookville Pit; Flick pile removed
02/05/02	Gob being loaded and hauled to Brookville Pit; DEP Inspection (T. Elicker)
02/11/02	Piezometer installation
02/13/02	Approval from US Army Corps of Engineers (Permit #200101665)
02/22/02	Gob pile on south side of Seaton Creek mostly removed; DEP Inspection (T. Elicker)
03/13/02	Gob removed to approx. water level in stream; DEP Inspection (T. Elicker)
03/20/02	US Army Corps of Engineers Public Notice for issuance of permit #200101665
03/28/02	Site investigation; piezometer water levels & discharge flows measured; lowered 63E1 discharge elevation; raised 63B discharge with pipe
03/29/02	Site investigation; piezometer water levels & discharge flows measured
04/02/02	Site investigation; piezometer water levels & discharge flows measured
04/03/02	Site tour with Estudio Grau Environmental Group from Peru; reported in 6/02 “Catalyst”
04/04/02	Gob removed & hauled to Brookville pit reclamation site; wetland being constructed in area of gob removal; alkaline pond fines [from Boyers Quarry] placed in wetland area; topsoil/compost mixture [from Tiche Mine] spread over pond fines; DEP Inspection (T. Elicker)
04/05/02	Site investigation; piezometer water levels & discharge flows measured

04/12/02	SRWC Symposium site tour; reported in 5/02 "Catalyst"
04/14/02	DEP Inspection (T. Elicker)
04/18/02	Wetland construction on south side of Seaton Creek; road constructed to Flick gob pile to receive pond fines and topsoil/compost mixture; DEP Inspection (T. Elicker); Quarterly Reports submitted to PA DEP Knox DMO
05/07/02	Site investigation; located 63B; purged & sampled monitoring wells; field review for design
05/10/02	Harvested hydrophytic vegetation for wetland planting
05/11/02	Wetland planting with Americorps (SRU chapter), gob pile removal areas; reported in 6/02 "Catalyst"; site investigation of 63B
05/14/02	Gob removal and wetland construction; gob removal areas graded, covered with alkaline pond fines, and then a topsoil/compost mixture; woody debris placed on topsoil/compost; Z-pilings installed along downstream side of wetland to maintain water level; limestone riprap placed along top of z-piling to prevent erosion and encourage sheet flow out of the wetland; DEP Inspection (T. Elicker)
05/17/02	Wetland planting in gob pile removal areas
05/23/02	Site investigation; piezometer water levels and discharge flows measured
05/31/02	Field meeting with Jack and John Foreman to review passive treatment design and discuss previous efforts conducted under Operation Scarlift; 21 Karns City students planting Willow Waddles in footprint of Flick refuse pile
06/04/02	Submitted E&S control plan to Butler County Conservation District for Phase II; Property info at tax assessment office
06/11/02	Wetland planting with BCJCS WORC program in gob pile removal areas
06/13/02	Site included as part of PA DEP Watershed Academy Tour
06/14/02	Site tour for Dr. Nairn and students, Univ. of OK; reported in 7/02 "Catalyst"
06/18/02	Wetland planting with BCJCS WORC program in gob pile removal areas
06/20/02	Budget Revision request for Gob Removal grant submitted to PA DEP Knox DMO
06/25/02	Preliminary field construction meeting with PA DEP, BioMost, Quality Aggregates, and Aquascape; wetland planting with BCJCS WORC program in gob pile removal areas; E&S Control Plan approved by Butler Co. Conservation District; dozer starting construction of upper diversion ditch; Constructed Wetlands partially planted; DEP Inspection (T. Elicker)
07/02/02	Budget Revision for Gob Removal grant approved by PA DEP Knox DMO
07/03/02	Approved revised E&S Control Plan submitted to PA DEP Knox DMO
07/09/02	Wetland planting with BCJCS WORC program in gob pile removal areas
07/11/02	Diversion Ditch DD1 installed; straw matting mostly in place; filter fence installed along Seaton Creek; dozer & excavator actively clearing brush; DEP Inspection (T. Elicker); Working Capital request submitted
07/12/02	Working Capital request approved by PA DEP Knox DMO
07/15/02	Field construction meeting; flagged holes for survey crew; piezometer water level measurements
07/16/02	Dozer working on Diversion Ditch; excavator actively clearing brush and large rocks, majority of site cleared; DEP Inspection (T. Elicker)

09/20/02	Limestone being delivered and spread in ALD1; geotextile fabric in place in bottom of ALD1; perforations drilled in pipe at east end of ALD1; excavator constructing Settling Pond 2; Emergency spillway built for HFLB; roller being used to maintain township road; DEP Inspection (T. Elicker)
09/20/02 09/21/02	Poster featuring Erico Bridge site used at the PA Watershed Conference
09/27/02	Site idle due to rain; additional work completed on Settling Pond 2; additional limestone in ALD1; road stable; DEP Inspection (T. Elicker)
09/30/02	Poster featuring Erico Bridge site used at the New Castle of the World Summit held at Slippery Rock University
10/30/02	Site remains idle with no work completed since last inspection; Updated design plans needed; DEP Inspection (T. Elicker)
10/11/02	Current design plans submitted to PA DEP Knox DMO; Scope of Work and Budget revision request submitted to PA DEP Knox DMO
10/14/02	Water sampling and site inspection
10/21/02	Scope of Work and Budget revision request approved by PA DEP Knox DMO; Quarterly Reports submitted
10/31/02	Reimbursement Request submitted to PA DEP Knox DMO
11/01/02	Site idle with no equipment; no work completed since last inspection; lower berm impounding water; more complete design plans received; DEP Inspection (T. Elicker)
11/05/02	Reimbursement Request revision submitted to PA DEP Knox DMO
12/03/02	Site idle with no equipment; no work completed since last inspection; lower berm impounding water; DEP Inspection (T.Elicker and T. VanDyke)
12/11/02	Most of limestone leveled; excavator excavating for collection system at west end of ALD1; dozer spreading dirt over geotextile fabric at east end of ALD1; DEP Inspection (T. Elicker)
12/24/02	Site idle; limestone in ALD1 leveled and collection system installed at west end; geotextile and dirt cover spread over eastern 2/3 of ALD1; Settling Pond 1 and lower berm impounding water; DEP Inspection (T. Elicker)
01/13/03	Quarterly Reports submitted
01/15/03	Reimbursement Request submitted to PA DEP Knox DMO; construction idle; site recently active with grading on east end of Wetland 2; west end of ALD1 covered with dirt; DEP Inspection (T. Elicker)
01/28/03	Construction idle; site recently active; Z-pilings and rock installed to construct spillway between Settling Ponds 1 and 2; remaining limestone spread in HFLB; some grading completed in the areas of Wetland 1 and Settling Pond 4; DEP Inspection (T. Elicker)
02/03/03	Reimbursement Request review letter from PA DEP Knox DMO
02/07/03	Settling Pond 2 nearly completed with excavator working at west end; dozer clearing Settling Pond 4 area; iron precipitate removed from this area with clay encountered under iron precipitate; ST63B and ST63C flowing in channels; DEP Inspection (T. Elicker)
02/11/03	Site tour with Dominion Peoples; reported in 3/03 "Catalyst"
02/12/03	Application for Reimbursement submitted to Butler Co. Planning Comm.

02/19/03	Excavator, highlift, and dozer constructing western end of lower berm for wetland; Discharges ST63B and ST63C temporarily piped under berm to allow for construction; encountered wetland and topsoil-type material stockpiled for use in constructed wetlands; piping for anoxic collection system for discharge ST63E installed and buried; ST63E being piped across Settling Pond 2 and HFLB; DEP Inspection (T. Elicker)
02/28/03	Lower berm extended to the west; spillway from Settling Pond 2 to Wetland 1 constructed; DEP Inspection (T. Elicker)
03/10/03	Quarterly reports submitted
03/18/03	Lower berm completed around the site; ALD2 excavation nearing completion; water flowing into ALD2 being pumped as necessary; discharges diverted around construction area; Settling Pond 1 discharging to Settling Pond 2; HFLB discharging; stream flowing through channel in z-piling; DEP Inspection (T. Elicker)
03/26/03	Additional data provided to PADEP Knox DMO for Reimbursement Request
04/03/03	Limestone being delivered and placed in ALD2; water flowing into SE corner of ALD2 directly off the coal; pipe carrying ST63E during construction separated allowing discharge to flow through HFLB; construction of lower berm completed; additional Z-piling being placed in stream channel to raise water level; DEP Inspection (T. Elicker)
04/10/03	Excavator, rock truck, and dozer are active; excess material from Plunge Pool 1 and Wetland 2 being trucked to area south of ALD1; additional limestone placed in ALD2; water still flowing into SE corner of ALD2 being pumped; pipe to ST63E repaired; DEP Inspection (T. Elicker)
04/11/03	SRWC Symposium site tour; reported in 5/03 "Catalyst"
04/17/03	Quarterly Reports Submitted
04/23/03	Site inspection; final dirt being placed on ALD2; finishing WL1 excavation
04/29/03	Grant extension request submitted to PA DEP Knox DMO
05/02/03	Grant extension request approved by PA DEP Knox DMO
05/06/03 05/07/03	Erico Bridge included in DEP Watershed Academy for Local Government; Reported in PA DEP Update on 5/16/03; Reported in 6/03 "Catalyst"
05/09/03	Reimbursement Request submitted to PA DEP Knox DMO; dozer active above ALD1 burying iron sludge and grading; ALD2 covered and discharging to roadside ditch; substrate placed in Wetland 1; part of substrate placed in Wetland 2; DEP Inspection (T. Elicker)
05/22/03	Dozer grading access road above ALD2; excavator spreading wetland substrate in Wetland 2; upper diversion carrying clear water away from treatment system; HFLB discharging; DEP Inspection (T. Elicker)
05/24/03	Jennings teacher workshop site tour; reported in 9/03 "Catalyst"
06/06/03	Construction continuing; excavator working along SE side of Wetland 2; most of ST63E flowing through ALD1; part of ST63E piped across HFLB; water flowing through ALD2 discharging to roadside ditch while Settling Pond 4 under construction; Settling Pond 3 built with spillway in place to Plunge Pool 1; area graded for new access road above treatment system; DEP Inspection (T. Elicker)
06/24/03	Construction of passive system nearly complete; ST63B through ST63E are

07/17/02	Quarterly Reports submitted to PA DEP Knox
07/18/02	Drilling and piezometer installation; reported in 8/02 "Catalyst"
07/19/02	Request for dam waiver submitted to PA DEP; piezometer water levels measured; drilling and piezometer installation; reported in 8/02 "Catalyst"
07/22/02	Site investigation; piezometer water levels measured; electro-fishing survey of Seaton Creek; reported in 9/02 "Catalyst"
07/23/02	Piezometer water levels measured; electro-fishing survey of Seaton Creek; reported in 9/02 "Catalyst"
07/24/02	Dozers(2), excavator, rock truck operating; Settling Pond 1 being excavated; material being trucked to the north for berm around lower side of site; additional peizometers installed; DEP Inspection (T. Elicker)
07/31/02	Dozer actively clearing brush above discharge ST63C; excavator constructing berm along lower side of site; Settling Pond 1 constructed; Hay bales in place through wetlands at northwest end of site and being staked in place; DEP Inspection (T. Elicker)
08/01/02	Construction Inspection; passive system layout
08/02/02	Field meeting; reviewed passive system design with Roger Bowman, PA DEP, John Stoops, Quality Aggregates
08/05/02	Draft Passive Treatment System design submitted to PA DEP Knox DMO
08/08/02	Excavator loading rock truck hauling material to berm along lower side of site; dozer and roller working on berm; Settling Pond 1; Diversion ditch, silt fence, and hay bales in place; Design plan for site has been received; DEP Inspection (T. Elicker)
08/14/02	Lower berm extended to west; dozer actively grading road; runoff from heavy rains collected by lower berm being pumped out; DEP Inspection (T. Elicker)
08/22/02	Site inspection
08/23/02	Dozer actively excavating ALD1; excavator and rock truck excavating for HFLB with material being trucked to south of ALD1; Diversion Ditch and lower berm in place; DEP Inspection (T. Elicker)
08/28/02	Confirmation by PA DEP that proposed dam meets permit waiver provision
09/04/02	Request for dam waiver submitted to US ACE for construction of small z-piling dam on Seaton Creek
09/05/02	HFLB excavated; geotextile and some limestone in place northeast end of HFLB; pipe in place below limestone; east end of ALD1 excavated; E&S control in place
09/06/02	Site tour with home school children; Governor's Award video shoot; reported in 10/02 "Catalyst"
09/11/02	Site inspection; ALD1 outlet pipe marked for drilling perforations; additional limestone trucked and spread into HFLB; some remains piled in HFLB; dozer and excavator excavating ALD1; pipe in place between ALD1 and Settling Pond 1; DEP Inspection (T. Elicker)
09/12/02	Approval granted by US ACE for construction of small steel z-piling dam
09/19/02	Poster featuring Erico Bridge site used at the 1st Annual Ohio River Watershed Celebration

	flowing through the system; final grading needed; mulch hay on site; site needs to be planted; DEP Inspection (T. Elicker)
06/30/03	Wetland plant harvesting
07/01/03	Wetland planting with BCJCS WORC program in PTS wetland
07/07/03	Wetland plant harvesting
07/08/03	Quarterly Reports submitted; Wetland planting with BCJCS WORC program in PTS wetland
07/09/03	Wetland planting
07/15/03	Wetland planting with BCJCS WORC program in PTS wetland
07/22/03	Wetland planting with BCJCS WORC program in PTS wetland; reported in 9/03 "Catalyst"
07/23/03	Site inspection and water monitoring; fish observed in Seaton Creek at Erico Bridge; wetland plant harvesting
07/24/03	Wetland planting preparations
07/25/03	Wetland planting preparations
07/26/03	Wetland planting and construction of blue bird boxes with Pittsburgh North Stake of the Church of Jesus Christ of Latter-day Saints; Reported in 9/03 "Catalyst"; Reported in Watershed TV on 9/9/03
07/28/03	Spillway repair
07/29/03	Wetland planting with BCJCS WORC program in PTS wetland
07/30/03	Site seeded and mulched; additional grading completed; recent heavy rains caused some erosion and a slump; wetlands being planted; fish observed in Seaton Creek at Erico Bridge; DEP Inspection (T. Elicker)
08/07/03	Grasses growing on site; fish observed in Seaton Creek at Erico Bridge; DEP Inspection (T. Elicker)
08/15/03	Wetland plant harvesting and planting
08/19/03	Installation of wetland monitoring points and wildlife enclosures
08/25/03	Upland planting
08/26/03	Wetland and upland plantings
09/03/03	Site tour with Marcia Haberman, US ACE, Elias J. Heferle, Knox DMO, and Rich Neville, PADEP
09/03/03	Wetland shrub planting
09/04/03	Site inspection
09/16/03	Trees being planted; fish observed in Seaton Creek at Erico Bridge; DEP Inspection (T. Elicker)
10/15/03	Quarterly Reports submitted
10/23/03	Dam maintenance
10/30/03	Site inspection and water monitoring; wetlands with good growth for just being established; good growth of grasses and legumes; trees planted on part of the site; fish observed in Seaton Creek at Erico Bridge; DEP Inspection (T. Elicker)
11/11/03	Construction of wood duck boxes by Cub Scout Pack 76; reported in 1/04 "Catalyst"
11/26/03	Site inspection
12/18/03	Three curtains installed in Settling Pond 1; DEP Inspection (T. Elicker);

01/14/04	Quarterly Reports submitted
03/13/04	Site tour with Grove City Cub Scout Pack 76; installation of wood duck boxes; reported in 4/04 "Catalyst"
03/20/04	Site tour with Grove City College Environmental Club; installation of kestrel boxes
03/23/04	Curtains placed in Settling Pond 1; DEP Inspection (T. Elicker);
03/25/04	Site inspection and water monitoring
03/29/04	Site inspection; field meeting and site review with Quality Aggregates
04/01/04	Quarterly Reports submitted
04/05/04	Grant extension request submitted by email to PA DEP Knox DMO
04/16/04	SRWC Symposium site tour; reported in 5/04 "Catalyst"
04/27/04	Construction of ALD3 and SP5
04/28/04	Field meeting to discuss remaining work; Construction of ALD3 and SP5
04/29/04	ALD3 under construction to treat ST63A; excavation lined with geotextile; limestone being placed; Settling Pond 5 under construction; DEP Inspection (T. Elicker)
04/30/04	Construction of ALD3
05/05/04	Hay bale barrier placed across end of Wetland 2; ALD3 nearly complete; limestone placed, covered with geotextile fabric, and partially covered with dirt; ST63A not turned in yet; Settling Pond 5 excavated; DEP Inspection (T. Elicker); Grant Extension Request submitted to PA DEP Knox DMO
05/06/04	Grant Extension Request approved by PA DEP Knox DMO
05/11/04	63A discharging into ALD3
05/13/04	ALD3 being completed; ST63A has been turned into ALD3; ALD3 discharging to Settling Pond 5 which discharges to Seaton Creek; additional material being trucked in to cover ALD3; brown dirt spread on unvegetated areas of wetland embankment; DEP Inspection (T. Elicker)
06/08/04	Site inspection and water monitoring; fish observed in Seaton Creek at Erico Bridge
06/16/04	ALD3 has been completed; areas of poor growth covered with dirt, seeded and mulched; slumps repaired, seeded, and mulched; hay bale rolled out into Wetland 2 to prevent channelized flow; curtain placed in Settling Pond 3; DEP Inspection (T. Elicker); Wetland Monitoring by Aquascape
06/25/04	Installed safety fence and planted around fence to discourage preferential flow paths and short-circuiting; Wetland Monitoring by Aquascape
07/12/04	Quarterly Reports submitted
07/20/04	Site inspection and water monitoring; fish observed in Seaton Creek
07/21/04	Supplemental plantings in Wetland 1
09/01/04	Site inspection and water monitoring
09/02/04	Field meeting with surveyor Jack Chamberlin
09/08/04	Site inspection after Hurricane Francis
09/20/04	Site inspection after Hurricane Ivan
11/05/04	DEP Inspection (T. Elicker)

PROJECT DESCRIPTION

Introduction

This restoration effort is holistic in approach and strives not only to improve the severely degraded abandoned drainage at the ~24-acre Erico Bridge site but also to expand and sustain the watershed stewardship effort. Along with the dramatic improvement of site drainage and enhancement of wildlife habitat, which have been of interest to many including national and international visitors, the community has also expressed an interest in the history of the site; thereby, continuing and expanding enthusiasm in the project locally. As all reclamation activities require maintenance and as additional efforts are necessary to further the restoration of the watershed, sustained support is imperative. As part of the team approach, Quality Aggregates Inc. has provided a five-year warranty on the site revegetation and structural integrity of the passive components.

All work completed at the site has been accomplished by partnering. To date, this is one of the largest passive treatment complexes in PA. A greatly expanded effort has been accomplished, without change orders requesting increased funding, due to the team support and contributions by our partners. Instead of the four passive components proposed, sixteen have been installed. Instead of the Scarlift (ca. 1970) estimate of 15,000 CY of coal refuse, ~40,000 CY were rehandled, a >60% increase. Monitoring prior to construction indicated that an average of ~320 gpm of mine drainage would be treated by the main system. Post-construction monitoring for more than a year indicates that the average flow has been ~500 gpm, a >33% increase.

Regional and Local Mining History

The early history of the region and of this site is defined by mining and the railroads that provided transportation for the coal and limestone produced. (For instance, a large portion of this site is currently owned by the B&LE Railroad and was formerly owned by Rodis Coal Co.) In northern Butler County in western Pennsylvania, coal mining has been conducted in the 27-square mile area of the Slippery Rock Creek headwaters for over 100 years. As early as 1855, Hugh McKee and Thomas White of Butler explored the “cannel” coal (probably correlative to the Middle Kittanning coalbed horizon) in Washington and Venango Townships and leased a large tract of land for mining.

Until railroads were built to transport the coal to market, mining was limited, however. The mining “boom” in the area started when the Mercer Mining & Manufacturing Company opened mines at Pardoe and Harrisville (~10 miles west of what is now known as Erico), Mercer and Butler County, respectively, and formed the Shenango & Allegheny Railroad for the purpose of transporting coal to Shenango, Branchton, and later to Butler. Locally, within the Slippery Rock Creek headwaters, the mining “boom” began around 1876 when the railroad was extended to Hilliards (~1½ miles south of Erico). The extensions in the area carried their own descriptive corporate names and after a series of reorganizations the railroad became known as the Pittsburgh, Shenango and Lake Erie (PS&LE).

By 1892, the railroad connected the coal reserves in the Slippery Rock Creek Watershed to the port of Conneaut, OH. At this same time, the first ore boat from the Missabe (aka Mesabi) iron range arrived, a pivotal event for the steel industry. Five years later, the railroad also connected the coal reserves in the Slippery Rock Creek Watershed to Pittsburgh. This was accomplished by an April 8, 1896, tri-party agreement between PS&LE, Union Railroad Company, and the Carnegie Steel Company which formed the Butler and Pittsburgh Railroad Company (B&P) with the railroad constructed to Pittsburgh in <1 year including a bridge across the Allegheny River. (This bridge can still be seen today paralleling the Pennsylvania Turnpike Bridge near the New Kensington exit at Harmarville.)

In 1897, PS&LE and B&P were consolidated into the Pittsburgh, Bessemer & Lake Erie. Four years later, Andrew Carnegie formed the Bessemer and Lake Erie Railroad under exclusive ownership and arranged to lease the PS&LE for 999 years. This arrangement remained until the formation of U. S. Steel in 1901, which bought out Carnegie interests.

With the Industrial Revolution, mining changed from providing coal for household use to supplying coal for railroads and steel mills. To move the coal to market, the B&LE extended a six-mile spur from the main line in the Slippery Rock Creek headwaters. Mining towns (like Erico and nearby Goff Station) sprang up all along the railroad. Although the coal produced in the area could be shipped to Pittsburgh, the coal mined along the B&LE was said to be of superior quality for steam purposes and the entire production from the mines in Butler County were reportedly shipped north for distribution along the Great Lakes. A portion of a map depicting the Pittsburgh and Lake Erie Railroad and affiliated railroad lines can be seen in Figure 1. The map shows the B&LE from Conneaut, OH along Lake Erie to the Union Railroad near North Bessemer, PA.

By 1908, there were twenty-five coal companies operating in Butler County employing about 2,000 men. The total production for 1907 was about 865,000 tons. That equates to over 2000 lbs of coal produced per day per man. The Butler District is said to have been relatively free from strikes, labor troubles, and mine disasters that many other mining districts encountered.

Slippery Rock Creek Watershed Restoration Effort

Many of the mining towns which were once bustling communities are now essentially abandoned, leaving only polluted streams, coal refuse, spoil, and highwalls. The residents that stayed called Slippery Rock Creek, "Sulfur Creek", due to the effects of mine drainage. In the early 1970s, during the Commonwealth's Operation Scarlift, many of the underground mine entries in the headwaters were sealed to address "the most severe condition of coal mine drainage… Indeed, very little drainage from this region is produced exclusive of contact with, or issuance from mine workings." (About 4,000 acres are underlain by mine workings and 8,000 acres were included in surface mine permits.) Furthermore, within the 410 square miles of the Slippery Rock Creek Watershed, streambed sediments in the headwaters have the highest heavy metal concentrations.

In December 1994, individuals representing private industry, schools, government agencies, service groups, and others that lived and/or worked in the area formed the all volunteer Slippery Rock Watershed Coalition. This Public-Private Partnership team effort has combined talents and resources while utilizing individual strengths and experiences to provide multiple sources of ideas, skills, education, and knowledge that has

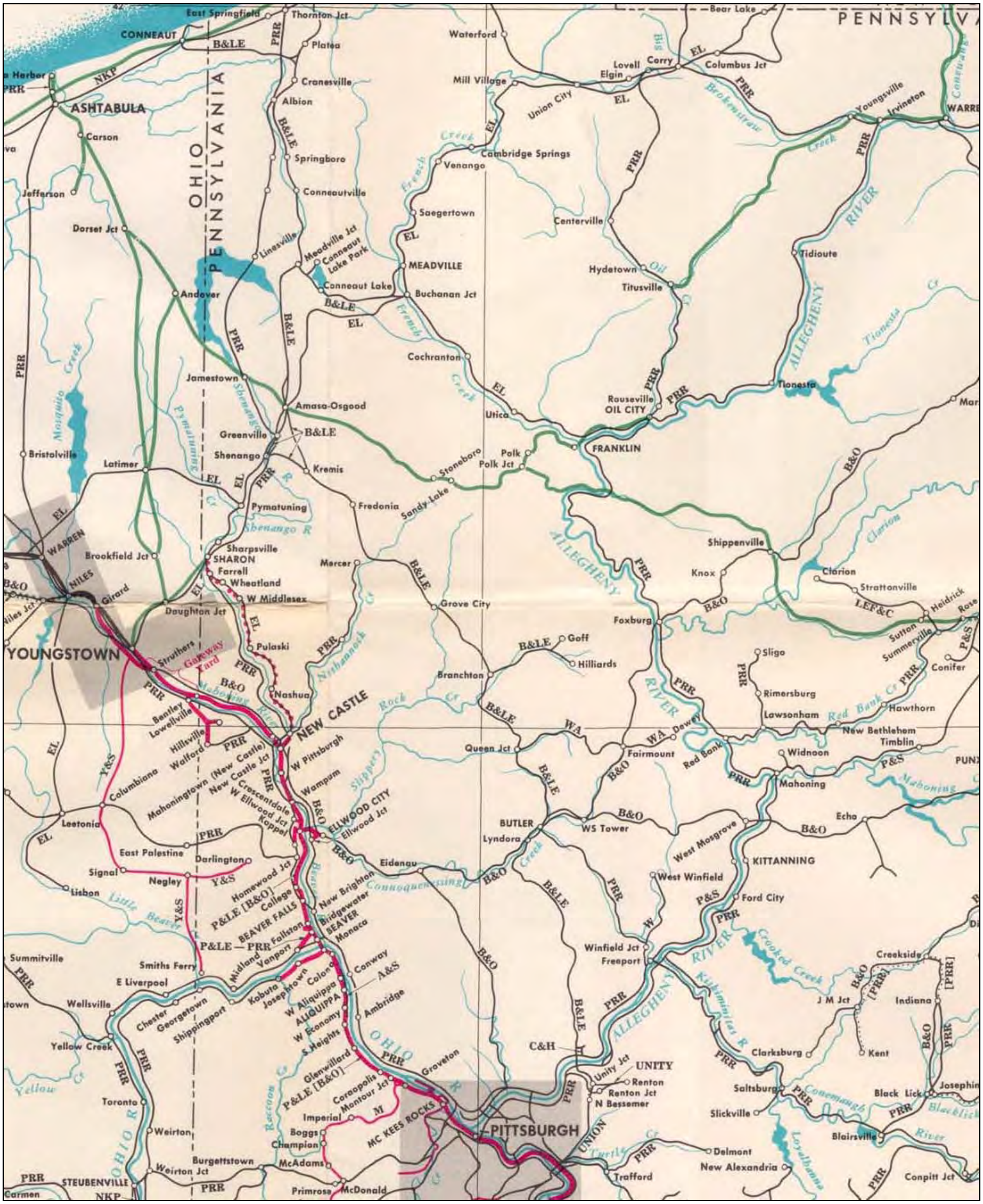


Figure 1: A portion of map (Circa 1960) showing Pittsburgh and Lake Erie Railroad and other affiliated companies. The B&LE line begins at Conneaut, OH on Lake Erie and runs south to North Bessemer located just east of Pittsburgh.

resulted in the development of innovations to creatively solve problems in an economic, effective and efficient manner.

Participants in the Slippery Rock Watershed Coalition have been working to restore the headwaters and have successfully completed sixteen passive systems that treat ~750 million gallons annually of abandoned mine drainage. As reported in the PA DEP, Knox District Mining Office (10/01) Slippery Rock Creek Progress Report: 2001, these systems have been about 100% effective in neutralizing acidity and 60 to 100% effective in reducing metal loadings. Also reported is the significant improvement of 11 miles of stream.

Completed Seaton Creek Restoration Projects

According to the CMRS, Seaton Creek was the most heavily impacted tributary to Slippery Rock Creek contributing 42% of the acid load and 49% and 41% of the iron and aluminum loadings, respectively. Much of the reclamation efforts of the Slippery Rock Watershed Coalition have focused on this subwatershed. In all projects, education and outreach have been stressed.

<u>De Sale Restoration Area:</u> About 100 acres severely impacted by pre-act surface coal mining (including coal refuse disposal) activities on the Middle Kittanning coalbed (Kittanning Fm.; Allegheny Gp.) surrounded two unnamed tributaries, which form the northeastern uppermost reaches of Seaton Creek. The easterly, unnamed tributary is substantially improved by a passive treatment system (online 5/26/00) at De Sale Phase I. This system was funded through the Commonwealth's "Reclaim PA" initiative and matching/in-kind contributions. (Refer to De Sale Phase I Final Report, 07/2000.) The westerly, unnamed tributary is improved by a passive treatment system (online 9/28/00) at De Sale Phase II. Funding for De Sale II was received through the PA DEP "Growing Greener" initiative and again through substantial participant contributions. De Sale II treats, except during high flow events, the entire westerly watercourse, whose contributory drainage area is dominated by degraded seeps. (Refer to De Sale Phase II Final Report, 06/2002.) A surface coal mine operation (MDP #10800122) on the Middle Kittanning coalbed was previously conducted by the former Pengrove (Adobe) Coal Co. that resulted in degraded post-mining discharges. During mining, the drainage was actively treated with ~20 (50-lb) bags of soda ash briquettes per day. Funding from PA DEP "Growing Greener", Butler County Commissioners, Western PA Watershed Program, and other participant in-kind services and donations was utilized to complete the De Sale Phase III passive systems. (Refer to De Sale Phase III Final Report, 06/2004.)

<u>Goff Station Restoration Area:</u> This restoration effort which also included installation of a passive treatment complex, rehandling and placement of abandoned coal refuse, riparian area restoration, and creation of unique wildlife habitat was online by 8/21/01. At this site, ~83,000 lbs/yr acidity is being neutralized and ~13,200 lbs/yr metals are being retained within the passive system. (Refer to Goff Station Restoration Area Final Report, 11/2001.)

<u>Abel/Dreshman Reclamation Area:</u> About 55 acres of abandoned mine lands were reclaimed by incorporating about 140,000 tons of alkaline coal ash in the backfill during reclamation of open pits and spoil piles. Acidity as well as the iron, manganese, and aluminum content of the site drainage were substantially decreased. [Refer to J. Schueck,

J. Tarantino, T. Kania, B. Scheetz (undated) The Use of FBC Ash for Alkaline Addition at Surface Coal Mines, (available at the PA DEP Knox DMO).]

Erico Bridge Site History and Characterization

The Erico Bridge Restoration Project reportedly revolves around the Keystone Mine #3 operated by the Erie Coal Mining Company, on the Brookville coalbed. A B&LE railroad spur called the Goff-Kirby branch was extended to the Goff Station (Deegan) area. Another spur called the Seaton Creek Branch extended from the Goff-Kirby spur to the now nonexistent "ghost" mining company town of Erico (**Eri**e **Co**al Mining Company). Photos of the town and tipple can be seen in the photo section of this report.

During Operation Scarlift, reclamation activities were completed in the watershed including mine seal installations and land reclamation. The Erico Bridge site was identified during this time as Project Area No. 13, which is also referred to as the Keystone Area and was assigned a #1 priority rating for restoration. Discharge ST63 (See Table I below.) emanated from the Keystone #3 mine. The report generated proposed installing hydraulic seals for mine entries and the reclamation of an estimated 15,000 cubic-yard refuse pile. According to the previously noted, PADEP CMRS for Slippery Rock Creek, 3 deep mine seals with grout curtains were installed.

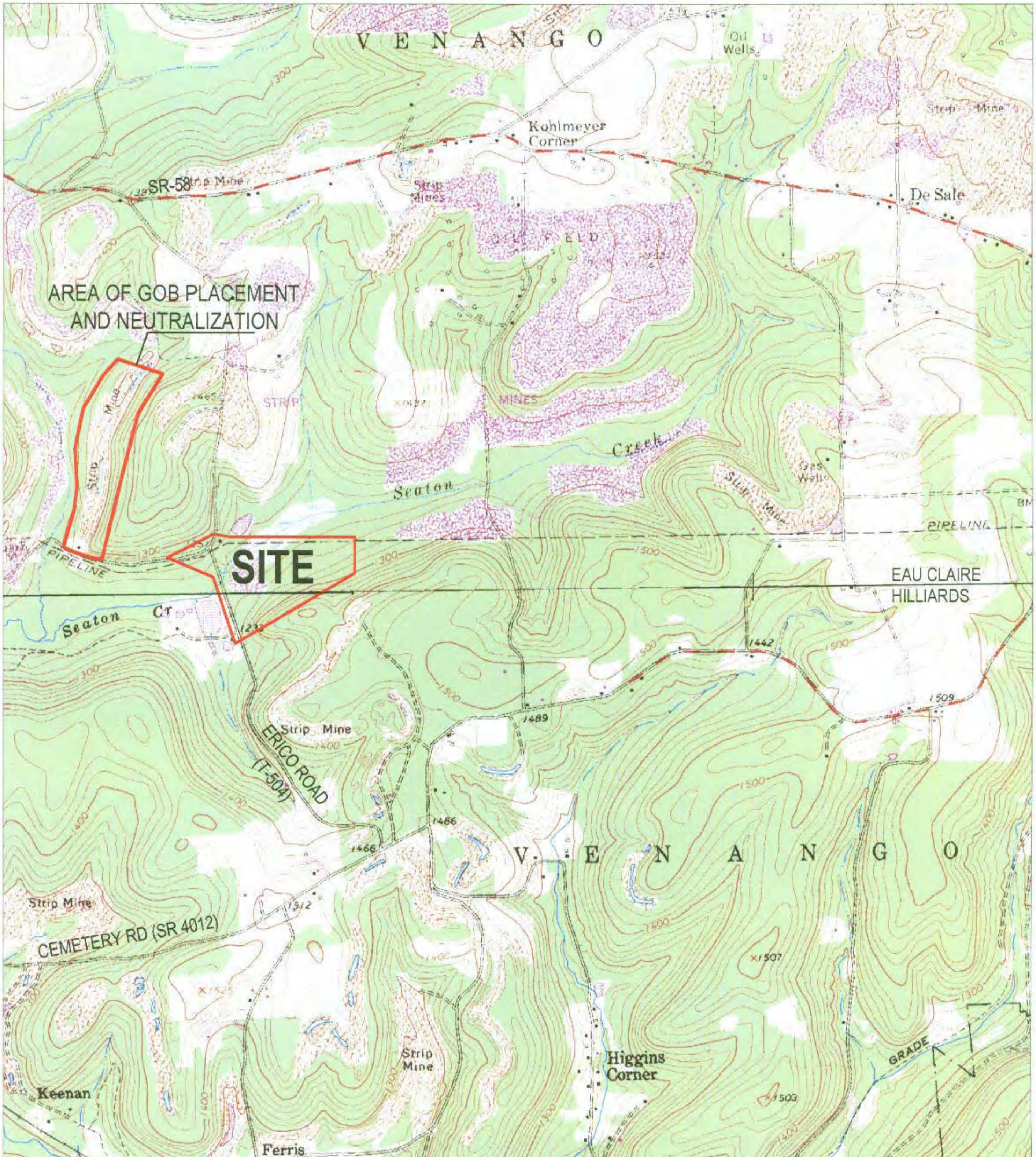
Table I. Drainage Characteristics: Pre-Installation of Mine Seals

Point	Flow	pH	Alk	Acd	Fe	Sulfates
ST63	243	3.8	1	197	22	522

Flow rates in gpm; concentrations in mg/L; total iron concentration; n = 12;

After some time, the drainage found alternative pathways to the surface in the form of 5 discharges ST63A, ST63B, ST63C, ST63D, and ST63E. Based on the 1998 CMRS, Erico Bridge was one of the areas (Priority Area 6) most heavily impacted by abandoned mines within the headwaters. Seaton Creek (PA DEP Stream Code# 34751; Segment ID #4571), the receiving stream for this area, was assigned a high priority for restoration due to abandoned mine impacts [1998 PA DEP 303(d) list].

According to the CMRS, these five discharges (See Table II below for pre-construction discharge characteristics.) are responsible for more than 1/2 (56%) of the acid load, 84% of the iron load, and 5% of the aluminum load in Seaton Creek. These discharges are also responsible for almost 1/4 (24%) of the acid load and 41% of the iron load for the entire 27-sq. mile Slippery Rock Creek headwaters. The significant accumulation of iron precipitates not only severely impacted aquatic life (essentially eliminating both the fish and the macroinvertebrate community) but also was a major contributor to the severe sedimentation problem, causing flooding concerns to community residents downstream. In addition, 40,000 cubic yards of abandoned coal refuse existed at the site, which contributed acidity, metals, and sediment to Seaton Creek.



PROJECT LOCATION - USGS 7.5' EAU CLAIRE, PA (PI1977) AND USGS 7.5' HILLIARDS, PA (PR1979)

ERICO BRIDGE RESTORATION AREA

Approximate Center of Project (deg-min-sec)
41-07-31 latitude 79-51-38 longitude

2000 1000 0 2000

Slippery Rock Watershed Coalition
Venango Township, Butler County, PA
Stream Restoration Incorporated
December 2004, Scale 1" = 2000'

BioMost, Inc.
Cranberry Twp. PA 61 As-Builts/Loc

Table II. Drainage Characteristics: Post-Mine Seals/Pre-Passive System Installation

Point	Flow	pH	Alk	Acd	Fe	Mn	Al	Sulfates
ST63A	12	5.7	70	178	80	21	<1	1005
ST63B	30	5.9	75	142	65	22	<1	810
ST63C	60	6.0	88	186	87	33	<1	1094
ST63D	10	5.0	12	33	6	10	<1	581
ST63E	210	5.7	36	144	56	34	<1	998

Abandoned mine discharges; average values; flow rate in gallons per minute; lab pH in standard units (s.u.); average pH not calculated from H-ion concentrations; alkalinity and acidity in mg/L $CaCO_3$; iron, manganese, and aluminum total metal concentrations in mg/L; sulfates in mg/L;

Wetlands within the Erico Bridge Restoration Area received hydrologic contributions from multiple abandoned mine discharges (ST63A-1, ST63B, ST63C, ST63D-1, ST63D-3, ST63E-1, ST63E-2, ST63G, and other seepage). A significant accumulation of iron precipitates from AMD was common throughout the wetlands. Analytical results of water samples collected from the impacted wetlands during the environmental assessment (August 2001) of the project area are provided in the following table:

Table III. Pre-Restoration Analytical Data from Erico Bridge Wetland Area

Point	pH	Alk	Acd	Fe	Mn	Sulfates
P2 (standing water)	3.1	N.D.	124	17	21	919
P3 (pit sample)	3.3	N.D.	216	85	43	1514

N.D. – Not Detectable; lab pH in standard units (s.u.); average pH not calculated from H-ion concentrations; alkalinity and acidity in mg/L of $CaCO_3$; iron and manganese total metal concentrations in mg/L; sulfates in mg/L;

Upland portions of the Erico Bridge Restoration Area were also characterized during the environmental assessment. The uplands bordering the wetlands were primarily old field growth, wooded areas, and coal refuse piles. Existing vegetation within the old field growth areas included deertongue and unidentified grasses, sedges, ferns, mayapple, goldenrod, and daisies. Vegetation within wooded areas included hickory, ironwood, hornbeam, cherry, shingle oak, pine, and club moss. Gob piles were sparsely vegetated with blackberries, shingle oak, red maple, and pine.

In addition, as part of the site characterization, 17 temporary piezometers were installed (22 boreholes) with limited monitoring conducted to gain a better understanding of the hydrology and water quality of the mine pool and zone underlying the glaciofluvial clay material replacing and downgradient of the Brookville coalbed (subcrop) in the proposed construction area in order to effectively design the passive treatment system. [Two monitoring wells remaining from the Scarlift effort (ca. 1970) were also sampled.]

Site Location

The project is located in Venango Township, Butler County east of Erico Road (T-504) along both banks of Seaton Creek on B&LE Railroad, Tiche, and Flick properties. The site is located on the 7½‘ USGS Eau Claire (PI1977) and Hilliards (PR1979) topographic maps with the approximate project center at latitude 41° 07’ 31” and longitude 79° 51’ 38”. (Refer to Location Map.)

Site Preparation

Erosion and Sediment Pollution Controls were installed upon completion of a written plan, approved by the Butler Co. Conservation District. Controls included a diversion ditch upgradient and silt fence downgradient of the earth disturbance activities. Requirements for a water obstruction and encroachment permit were waived under PA Code Title 25, Chapter 105.12(a)(16). Quality Aggregates Inc. addressed the road bond and highway occupancy permit requirements. Passive system design plans were completed by BioMost, Inc. and WOPEC and submitted to the PA DEP, Knox District Mining Office. For underground utility locations, PA One Call was contacted and the onsite gas line was identified in the field. The area to be affected was cleared and grubbed. The following is a list of permits/approvals/notifications that were required for site restoration:

Application/Notification	Agency	ID# (Date Approved/Satisfied)
Act 14, 67-68 Notification	Butler Co. Comm. Venango Twp. Supervisors	(submitted 08/01/01)
PA Natural Diversity Index	DEP-NW Region US Fish & Wildlife Service	Search N82587 (08/09/01)
Cultural Resource Notice	PA Historical & Museum Comm.	File ER 01-3605-019-A (08/22/01)
Species Impact Review	PA Fish & Boat Comm.	Search N82587 (08/29/01)
Environmental Assessment	DEP-NW Region	Waiver EA 10-017NW (09/18/01)
General Information Form	DEP-NW Region Butler Co. Cons. Dist.	(submitted 10/25/01)
Underground Utilities	PA One Call	2952154 (requested 10/25/01)
NPDES (gob: $100 fee)	Butler Co. Cons. Dist.	PAR10E173 (11/27/01)
E & S (gob: $100 fee)	Butler Co. Cons. Dist.	PAR10E173 (11/27/01)
GP-8 App. Temp. Rd. Access	Butler Co. Cons. Dist.	081002601 (01/16/02)
NPDES (PTS: $150 fee)	Butler Co. Cons. Dist.	PAR10E173 addendum (06/25/02)
E & S (PTS: $200 fee)	Butler Co. Cons. Dist.	PAR10E173 addendum (06/25/02)
Dept. of Army Permit ($100 fee)	US Army Corps of Engineers	200101665 (02/13/02)

With Venango Township Supervisors approval, one permanent and three temporary access roads were built to intersect public “dirt-and-gravel” roadways. Access #1 eliminated the sharp turn at Goff Road (T-649) and Erico Road (T-504) to transport gob from the Erico Bridge Restoration Area to the Tiche Abandoned Mine Reclamation Area for neutralization and placement. Access #2, located north of Seaton Creek, enabled construction of E&S Controls, Flick gob pile removal, construction of a wetland, and upland plantings. Access #3 enabled installation of E&S Controls, clearing and grubbing, other site preparation, L-Shaped gob pile removal, construction of the innovative water level control structure across Seaton Creek, etc. Access #4 (permanent) was used throughout construction of the passive complex, for education and outreach activities, etc.

Coal Refuse Removal

A portion of the estimated 40,000 cubic yards of abandoned coal refuse (aka gob piles) formed both banks of Seaton Creek. The piles created “narrows” that in conjunction with a beaver dam retarded the stream flow, developing degraded wetlands upstream of the bridge for Erico Road. The coal refuse piles were largely unvegetated, and erosion features were readily apparent.

Acid-base accounting analyses, tests typically conducted to characterize overburden for modern mining activities, were completed for samples obtained from the gob piles. The low pH of the coal refuse samples, as well as total sulfur levels above 0.5%, indicated that the material was potentially acid producing. The results of those analyses are provided in Table IV below.

Table IV. Acid-Base Accounting for Abandoned Coal Refuse

Sample	**Paste pH**	**Total % Sulfur** (+/- 0.01%)	**Max. Potential Acidity** (From % Sulfur)	**Neutralization Potential** (By Titration)
P1: "T-bone" gob pile				
1-foot	3.90	0.32	10.00	-2.16
2-feet	3.00	0.43	13.44	-2.58
3-feet	2.80	0.64	20.00	-5.19
4-feet	2.80	0.55	17.19	-3.59
P2: "L-shaped" gob pile (Top, gray gob)				
Surface	3.40	0.48	15.00	-3.02
1-foot	3.10	1.37	42.81	-4.05
2-feet	3.00	0.48	15.00	-4.67
3-feet	3.10	1.15	35.94	-2.79
4-feet	3.00	1.32	41.25	-2.74
P3: "L-shaped" gob pile (Base, near wetland)				
Surface	4.00	1.26	39.98	-2.58
1-foot	4.20	1.20	37.50	-1.52
2-feet	3.90	0.93	29.53	-1.93
3-feet	3.60	0.74	23.13	-2.60
P4: "L-shaped" gob pile (Top, orange red-dog)				
Surface	4.20	1.06	33.13	-1.85
1-foot	4.20	1.02	31.88	-1.93
2-feet	4.30	0.44	13.75	-1.21
3-feet	4.00	0.92	28.75	-2.29
4-feet	3.70	1.18	36.88	-2.50

The coal refuse was excavated, transported <1 mile, mixed with circulating fluidized alkaline coal ash from Scrubgrass Generating Plant, and then placed within an abandoned open cut on the Brookville coalbed east of Murrin Run effectively reclaiming two abandoned coal minesites at once. The reclamation of the old cut, known as the Tiche Abandoned Mine Reclamation Project, was conducted under a 9/29/99 Consent Order and Agreement between the PA DEP and Quality Aggregates Inc. and had previously been used for placement of coal refuse from the Goff Station Restoration Area. Reclamation of the abandoned cut was completed at no additional cost to the Commonwealth.

<u>Creation of Wetlands and Riparian Area Restoration</u>

Coal refuse removal from the banks of Seaton Creek allowed for the restoration of the riparian area and the creation of two wetlands adjacent to the existing degraded wetland area. The created wetlands, known as the Flick and L-Shaped Wetlands, were constructed within the footprint of the gob piles and comprehensive plantings provided wildlife habitat to conform with and enhance the existing wetlands along Seaton Creek.

During construction of the wetlands within the footprint of removed gob piles, elevations were monitored by laser level. The gob piles were excavated ~0.5 feet below pre-project water levels for the wetland complex adjacent to Seaton Creek. This was followed by the placement of a soil/mushroom compost/alkaline pond fines mixture, which was configured to provide microrelief within the relatively level basin. The wetlands were designed and constructed similar to treatment wetlands, with certain features (e.g. restricted outlet, low gradient basins, high vegetative densities, large proportion of woody species, high degree of microrelief, and large-sized woody debris) utilized to promote a high functional capability for water quality modification and abundance and diversity of flora and fauna.

Designs and wetland plantings in the areas of the Flick and L-shaped gob piles were performed by personnel now of Aquascape Wetland & Environmental Services and Beran Environmental Services, primarily in the spring and summer of 2002. Through the Butler County Juvenile Court Working Opportunities to Repay the Community Program, at-risk youth participated in several plantings within the L-shaped wetland. While the Slippery Rock University Chapter of Americorps assisted in the wetland planting on the Flick property. Together the wetlands in the former gob pile areas support over 50 plant species that provide both structural and species diversity adjacent to Seaton Creek. Monitoring the L-shaped and Flick wetlands has illustrated the habitat improvements accomplished from the removal of coal refuse. Refer to included Wetland Monitoring Report and Measurable Environmental Results for additional information on the Gob Pile Removal Wetlands.

Passive Treatment System Installation

The passive treatment system complex at the ~24-acre Erico Bridge Restoration Area consists of 16 components, some of which are shared by two of the three passive systems treating >5 abandoned mine discharges (ST63A-1, ST63B, ST63C, ST63D-1, ST63D-3, ST63E-1, ST63E-2, ST63G), as well as additional small, unnamed seeps. The passive treatment complex consists of the following sixteen components **(See "As-Builts" and photo section.)**:

1. Anoxic Collection System 1 **(ACS1)**
2. Anoxic Limestone Drain 1 **(ALD1)**
3. Settling Pond 1 **(SP1)**
4. Settling Pond 2 **(SP2)**
5. Wetland 1 **(WL1)**
6. Settling Pond 3 **(SP3)**
7. Plunge Pond 1 **(PP1)**
8. Anoxic Collection System 2 **(ACS2)**
9. Anoxic Limestone Drain 2 **(ALD2)**
10. Settling Pond 4 **(SP4)**
11. Wetland 2 **(WL2)**
12. Plunge Pond 2 **(PP2)**
13. Horizontal Flow Limestone Bed **(HFLB)**
14. Anoxic Collection System 3 **(ACS3)**
15. Anoxic Limestone Drain 3 **(ALD3)**
16. Settling Pond 5 **(SP5)**

Quality Aggregates Inc., Boyers Quarry (Boyers, PA) was the source of the high-calcium (90% $CaCO_3$), marine, Vanport limestone (Clarion Fm.; Allegheny Gp.) aggregate used at the site for channel stabilization and for the treatment medium in the Anoxic Limestone Drains, and Horizontal Flow Limestone Bed.

Anoxic Collection System 1 **(ACS1)**: The major discharge (ST63E-1) from the abandoned underground mine was flowing under confined conditions. Based on a geologic interpretation of site and exploratory drilling and piezometer data, ST63E-1 probably represented a "conduit" (possibly an old, "pressure relief" boring, enlarged over time) from the surface to the mine workings. ACS1 consists of a collection system with perforated laterals, bedded and overlain by PA DOT #3B river gravel. A 12", solid, SDR35 PVC header with anti-seep collar conveys the intercepted mine drainage to ALD1. The ALD1 bypass is 8", solid, SDR35 piping with anti-seep collar and 8" gate valve, which allows for future maintenance or system upgrades.

Anoxic Limestone Drain 1 **(ALD1)**: The primary purpose of the ALD is to generate alkalinity. Proton acidity is neutralized in the raw water with the excess alkalinity consuming the acidity generated by the formation of metal solids upon aeration within the settling ponds and aerobic wetlands. Geotextile is installed to completely "envelope" the ALD1. The 12", solid, SDR35 PVC inlet header with perforated manifold is along the inlet end on a 0.5' thick pad of PA DOT #2B river gravel and bedded within 1' to 2' of PA DOT #3 river gravel. Limestone aggregate (8308 tons, AASHTO #1, high calcium, 90% $CaCO_3$, Vanport limestone) is placed in the excavation (340' x 110') to a thickness of 5 feet. A manifold is also along the outlet end of ALD1. The 12", custom perforated, SDR35 PVC outlet manifold is on a 0.5' thick pad of PA DOT #2B river gravel, which is underlain by geotextile, covering an earthen ledge of in-place material (height: 2'). The piping is covered by ~1½' of AASHTO #1 limestone aggregate. A 12", solid, SDR35 PVC header with anti-seep collar is extended from the outlet manifold to convey the effluent to SP1. An upturned, 45^o elbow is installed near the outlet end.

Settling Pond 1 **(SP1)**: ALD1 discharges into SP1 the 29,950-SF (at water level) SP1 to encourage oxidation, settling, and storage of metal solids during normal operation of the system. Riprap is placed around the influent pipe to encourage "splashing" for aeration and berm protection. Increasing the dissolved oxygen content encourages iron oxidation and the formation of iron particulates. (About 1 mg/L of dissolved oxygen is needed to oxidize 7 mg/L of dissolved ferrous iron. With a groundwater temperature of ~10^oC, the maximum dissolved oxygen content is ~10 mg/L.) Three directional baffle curtains were installed to maximize retention time and discourage short-circuiting (depth of water: ~3'). As additional aeration is needed due to the high (up to $>100^+$ mg/L) dissolved iron content in the mine drainage, the outlet spillway was constructed utilizing z-piling and riprap (NCSA R-4 limestone) to oxygenate the effluent and convey the flow to Settling Pond 2.

Settling Pond 2 **(SP2)**: SP2 receives flow from SP1 via the z-piling and riprap spillway. SP2 is a long narrow settling pond 26,730 SF in size at water level and has a water depth of ~3'. SP2 provides for additional oxidation, settling, and storage of metal solids for the ALD1 treated flow. During upgrades or maintenance to ALD1 or SP1, SP2 is also designed to receive the raw water from the ALD1 bypass. The SP2 effluent is influent to Wetland 1.

<u>Wetland 1</u> **(WL1)**: The 9,110-SF WL1 receives flow from SP2 via a riprap (NCSA R-4 limestone) spillway and discharges into Settling Pond 3. A mixture of soil material/spent mushroom compost/alkaline pond fines is used for the substrate. In addition to encouraging further settling of iron solids from treated ST63E-1 drainage, WL1 is configured to intercept untreated, degraded discharges ST63E-2, ST63D-1, and ST63D-3. Any remaining alkalinity generated by ALD1 assists in the treatment of these discharges. The effluent from WL1 is the influent to Settling Pond 3. (See wetlands function at end of section.)

<u>Settling Pond 3</u> **(SP3)**: SP3 receives flow from WL1 via a riprap (NCSA R-4 limestone) spillway. With a water depth of ~3', SP3 is approximately 8,600 SF in size at the water level. SP3 continues the oxidation and settling of iron solids. A directional baffle curtain increases retention time and discourages short-circuiting. A long, steep, riprap spillway lined with NCSA R-4 limestone and oversize onsite durable rock aerates and conveys the effluent from SP3 to Wetland 2.

<u>Plunge Pond 1</u> **(PP1)**: With a water depth of ~3 feet, PP1 is a small structure used to settle solids and to dissipate the energy of the flow from the steep riprap spillway from SP3. The flow from PP1 is conveyed through an earthen level spreader (~30'W x ~6'L) to Wetland 2.

<u>Wetland 2</u> **(WL2)**: At 101,535 SF (~2½ acres), WL2 is the largest of the treatment wetlands at the site. WL2 is specifically designed not only to provide treatment but also to provide exceptional-value wildlife habitat with high plant species diversity. A mixture of alkaline pond fines and soil material with a small amount of spent mushroom compost is used for the substrate. This is a component shared by treated flows from ALD1, ALD2, and untreated seepage encountered in preceding ponds and wetlands. Several seeps also emanate along the southern cut bank that are directed by a small earthen berm to the upper end of WL2. Hay/straw bales (selected areas) and silt fence (near PP2) are used as directional barriers and as filters for particulates. An earthen level spreader conveys the WL2 effluent to Plunge Pond 2. (See discussion of wetlands function at end of section.)

<u>Anoxic Collection System 2</u> **(ACS2)**: Discharges ST63B and ST63C issued from existing pipes of unknown origin. An aggregate-filled ditch with collection piping intercepts these discharges and other seepage. A 10", perforated, SDR35 PVC pipe (length ~350') is placed on ~0.5' of PA DOT #3B river gravel and is covered with ~4' of the same material. The piping is connected to the individual discharge pipes of ST63B and ST63C with a Fernco. The collection system (aggregate and piping) is wrapped in geotextile. All pipe fittings are pressure rated.

<u>Anoxic Limestone Drain 2</u> **(ALD2)**: ACS2 discharges into ALD2. Geotextile is installed to completely "envelope" ALD2. The inlet manifold (10", perforated, SDR35 PVC pipe) is extended along the eastern end of ALD2, being placed on 0.5' of PA DOT #2B river gravel and bedded within 1' to 2' of PA DOT #3 river gravel. Limestone aggregate (3,304 tons, AASHTO #1, high calcium, 90% $CaCO_3$, Vanport limestone) is placed to a thickness of 5 feet. The collection manifold along the westerly end of ALD2 is 10", custom perforated, SDR35 PVC piping on 0.5' of PA DOT #2B river gravel, which is underlain by geotextile,

covering an earthen ledge of in-place material (height: 2'). A 10", solid, SDR35 PVC header with anti-seep collar is extended from the manifold to convey the effluent to SP4. An upturned, 45^o elbow is installed near the outlet end.

Settling Pond 4 **(SP4)**: ALD2 discharges into the 12,900-SF (at water level) SP4. The pond provides for oxidation, settling, and storage of metal solids during normal operation of the system. Rocks are placed around the effluent pipe from ALD2 to encourage "splashing" to increase dissolved oxygen content. A broad, rock-lined, level spreader is used to convey the flow to WL2. WL2 is a component shared by flows from both ALD1 and ALD2. WL2 flows into Plunge Pond 2.

Plunge Pond 2 **(PP2)**: A broad, earthen, level spreader is used to convey the flow from WL2 to PP2. With a water depth of ~2 feet, PP2 is a small structure used to settle metal solids and debris from WL2. Because the water depth is greater than in WL2, this feature also discourages the migration of wetland plants to the Horizontal Flow Limestone Bed. The flow from PP2 is conveyed through a via a broad, earthen level spreader to the Horizontal Flow Limestone Bed.

Horizontal Flow Limestone Bed (HFLB): As much of the alkalinity generated by ALD1 and ALD2 is consumed during precipitation of metals, the primary function of the Horizontal Flow Limestone Bed (8,999 tons, AASHTO #1, high calcium, 90% $CaCO_3$, Vanport limestone) is to provide an alkalinity "boost" before discharging to Seaton Creek. A secondary function, which has received national interest, is the ability of the HFLB to remove manganese. Removing dissolved manganese by active chemical treatment is traditionally problematic due to the high pH requirement. With this component, however, high pH does not appear to be needed, probably due to several factors including establishment of substrate, low concentrations of dissolved iron, availability of dissolved oxygen, bacteriological activity, and other factors. Water is encouraged to flow horizontally through the limestone aggregate (~6' in thickness) to a 15", perforated, SDR35 outlet manifold along the opposite end near the base of the component. The manifold is on a 0.5' pad of AASHTO #57. Geotextile lines the bottom and sides of the HFLB. A 15", solid, SDR35 header with anti-seep collar followed by a 45^o elbow conveys the flow intercepted by the outlet manifold to discharge. The outlet riser extends to an elevation that is within ~1' of the top of the limestone, the design water level. The HFLB is one of two final effluent discharge points of the passive treatment complex and is the primary discharge point for the majority (>95%) of the flow. The final effluent flows directly to a formerly degraded wetland complex of Seaton Creek.

Anoxic Collection System 3 **(ACS3)**: The PA DEP, Knox District Mining Office, discovered and monitored ST63A-1, issuing along a public road (T-504). Through partnering with the Venango Twp. Supervisors, the discharge area was excavated. During excavation, a compromised, 8", terracotta, pipe was encountered that appears to have formerly conveyed the raw mine drainage directly to Seaton Creek. ACS3 consists of plumbing onto the existing pipe with a Fernco and installing an 8", solid, SDR35 PVC header ~23' in length. ACS3 discharges to ALD3.

Anoxic Limestone Drain 3 **(ALD3)**: The ACS3 header is connected to the inlet manifold for ALD3. Perforated 8" SDR35 PVC manifolds are along the inlet and outlet ends of ALD3 and are underlain by a ~0.5' thick pad of PA DOT #3 river gravel (inlet) and PA DOT #2B limestone (outlet). The entire ALD3, containing 413 tons, 90% $CaCO_3$, AASHTO #1, Vanport limestone, is "wrapped" in geotextile. From the outlet manifold is an 8", solid, SDR35 PVC header to convey the ALD3 effluent to Settling Pond 5. An anti-seep collar is installed with an upturned, 45^o elbow near the outlet end.

Settling Pond 5 **(SP5)**: ALD3 discharges into SP5. The 3,120-SF (at water level) SP5 is for oxidation, settling, and storage of metal solids during normal operation of the system. Due to the proximity of Seaton Creek, space was not available for a treatment wetland. SP5 is one of two final effluent points of the passive treatment complex and is a minor discharge point making up <5% of the flow treated at the site. The final effluent flows directly into existing degraded wetlands along Seaton Creek.

General Description of Treatment Wetlands

Wetlands have the ability to remove suspended and dissolved solids from water by converting this matter into gas, filtering solids, or by incorporating the solids into the biomass. There are several ways in which this may occur, including absorption and adsorption by soil particles, uptake by vegetation, and loss into the atmosphere. Recycling of these elements between soil, water, vegetation, and the atmosphere occurs by means of uptake during plant growth, release through decomposition, and exchange with the atmosphere and water.

The wetlands design was based on current accepted principles, new technology, and personal experience that identify features to provide a variety of desirable functions. Wetlands that provide a high degree of function in specific categories have certain measurable features that contribute to the ability to perform these functions.

The targeted functions for the constructed wetlands at Erico Bridge are:

1. to improve water quality,
2. to contribute to the abundance and diversity of wetland vegetation, and
3. to contribute to the abundance and diversity of wetland fauna.

Although the abundance and diversity of wetland vegetation and fauna may be limited within the passive treatment wetlands due to water quality, it is believed that these wetlands can provide substantial habitat opportunities in addition to treatment functions.

General considerations that effect functions include wetland size, plant community structure and composition, vegetation density, and flow characteristics. The following features influence the level of function of a particular wetland:

-**Restricted Outlet/Flow**
-**Dominant Vegetation Type**
-**Cover Distribution**
-**Microrelief of Wetland Surface**
-**Dead Woody Material**

Restricted Outlet/Flow retains drainage, facilitating interaction with wetland plants and soil. Similarly, low gradient wetlands allow water to reside and interact with soils and vegetation. Treatment Wetlands WL1 and WL2 were constructed with restricted outlets and low gradient basins. Modifications have been made to WL2 to provide greater retention times, allowing flows to have greater interaction with soils and vegetation. In addition, wetlands with stable and predictable hydrology can generally be expected to provide higher water quality function. The persistent flow characteristics associated with the AMD discharges will provide very stable hydrology to the treatment wetlands.

Wetlands with higher vegetative densities and greater proportions of woody plant species are likely to provide greater water quality improvement and habitat functions. Intensive wetland plantings, therefore, were conducted in WL1 and WL2 with greater quantities of shrub species than have been used in other treatment wetlands.

Even distribution of cover is an indicator for long-term storage of water, resulting in particulate retention and interaction of nutrients and contaminants with soil and vegetation. The intensive wetland plantings in Wetlands WL1 and WL2 have resulted in large sections of dense vegetation within these wetlands. Significant areas, however, of open water persist one year after wetland plantings. The open water areas are in part due to water depths that are excessive for some species of vegetation. Deeper water areas provide additional volume for water retention and slow velocities to encourage deposition of suspended particles.

Wetlands with strongly developed microrelief provide more reactive surface areas for plants and soil, as well as higher vegetation diversity and better water storage for promoting sedimentation of particulates. The basins of WL1 and WL2 were constructed with a high degree of microrelief.

The presence of logs and woody debris results in particulate retention and increases opportunities for interaction with soil and water, in addition to providing resting places and habitat for wildlife. Following construction of the WL1 and WL2 wetlands, large woody debris was scattered throughout each of the wetland basins.

In addition, high vegetative diversity typically encourages high faunal diversity. Factors leading to high vegetative diversity include stable hydrology, numerous areas of microtopographic relief, high degree of plant interspersion, high percentage of cover, and the presence of several vegetative layers.

By utilizing features described above, the design and construction of the treatment wetlands promote a higher functional capability for water quality modification and contribute to the abundance and diversity of flora and fauna.

Monitoring of the wetlands will provide valuable information for the prevention and correction of problems that may potentially arise during the establishment and maintenance of vegetation within AMD treatment wetlands. Data obtained by implementing the monitoring plan will assist in the development of improved design of future wetlands constructed as components of passive treatment systems.

Refer to the attached Wetland Monitoring Report for additional information on the development of the Passive Treatment System Wetlands.

Habitat Structures and Upland Plantings

In order to optimize the restoration effort and provide education and outreach opportunities, wildlife habitat structures were constructed and installed to complement and to integrate the upland and wetlands plantings.

To provide a wooded buffer between the Flick Wetland and residential land use, as well as to provide structural and vegetative diversity, the upland area adjacent to the Flick Wetland was planted in the spring of 2003 with the following trees and shrubs:

Scientific Name	Common Name	Wetland Indicator Status
Betula populifolia	Birch, Gray	FAC
Carpinus caroliniana	Musclewood	FAC
Cornus florida	Dogwood, Flowering White	FACU-
Liquidumbar styraciflua	Gum, Sweet	FAC
Nyssa sylvatica	Gum, Black	FAC
Populus deltoides	Cottonwood	FAC
Prunus virginiana	Chokecherry	FACU

In addition to these plantings, which were accompanied by seeding with a Native Upland Wildlife Meadow Mix, Quaking Aspen and Big-Tooth Aspen have been observed to be providing significant volunteer establishment in this area.

To assist in soil stabilization as well as to provide structural and vegetative diversity, the following container-grown trees and shrubs were planted upslope of the passive treatment system in summer 2004:

Scientific Name	Common Name	Wetland Indicator Status
Amorpha fruticosa	False Indigo	FACW
Aronia melanocarpa	Black Chokeberry	FAC
Cornus amomum	Dogwood, Silky	FACW
Cornus racemosa	Dogwood, Gray	FAC
Fraxinus americana	Ash, White	FACU
Physocarpus opulifolius	Ninebark	FACW-
Pinus strobus	Pine, White	FACU
Robinia pseudoacacia	Locust, Black	FACU-
Sambucus canadensis	Elder, American	FACW-

Habitat structures within the Erico Bridge Restoration Area ---

9 Bluebird boxes
6 Wood duck boxes
3 Kestrel boxes
2 Osprey nesting platforms

Pittsburgh North Stake of the Church of Jesus Christ of Latter-day Saints with assistance from Aquascape Wetland and Environmental Services, Beran Environmental Services, and Slippery Rock Watershed Coalition volunteers, constructed bluebird boxes. The boxes were installed later in the summer 2003. Few had been utilized when students from the

Grove City College Environmental Club and personnel from Beran Environmental monitored the bluebird boxes in March 2004.

The Bear Cubs and Webelos of the Grove City Cub Scout Pack built wood duck boxes late in 2003 from materials donated by the employees of Beran Environmental. The Grove City Cub Scout Pack and Beran Environmental installed the boxes in March 2004.

In March 2004, the first kestrel boxes to be installed in a restoration project within the Slippery Rock Creek Watershed were placed at the Erico Bridge Restoration Area by the Grove City College Environmental Club and personnel from Beran Environmental. The boxes constructed by the Environmental Club with wood donated by Beran Environmental, have not yet been monitored.

Osprey nesting platforms were constructed by George Jr. Republic and installed by personnel from Quality Aggregates during the construction of Wetland 2 of the passive treatment complex. The osprey nesting platforms, as well as the constructed snags to which they are attached, are firsts for restoration projects within the Slippery Rock Creek Watershed. Although nests have not yet been built on the structures, red-winged blackbirds and great blue herons have been observed using the platforms as perches.

PASSIVE TREATMENT SYSTEM PERFORMANCE

Construction and Monitoring Partners

Quality Aggregates Inc. constructed the passive treatment complex. The main systems (ALD1 & ALD2 with retention components) have been online and functional since June 2003. ALD3 with SP5 has been online and functional since May 2004. PA DEP, Knox District Mining Office, and BioMost, Inc., conducted water monitoring. Wetland monitoring conducted by Aquascape and Beran Environmental.

Improvement of Mine Drainage Quality through Passive Treatment Complex

At the Erico Bridge site, the raw mine drainage associated with the abandoned underground mine in the Brookville coalbed is characterized as being net acidic with high concentrations of dissolved (ferrous) iron, elevated concentrations of manganese, and very low concentrations of aluminum. The restoration effort included the construction of a passive complex to treat the site drainage. Pre-construction monitoring indicated that the site drainage, on average, had a flow rate of ~300 gpm (~700 gpm max.), 5.7 pH, 62 mg/l (total/dissolved 166 mg/l max.) iron, and 31 mg/l manganese. [The average post-construction flow rate and iron content are higher, 500 gpm and ~70 mg/l, respectively. (See monitoring data sheets.)]

Even though sampling has been conducted for ~18 months (~1½ years), the results must be considered preliminary when considering the design life of the system to be 25 years. Table V identifies the influent and effluent characteristics through the components. The characteristics are also demonstrated visually in Figures 3 through 6.

Table V. Discharge Characteristics Through the Erico Bridge Passive Treatment Complex

Component	Flow	pH (*field*/lab)	Alkalinity (*field*/lab)	Acidity	DFe	DMn	DAl	DO
ALD1	363	*6.5*/6.4	*234*/190	-12	71	27	<1	0
SP1	NM	*6.7*/6.4	*187*/111	-36	46	24	<1	1
SP2	NM	*6.8*/6.6	*147*/104	-45	24	23	<1	6
WL1	NM	*6.9*/6.7	*131*/99	-17	17	24	<1	6
SP3	NM	*7.0*/6.8	*118*/98	-37	11	23	<1	7
ALD2	63	*6.6*/6.5	*256*/213	-41	68	18	<1	0
SP4	NM	*6.7*/6.6	*162*/114	-64	31	17	<1	3
WL2	NM	*6.9*/6.7	*76*/75	-18	6	18	<1	8
HFLB (major final effluent)	479	*7.2*/7.0	*111*/112	-60	1	3	<1	3
ALD3	15	*6.5*/6.4	*220*/148	3	81	16	<1	0
SP5 (minor final effluent)	NM	*6.5*/6.3	*118*/69	-5	26	15	<1	4
Composite Final Effluent (weighted value)	**494**	***7.2*/7.0**	***112*/111**	**-58**	**2**	**3**	**<1**	**3**

Average values; flow in gpm; flow measured at ALD1, ALD2, ALD3, and HFLB outlet pipe; other flows assumed; lab and field pH not averaged from H-ion concentrations; alkalinity, acidity, dissolved metals, and dissolved oxygen expressed in mg/L; Composite Final Effluent for general description only---monitoring events and frequency not coincident; n (See attached sample analyses.)

Overall, the passive complex appears to be working well. On average, the entire complex is treating about 500 gpm with maximum flows roughly measured to be 700^+ gpm in the spring of 2004. As expected, alkalinity is generated by the limestone-based components (Anoxic Limestone Drain and Horizontal Flow Limestone Bed) and consumed in the components constructed for formation and retention of metal solids (Settling Ponds and Aerobic Wetlands).

Based on average values, the final effluent from the HFLB to Seaton Creek is net alkaline (111 mg/L alkalinity and –60 mg/L acidity) with 1 mg/L and 3 mg/L dissolved iron and manganese concentrations, respectively. (Note that average values are skewed, however, due to "back-to-back" sampling events.) Typically, the effluent concentrations for iron and manganese are <1 mg/L. The final effluent from SP5 for the ALD3 system is generally net alkaline with significantly lower concentrations of iron than in the raw water but the effluent still contains 26 mg/L and 15 mg/L of iron and manganese, respectively. (Due to the proximity of raw mine water discharge ST63A-1 relative to Seaton Creek, space was not feasibly available for construction of additional passive components for retention.)

Decrease in Pollutant Loadings through Passive Treatment Complex

A more impressive evaluation of the system can be made through a loadings analysis. As can be seen from the loadings table (Table VI), by summing the average loadings for each raw discharge, there was according to pre-construction monitoring data, 620 lbs/day of acidity, 261 lbs/day of iron, and 79 lbs/day of manganese entering Seaton Creek. It is important to note that these loadings were calculated using only the data that included flow measurements, which for some discharges represented only a small percentage of the monitoring events. This makes an accurate representation of the loadings difficult. In addition, post-construction monitoring indicated changes in the quality and flow rates of the discharges. Table VII illustrates loading values through the passive treatment complex.

Table VI. Pre-Construction Loadings Analysis for Discharges ST63A-ST63E

Component	Alkalinity (lab)	Acidity (net)	TFe	TMn
ST63A	11	34	14	4
ST63B	28	71	31	4
ST63C	61	136	62	24
ST63D	2	6	2	1
ST63E	85	374	152	47
Total	**187**	**620**	**261**	**79**

Average loading values in pounds per day; Fe and Mn loadings calculated from total concentrations; pre-construction loading values limited due to lack of flow measurements for much of the data sets;

Table VII. Loading Analysis for the Erico Bridge Passive Treatment Complex

Component	Alk (field)	Alk (lab)	Acd (net)	TFe	Fe Removal Rate	TMn	Mn Removal Rate
ALD1	1025	620	-105	317		117	
SP1	834	491	-157	242	109	112	Neg
SP2	667	460	-207	182	98	106	Neg
WL1	592	413	-170	140	201	104	Neg
SP3	530	433	-173	105	177	103	Neg
ALD2	194	118	-40	54		14	
SP4	123	86	-48	29	84	13	Neg
WL2	423	373	-164	52	42	95	11
HFLB (final effluent)	594	559	-443	10		23	
ALD3	39	18	-1	15		3	
SP5 (final effluent)	21	11	-3	7	112	3	Neg
Total Final Effluent	**615**	**570**	**-446**	**17**		**26**	

Average effluent loading values in lbs/day; Removal Rate in lbs/ac/day; Fe and Mn loadings calculated from total concentrations; Total Final Effluent sum of HFLB and SP5 loadings; not shown but included in removal rate calculations are the loadings for the seep in WL2 of 17 lbs/day Fe and 5 lbs/day Mn

The above table presents conservative values relating to the decrease in loadings by the passive complex due to the interception of raw abandoned mine seepage, especially noted in WL1 (63E1, 63D1, 63D2) and WL2. For instance the seep encountered in WL2 has an average estimated flow of ~25 gpm with a 5.8 pH, 81 mg/l alkalinity, 53 mg/l dissolved Fe, and 17 mg/l dissolved Mn. Needless to say, these encountered untreated discharges greatly add to the metals loadings decreased by the passive treatment complex. The passive complex, therefore, is more effective and more efficient in treating the site drainage than indicated by the values in Table VII.

Accepted removal rates for iron and manganese are 90 to 180 lbs/ac/day and 4.5 to 9 lbs/ac/day, respectively, for constructed wetlands (USDA et al, undated). The Aerobic Wetlands and Settling Ponds at the site appear to support the expected removal rates relative to iron loadings, except in the case of WL2. This may be due to the relatively low iron concentrations in the major flow to WL2 or the immaturity of the wetland. With respect to manganese, WL2 greatly exceeds the expected removal rate. Note that the majority of the manganese is being removed by the HFLB.

While pre-construction data for the site indicated a combined loading of 261 lbs/day of total iron and 79 lbs/day of total manganese, post-construction monitoring indicates that on average about 385 lbs/day (70 tons/year) of total iron and 134 lbs/day (21 tons/year) of total manganese are being removed by the passive treatment complex, an increase of ~30% from pre-construction monitoring. Based on the post-construction iron and manganese loadings, the acidity loading neutralized is greater than the pre-construction 620 lbs/day (113 tons/year). By assuming that all acidity is mineral/metal acidity from the formation of metal solids due to dissolved ferrous iron and manganese and utilizing stoichiometric terms from the calculated acidity equation, the post-construction metal acidity neutralized is estimated to be on average nearly 900 lbs/day (164 tons/year). In addition, the amount of alkalinity consumed through chemical reactions was calculated to be 850 lbs/day, which compares well with the previous estimate, again an increase of ~30% from pre-construction estimates.

Based on available data to date, the average (weighted value) combined alkalinity loading in the effluent from ALD1, ALD2, ALD3, and HFLB is >1,800 lbs/day (nearly a ton/day).

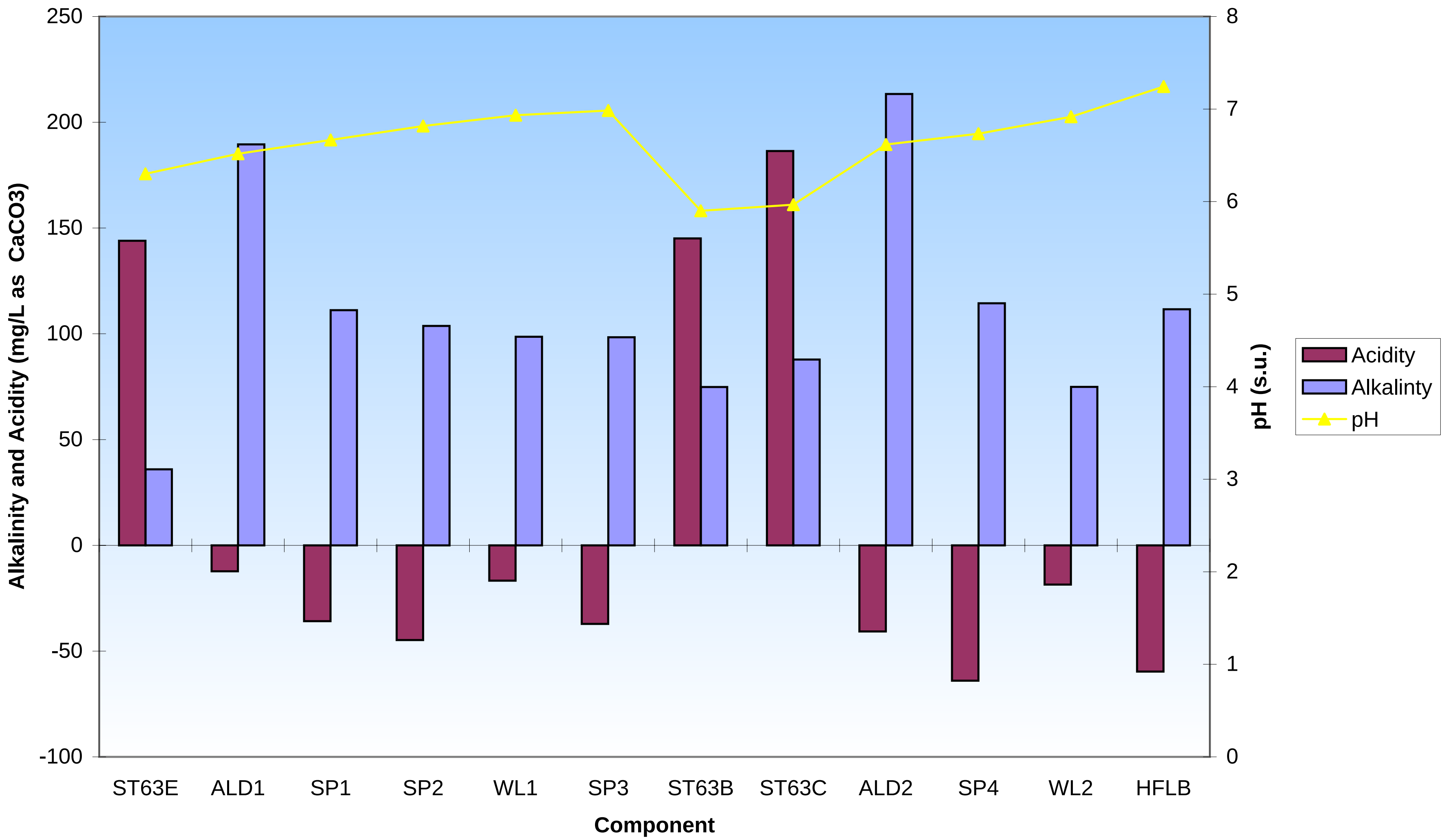
The passive complex is also removing 97% of the dissolved iron loading and 81% of the dissolved manganese loading. As noted previously, these are conservative values due to the untreated abandoned mine seeps encountered in WL1 and WL2.

Table VIII. Effectiveness of Erico Bridge Passive Complex in Metals Removal

Treatment System	**Component**	**Iron Loadings**		**Mn Loadings**	
		DFe	**Decrease**	**DMn**	**Decrease**
ALD1	ALD1	308	0%	112	0%
	SP1	215	30%	100	12%
	SP2	119	61%	98	13%
	WL1	86	72%	101	10%
	SP3	56	82%	100	11%
ALD2	ALD2	51	0%	14	0%
	SP4	28	45%	13	7%
ALD1/ALD2	WL2	32	91%	93	26%
	HFLB (major final effluent)	7	98%	22	83%
ALD3	ALD3	14	0%	3	0%
	SP5 (minor final effluent)	5	64%	3	0%
ALD1/ALD2/ALD3	**(weighted value)**	**12**	**97%**	**25**	**81%**

Average values; dissolved Fe and Mn in lbs/day for effluent of individual components. Percent decrease identifies the combined ("running") total decrease as the treated drainage flows through the individual components in series. WL2 and HFLB are shared components for drainage treated by ALD1 and ALD2.

Comparison of pH, Alkalinity, and Acidity Through Main Passive Treatment Complex (Average Values)



Comparison of Iron and Manganese Values Through the Main Passive Treatment Complex (Average Values)

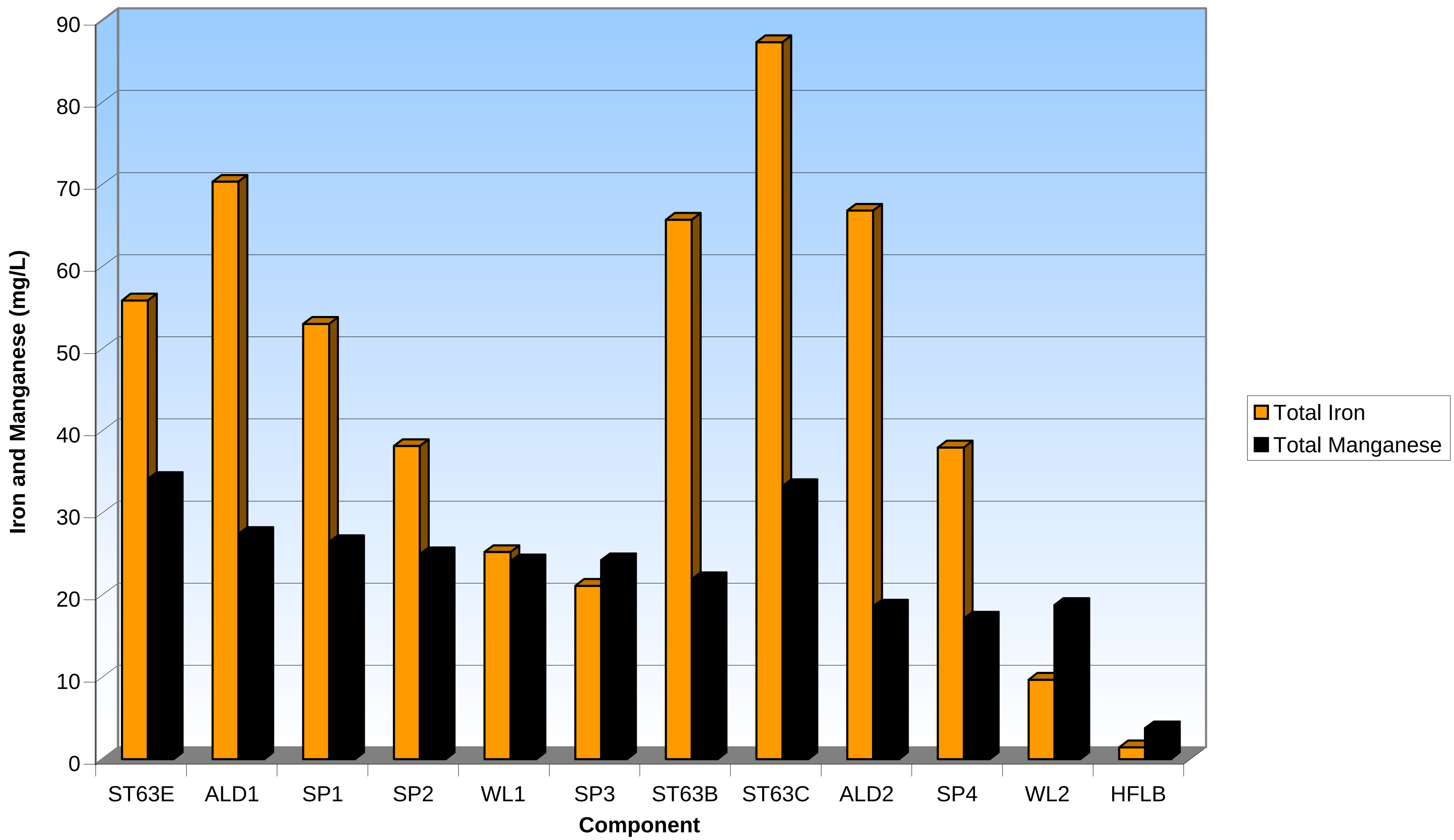


Figure 4

Comparison of pH, Alkalinity, and Acidity through the ALD3 Passive Treatment System (Average Values)

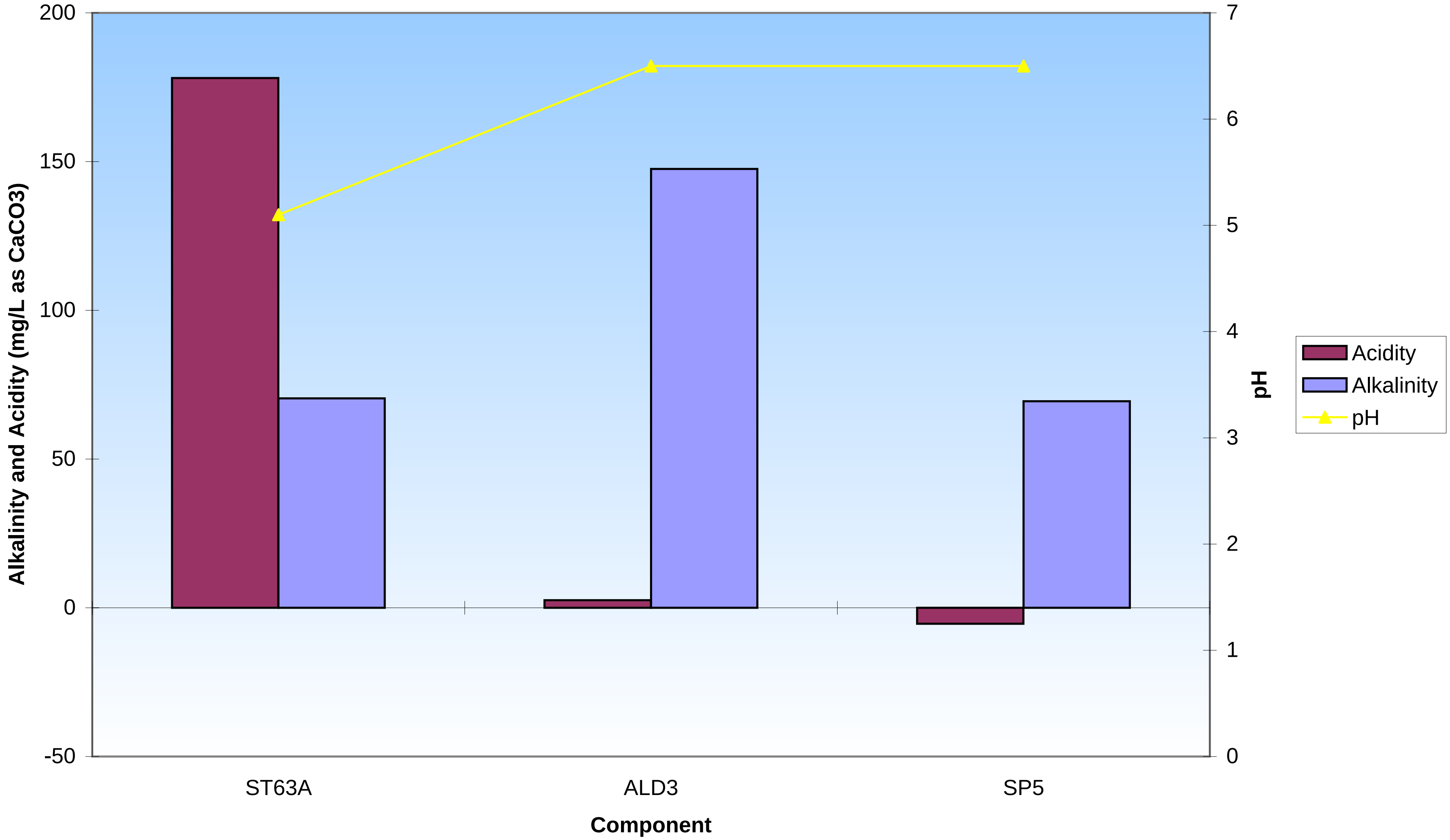


Figure 5

Comparison of Iron and Manganese Values Through ALD3 Passive Treatment System (Average Values)

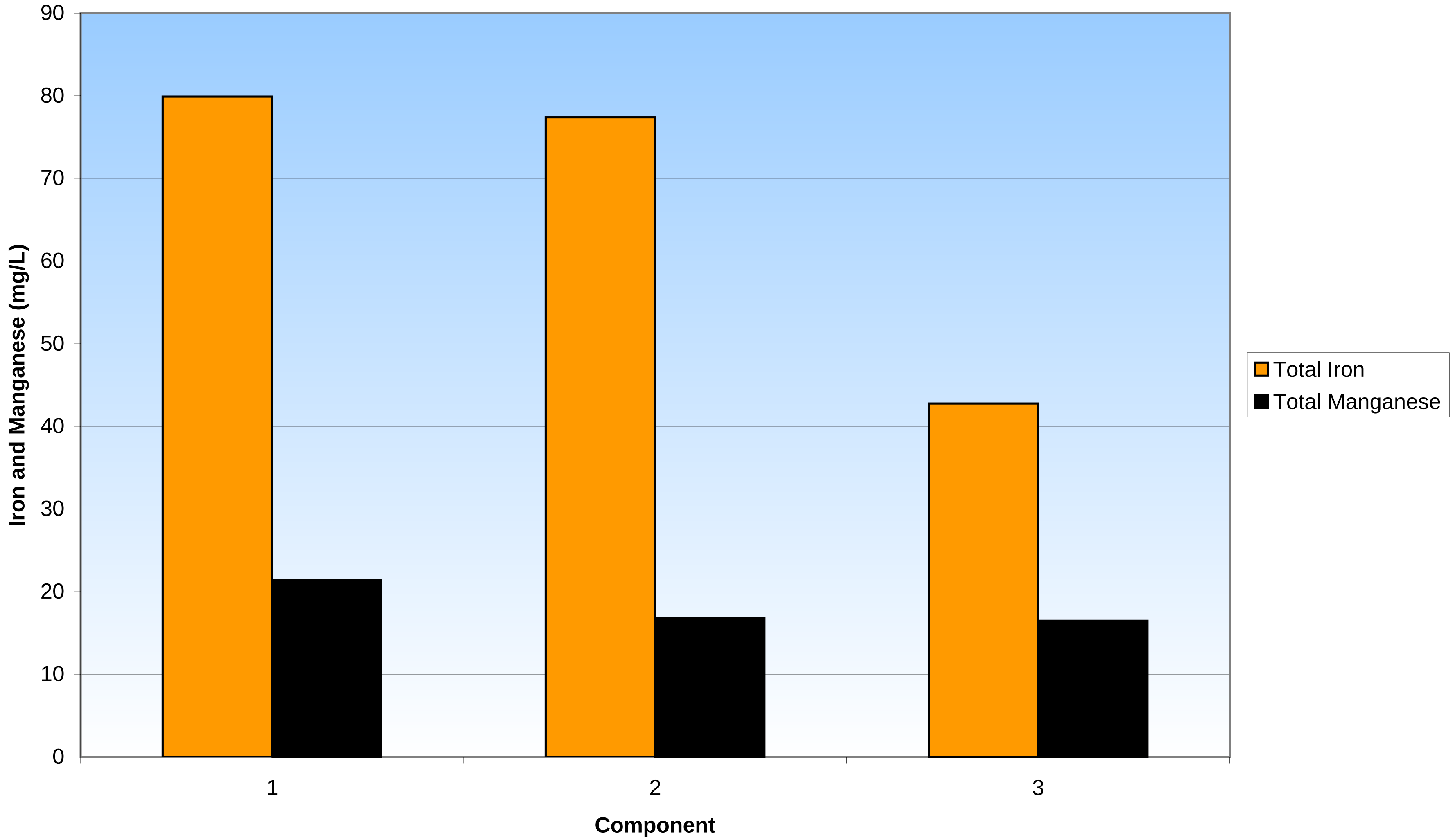


Figure 6

MEASURABLE ENVIRONMENTAL RESULTS

Site Drainage Quality Improvement

Based on the water quality data collected by various project partners including the PA DEP, the Erico Bridge passive complex is successfully treating the mine drainage at the site. The larger passive system was first noted to be discharging in June 2003. Site water monitoring to date has included the raw untreated (pre-construction) and passive treatment components (post-construction). The average water quality for the raw (untreated) mine drainage and the final effluent of the passive system is presented in Table IX below.

Table IX. Discharge Quality "Before and After"

Description	Point	Flow	pH	Alk	Acd	Fe	Mn	Al
Raw water (pre-construction)	ST63A	12	5.7	70	178	80	21	<1
	ST63B	30	5.9	75	142	65	22	<1
	ST63C	60	6.0	88	186	87	33	<1
	ST63D	10	5.0	12	33	6	10	<1
	ST63E	210	5.7	36	144	56	34	<1
	Sum (weighted)	**322**	**5.7**	**50**	**150**	**62**	**31**	**<1**
Treated water (post-construction)	HFLB	479	7.2	111	-60	1	3	<1
	SP5	15	6.5	118	-5	26	15	<1
	Sum (weighted)	**494**	**7.0**	**111**	**-58**	**2**	**3**	**<1**

Abandoned mine discharges; average values; flow rate in gallons per minute; pH measured in standard units (s.u.); average pH not calculated from H-ion concentrations; alkalinity and acidity in mg/L of $CaCO_3$; iron, manganese and aluminum total metal concentrations in mg/L;

The final effluent from the HFLB accounts for more than 95% of the treated flow (480 gpm) from the entire complex and can be characterized as a net alkaline discharge with low concentrations of iron, manganese, and aluminum. The average HFLB final effluent is of better quality than the standard surface mine permit effluent limits (instantaneous values: 6 to 9 pH, alkalinity > acidity, total iron $\leq$7 mg/l, and total manganese $\leq$4 mg/l). The final effluent from SP5 of the ALD3 system which contributes <5% of the flow (15 gpm) can be characterized as a net alkaline, iron- and manganese-bearing discharge that exceeds standard surface mine permit effluent limits. (ST63A emanated near the bank of Seaton Creek. Space, economically feasible for construction of passive components, was extremely limited.) On average, about 900 lbs/day of acidity and about 500 lbs/day of metals no longer enter Seaton Creek due to the removal of the abandoned coal refuse and installation of the passive treatment complex.

Decreasing acidity loadings by 100%, iron loadings by 97% and manganese loadings by 81%, based upon current water quality data and assuming continued effective treatment, the passive complex will result in the prevention of the following pollutants from entering Seaton Creek annually:

- 328,000 lbs/year of acidity
- 140,000 lbs/year of total iron
- 48,000 lbs/year of total manganese

Seaton Creek Water Quality Improvement

The Seaton Creek subwatershed was documented by the CMRS to be the most heavily impacted major tributary to Slippery Rock Creek contributing 42% of the acid loading, 49% of the iron loading, and 27% of the aluminum loading. (Manganese loadings were not considered in the CMRS report.) The Seaton Creek subwatershed, therefore, has been a major focus of the Slippery Rock Watershed Coalition. Several reclamation efforts have been completed over the last six years including the installation of four passive treatment systems. Table X presents an overview of these completed efforts.

Table X. Seaton Creek Subwatershed Reclamation Efforts

Name	Description	Completion Date
Chernicky (Abel-Dreshman)	55 ac. reclaimed with CFB coalash	09/1998
De Sale Phase I (DS1)	8 ac. reclaimed with CFB coalash; passive system installed	05/2000
De Sale Phase II (DS2)	passive system installed	08/2000
De Sale Phase III (DS3)	passive system installed	09/2002
Erico Bridge Restoration Area	passive treatment system installed 40,000 cubic yards of gob removed	05/2004

As can be seen in Table XI, these reclamation efforts have resulted in a significant improvement in water quality within Seaton Creek. The De Sale Phase I, II, and III passive treatment systems along with the land reclamation of the Chernicky (Abel-Dreshman) site have significantly improved the water quality at sample point 48, which is located at the McJunkin Road bridge across Seaton Creek. The point is downstream of the De Sale Restoration Area and upstream of the Erico Bridge Restoration Area. As can be seen from Table XI, the water quality improved significantly after the reclamation of the Chernicky site and the completion of De Sale Phases I and II restoration efforts. The impact was almost instantaneous, changing from a deteriorated acidic, low pH, metal-laden, stream to an alkaline stream with low metal content. (See Table XI and attached graphs.) Fish surveys conducted in late summer of 2001 and 2002 revealed that fish are now present in this section of Seaton Creek. Aquatic surveys by Grove City College students, prior to the installation of the passive systems, indicated that there were essentially no macroinvertebrates and no fish. With the installation of the De Sale Phase III system there appeared to be additional minor improvement to Seaton Creek at sample point 48 (See Table XI and attached graphs.) in the overall averaged data.

Sampling point 19.1, located at the Erico Road bridge, is the immediate downstream monitoring location for the Erico Bridge Restoration Area. At this point, Seaton Creek has been substantially improved to a net alkaline stream with low metal concentrations. For those familiar with this sampling point a visible improvement can be seen as the water is much clearer and the streambed less red. Although an aquatic survey has not been conducted at this point since completion of the system, schools of fish have been spotted numerous times and spawning beds have been observed in the wetlands created after removal of the gob piles indicating that fish are at least trying to reproduce.

A similar improvement can be seen ~½ mile downstream from 19.1 at sampling point 19, located just before the confluence of Murrin Run with Seaton Creek.

TableXI. Quality of Receiving Stream "Before and After"

Mon Pt #	Location	Restoration Completed	pH (lab)	Alk (lab)	Acd	TFe	TMn	TAl
48	**Seaton Creek** @ McJunkin Road	Before any reclamation	4.8	10	62	1	16	5
		DS1, 2, 3, & Chernicky (pre-EB)	6.3	24	7	<1	9	<1
		After Erico Bridge	6.3	31	3	<1	8	<1
19.1	**Seaton Creek** @ Erico Road	DS1, 2, 3, & Chernicky (pre-EB)	5.3	12	46	7	12	1
		After Erico Bridge	6.5	32	<0	1	4	<1
19	**Seaton Creek** above Murrin Run	Before any reclamation	4.1	4	53	2	14	1
		After Erico Bridge	6.8	39	-14	1	3	<1
68	**Seaton Creek** above Slippery Rock Creek	Before any reclamation	5.7	14	19	1	9	1
		DS1, 2, 3, & Chernicky (pre-EB)	6.3	25	10	3	8	<1
		After Erico Bridge	6.8	35	8	3	6	<1
65	**Slippery Rock Creek** below Seaton Creek @ Boyers Sportsmen Club	Before any reclamation	6.2	22	7	<1	5	<1
		After Erico Bridge	6.3	16	13	<1	<1	<1

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

At sampling point 68, which is the final downstream point for Seaton Creek before the confluence with Slippery Rock Creek, improvements to water quality can also be observed as a result of the reclamation efforts. In addition to eliminating pollutants, the excess alkalinity in the treated discharges ameliorates impacts from other sources of abandoned mine drainage downstream of the sites. As depicted in the previous table at point 68, the pH of Seaton Creek has increased from a 5.7 to a 6.8. Alkalinity has also increased while acidity and metals have decreased. Depending on interpretation, the stream may also be slightly net acidic.

Long-Term Collective Impact On Seaton Creek: Continued water monitoring of the systems and receiving stream is necessary to document the long-term effectiveness of passive technology to treat mine drainage. To aid in demonstrating the sustainability of the ecosystem recovery, an annual electro-fishing and macroinvertebrate survey program has been implemented and is to be ongoing, contingent upon available resources.

Wetlands

The naturally-functioning treatment wetlands have not only improved water quality but also created valued wildlife habitat. Dense and diverse vegetation has been successfully established in the treatment wetlands as well as the wetlands constructed in the footprints of the removed gob piles. About 7 acres of wetlands have been either created or enhanced as part of the Erico Bridge restoration effort.

Comparison of water quality data for the influent and effluent of WL1 indicates that pH increases and total iron significantly decreases within the component. During monitoring of WL1 in June 2004, 26 species of vegetation were documented. Within WL2 there is also an increase in pH and a significant decrease in total iron concentration. This is remarkable as this component, in addition to being a shared component for treated flows from ALD1 and ALD2, also intercepts raw mine drainage. Nonetheless, pH increases and total iron significantly decreases. During monitoring of WL2, 45 plant species were documented as well as 46 plant species within the L-shaped Wetland and 40 species within the Flick Wetland.

Species observed within the treatment wetlands include swallows, killdeer, hummingbirds, damselflies, dragonflies, water striders, aquatic beetles, butterflies, moths, ladybugs, spiders, and frogs. Hawks and turtles, as well as turkey and deer tracks, have been observed in areas adjacent to the treatment wetlands. Many small fish were observed at the edge of the L-shaped wetland that borders Seaton Creek. The fish, tentatively identified as bluegill, ranged in size to ~4 inches. Also observed at the edges of both the Flick and L-shaped Wetlands were many potential spawning beds (small areas in shallow water at the edge of the L-shaped wetland that had been cleared of organic debris and vegetation).

A list of vegetation planted and observed within the Erico Bridge Restoration Area is provided in the following table.

Table XII: Plant Species of Erico Bridge Restoration Area

Herbaceous Plants

Scientific Name	Common Name	WIS	Location (Zone)	Life Stage Introduced
Acorus calamus	Sweetflag	OBL	WL2	Transplant
Alisma plantago-aquatica	Plantain, Water	OBL	L	Transplant
Andropogon gerardii	Big Bluestem	FAC	UPL	Seed
Andropogon scoparius	Little Bluestem	FACU-	UPL	Seed
Asclepias incarnata	Milkweed, Swamp	OBL	F, L	Transplant
Cardamine pennsylvanica	Bittercress, Pennsylvania	OBL	L	
Carex stricta	Sedge, Tussock	OBL	WL2	Transplant
Carex vulpinoidea	Fox Sedge	OBL	F, L, WL1, WL2	Transplant, Volunteer
Carex spp.	Sedges (three species)	--	F, L, WL1, WL2	Transplant, Volunteer
Chamaecrista fasciculata	Partridge Pea	FACU	UPL	Seed
Cirsium muticum	Thistle, Swamp	OBL	L	Volunteer
Cirsium sp.	Thistle	--	F	Volunteer
Coreopsis tinctoria	Plains coreopsis	FAC-	UPL	Seed
Dichanthelium clandestinum	Deertongue	FAC+	F, WL1, WL2, UPL	Transplant, Volunteer
Dulichium arundinaceum	Sedge, Three-way	OBL	F, WL2	Transplant
Echinochloa sp.	Grass, Barnyard	--	WL2	Volunteer
Eleocharis obtuse	Spikerush, Blunt	OBL	F, L, WL1, WL2	Transplant, Volunteer
Eleocharis spp.	Spikerush	--	WL2	Volunteer
Elodea Canadensis	Waterweed, Common	OBL	F, WL1, WL2	Transplant, Volunteer
Elymus virginicus	Virginia Wild Rye	FACW-	UPL	Seed
Elymus sp.	Wild Rye	--	L	Volunteer
Epilobium hirsutum	Willow-herb, Hairy	FACW	F, L	Volunteer
Epilobium sp.	Willow-herb	--	F, L	Volunteer
Eupatoreum perfoliatum	Boneset	FACW+	F, L, WL2	Volunteer
Glyceria sp.	Mannagrass	--	WL2	Volunteer
Gratiola aurea	Hedgehyssop, Golden	OBL	WL2	Volunteer
Gratiola neglecta	Hedgehyssop, Neglecta	OBL	L, WL1, WL2	Volunteer
Hydrocotyle americana	Pennywort, American	OBL	F	Volunteer
Impatiens capensis	Touch-Me-Not, Spotted	FACW	F, L	Volunteer
Juncus effuses	Rush, Soft	FACW+	F, L, WL1, WL2	Transplant, Volunteer
Juncus sp.	Rush	--	F, L, WL1, WL2	Transplant, Volunteer
Leersia oryzoides	Cutgrass, Rice	OBL	F, L, WL1, WL2	Transplant

Herbaceous Plants (cont.)				
Scientific Name	**Common Name**	**WIS**	**Location (Zone)**	**Life Stage**
Lemna minor	Duckweed, Lesser	OBL	F, L	Transplant, Volunteer
Ludwigia palustris	Water-purslane	OBL	F, L, WL2	Transplant
Lycopus sp.	Bugleweed	--	F, L	Volunteer
Lysimachia nummularia	Moneywort	OBL	WL2	Volunteer
Mimulus ringens	Monkeyflower	OBL	F, L	Volunteer
Myriophyllum sp.	Water-milfoil	OBL	F, L	Transplant, Volunteer
Nuphar luteum	Spatterdock	OBL	F, L, WL2	Transplant
Nymphaea sp.	Water-lily	OBL	WL1, WL2	Transplant
Onoclea sensibilis	Fern, Sensitive	FACW	WL2	Volunteer
Osmunda cinnamomea	Fern, Cinnamon	FACW	F	Volunteer
Panicum virgatum	Switchgrass	FAC	UPL	Seed
Phytolacca americana	Pokeweed	FACU+	WL2	Volunteer
Poa palustris	Fowl Bluegrass	FACW	UPL	Seed
Polygonum persicaria	Lady's Thumb	FACW	F, L, WL1, WL2	Volunteer
Polygonum sagittatum	Tearthumb, Arrowleaf	OBL	WL1	Transplant, Volunteer
Polygonum sp.	Smartweed	---	F, L, WL2	Transplant, Volunteer
Pontederia cordata	Pickerel Weed	OBL	WL1, WL2	Transplant
Potentilla sp.	Cinquefoil	--	L, WL1, WL2	Volunteer
Rudbeckia hirta	Black-eyed Susan	FACU-		
Rumex crispus	Dock, Curly	FACU	F, L, WL2	Volunteer
Rumex obtusifolius	Dock, Bitter	FACU-	L, WL1, WL2	Volunteer
Scirpus atrovirens	Bulrush, Green	OBL	L, WL1, WL2	Transplant, Volunteer
Scirpus cyperinus	Wool-grass	FACW+	F, L, WL1, WL2	Transplant
Scirpus validus	Bulrush, Soft-stemmed	OBL	L, WL1, WL2	Transplant
Sorghastrum nutans	Indiangrass	UPL	UPL	Seed
Solidago sp.	Goldenrod	--	F, L, WL2	Volunteer
Sparganium americanum	Burreed, American	OBL	F, L, WL2	Transplant
Sparganium eurycarpum	Burreed, Giant	OBL	L	Volunteer
Trifolium repens	Clover, White	FACU-	WL2	Volunteer
Tripsacum dactyloides	Eastern Gammagrass	FACW	UPL	Seed
Tussilago farfara	Colt's Foot	FACU	F, WL2	Volunteer
Typha angustifolia	Cattail, Narrow-leaf	OBL	L	Volunteer
Typha latifolia	Cattail, Broad-leaf	OBL	F, L, WL1, WL2	Volunteer
Verbena hastate	Vervain, Blue	FACW+	F, L, WL1, WL2	Transplant, Volunteer

Shrubs & Trees

Acer rubrum	Maple, Red	FAC	WL1	Volunteer
Alnus rugosa	Alder, Speckled	FACW+	F	Bare root
Amorpha fruticosa	False Indigo	FACW	UPL	Container-grown
Aronia melanocarpa	Black Chokeberry	FAC	UPL	Container-grown
Betula nigra	Birch, River	FACW	F	Container-grown
Betula populifolia	Birch, Gray	FAC	UPL	Bare root
Carpinus caroliniana	Musclewood	FAC	UPL	Bare root
Cephalanthus occidentalis	Buttonbush	OBL	L, WL2	Wattles, live cuttings
Cornus amomum	Dogwood, Silky	FACW	WL1, WL2, UPL	Wattles, live cuttings, Container-grown
Cornus florida	Dogwood, Flowering White	FACU-	UPL	Bare root
Cornus racemosa	Dogwood, Gray	FAC	UPL	Container-grown
Fraxinus americana	Ash, White	FACU	UPL	Container-grown
Ilex verticillata	Holly, Winterberry	FACW+	F	Bare root
Liquidumbar styraciflua	Gum, Sweet	FAC	UPL	Bare root
Nyssa sylvatica	Gum, Black	FAC	UPL	Bare root
Physocarpus opulifolius	Ninebark	FACW-	UPL	Container-grown

Shrubs & Trees				
Scientific Name	**Common Name**	**WIS**	**Location (Zone)**	**Life Stage**
Pinus strobes	Pine, White	FACU	UPL	Container-grown
Populus deltoids	Cottonwood	FAC	UPL	Bare Root
Populus grandidentata	Aspen, Big-tooth	FACU-	F, UPL	Volunteer
Populus tremula	Aspen, Quaking	FACU	F, L, UPL	Volunteer
Prunus virginiana	Chokecherry	FACU	UPL	Bare root
Robinia pseudoacacia	Locust, Black	FACU-	UPL	Container-grown
Rosa multiflora	Rose, Multiflora	FACU	L	Volunteer
Rosa palustris	Rose, Swamp	OBL	F, L	Container-grown
Rubus sp.	Blackberry	--	L, WL2	Volunteer
Salix discolor	Pussy Willow	FACW	Seep Area	Rooted cuttings
Salix sericea	Willow, Silky	OBL	L, WL1, WL2	Wattles, live cuttings
Salix sp.	Willow	--	F	Volunteer
Sambucus canadensis	Elder, American	FACW-	F, WL1, WL2, UPL	Bare root, Volunteer Container-grown
Spiraea sp.	Meadowsweet	--	F, L, WL2	Transplant

Wetland Indicator Status (WIS):

OBL Obligate Wetland - Occur >99% in wetlands natural conditions
FACW Facultative Wetland - Occur 67%-99% in wetlands
FAC Facultative Wetland - Occur 34% - 66% in wetlands
FACU Facultative Upland - Occur <33% in wetlands
UPL Obligate Upland - Occur >99% in non-wetlands

"**Location**" refers to the location planted, seeded, or observed within the project area.

F: Flick Wetland (gob pile removal wetland)
L: L-shaped Wetland (gob pile removal wetland)
WL1: Wetland 1 (treatment wetland)
WL2: Wetland 2 (treatment wetland)

"**Life Stage**" refers to the form that vegetation was planted or introduced into the project area.

Comparison of pH, Alkalinity, and Acidity at Seaton Creek Sampling Polint 68 Over Time

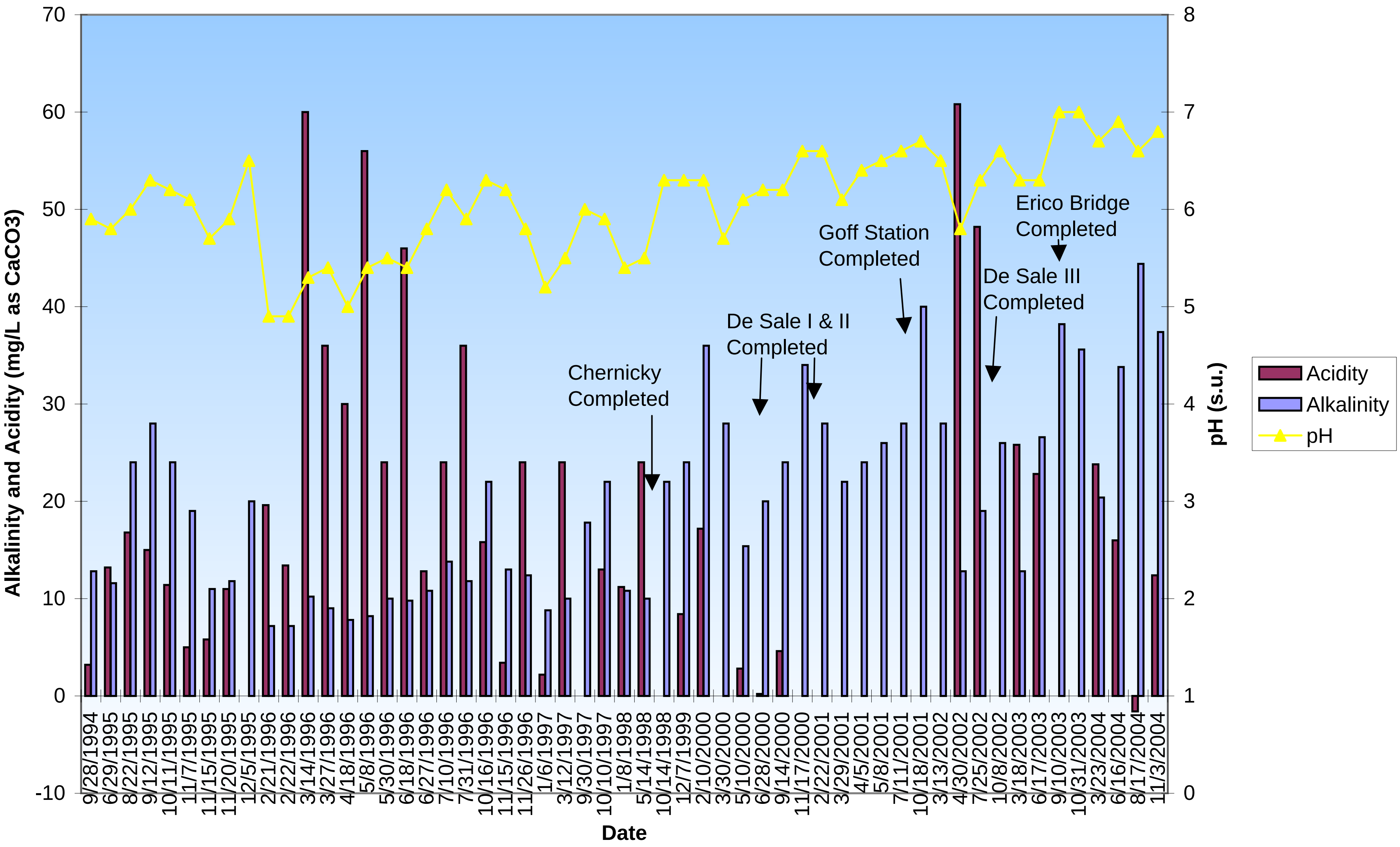


Figure 11

Comparison of Total Metal Concentrations at Seaton Creek Sampling Point 19.1 Over Time

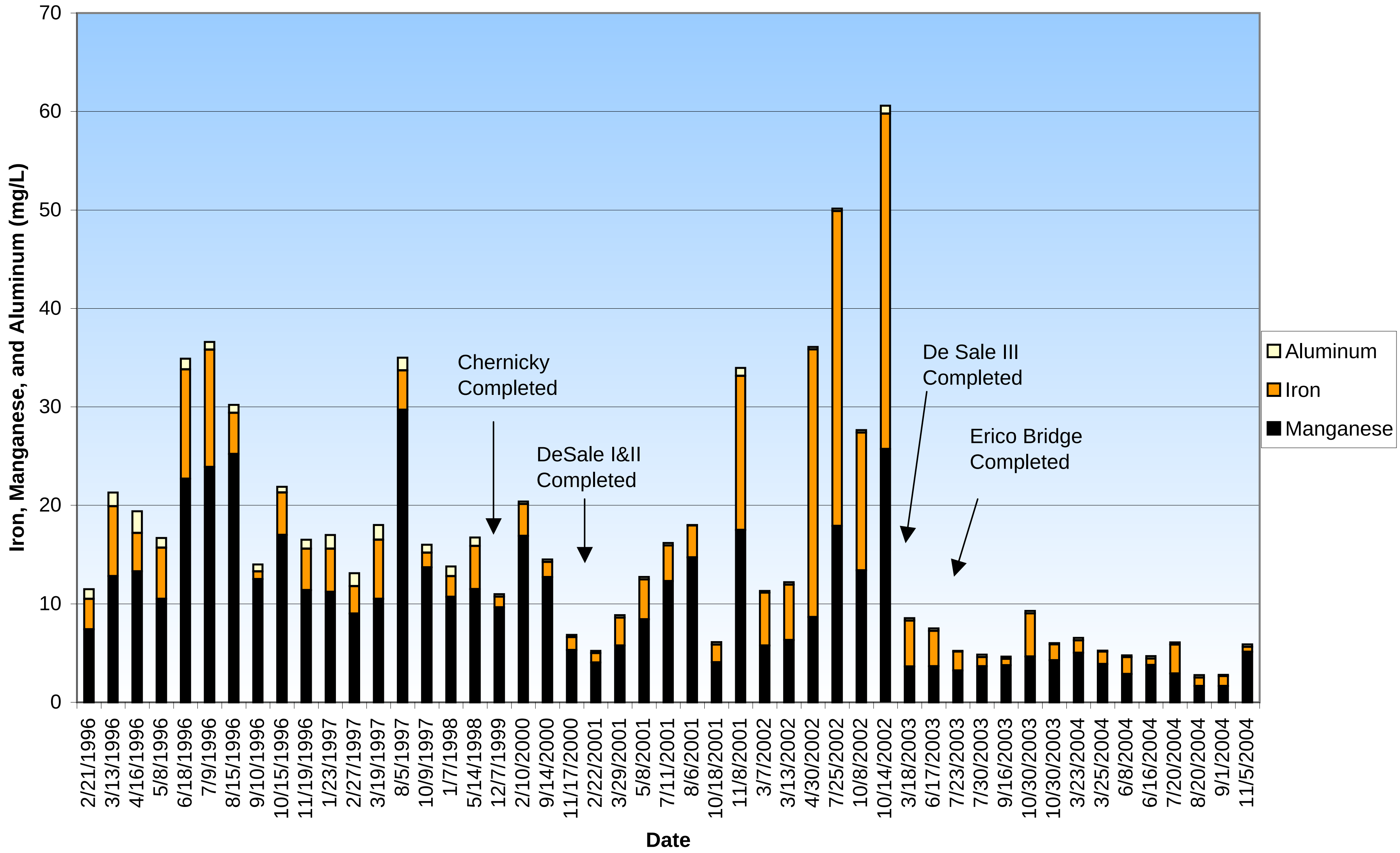
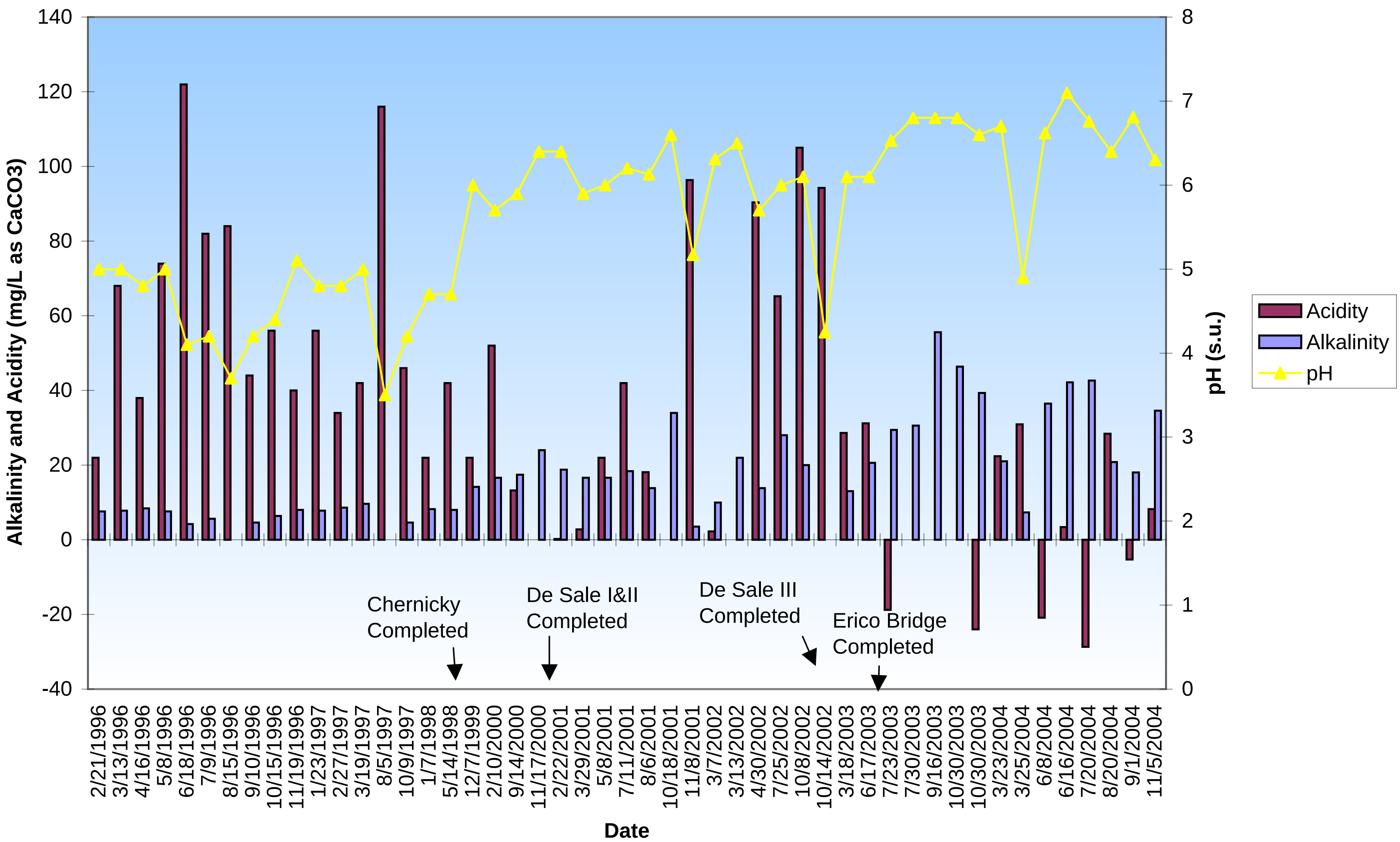


Figure 10

Comparison of pH, Alkalinity, and Acidity Over Time at Seaton Creek Sampling Point 19.1



Comparison of Total Metal Concentrations in Seaton Creek at McJunkin Road Over Time

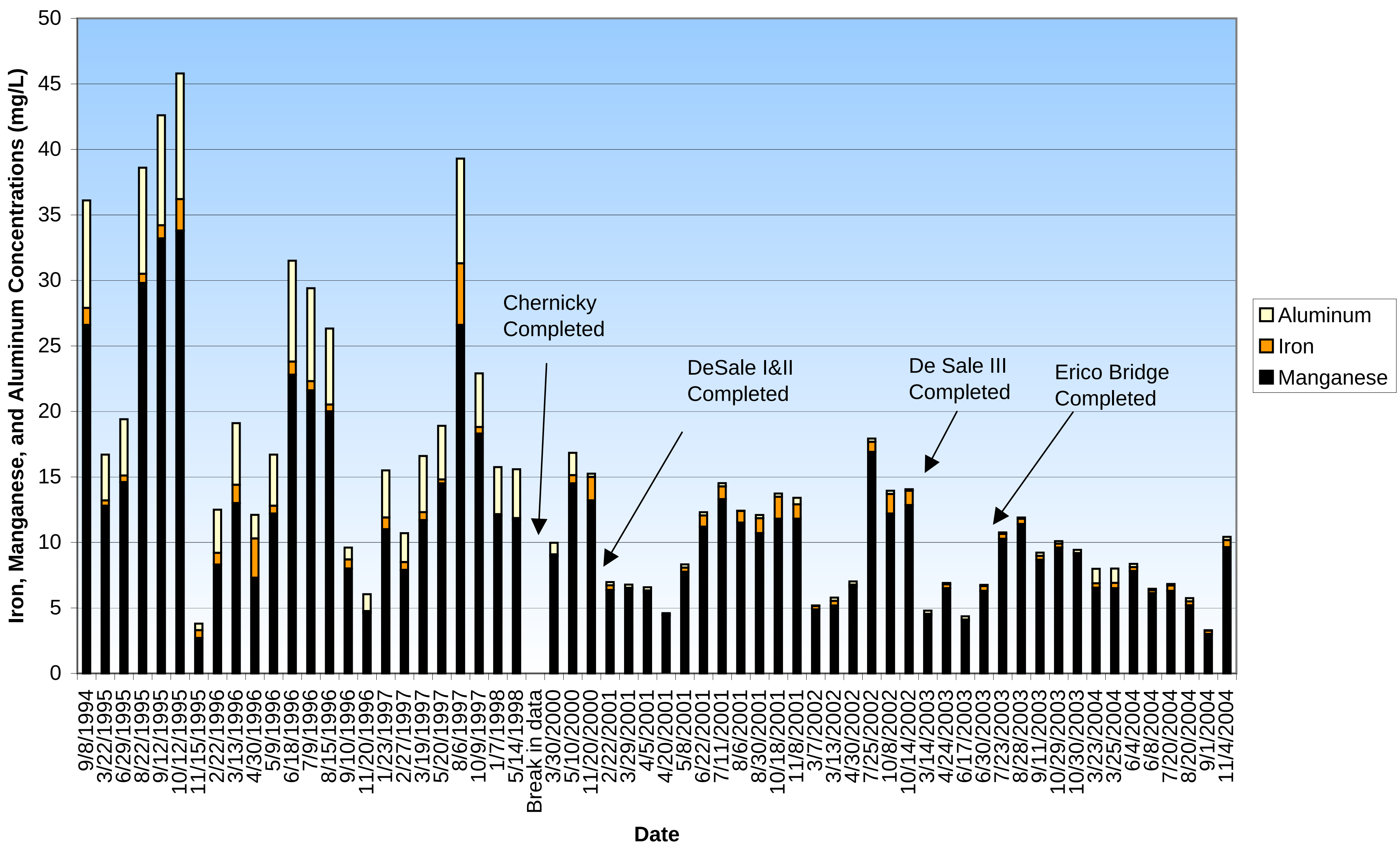


Figure 8

Comparison of pH, Alkalinity, and Acidity in Seaton Creek at McJunkin Road Over Time

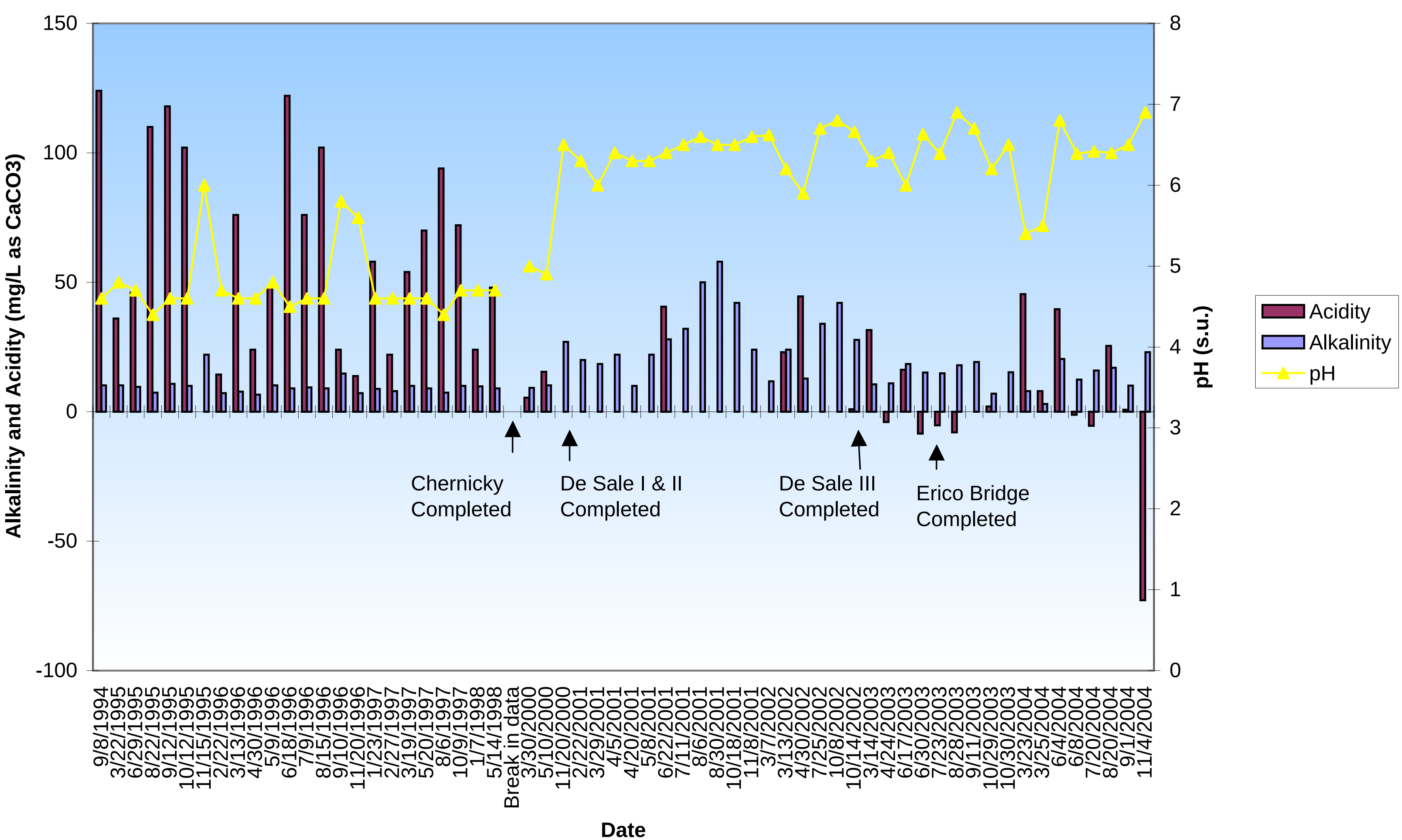


Figure 7

Comparison of Total Metals at Seaton Creek Sampling Point 68 Over Time

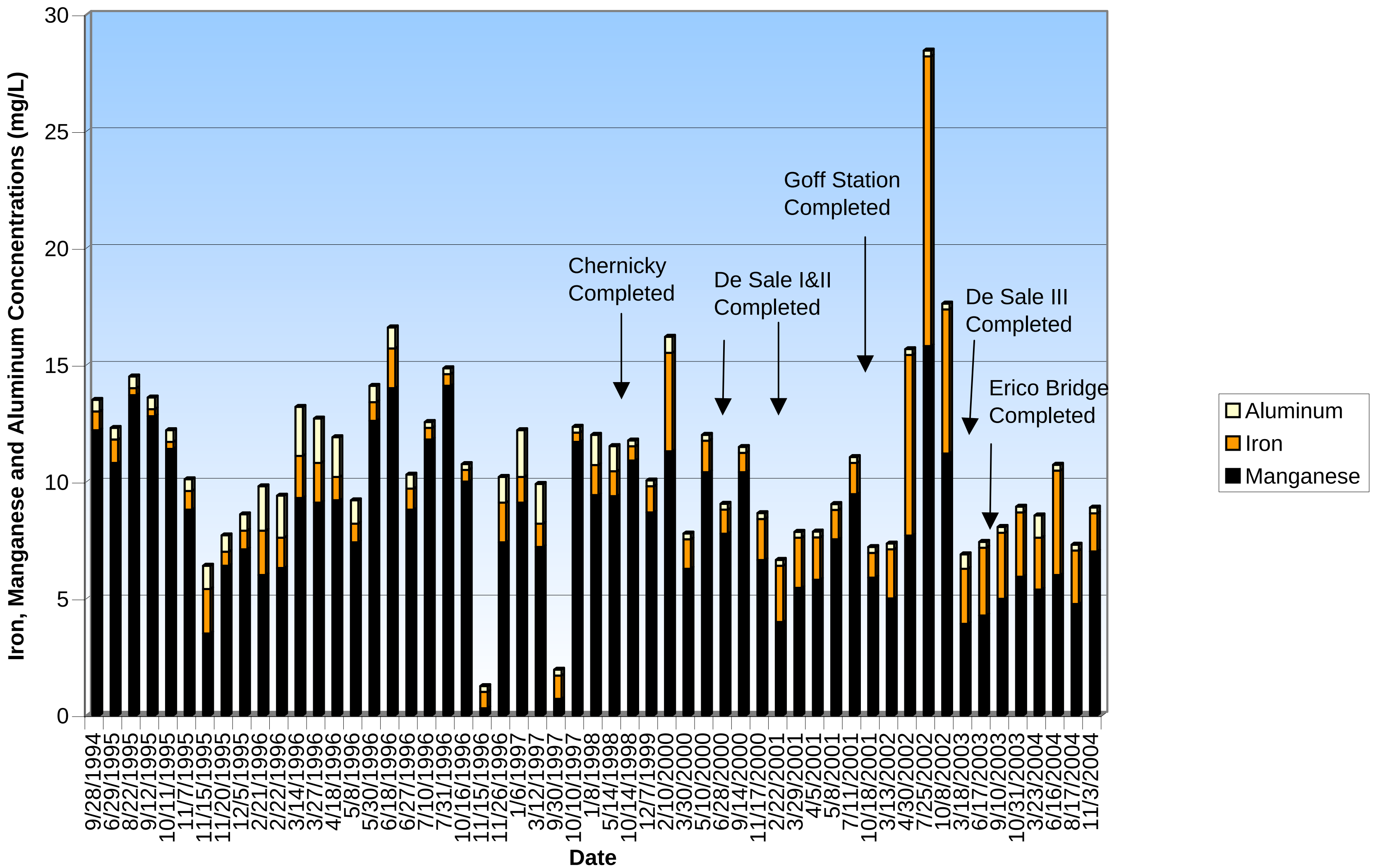


Figure 12

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WETLAND MONITORING REPORT

Erico Bridge Restoration Area
Venango Township, Butler County

Prepared for
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3016 Unionville Road
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July 2004

WETLAND MONITORING REPORT

Erico Bridge Restoration Area
Venango Township, Butler County

CONTENTS

EXECUTIVE SUMMARY

Erico Bridge was identified as a priority area for the headwaters of the Slippery Rock Creek identified by the Pennsylvania Department of Environmental Protection's (PA DEP) Knox District Mining Office in the *Comprehensive Mine Reclamation Strategy* report. In the fall of 2001, a groundbreaking ceremony was held for the gob removal and mine drainage abatement that was funded primarily by the PA DEP through the Growing Greener Program. During the completion of the Erico Bridge Restoration Area, an estimated 25,000 cubic yards of coal refuse were removed from the site with two wetlands (L-shaped Wetland and Flick Wetland) created in the footprints of the removed gob piles. The combined area of these constructed wetlands is approximately 1.5 acres. Multiple passive treatment systems were installed for the abatement of several abandoned mine discharges. The passive systems contain two treatment wetland components (WL1 and WL2) that encompass a total of approximately 3 acres. Effluent from the passive treatment complex enters Seaton Creek, which subsequently flows into Slippery Rock Creek.

Monitoring of WL1, which receives flows from the ALD1 system, and WL2, which receives flow from both the ALD1 and ALD2 systems, will provide valuable information for the development of improved design and establishment of future wetlands constructed as components of AMD passive treatment systems. Monitoring of the L-shaped wetland and Flick wetlands will demonstrate the habitat improvements accomplished within the project area from the removal of coal refuse.

Planting of the Flick wetland and L-shaped wetland occurred in the Spring and Summer of 2002. Plantings of WL1 and WL2 occurred in the summer of 2003. The monitoring event described in this report occurred in June 2004.

1.0 METHODOLOGY

Monitoring stations have been established in the constructed wetlands at the Erico Bridge Restoration Area. The locations of the constructed wetlands (WL1, WL2, L-shaped wetland, Flick wetland) and monitoring points are provided in the Monitoring Site Plan (Appendix A).

The targeted wetland functions for the constructed wetlands at Erico Bridge are:

To perform water quality functions

To contribute to the abundance and diversity of wetland vegetation

To contribute to the abundance and diversity of wetland fauna

Although the abundance and diversity of wetland vegetation and fauna may be limited within the passive treatment wetlands due to water quality, it is believed that these treatment wetlands can provide substantial habitat opportunities in addition to treatment functions.

Monitoring efforts consisted of documenting density and diversity of vegetation, visual observation of successful establishment or stress of vegetation, hydrology, photographic documentation, and evidence of wildlife use. Density and diversity of vegetation were recorded by the establishment of fixed observation points and transects between observation points. Observation points were marked with a PVC pipe, and locations were recorded with a Trimble GeoExplorer CE GPS unit. Modified Routine Wetland Determination Data Forms from the 1987 Corps of Engineers Wetland Delineation Manual were used to record hydrology data at the observation points and the percent cover of vegetation within 1m x 1m quadrats centered at the observation points. Modified Point Intercept Data Forms from the operational draft of Wetland Monitoring Guidelines (Tiner, 1999) were used to document the frequency of occurrence of plant species along the transects between observation points. These data forms are provided in Appendix B.

The data recorded on these forms will provide quantitative and qualitative data to identify trends in the vegetative communities within the constructed wetlands. Photographic documentation from established reference locations allows for visual comparison of present wetland conditions to past and future conditions. Photographs of the constructed wetland areas are provided in Appendix C.

2.0 RESULTS

Monitoring of the constructed wetlands at the Erico Bridge Restoration Area occurred on June16th and 25th, 2004. As of the week ending June 13, 2004, Slippery Rock, PA had received 3.96 inches of precipitation above normal for the growing season. As of the week ending June 27, 2004, Slippery Rock, PA had received 4.74 inches of precipitation above normal.

WL1

Two observation points are located in WL1 (WL1 P1 and WL1 P2). Refer to the Monitoring Site Plan (Appendix A) for the locations of the observation points and the WL1 transect.

The depth of water at WL1 P1 was less than 1 inch. Vegetation present within the 1m x 1m quadrat at WL1 P1 included

Scientific Name	Common Name	% cover	Wetland Indicator Status
Eleocharis obtusa	Spikerush, Blunt	45	OBL
Juncus effusus	Rush, Soft	35	FACW+
Polygonum persicaria	Lady's Thumb	15	FACW
Carex vulpinoidea	Sedge, Fox	10	OBL
Juncus sp.	Rush	< 5	--
Typha latifolia	Cattail, Broad-leaved	< 5	OBL
Leersia oryzoides	Rice Cutgrass	< 5	OBL

A small layer (< 1 inch) of accumulated sand and iron precipitate was noted on the surface of the wetland substrate at this location. Areas of WL1 south of WL1 P1 were observed to have elevations above water level. Pits dug in these exposed areas revealed up to 4 inches of sediment accumulation.

The depth of water at WL1 P2 was 1 inch. Vegetation present within the 1m x 1m quadrat at WL1 P2 included

Scientific Name	Common Name	% cover	Wetland Indicator Status
Juncus effusus	Rush, Soft	20	FACW+
Juncus sp.	Rush	15	--
Scirpus cyperinus	Wool-grass	10	FACW+
Carex vulpinoidea	Sedge, Fox	< 5	OBL
Polygonum sp.	Smartweed	< 5	--
--	Unidentified grass	< 5	--

A small layer of iron precipitate was noted on the surface of the wetland substrate at this location.

Vegetation observed in the WL1 transect between WL1 P1 and WL1 P2 included the following species, provided in order from highest number of occurrences to fewest number of occurrences:

Scientific Name	Common Name	Wetland Indicator Status
Juncus effusus	Rush, Soft	FACW+
Eleocharis obtusa	Spikerush, Blunt	OBL
Carex vulpinoidea	Sedge, Fox	OBL
Juncus sp.	Rush	--
Polygonum persicaria	Lady's Thumb	FACW
Scirpus cyperinus	Wool-grass	FACW+
	Unknown grasses (2 species)	--
Carex sp.	Unknown sedges (2 species)	--
Typha latifolia	Cattail, Broad-leaved	OBL
Gratiola neglecta	Hedgehyssop, Clammy	OBL
Leersia oryzoides	Rice Cutgrass	OBL
Dichanthelium clandestinum	Deertongue	FAC+
Rumex obtusifolius	Dock, Bitter	FACU-
Salix sp.	Willow	--
Polygonum sagittatum	Tearthumb, Arrow-leaf	OBL
Pontederia cordata	Pickerelweed	OBL
Elodea canadensis	Waterweed, Common	OBL

Additional plant species observed within WL1 include:

Scientific Name	Common Name	Wetland Indicator Status
Acer rubrum	Maple, Red	FAC
Nymphaea sp.	Water-lily	OBL
Potentilla sp.	Cinquefoil	--
Sambucus canadensis	Elderberry	FACW-
Scirpus atrovirens	Bulrush, Green	OBL
Scirpus validus	Bulrush, Soft-stem	OBL
Verbena hastata	Vervain, Blue	FACW+

A total of 26 plant species were observed within WL1. Thirteen of these species were observed with flowers or fruits, indicating good plant health. Evidence of animal browsing was observed on pickerelweed and spikerush.

The woodduck box in WL1, placed along the breastwork nearest WL2, was housing a family of birds, tentatively identified as common grackles. Other wildlife observed in WL1 included damselflies, water striders, aquatic beetles, and spiders.

Areas of shallow water and exposed ground within WL1 were observed to have very dense vegetation with good diversity. However, a significant portion of these shallow areas and all of the exposed areas are reducing the ability of WL1 to provide water quality improvement. Although it may result in a decrease in vegetative density and diversity, an increase in water elevation of the wetland will increase retention time and improve the water quality treatment potential in WL1. Transplanting vegetation from within WL1 to the rock lined spillway at the outlet to SP3 may serve to increase water levels. Plastic netting has been installed near the inlet of WL1 to disperse flow energies as they enter the wetland to encourage additional deposition and increase the likelihood of vegetative establishment in the line between WL1's inlet and outlet. Plants were transplanted along the netting to initiate vegetative establishment in this area.

WL2

Three observation points are located in WL2 (WL2 P1, WL2 P1E, WL2 P2, WL2 P3E and WL2 P3E). The observation points at WL2 P1, and WL2 P3 each consist of an observation point marked by a PVC pipe paired with a fenced exclosure approximately 6 feet in diameter. WL2 P1 is located near the inlet from SP4, near the western edge of WL2. WL2 P2 is located in the central portion of WL2, north of the spillway from SP3 into WL2. WL2 P3 is located near the outlet of WL2 into the HFLB. The locations of observation points are provided in Appendix A. The WL2 transect is the line within WL2 from WL2 P1 to WL2 P2 to WL2 P3.

The depth of water at WL2 P1 was 6 inches. Vegetation present within the 1m x 1m quadrat at WL2 P1 included

Scientific Name	Common Name	% cover	Wetland Indicator Status
Juncus effusus	Rush, Soft	80	FACW+
Typha latifolia	Cattail, Broad-leaved	20	OBL
Sparganium americanum	Burreed, Eastern	15	OBL
Leersia oryzoides	Rice Cutgrass	< 5	OBL
Scirpus cyperinus	Wool-grass	< 5	FACW+

The depth of water at the exclosure area at WL2 P1 (WL2 P1E) was 8 inches. Vegetation present within the 1m x 1m quadrat at WL2 P1E included

Scientific Name	Common Name	% cover	Wetland Indicator Status
Juncus effusus	Rush, Soft	50	FACW+
Sparganium americanum	Burreed, Eastern	30	OBL
Leersia oryzoides	Rice Cutgrass	20	OBL
Typha latifolia	Cattail, Broad-leaved	15	OBL
Carex sp.	Unidentified sedge	10	--

The depth of water at WL2 P2 was 15 inches. Vegetation present within the 1m x 1m quadrat at WL2 P2 included

Scientific Name	Common Name	% cover	Wetland Indicator Status
Eleocharis sp.	Spikerush	< 5	--
Polygonum sp.	Smartweed	< 5	--
Leersia oryzoides	Rice Cutgrass	< 5	OBL

The depth of water at WL2 P3 was 3 inches. Vegetation present within the 1m x 1m quadrat at WL2 P3 included

Scientific Name	Common Name	% cover	Wetland Indicator Status
Juncus effusus	Rush, Soft	25	FACW+
Juncus sp.	Rush	20	--
Scirpus cyperinus	Wool-grass	10	FACW+
Leersia oryzoides	Rice Cutgrass	< 5	OBL
Carex sp.	Unidentified sedge	< 5	--
Sparganium americanum	Burreed, Eastern	< 5	OBL
Eleocharis sp.	Spikerush	< 5	--
Elodea canadensis	Waterweed, Common	< 5	OBL

The depth of water at the exclosure area at WL2 P3 (WL2 P3E) was 1 inch. Vegetation present within the 1m x 1m quadrat at WL2 P3E included

Scientific Name	Common Name	% cover	Wetland Indicator Status
Juncus effusus	Rush, Soft	25	FACW+
Juncus sp.	Rush	20	--
Scirpus cyperinus	Wool-grass	10	FACW+
Carex sp.	Unidentified sedge A	10	--
Carex sp.	Unidentified sedge B	< 5	--
Eleocharis obtusa	Spikerush, Blunt	< 5	OBL

A small layer of iron precipitate was noted on the surface of the wetland substrate at each observation point.

Vegetation observed in the WL2 transect between WL2 P1, WL2 P2, and WL2 P3 included the following species, which are listed in order from highest number of occurrences to fewest number of occurrences:

Scientific Name	Common Name	Wetland Indicator Status
Juncus effusus	Rush, Soft	FACW+
Typha latifolia	Cattail, Broad-leaved	OBL
Scirpus cyperinus	Wool-grass	FACW+

Carex vulpinoidea	Sedge, Fox	OBL
Eleocharis obtusa	Spikerush, Blunt	OBL
Sparganium americanum	Burreed, Eastern	OBL
Leersia oryzoides	Rice Cutgrass	OBL
Scirpus atrovirens	Bulrush, Green	OBL
Juncus sp.	Rush	--
	Unknown grasses (2 species)	--
Pontederia cordata	Pickerelweed	OBL
Polygonum sp.	Smartweed	--
Rumex sp.	Dock	--
Carex sp.	Unknown sedges (2 species)	--
Nuphar luteum	Spatterdock	OBL
Dulichium arundinaceum	Sedge, Three-way	OBL
Eleocharis sp.	Spikerush	--
Gratiola neglecta	Hedgehyssop, Clammy	OBL
Carex stricta	Sedge, Tussock	OBL
Solidago sp.	Goldenrod	--
Cornus sp.	Dogwood	--
Rumex obtusifolius	Dock, Bitter	FACU-
Glyceria sp.	Unidentified grass	OBL
Echinochloa sp.	Barnyard grass	--
Scirpus validus	Bulrush, Soft-stem	OBL
Dichanthelium clandestinum	Deertongue	FAC+
Salix sp.	Willow	--
Phytolacca americana	Pokeweed	FACU+
Verbena hastata	Vervain, Blue	FACW+

Additional plant species observed within WL2 include:

Scientific Name	**Common Name**	**Wetland Indicator Status**
Acorus calamus	Sweetflag	OBL
Cephalanthus occidentalis	Buttonbush	OBL
Eupatorium perfoliatum	Boneset	FACW+
Gratiola aurea	Hedgehyssop, Golden	OBL
Ludwigia palustris	Water purslane	OBL
Lysimachia nummularia	Moneywort	OBL
Nymphaea sp.	Water-lily	OBL
Potentilla sp.	Cinquefoil	--
Rubus occidentalis	Black Raspberry	UPL
Rumex crispus	Dock, Curled	FACU
Sambucus canadensis	Elderberry	FACW-
Spiraea sp.	Meadowsweet	--
Trifolium repens	Clover, White	FACU-
Tussilago farfara	Colt’s foot	FACU

A total of 45 plant species were observed within WL2, 20 of which were observed with flowers or fruits. Evidence of animal browsing was observed on pickerelweed, spikerush, rice cutgrass, green bulrush, burreed, cattail, and unidentified rushes.

Constructed habitat features within WL2 include woodduck boxes and two constructed snags with osprey nesting platforms. Redwinged blackbirds have been observed perched on the osprey nesting platforms. Other wildlife observed within WL2 included swallows, killdeer, hummingbirds, damselflies, dragonflies, water striders, aquatic beetles, butterflies, moths, ladybugs, and spiders. Evidence of wildlife use included deer tracks, a bird nest with one egg, and animal scat next to black feathers on an exposed mound of soil near the outlet of WL2.

Hay bales have been placed within WL2 at two locations to prevent channelization by raising water levels in portions of the wetland. This also serves to increase retention time and improve the water quality treatment. There are areas of open water with little vegetation interspersed with large areas of dense vegetative establishment. Areas that previously had excessive amounts of exposed ground appear to have been adequately addressed with the placement of hay bales. Rooted cuttings of buttonbush and willow were planted within the hay bales to allow vegetative establishment and root growth within the hay bales to better ensure long term maintenance of current water levels. Additional plantings of shrubs or transplanting of herbaceous plants among the hay bales is suggested.

L-shaped Wetland

One observation point is located in the L-shaped Wetland (L P1). Refer to the Monitoring Site Plan (Appendix A) for the location of L P1 and the transect within the L-shaped wetland.

The soil was saturated to the surface at L P1 with free water in the pit at a depth of 7 inches. Vegetation present within the 1m x 1m quadrat at L P1 included

Scientific Name	Common Name	% cover	Wetland Indicator Status
Polygonum sp.	Smartweed	50	--
Juncus effusus	Rush, Soft	20	FACW+
Carex sp.	Unidentified Sedge	15	--
Epilobium sp.	Willow-herb	10	--
Typha latifolia	Cattail, Broad-leaved	10	OBL
Rumex obtusifolius	Dock, Bitter	< 5	FACU-
Carex vulpinoidea	Sedge, Fox	< 5	OBL
Leersia oryzoides	Rice Cutgrass	< 5	OBL

Vegetation observed in the L-shaped Wetland transect included the following species, which are listed in order from highest number of occurrences to fewest number of occurrences:

Scientific Name	Common Name	Wetland Indicator Status
Typha latifolia	Cattail, Broad-leaved	OBL
Verbena hastata	Vervain, Blue	FACW+
Lemna minor	Duckweed, Lesser	OBL
Juncus effusus	Rush, Soft	FACW+
Epilobium sp.	Willow-herb	--
Polygonum sp.	Smartweed	--
Polygonum persicaria	Lady's Thumb	FACW
Eupatorium perfoliatum	Boneset	FACW+
Salix sp.	Willow	--
Populus tremula	Aspen, Quaking	FACU
Carex sp.	Unknown sedges (3 species)	--
Scirpus cyperinus	Wool-grass	FACW+
Impatiens capensis	Jewelweed	FACW
Carex vulpinoidea	Sedge, Fox	OBL
Ludwigia palustris	Purslane, Water	OBL
	Unknown grasses	--
Asclepias incarnata	Milkweed, Swamp	OBL
Sparganium americanum	Burreed, Eastern	OBL
Juncus sp.	Rush	--
Solidago sp.	Goldenrod	--
Potentilla sp.	Cinquefoil	--
Mimulus ringens	Monkeyflower	OBL
Eleocharis obtusa	Spikerush, Blunt	OBL
Leersia oryzoides	Rice Cutgrass	OBL
Spiraea sp.	Meadowsweet	--
Rubus sp.	Blackberry	--
Rumex crispus	Dock, Curled	FACU
Alisma plantago-aquatica	Plantain, Water	OBL
Scirpus validus	Bulrush, Soft-stem	OBL
Gratiola sp.	Hedgehyssop	--
Elodia canadensis	Waterweed, Common	OBL
Rumex obtusifolius	Dock, Bitter	FACU-
Cirsium muticum	Thistle, Swamp	OBL
Typha angustifolia	Cattail, Narrow-leaved	OBL
Scirpus atrovirens	Bulrush, Green	OBL
Cardamine pensylvanica	Bittercress, Pennsylvania	OBL
Viburnum recognitum	Arrowwood, Northern	FACW-
Rosa multiflora	Rose, Multiflora	FACU

Additional plant species observed within the L-shaped Wetland include:

Scientific Name	Common Name	Wetland Indicator Status
Cephalanthus occidentalis	Buttonbush	OBL
Elymus sp.	Wild-rye	--
Epilobium sp.	Willow-herb (2nd species)	--
Lycopus sp.	Bugleweed	OBL
Myriophyllum sp.	Water-milfoil	OBL
Nuphar luteum	Spatterdock	OBL

A total of 46 plant species were observed within the L-shaped Wetland, 21 of which were observed with flowers or fruits.

Although cattails are dominant in the natural wetland complex adjacent to Seaton Creek and cattails are the most prevalent species in the L-shaped wetland, vegetative diversity remains high two years after its construction and initial plantings. Many small fish were observed at the edge of the L-shaped wetland that borders Seaton Creek. The fish, tentatively identified as bluegill, ranged in sizes up to approximately 4 inches. Also observed were many potential spawning beds (small areas in shallow water at the edge of the L-shaped wetland that had been cleared of organic debris and vegetation).

The construction of the shallow dam between the L-shaped Wetland and the Flick Wetland has improved the hydrology available to the L-shaped Wetland and is believed to be a large factor in the establishment of a wide variety of wetland plants.

Flick Wetland

One observation point is located in the Flick Wetland (F P1). Refer to the Monitoring Site Plan (Appendix A) for the location of F P1 and the transect within the L-shaped wetland.

The soil was inundated to a depth of 2 inches at F P1. Vegetation present within the 1m x 1m quadrat at F P1 included

Scientific Name	Common Name	% cover	Wetland Indicator Status
Ludwigia palustris	Purslane, Water	65	OBL
Juncus effusus	Rush, Soft	20	FACW+
Typha latifolia	Cattail, Broad-leaved	10	OBL
Impatiens capensis	Jewelweed	10	FACW
Epilobium sp.	Willow-herb	5	--
Dichanthelium clandestinum	Deertongue	5	FAC+
Leersia oryzoides	Rice Cutgrass	5	OBL
Polygonum sp.	Smartweed	< 5	--
Hydrocotyle americana	Pennywort, American	< 5	OBL

Lemna minor	Duckweed, Lesser	< 5	OBL
Eleocharis obtusa	Spikerush, Blunt	< 5	OBL

Vegetation observed in the Flick Wetland transect included the following species, which are listed in order from highest number of occurrences to fewest number of occurrences:

Scientific Name	Common Name	Wetland Indicator Status
Typha latifolia	Cattail, Broad-leaved	OBL
Juncus effusus	Rush, Soft	FACW+
Impatiens capensis	Jewelweed	FACW
Carex vulpinoidea	Sedge, Fox	OBL
Verbena hastata	Vervain, Blue	FACW+
Polygonum sp.	Smartweed	--
Polygonum persicaria	Lady's Thumb	FACW
Ludwigia palustris	Purslane, Water	OBL
Leersia oryzoides	Rice Cutgrass	OBL
Populus tremula	Aspen, Quaking	FACU
Sambucus canadensis	Elderberry	FACW-
Carex sp.	Unknown sedges (2 species)	--
Sparganium americanum	Burreed, Eastern	OBL
Eupatorium perfoliatum	Boneset	FACW+
Scirpus cyperinus	Wool-grass	FACW+
Populus grandidentata	Aspen, Big-tooth	FACU-
Rumex crispus	Dock, Curled	FACU
Spiraea sp.	Meadowsweet	--
Lemna minor	Duckweed, Lesser	OBL
Hydrocotyle americana	Pennywort, American	OBL
Salix sp.	Willow	--
	Unknown grasses	--
Tussilago farfara	Colt's foot	FACU
Eleocharis obtusa	Spikerush, Blunt	OBL
Mimulus ringens	Monkeyflower	OBL
Dichanthelium clandestinum	Deertongue	FAC+
Epilobium hirsutum	Willow-herb, Hairy	FACW
Osmunda cinnamomea	Fern, Cinnamon	FACW
Cirsium sp.	Thistle	--
Epilobium sp.	Willow-herb	--
Lycopus sp.	Bugleweed	OBL
Solidago sp.	Goldenrod	--

Additional plant species observed within the Flick Wetland include:

Scientific Name	Common Name	Wetland Indicator Status
Asclepias incarnata	Milkweed, Swamp	OBL
Dulichium arundinaceum	Sedge, Three-way	OBL
Elodea canadensis	Waterweed, Common	OBL
Juncus sp.	Rush	--
Myriophyllum sp.	Water-milfoil	OBL
Nuphar luteum	Spatterdock	OBL
Rosa palustris	Rose, Swamp	OBL

A total of 40 plant species were observed within the Flick Wetland, 17 of which were observed with flowers or fruits.

Additional plant species observed within the reclaimed upland area adjacent to the Flick Wetland include:

Scientific Name	Common Name	Wetland Indicator Status
Chrysanthemum leucanthenum	Daisy, Oxeye	UPL
Dipsacus sylvestris	Teasel	NI
Erigeron strigosus	Fleabane, Daisy	FACU+
Oenothera biennis	Evening-primrose	FACU-
Phleum pratense	Timothy	FACU
Rudbeckia hirta	Black-eyed Susan	FACU-
Verbascum blattaria	Mullein, Moth	UPL
Vicia sp.	Vetch	--

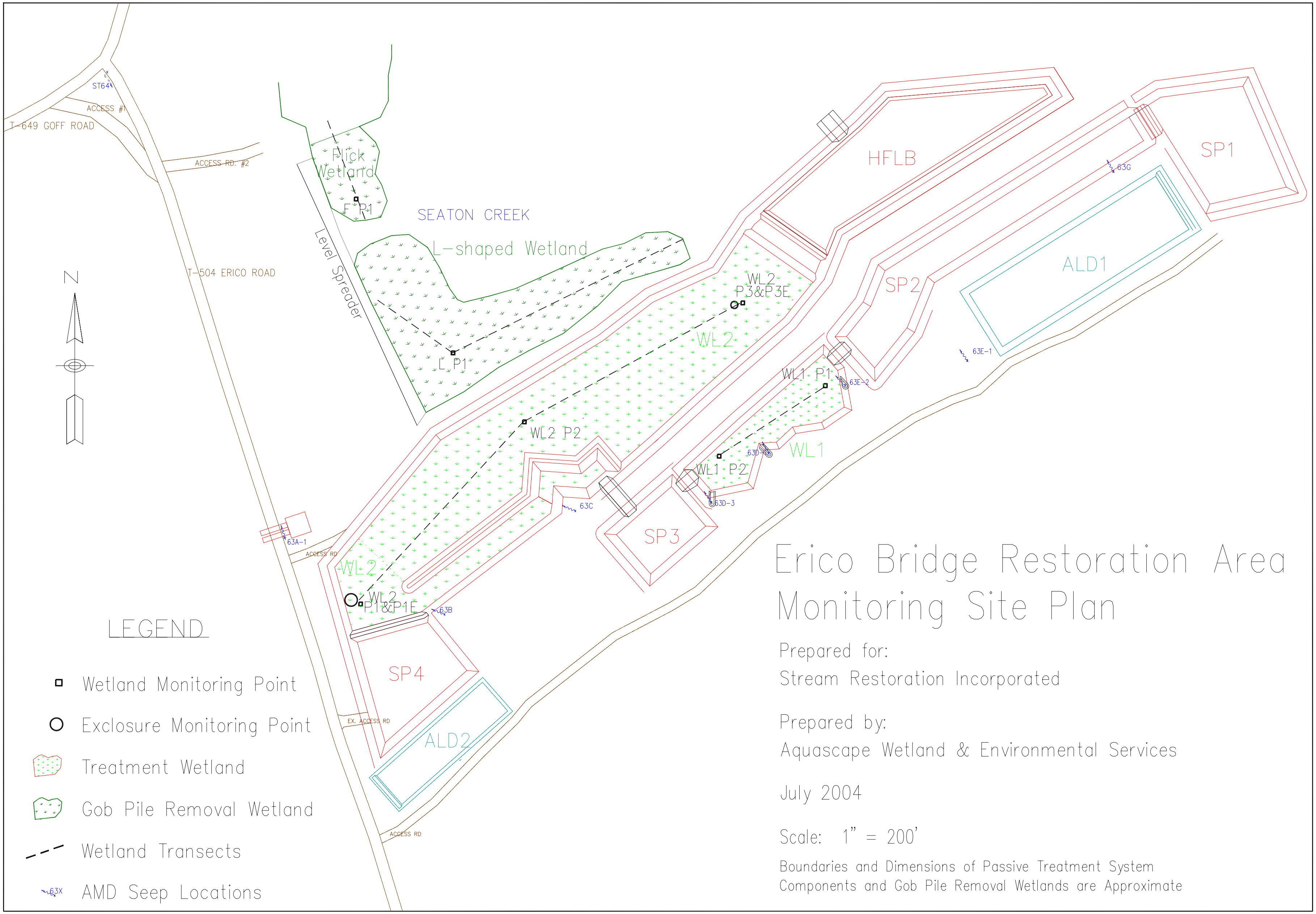
3.0 CONCLUSIONS

The treatment wetlands at the Erico Bridge Restoration Area provide an accessible opportunity for observations of vegetative community establishment in treatment wetlands. Continued monitoring will allow for observation and documentation of changing conditions over time, which may be used in planning for future treatment wetlands.

The June 2004 wetland monitoring revealed a greater diversity than anticipated for vegetation within the constructed wetlands. Areas of inadequate hydrology were identified in WL1, and it is recommended that measures be implemented to raise water levels and encourage flows to areas of WL1 that are not currently being utilized for water quality improvement. Measures have been taken to address areas of inadequate hydrology within WL2, and have been observed to be performing well. A limited amount of planting within the bales has occurred, and additional plantings are recommended within the hay bales within WL2 to better ensure continuation of current water levels.

Of the plants observed within the treatment wetlands at Erico Bridge, *pontederia cordata* (pickerel weed) appeared to be experiencing the greatest stress. Despite planting large quantities of *pontederia cordata* in the summer of 2003, no areas were observed in which *pontederia cordata* was providing uniform ground cover.. Relatively few of those transplants appear to be surviving in good condition. The healthiest observed *pontederia cordata* specimens were observed in areas densely vegetated with other species. The pH preference of *pontederia cordata* is reported to be 6.0 to 8.0. Analysis of water samples from WL1 and WL2 have been within this range. The primary source of stress to *pontederia cordata* is not known. Possibilities include other water quality parameters (suspended solids, iron precipitate) or the animal browsing and insect damage that has been observed. Due to the poor condition of *pontederia cordata* observed within the treatment wetlands, future transplanting of *pontederia cordata* would be discouraged in favor of other species such as *Juncus effusus, Typha latifolia, Scirpus cyperinus, Carex vulpinoidea*, *Eleocharis obtusa, Sparganium americanum,* and *Leersia oryzoides.*

Appendix A:
Monitoring Site Plan



Erico Bridge Restoration Area Monitoring Site Plan

Prepared for:
Stream Restoration Incorporated

Prepared by:
Aquascape Wetland & Environmental Services

July 2004

Scale: 1" = 200'

Boundaries and Dimensions of Passive Treatment System Components and Gob Pile Removal Wetlands are Approximate

Appendix B: Photographs

Photo 1: WL1, from SE corner

Photo 2: Observation point WL1 P1, facing east

Photo 3: Observation point WL1 P2, facing northeast

Photo 4: WL1, from WL1 P2 facing east

Photo 5: WL2, from west edge

Photo 6: WL2, from breastwork of WL1

Photo 7: Observation point WL2 P1, facing east

Photo 8: Observation point WL2 P2, facing south

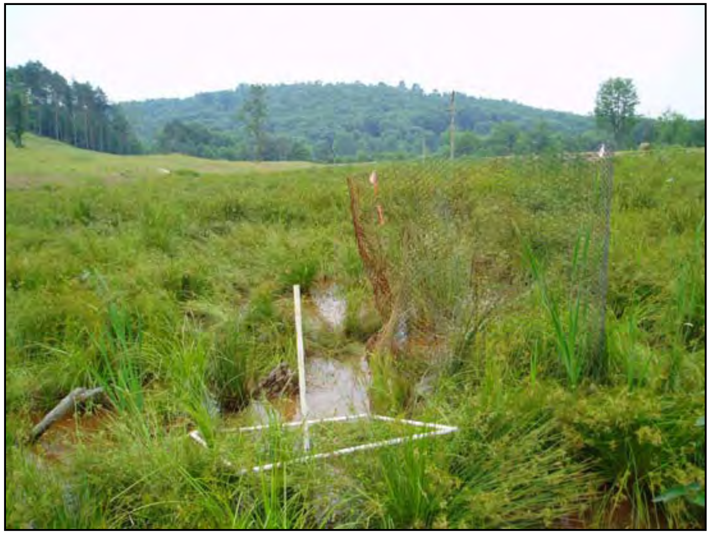


Photo 9: Observation point WL2 P3, facing west

Photo 10: L-shaped Wetland, from breastwork of WL2

Photo 11: Observation point L P1

Photo 12: L-shaped Wetland, from L P1 facing east


Photo 13: edge of L-shaped Wetland and Seaton Creek


Photo 14: Edge of Flick Wetland


Photo 15: Observation Point F P1, facing east


Photo 16: Reclaimed upland adjacent to Flick Wetland

Appendix C:
Data Forms

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Erie bridge WL 1 P1	Date: 6-16-04
Applicant/Owner: SRI	County: Butler
Investigator: Jeff & Karl Mathias	State: Pa
Do Normal Circumstances exist on the site? **(Yes)** No	Community ID:
Is the site significantly disturbed (Atypical Situation)? Yes **(No)**	Transect ID: WL 1
Is the area a potential Problem Area? Yes **(No)**	Plot ID: P1
(If needed, explain on reverse)	

VEGETATION

	Dominant Plant Species	Stratum	Indicator	% Cover		Dominant Plant Species	Stratum	Indicator	% Cover
1.	Juncus effusus	H	FACW	35%	9.				
2.	Obtusa eleocharis	H	OBL	45%	10.				
3.	Carex vulpinoidea	H	OBL	10%	11.				
4.	Polygonum persicaria	H	FACW	15%	12.				
5.	Juncus sp	H	—	5%	13.				
6.	Typha latifolia	H	OBL	<5%	14.				
7.	Leersia oryzoides	H	OBL	<5%	15.				
8.					16.				

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-)

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks): ___ Stream, Lake, or Tide Gauge ___ Aerial Photographs Other ___ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: X Inundated ___ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits ___ Drainage Patterns in Wetlands Secondary Indicators (2 or more required): ___ Oxidized Root Channels in Upper 12 Inches ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test ___ Other (Explain in Remarks)
Field Observations: Depth of Surface Water: <1 (in.) Depth to Free Water in Pit: ____ (in.) Depth to Saturated Soil: ____ (in.)	

Remarks:

SOILS

Map Unit Name
(Series and Phase):

Drainage Class:

Field Observations

WRA

Confirm Mapped Type? Yes No

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Small Accumulation of Sand & Iron Texture, Concretions, Structure, etc.
0-4.5	A	5Y42			
4.5-12	B	2.5Y41			Hard layer at
8					12 in

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: area is inundated

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	No	Is this Sampling Point Within a Wetland?
Wetland Hydrology Present?	Yes	No	
Hydric Soils Present?	Yes	No	Yes No

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Enco bridge	Date: 6-16-04
Applicant/Owner: SRI	County: Butler
Investigator: KARL MATHIAS / J. Reidenbaugh	State: Pa
Do Normal Circumstances exist on the site? (Yes) No	Community ID:
Is the site significantly disturbed (Atypical Situation)? Yes (No)	Transect ID: WL 1
Is the area a potential Problem Area? Yes (No) (If needed, explain on reverse)	Plot ID: P2

VEGETATION

Dominant Plant Species	Stratum	Indicator	% Cover	Dominant Plant Species	Stratum	Indicator	% Cover
1. Juncus effusus	H	FACW+	20%	9.			
2. Juncus sp	H	—	15%	10.			
3. Scirpus cyperinus	H	FACW+	10%	11.			
4. Carex vulpinoidea	H	OBL	<5%	12.			
5. Polygonum sp.	H	—	<5%	13.			
6. unidentified grass	H	—	<5%	14.			
7.				15.			
8.				16.			

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-)

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- Other

___ No Recorded Data Available

Field Observations:
- Depth of Surface Water: 1 (in.)
- Depth to Free Water in Pit: ___ (in.)
- Depth to Saturated Soil: ___ (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- X Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

POINT INTERCEPT DATA FORM (Form V3)

Site Name: Erico bridge WL 1 Transect Date: 6-16-04
Site Location: Erico Rd. (Street) Butler (County) Boyers (Town) Pa. (State)
Investigator: Karl Matthias, Jeff Riedenbaugh
Affiliation: AQUASCAPE

Monitoring Year: X1 __2 __3 __4 __5 __6 __7 __8 __9 __10 __

Point Intercept Sampling Results

Transcect No. WL 1

	Plant Species	Total Occurrences*	OBL	FACW	FAC	FACU	UPL
F	24 Eleocharis obtusa	𝍸𝍸𝍸𝍸 IIII	X				
F	3 Gratiola neglecta	III	X				
	10 Polygonum persicaria	𝍸𝍸		X			
F	30 Juncus effusus	𝍸𝍸𝍸𝍸𝍸𝍸	X				
	4 Typha latifolia	IIII	X				
	3 Leersia oryzoides	III	X				
F	3 unknown grass 1	III					
F	24 Carex vulpinoidea	𝍸𝍸𝍸𝍸 IIII	X				
	9 Scirpus cyperinus	𝍸 IIII	X				
F	11 Juncus sp 1 (acuminatus?)	𝍸𝍸 I					
F	6 unknown grass 2	𝍸 I					
F	5 Carex sp 1	𝍸					
F	2 Carex sp 2 (intumescens)	II					
F	1 Rumex obtusifolius	I				X	
F	1 Panicum clandestinum deertongue	I		X			
	1 Salix sp	I					
	1 Polygonum sagittatum	I	X				
	1 Pontederia cordata	I	X				
	1 Elodea canadensis	I	X				
	Total						

*Record individual tallies on back of this sheet.

Prevalence Index for this Transect: ______

Mean Prevalence Index for this Wetland: ______ (based on 3 or more transects)

Water Stryders
Damsel Fly

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Erzo Bridge	Date: 6-16-04
Applicant/Owner: SRI	County: Butler
Investigator: KARL MATHIAS / J REIDENBAUGH	State: Pa
Do Normal Circumstances exist on the site? (Yes) No	Community ID:
Is the site significantly disturbed (Atypical Situation)? Yes (No)	Transect ID: WL 2
Is the area a potential Problem Area? Yes (No)	Plot ID: P1
(If needed, explain on reverse)	

VEGETATION

	Dominant Plant Species	Stratum	Indicator		Dominant Plant Species	Stratum	Indicator
1.	Juncus effusus	H 80%	FACW+	9.			
2.	Typha latifolia	H 20%	OBL	10.			
3.	Sparganium Americanum	H 15%	OBL	11.			
4.	Leersia oryzoides	H <5%	OBL	12.			
5.	Scirpus cyperinus	H <5%	FACW+	13.			
6.				14.			
7.				15.			
8.				16.			

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-)

Remarks: Damsel Fly

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- ___ Other

___ No Recorded Data Available

Field Observations:
- Depth of Surface Water: 6 (in.)
- Depth to Free Water in Pit: ____ (in.)
- Depth to Saturated Soil: ____ (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- X Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Enzo Bridge	Date: 6-16-04
Applicant/Owner: SRI	County: BUTLER
Investigator: KARL MATHIAS / J. Reidenbaugh	State: PA
Do Normal Circumstances exist on the site? (Yes) No	Community ID:
Is the site significantly disturbed (Atypical Situation)? Yes (No)	Transect ID: WL2
Is the area a potential Problem Area? Yes (No)	Plot ID: PIE
(If needed, explain on reverse)	

VEGETATION

	Dominant Plant Species	Stratum	Indicator		Dominant Plant Species	Stratum	Indicator
1.				9.			
2.	Juncus effusus	H 50%	FACW+	10.			
3.	Sparganium Americanum	H 30%	OBL	11.			
4.	Leersia oryzoides	H 20%	OBL	12.			
5.	Typha latifolia	H 15%	OBL	13.			
6.	unidentified sedge	H 10%	—	14.			
7.				15.			
8.				16.			

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-)

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):	Wetland Hydrology Indicators:
___ Stream, Lake, or Tide Gauge	Primary Indicators:
___ Aerial Photographs	X Inundated
___ Other	___ Saturated in Upper 12 Inches
___ No Recorded Data Available	___ Water Marks
	___ Drift Lines
Field Observations:	___ Sediment Deposits
Depth of Surface Water: 4 (in.)	___ Drainage Patterns in Wetlands
	Secondary Indicators (2 or more required):
Depth to Free Water in Pit: ___ (in.)	___ Oxidized Root Channels in Upper 12 Inches
	___ Water-Stained Leaves
Depth to Saturated Soil: ___ (in.)	___ Local Soil Survey Data
	___ FAC-Neutral Test
	Other (Explain in Remarks)

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: ERICO BRIDGE	Date: 6-16-04
Applicant/Owner: SRI	County: BUTLER
Investigator: Kurt Matthews / J. Reitenbaugh	State: PA
Do Normal Circumstances exist on the site? Yes No	Community ID:
Is the site significantly disturbed (Atypical Situation)? Yes No	Transect ID: WL7
Is the area a potential Problem Area? Yes No	Plot ID: P2
(If needed, explain on reverse)	

VEGETATION

	Dominant Plant Species	Stratum	Indicator	% Cover		Dominant Plant Species	Stratum	Indicator	% Cover
1.	Eleocharis sp	H	-	<5%	9.				
2.	Polygonum sp	H	-	<5%	10.				
3.	Leersia oryzoides	H	OBL	<5%	11.				
4.					12.				
5.					13.				
6.					14.				
7.					15.				
8.					16.				

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-)

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks): ___ Stream, Lake, or Tide Gauge ___ Aerial Photographs Other X No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: ___ Inundated ___ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits ___ Drainage Patterns in Wetlands
Field Observations: Depth of Surface Water: 15 (in.) Depth to Free Water in Pit: - (in.) Depth to Saturated Soil: ___ (in.)	Secondary Indicators (2 or more required): ___ Oxidized Root Channels in Upper 12 Inches ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test Other (Explain in Remarks)

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Cran bridge	Date: 6-16-04
Applicant/Owner: SRI	County: Butler
Investigator: Jeff R Karl MATHIAS	State: Pa
Do Normal Circumstances exist on the site? **(Yes)** No	Community ID:
Is the site significantly disturbed (Atypical Situation)? Yes **(No)**	Transect ID: WL 2
Is the area a potential Problem Area? Yes **(No)**	Plot ID: P3
(If needed, explain on reverse)	

VEGETATION

Dominant Plant Species	Stratum	Indicator	% Cover	Dominant Plant Species	Stratum	Indicator	% Cover
1. Juncus Effusus	H	FACW+	25	9.			
2. Juncus Sp	H	—	20%	10.			
3. Scirpus cyperinus	H	FACW+	10%	11.			
4. Leersia Oryzoides	H	OBL	<5%	12.			
5. Carex Sp.	H	—	<5%	13.			
6. Sparganium Americanum	H	OBL	<5%	14.			
7. Eleocaris Sp	H	—	<5%	15.			
8. Elodea canadensis	H	OBL	<5%	16.			

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-)

Remarks:

HYDROLOGY

__ Recorded Data (Describe in Remarks): __ Stream, Lake, or Tide Gauge __ Aerial Photographs Other __ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: X Inundated __ Saturated in Upper 12 Inches __ Water Marks __ Drift Lines __ Sediment Deposits __ Drainage Patterns in Wetlands
Field Observations: Depth of Surface Water: 3 (in.) Depth to Free Water in Pit: __ (in.) Depth to Saturated Soil: __ (in.)	Secondary Indicators (2 or more required): __ Oxidized Root Channels in Upper 12 Inches __ Water-Stained Leaves __ Local Soil Survey Data __ FAC-Neutral Test __ Other (Explain in Remarks)

Remarks:

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: Enco Bridge	Date: 6-16-04
Applicant/Owner: SEI	County: Butler
Investigator: Jeff Kohl Matthias	State: Pa.
Do Normal Circumstances exist on the site? **(Yes)** No	Community ID:
Is the site significantly disturbed (Atypical Situation)? Yes **(No)**	Transect ID: WL2
Is the area a potential Problem Area? Yes **(No)**	Plot ID: P3E
(If needed, explain on reverse)	

VEGETATION

	Dominant Plant Species	Stratum	Indicator	% Cover		Dominant Plant Species	Stratum	Indicator	% Cover
1.	Juncus effusus	H	FACW+	25%	9.				
2.	Scirpus cyperinus	H	FACW+	10%	10.				
3.	Juncus sp	H	—	20%	11.				
4.	Carex sp1	H	—	<5%	12.				
5.	Carex sp2	H	—	10%	13.				
6.	Eleocharis obtusa	H	OBL	<5%	14.				
7.					15.				
8.					16.				

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-)

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks): ___ Stream, Lake, or Tide Gauge ___ Aerial Photographs Other ___ No Recorded Data Available	Wetland Hydrology Indicators: Primary Indicators: X Inundated ___ Saturated in Upper 12 Inches ___ Water Marks ___ Drift Lines ___ Sediment Deposits ___ Drainage Patterns in Wetlands
Field Observations: Depth of Surface Water: 1 (in.) Depth to Free Water in Pit: ___ (in.) Depth to Saturated Soil: ___ (in.)	Secondary Indicators (2 or more required): ___ Oxidized Root Channels in Upper 12 Inches ___ Water-Stained Leaves ___ Local Soil Survey Data ___ FAC-Neutral Test Other (Explain in Remarks)

Remarks:

POINT INTERCEPT DATA FORM (Form V3)

Site Name: WLZ **Date:** 6-16-09
Site Location: ERICO BRIDGE (Street) BUTLER (County) BOYERS (Town) PA (State)
Investigator: KARL MATHIAS, Jeff Reidenbaugh
Affiliation: AQUASCAPE

Monitoring Year: X 1 __ 2 __ 3 __ 4 __ 5 __ 6 __ 7 __ 8 __ 9 __ 10 __

Point Intercept Sampling Results

Transect No. 1

	Plant Species	Total Occurrences* ||||| ||||| ||	OBL	FACW	FAC	FACU	UPL
F	57 Juncus effusus	||||| ||||| ||||| ||||| ||||| ||||| |||||		X			
B F	17 Sparganium americanum	||||| ||||| ||||| ||	X				
F	27 Typha latifolia	||||| ||||| ||||| ||||| ||||| ||	X				
B F	15 Juncus sp	||||| ||||| |||||					
F	26 Scirpus cyperinus	||||| ||||| ||||| ||||| |||||			X			
B F	18 Eleocharis obtusa	||||| ||||| ||||| |||	X				
B	16 Leersia oryzoides	||||| ||||| |||||		X				
F	6 Carex sp 1	|||||						
F	16 Scirpus atrovirens	||||| ||||| |||||		X				
F	2 Carex stricta	||	X				
F	1 Echinochloa sp							
?B	11 Pontederia cordata	||||| |||||		X				
	4 Dulichium arundinaceum	||||	X				
	7 Polygonum sp	||||| ||					
F	6 Nuphar lutea	|||||		X				
	15 unidentified grass 1	||||| ||||| |||||					
F	1 [illegible] validus			X				
	3 Eleocharis sp	|||					
	7 Rumex sp.	||||| ||					
F	19 Carex vulpinoidea	||||| ||||| ||||| ||||	X				
	2 Solidago sp.	||					
	2 Cornus sp.	||					
	1 Salix sp							
F	3 Gratiola neglecta	|||	X				
F	1 Pokeberry Phytolacca americana					X		
F	2 Rumex obtusifolius	||				X	
F	4 Carex sp 2	||||					
F	1 Dichanthelium Panicum clandestinum				X			
	1 Verbena hastata				X			
	2 glyceria sp.	||	X				
	Total						

*Record individual tallies on back of this sheet.

Prevalence Index for this Transect: ______

Mean Prevalence Index for this Wetland: ______ (based on 3 or more transects)

Hummingbird
Ladybug
Water strider
barn swallow
damsel fly

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	ERIC BRIDGE	Date:	6-16-04
Applicant/Owner:	SRI	County:	BUTLER
Investigator:	Karl Mathias / J. Reddenbaugh	State:	PA
Do Normal Circumstances exist on the site?	Yes No	Community ID:	
Is the site significantly disturbed (Atypical Situation)?	Yes No	Transect ID:	L-Shaped wetland
Is the area a potential Problem Area? (If needed, explain on reverse)	Yes No	Plot ID:	F1

VEGETATION

	Dominant Plant Species	Stratum	Indicator	% Cover		Dominant Plant Species	Stratum	Indicator	% Cover
1.	Polygonum sp	H	—	50%	9.				
2.	Juncus effusus	H	FACW+	20%	10.				
3.	Carex sp	H	—	15%	11.				
4.	Epilobium sp	H	—	10%	12.				
5.	Typha latifolia	H	OBL	10%	13.				
6.	Rumex obtusifolius	H	FACW-	<5%	14.				
7.	Carex vulpinoidea	H	OBL	<5%	15.				
8.	Leersia oryzoides	H	OBL	<5%	16.				

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-)

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- Other

___ No Recorded Data Available

Field Observations:

Depth of Surface Water: — (in.)

Depth to Free Water in Pit: 7 (in.)

Depth to Saturated Soil: 0 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- ___ Inundated
- X Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- Other (Explain in Remarks)

Remarks:

SOILS

Map Unit Name
(Series and Phase):

Drainage Class:

Field Observations
Confirm Mapped Type? Yes No

WRA

Profile Description:

Depth (inches)	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-8	A	2.5Y 4/2			
8+	B	5Y 4/1	5Y 5/2		

Hydric Soil Indicators:

- ___ Histosol
- ___ Histic Epipedon
- ___ Sulfidic Odor
- ___ Aquic Moisture Regime
- ___ Reducing Conditions
- X Gleyed or Low-Chroma Colors
- ___ Concretions
- ___ High Organic Content in Surface Layer in Sandy Soils
- ___ Organic Streaking in Sandy Soils
- ___ Listed on Local Hydric Soils List
- ___ Listed on National Hydric Soils List
- ___ Other (Explain in Remarks)

Remarks: 0-8 inches in recently placed material, mixed w/ mushroom compost
Blackened organic matter present in B horizon

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	Yes	No	Is this Sampling Point Within a Wetland?
Wetland Hydrology Present?	Yes	No	
Hydric Soils Present?	Yes	No	Yes No

Remarks:

POINT INTERCEPT DATA FORM (Form V3)

Site Name: L-SHAPED WETLAND **Date:** 6-16-04, 6-25-04

Site Location: ERICO BRIDGE (Street) BUTLER (County) BOYERS (Town) PA (State)

Investigator: KARI MATTHIAS, Jeff Reidenbaugh

Affiliation: AQUASCAPE

Monitoring Year: X 1 __ 2 __ 3 __ 4 __ 5 __ 6 __ 7 __ 8 __ 9 __ 10 __

Point Intercept Sampling Results

FISH - [illegible]
+ Many minnows & spawning [illegible]

Transect No.___

Plant Species	Total Occurrences*	OBL	FACW	FAC	FACU	UPL
F 21 Polygonum sp	21					
F 21 Epilobium sp	21					
F 32 Juncus effusus	32		X			
F 68 Typha latifolia	68	X				
3 Leersia oryzoides	3	X				
F 2 Rumex crispus	2				X	
F 3 Spiraea sp	3					
15 Eupatorium perfoliatum	15		X			
F 40 Verbena hastata	40		X			
10 Scirpus cyperinus	10		X			
F 7 Asclepias incarnata	7	X				
11 Populus tremula	11				X	
3 Rubus sp	3					
4 Potentilla sp [illegible]	4					
F 9 Carex vulpinoidea	9	X				
F 11 Carex sp 1	11					
F 1 Cirsium muticum	1	X				
F 18 Polygonum persicaria	18		X			
F 4 Carex sp 3	4					
38 Lemna minor	38	X				
water purslane 9 Ludwigia palustris	9	X				
2 Alisma plantago-aquatica	2	X				
8 Unidentified grass	8					
14 Salix sp	14					
F 7 Sparganium americanum	7	X				
F 2 Scirpus validus	2	X				
1 Typha angustifolia	1	X				
4 Mimulus Ringens	4	X				
3 Carex sp 2	3					
6 Juncus sp	6					
F 1 Scirpus atrovirens	1	X				
2 Gratiola sp	2					
Total						
F 4 Eleocharis obtusa	4	X				
2 Pond weed	2	X				
10 Impatiens capensis	10		X			

*Record individual tallies on back of this sheet.

Prevalence Index for this Transect: _______

Mean Prevalence Index for this Wetland: _______ (based on 3 or more transects)

dat-) Bird's nest

F 1 Cardamine pensylvanica	1	X				
1 Viburnum recognitum	1		X			

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site: ERICO BRIDGE	Date: 6-25-04
Applicant/Owner: SR 1	County: BUTLER
Investigator: KARL MATHIAS, Jeff Reidenbaugh	State: PA
Do Normal Circumstances exist on the site? Yes No	Community ID:
Is the site significantly disturbed (Atypical Situation)? Yes No	Transect ID: FLICK
Is the area a potential Problem Area? Yes No	Plot ID: A1
(If needed, explain on reverse)	

VEGETATION

	Dominant Plant Species	Stratum	Indicator	% Cover		Dominant Plant Species	Stratum	Indicator	% Cover
1.	LUDWIGIA PALUSTRIS	H	OBL	65%	9.	polygonum sp	H	—	<5%
2.	JUNCUS EFFUSUS	H	FACW+	20%	10.	lemna minor	H	OBL	<5%
3.	TYPHA LATIFOLIA	H	OBL	10%	11.	Eleocharis obtusa	H	OBL	<5%
4.	IMPATIENS CAPENSIS	H	FACW	10%	12.				
5.	Epilobium sp.	H	–	5%	13.				
6.	Dichanthelium clandestinum	H	FAC+	5%	14.				
7.	Hydrocotyle americana	H	OBL	<5%	15.				
8.	Leersia oryzoides	H	OBL	5%	16.				

Percent of Dominant Species that are OBL, FACW or FAC (excluding FAC-)

Remarks:

HYDROLOGY

___ Recorded Data (Describe in Remarks):
- ___ Stream, Lake, or Tide Gauge
- ___ Aerial Photographs
- Other

X No Recorded Data Available

Field Observations:
- Depth of Surface Water: 2" (in.)
- Depth to Free Water in Pit: — (in.)
- Depth to Saturated Soil: — (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- X Inundated
- ___ Saturated in Upper 12 Inches
- ___ Water Marks
- ___ Drift Lines
- ___ Sediment Deposits
- ___ Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- ___ Oxidized Root Channels in Upper 12 Inches
- ___ Water-Stained Leaves
- ___ Local Soil Survey Data
- ___ FAC-Neutral Test
- ___ Other (Explain in Remarks)

Remarks:

POINT INTERCEPT DATA FORM (Form V3)

Site Name: Flick Wetland transect **Date:** 6-25-05
Site Location: Erie Bridge / Butler / Boyers / Pa
Street / County / Town / State
Investigator: Jeff Reidenbaugh + Karl Mathias
Affiliation: AQUAScape

Monitoring Year: __1 __2 __3 __4 __5 __6 __7 __8 __9 __10 __

Point Intercept Sampling Results

Transect No.___

		Plant Species	Total Occurrences*	OBL	FACW	FAC	FACU	UPL
	8	Polygonum Sp.	卌 |||					
F	12	Juncus effusus	卌 卌 ||		X			
F	15	Typha latifolia	卌 卌 卌	X				
F	4	Sparganium Americanum	||||	X				
F	3	Rumex crispus	|||				X	
	7	Ludwigia Palustris	卌 ||	X				
	12	Impatiens Capensis	卌 卌 ||		X			
	7	Leersia oryzoides	卌 ||	X				
F	9	Carex vulpinoidea	卌 ||||	X				
	3	Spirea Sp	|||					
	4	Eupatorium perfoliatum	||||		X			
	5	Sambucus Canadensis	卌		X			
	5	Carex Sp 1	卌					
	3	Lemna minor	|||	X				
	3	Hydrocotyle americana	|||	X				
	2	Tussilago farfara	||				X	
F	9	Verbena Hastata	卌 ||||		X			
F	1	Epilobium Sp	|					
F	4	Scirpus Cyperinus	||||		X			
F	2	Eleocharis obtusa	||	X				
	8	Polygonum persicaria	卌 |||		X			
	3	Salix Sp	|||					
	3	unidentified grass	|||					
	6	Populus tremula	卌 |				X	
	2	Mimulus Ringens	||	X				
	4	Populus Grandidentata	||||				X	
F	1	Lycopus SP	|					
	1	Solidago sp	|					
	1	Osmunda Cinnamomea	|		X			
F	1	Epilobium hirsutum	|		X			
	1	Cirsium sp	|					
		Total						

*Record individual tallies on back of this sheet.

Prevalence Index for this Transect: _______

Mean Prevalence Index for this Wetland: _______ (based on 3 or more transects)