TREATMENT SYSTEM RESTORATION AND POWER GENERATION IN THE SLIPPERY ROCK CREEK WATERSHED

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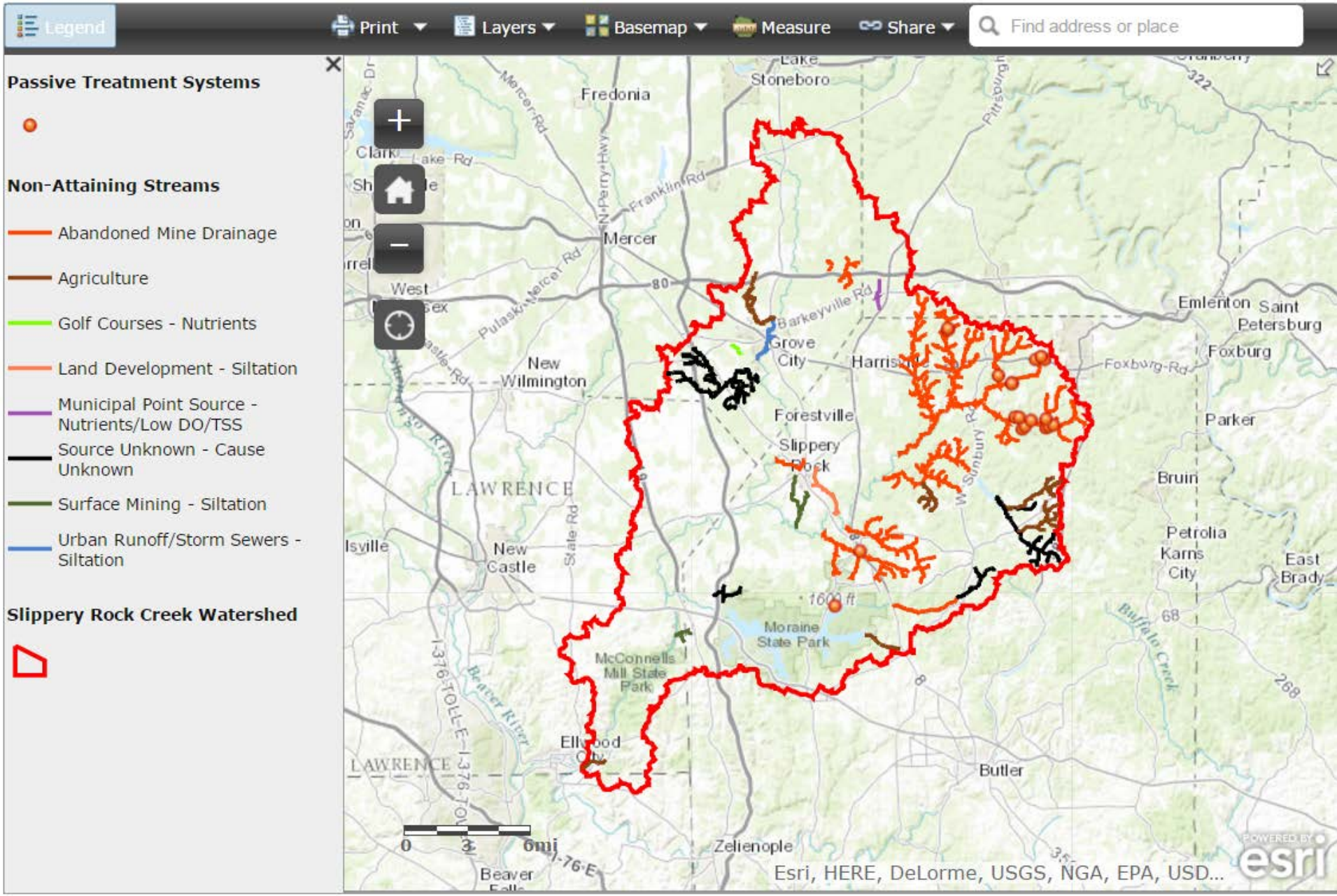
Slippery Rock Watershed

Slippery Rock Watershed Background

- Coal mining conducted in the area for over 100 years
- Approximately 25% of the watershed headwaters underlain by abandoned deep mine workings
- Approximately 50% of the watershed headwaters formerly permitted for surface mining
- SRWC over twenty years of work to address historic coal mining impacts in the SRC watershed

Impaired Stream Map



Slippery Rock Watershed Renaissance Initiative

- Three projects constructed/rehabilitated as part of grant funding
  - Erico Bridge Passive Treatment System (PTS)
  - McIntire PTS
  - Jennings Environmental Education Center PTS



Erico Bridge PTS Characteristics

AMD Source: Underground Refuse Venango Twp, Butler Co.

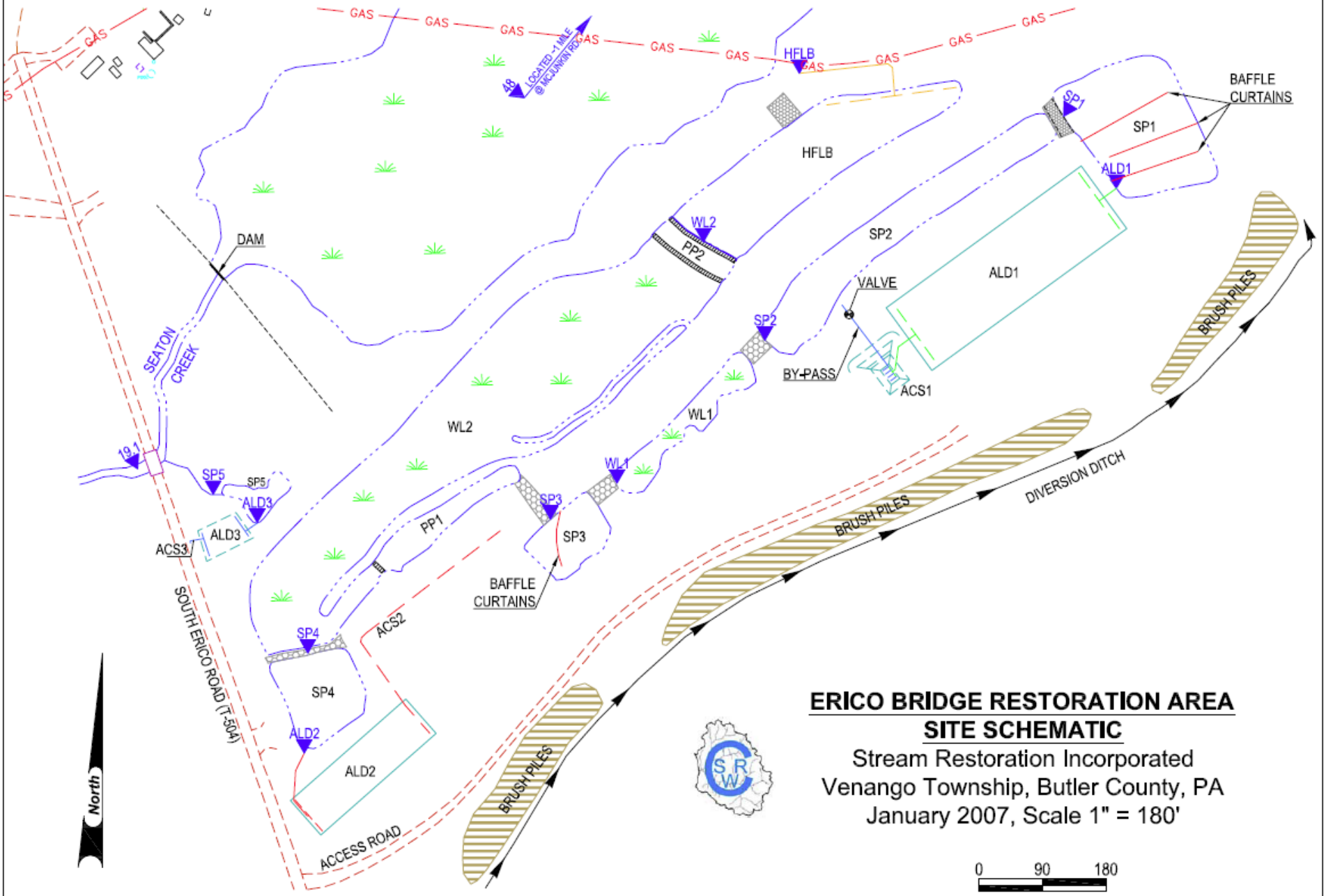
Funding:
Foundation for PA Watersheds, PA DEP Growing Greener

Stream: Seaton Creek

Water Quality (Avg.)

Parameter	ALD1 (Inlet)	HFLB (Effluent)
pH	6.43	6.92
alkalinity	185.26	100.83
acidity	neg	neg.
Fe	71.56	1.46
Mn	27.24	6.29
Al	0.65	<1

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



ERICO BRIDGE RESTORATION AREA
SITE SCHEMATIC

Stream Restoration Incorporated
Venango Township, Butler County, PA
January 2007, Scale 1" = 180'

Erico Bridge PTS

- In 2013, horizontal flow limestone bed (HFLB) became plugged
- Attempted backflushing, little improvement
- Stirring of HFLB recommended

Erico Bridge PTS

- Rehabilitation July-August 2015
- Sediment pond construction for retaining sludge
- Washing/stirring HFLB stone
- Improved design of HFLB

HFLB Draining

Beaver dam located at emergency spillway

Fe & Mn ‘flakes’ on spillway limestone

HFLB Drained

HFLB Stirring

Bulldozer used to keep sludge from settling while pumping

HFLB Stirring

Water pumped to a sludge pond via 6” hydraulic pump

HFLB Stirring

HFLB Stirring

Limestone was cleaned further with a water pump after the initial sludge layer was removed

HFLB Stirring

Limestone was cleaned further with a water pump after the initial sludge layer was removed

HFLB Stirring

Sludge/stone layering prior to cleaning

Limestone after cleaning

HFLB Stirring

A bypass valve was installed upgradient of the HFLB to simplify future maintenance activities.

HFLB Stirring

HFLB underdrain manifold replaced by outlet pool

System outlet cleared of vegetation and outlet pool constructed.

Pre/Post Maintenance Water Quality

SAMPLE DATE	SAMPLE ID	LAB PH	ALK. mg/L	IRON mg/L	MANG. mg/L	ALUM. mg/L
05/10/12	ALD	6.40	179.20	79.65	32.73	0.10
	HFLB	7.15	143.27	0.23	1.67	0.12
05/12/15	ALD	6.16	174.39	69.14	19.72	<0.10
	HFLB	7.07	143.84	<0.10	0.41	<0.10
9/17/15	ALD	6.32	151.03	65.66	26.14	<0.10
	HFLB	7.39	124.50	0.29	0.15	<0.10
11/17/15	ALD	6.32	176.93	81.95	29.17	0.13
	HFLB	7.28	119.93	0.25	0.33	0.18

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

Design Recommendations

- Beaver activity abatement
- Include sludge pond when designing site layout if large amounts of sludge are expected to be produced

McIntire PTS Characteristics

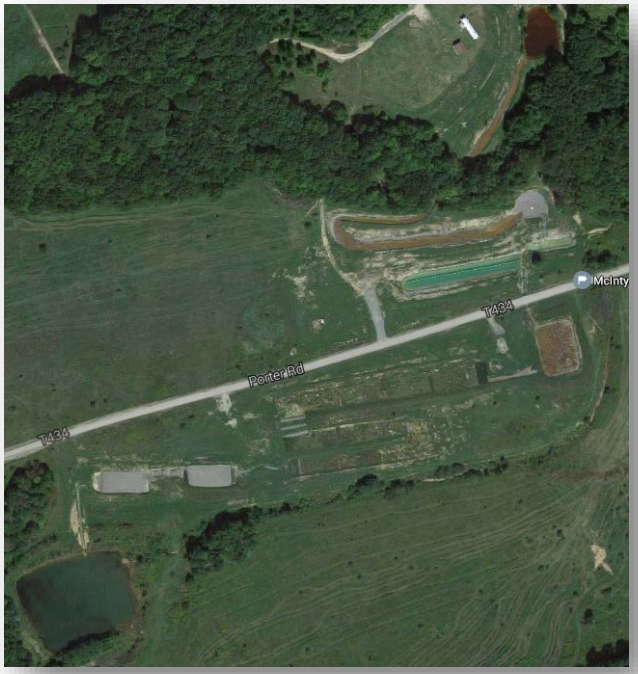
AMD Source: Underground, Refuse, Surface

Marion Twp, Butler Co.

Funding:

EPA Section 319

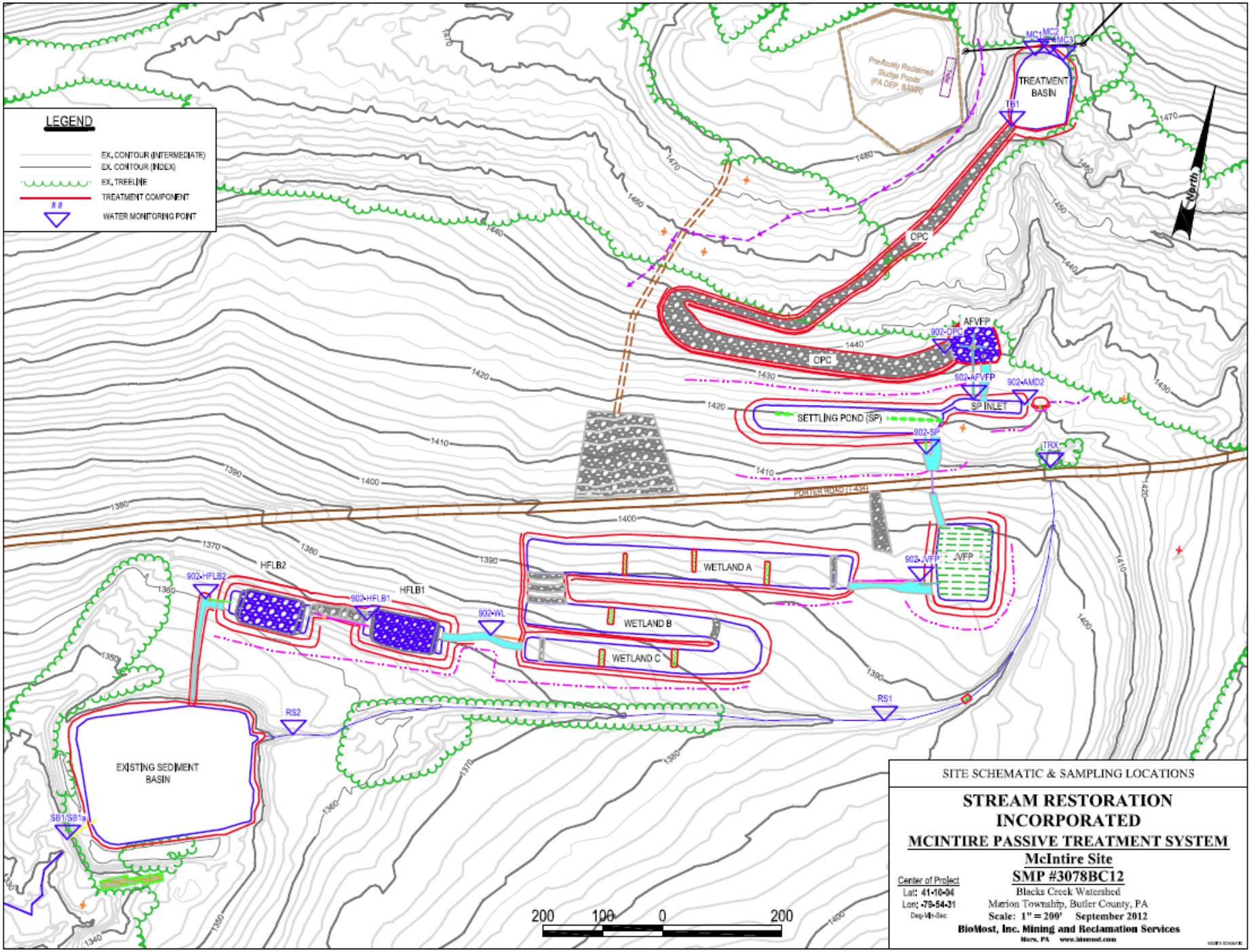
Stream: Blacks Creek



Water Quality (Avg.)

Parameter	MC2 (Raw)	SB1 (Effluent)
pH	2.71	7.01
alkalinity	0	81.83
acidity	743.46	neg.
Fe	258	0.4
Mn	76.99	3.58
Al	40.99	<1

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



SITE SCHEMATIC & SAMPLING LOCATIONS

STREAM RESTORATION INCORPORATED

MCINTIRE PASSIVE TREATMENT SYSTEM

McIntire Site

SMP #3078BC12

Blacks Creek Watershed

Marion Township, Butler County, PA

Center of Project
Lat: 41-10-04
Lon: -79-54-31
Deg-Min-Sec

Scale: 1" = 200' September 2012

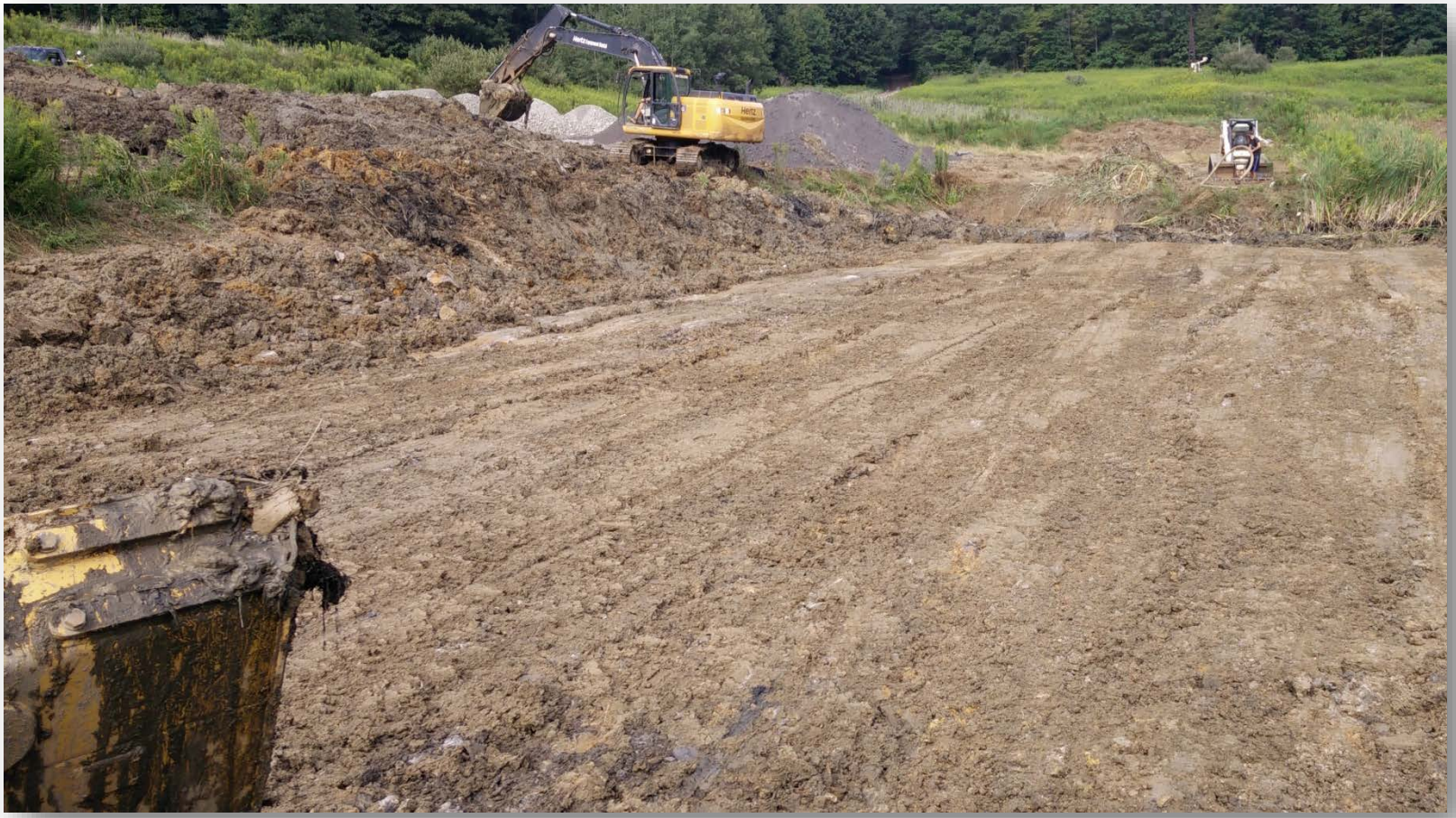
BioMost, Inc. Mining and Reclamation Services

Mars, PA www.biomost.com

McIntire PTS

- After construction, issues with water retention in wetlands
- Constructed on previously mined land
- Best available on-site material compacted & used to construct components

McIntire PTS



- Wetland substrate removed and stockpiled

McIntire PTS

- Harsco Mineral CSA used as lining material

McIntire PTS

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McIntire PTS

- Wetland substrate redistributed

McIntire PTS

- Water redirected to wetland cells

McIntire PTS

- Water redirected to wetland cells

McIntire PTS

- Fish present in sediment basin

McIntire PTS

- Issues with beaver activity at sediment basin

McIntire PTS

- Issues with beaver activity at sediment basin

Water Quality

SAMPLE DATE	SAMPLE ID	LAB PH	ALK. mg/L	IRON mg/L	MANG. mg/L	ALUM. mg/L
11/11/2015	MC2	2.87	ND	168	54.56	50.25
	SB1	6.79	70.51	1.29	1.61	0.1
3/22/2016	MC2	2.88	ND	146	52.76	64.46
	SB1	7.94	104.59	0.91	0.33	0.12

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

“The Beaver Deceiver”

- DeSale Phase II beaver dam issues

Design Recommendations

- Reduce potential for water leakage by using liners if known issues exist
  - building on mine spoil, rocky/sandy substrate
- Beaver activity abatement

Jennings Pico-Hydropower

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Jennings Pico-Hydropower

Stop for a good meal at North Country!

Thanks to our partners

- Harsco Minerals
- PA DEP
- Jennings Environmental Education Center
- Stream Restoration Inc.
- Slippery Rock Watershed Coalition

Any Questions?