



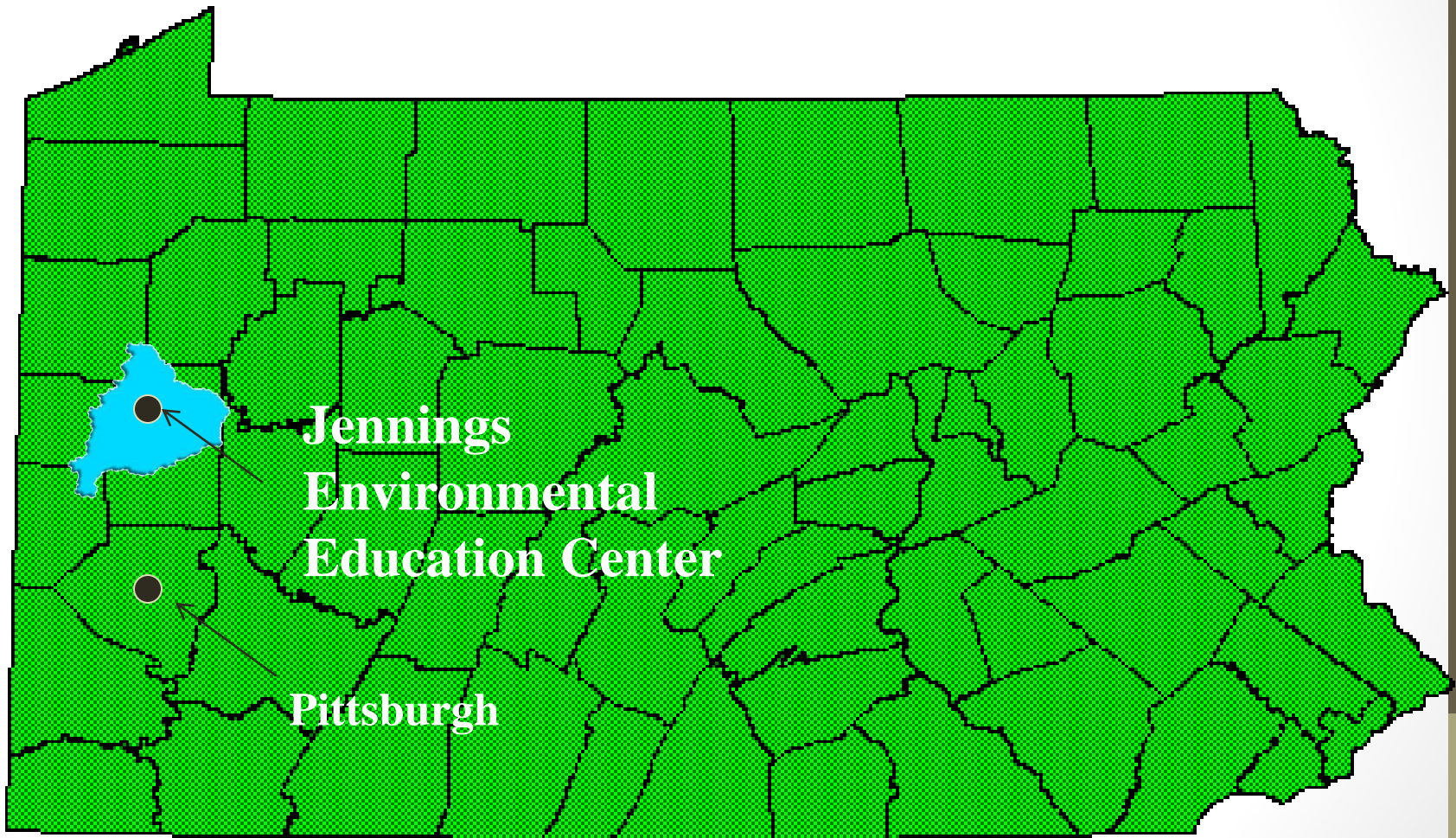
Jennings Passive Treatment System Rehabilitation



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Slippery Rock Creek Watershed

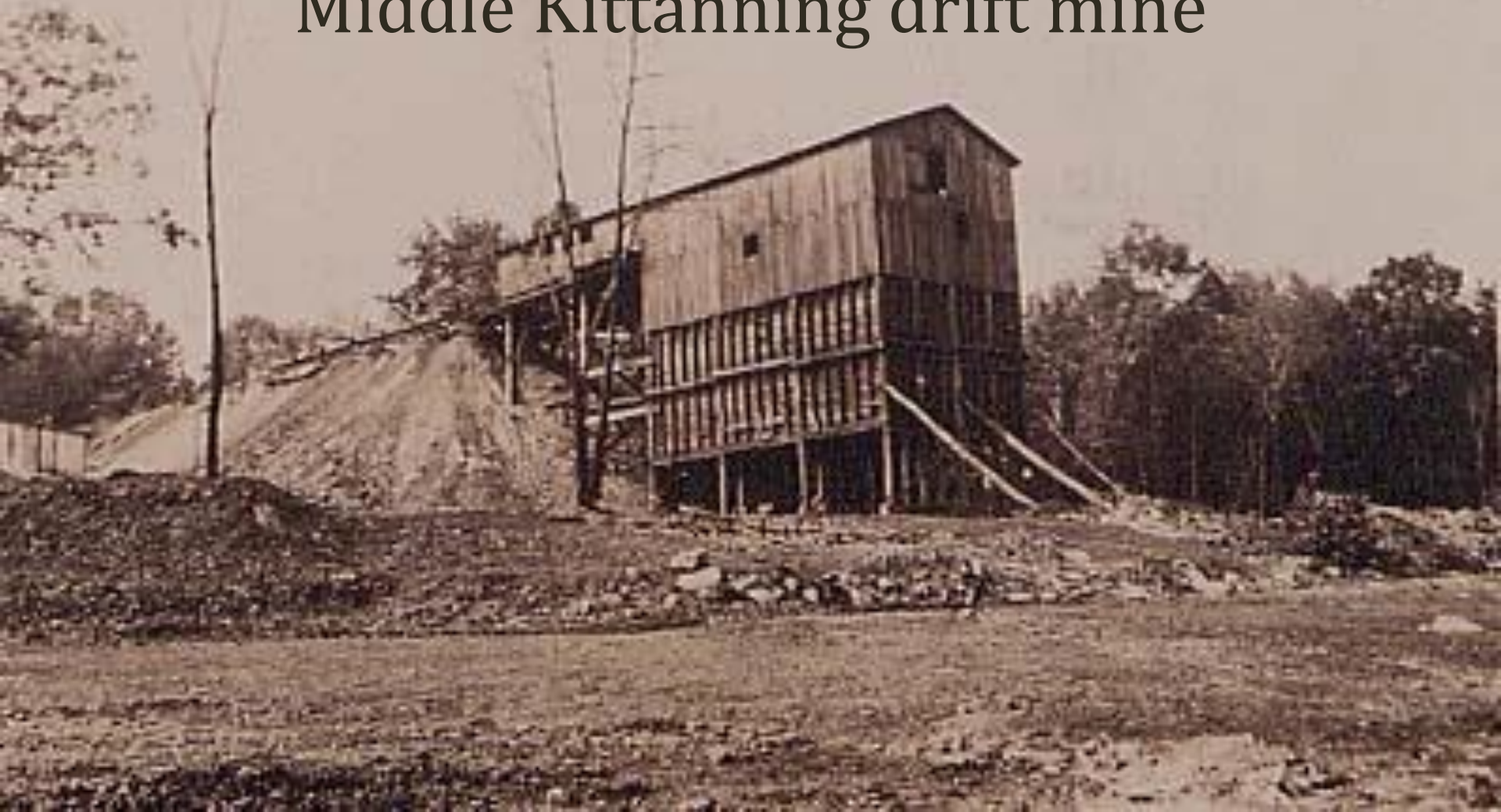


Jennings Background

- Special place
- Located within a PA State Park and Environmental Ed. Center
- One of the oldest, most monitored and successful passive treatment systems within Pennsylvania.
- Utilized for research by many organizations including the Slippery Rock Watershed Coalition, Stream Restoration Incorporated [non-profit], PA DEP, the former US Bureau of Mines, US Department of Energy, US Geological Survey, US Department of the Interior Office of Surface Mining, Slippery Rock University, Grove City College, Westminster College, etc.
- Educational program for thousands of people every year who have an opportunity to learn about the culture and history of coal mining in Pennsylvania as well as AMD, water treatment, and land reclamation
- Mining professionals from South Africa, South Korea, Australia, Brazil, and Peru have also visited the site to view the technologies being demonstrated.

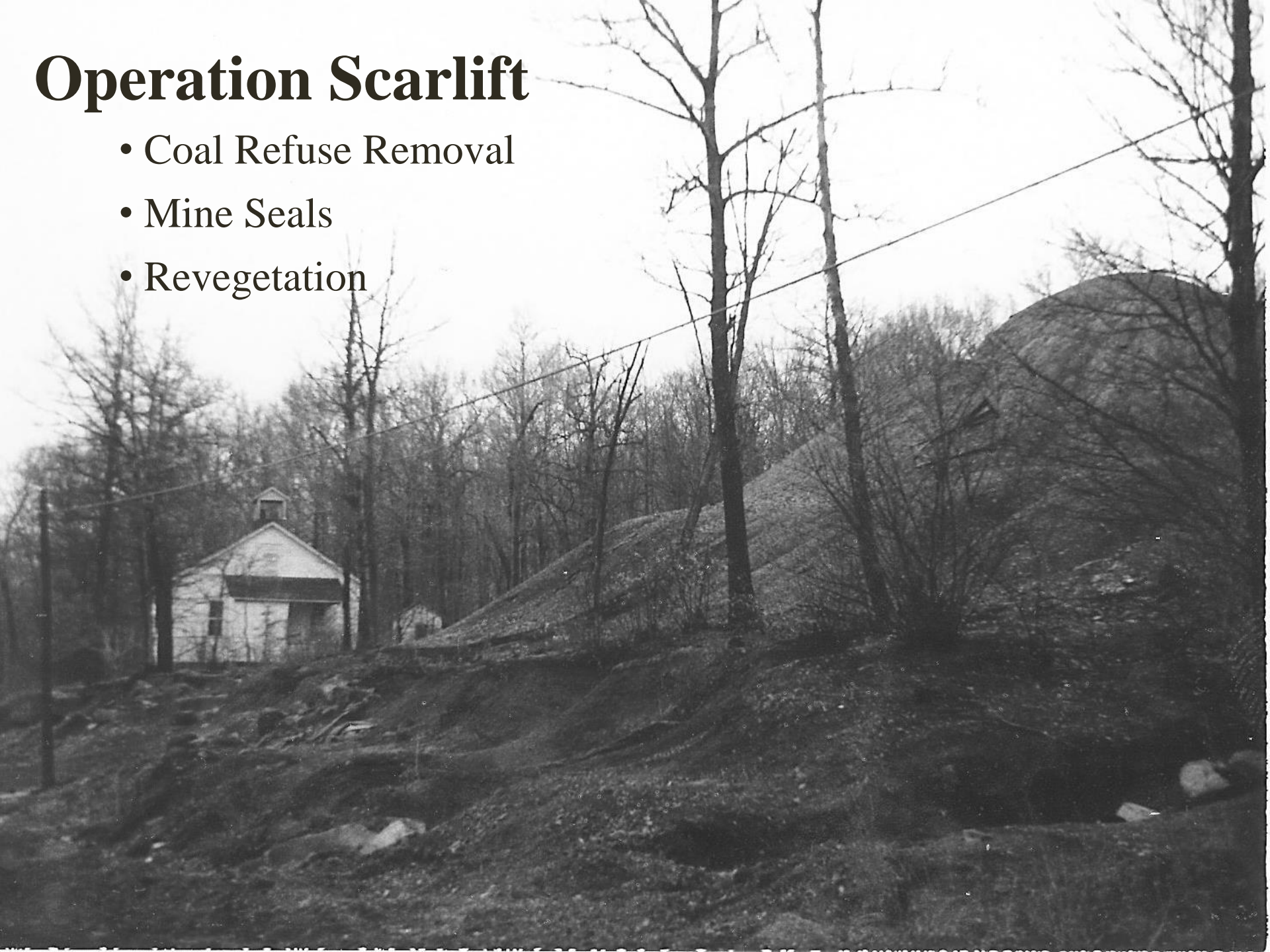
Brydon Mine

Operated Approximately 1935 to 1944
Middle Kittanning drift mine



Operation Scarlift

- Coal Refuse Removal
- Mine Seals
- Revegetation



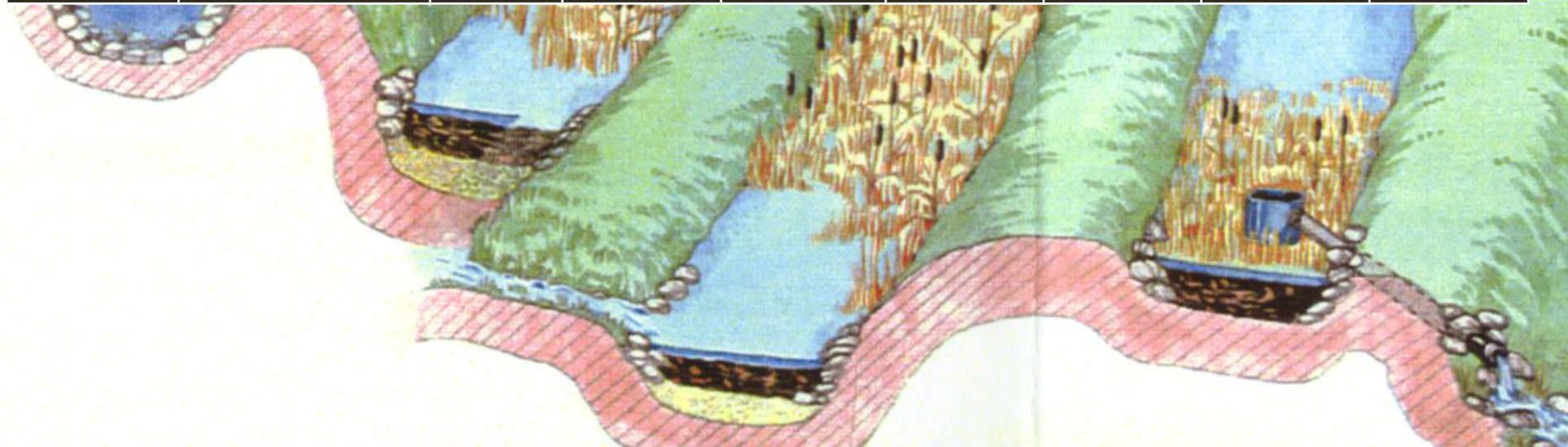
Mine Seal Blowout ~1984





Original Wetlands System Constructed ~1988

Point	Flow LPM (GPM)	pH	Alk mg/L	Acid mg/L	T. Fe mg/L	T. Al mg/L	T. Mn mg/L	SO4 mg/L
In	129 (34)	2.9	0	258	22	19	6	516
Out	NA	3.3	0	154	15	14	6	519



ALD – Installed 1993

Plugged with Al within ~9 months

Point	Flow LPM (GPM)	pH	Alk mg/L	Acid mg/L	T. Fe mg/L	T. Al mg/L	T. Mn mg/L	SO4 mg/L
In	NA	3.3	0	NA	81	21	9	691
Out	92 (24)	6.3	177	NA	62	<1	9	680



1997 VFP Built – Student Labor



Completed VFP with Overdrain

- 300 Tons (272 Metric Tons) mushroom compost
- 280 Tons (345 Metric Tons) #9 limestone aggregate
- 7-10 year design life of substrate
- 2004 – 2007 would be expected to fail



Jennings History Continued

- Occasional maintenance such as stirring the treatment media in 2004 (7 yrs) and 2007 (10yrs) is believed to have extended the life of the media
- In 2011(14 yrs), neither backflushing nor stirring events that were conducted were able to effectively increase sufficient permeability for significant time period.
- Rehabilitation necessary



Jennings Water Quality

Components: VFP, Bioswale, SP, WLs

Construction/maintenance to date: VFP stirring (7/2004, 7/2007, 2011) and revamp, channel cleanout (education site)

AMD Source: Underground

Watershed: Slippery Rock Creek

City: Brady Township

County: Butler

State: Pennsylvania

Primary Funding Partners: PA DEP,
Foundation for PA Watersheds

Stream: Big Run

Water Quality (Avg.)

Parameter	Raw	Effluent
pH	3.0	6.6
alkalinity	0	50
acidity	260	-4
Fe	40	<1
Mn	10	6
Al	15	<1

Total metals mg/L, acidity and alkalinity as CaCO₃ mg/L

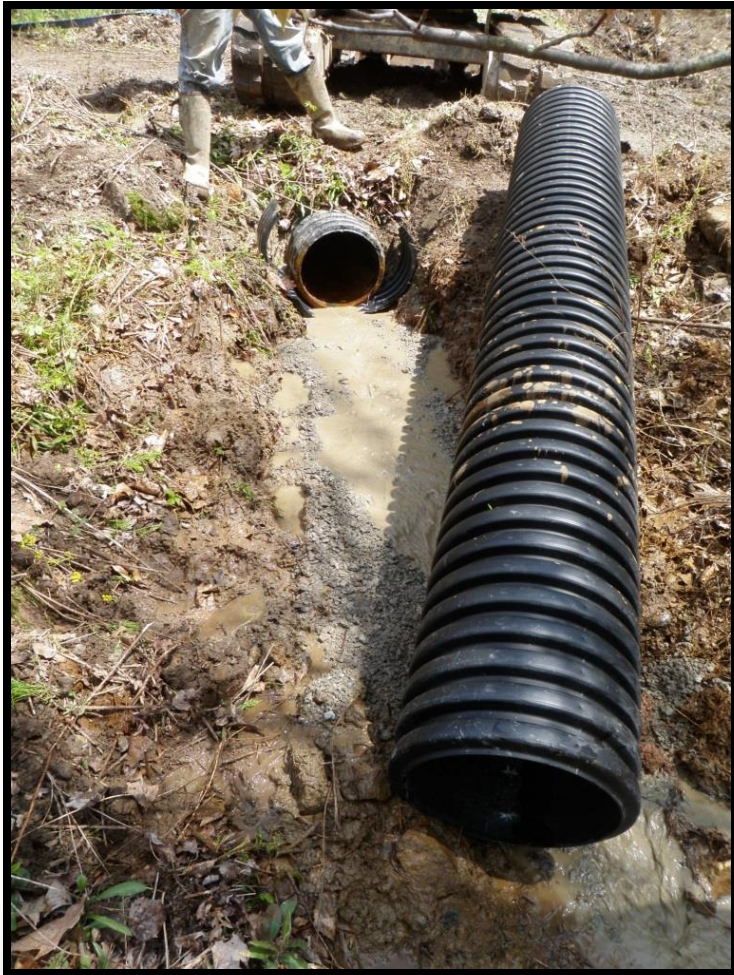
Jennings Rehab

- VFP drained to remove spent media – started April 18, 2012
- AMD diverted temporarily to AquaFix system for treatment



Jennings Rehab

- New culvert pipe installed for better truck access to bring in materials



Jennings Rehab

- Topsoil removed & stockpiled to create staging & encapsulation area
- Used Mineral CSA as pad to encapsulate old media/mix new media
- Mineral CSA Donated by Harsco Minerals



Jennings Rehab

- Spent media and clogged underdrain bedding stone was removed from VFP and placed on CSA pad – began May 9, 2012
- Removed clogged underdrain piping
- Spent media encapsulated within mineral CSA to prevent exposure to oxygen and to maintain an alkaline condition.









Jennings Rehab

- Topsoil placed on top of encapsulated spent media
- Seeded with warm season grasses
- Drainage ditch along toe of spent media to collect water and direct into the passive system



Jennings Rehab

- Non-reactive river gravel for underdrain bedding
- 2" underdrain piping installed
- New flush valve installed



Jennings Rehab

- Updated VFP water elevation control structure installed



New valves & raw water conveyance/ distribution system



Jennings Rehab



- New treatment media mixed by excavator and placed with loader
- 281 yds³ single shredded wood chips
- 281 yds³ spent mushroom compost
- 388 tons high CaCO₃ Vanport #8 limestone



Jennings Rehab

- Iron, vegetation, & debris removed from Bioswale to address overtopping of the berm & short-circuiting into lower wetland
- Inlet pool created



Water turned in back in July 5th
~ 3 months from start



Jennings Post-Rehab



Jennings Post-Rehab Data

June 2013

SAMPLE	Flow (gpm)	Field pH	Field Alk	Hot Acid	T. Fe	D. Fe	T. Mn	D. Mn	T. Al	D. Al	SO4
RAW	25	3.5	0	162	26	26	15	15	16	16	614
VFP	21	7.4	312	-178	0.4	0.4	13	12	0.2	<0.1	471
SP	21	7.5	250	-202	0.8	<0.1	0.8	0.8	0.1	<0.1	351
WL4	24	7.4	115	-84	0.4	0.1	0.3	0.4	0.1	<0.1	430

Alkalinity, acidity, sulfates, and metals in mg/L; Flow in gallons per minute

Jennings Post-Rehab Field Data

7-13-12 to 6-5-14

SAMPLE	Flow (gpm)	Field pH	Field Alkalinity	Field Iron
VFP	18	6.6	291	3
SP		7.0	257	1
WL4		6.8	82	<0.5

n is variable 20-30; alkalinity and iron in mg/L;
Flow in gallons per minute

Conclusions

- Acidic metal discharges can be successfully treated passively
- Maintenance (ex:stirring & backflushing) can increase system life
- End of treatment media life is not a failure
- System performance can be restored through rehabilitation
- Encapsulation appears to be valid option (at least so far = 2 years)



Acknowledgement

Project partners included:

- BioMost, Inc.
- Foundation for Pennsylvania Watersheds
- Harsco Mineral
- PA DEP's Growing Greener Program
- PA DCNR Bureau of State Parks
- Slippery Rock Watershed Coalition
- Stream Restoration Incorporated
- U.S. Office of Surface Mining
- Western PA Coalition for Abandoned Mine Reclamation

Thank You to everyone who made this project a success!!!

Questions?



Jennings Post-Rehab Data

SAMPLE	Flow (gpm)	Field pH	Lab pH	Field Alk	Lab Alk	Hot Acid	T. Fe	D. Fe	T. Mn	D. Mn	T. Al	D. Al	SO4
RAW	25	3.5	3.2	0	0	162	26.0	25.8	15.3	14.7	16.2	16.1	614
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SP	21	7.5	7.6	250	245	-202	0.8	<0.1	0.8	0.8	0.1	<0.1	351
WL4	24	7.4	7.5	115	107	-84	0.4	0.1	0.3	0.38	0.1	<0.1	430