

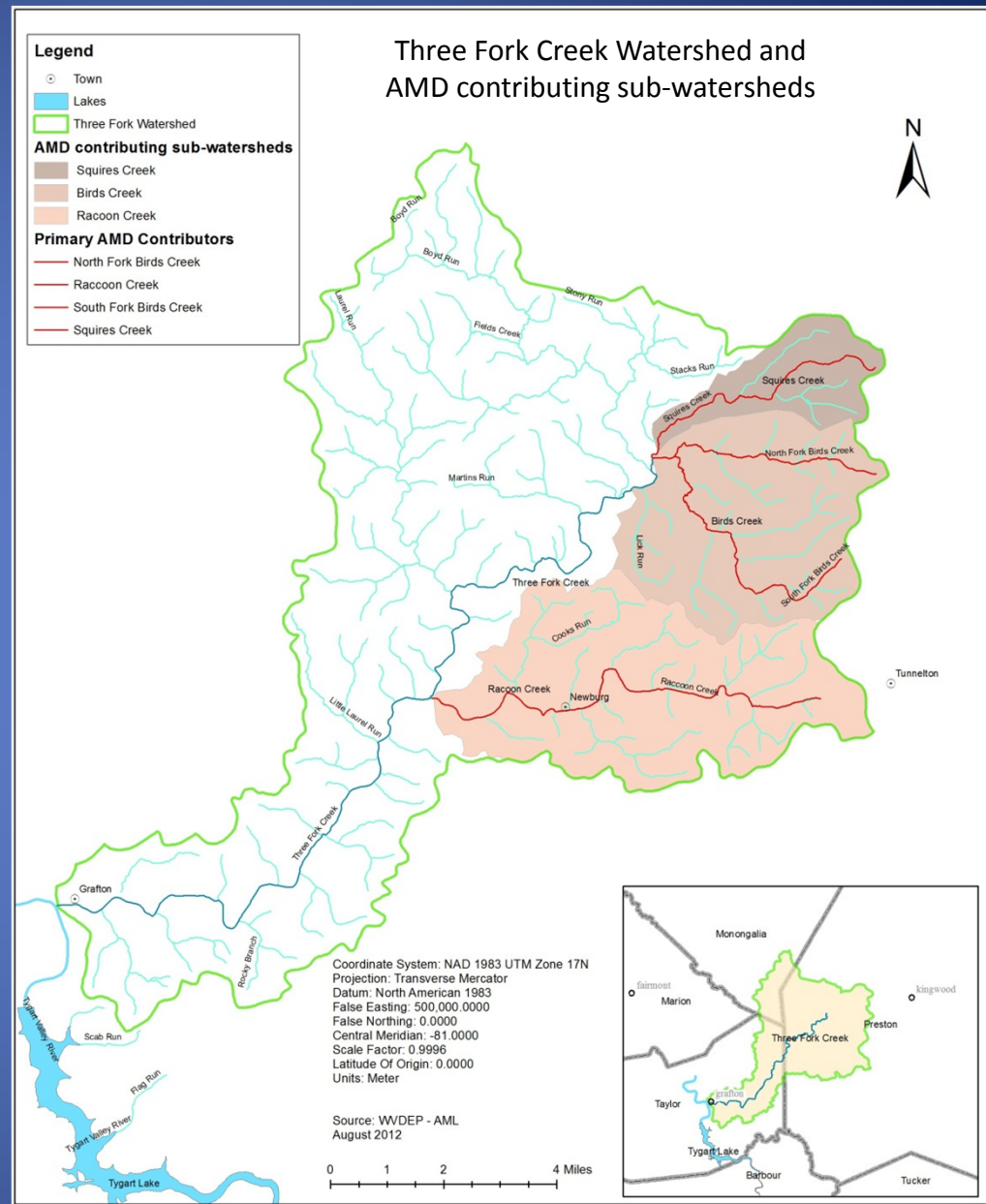


WV AML In-Stream Dosing for Treatment of AMD

West Virginia Department of
Environmental Protection
Office of Abandoned Mine Lands and
Reclamation

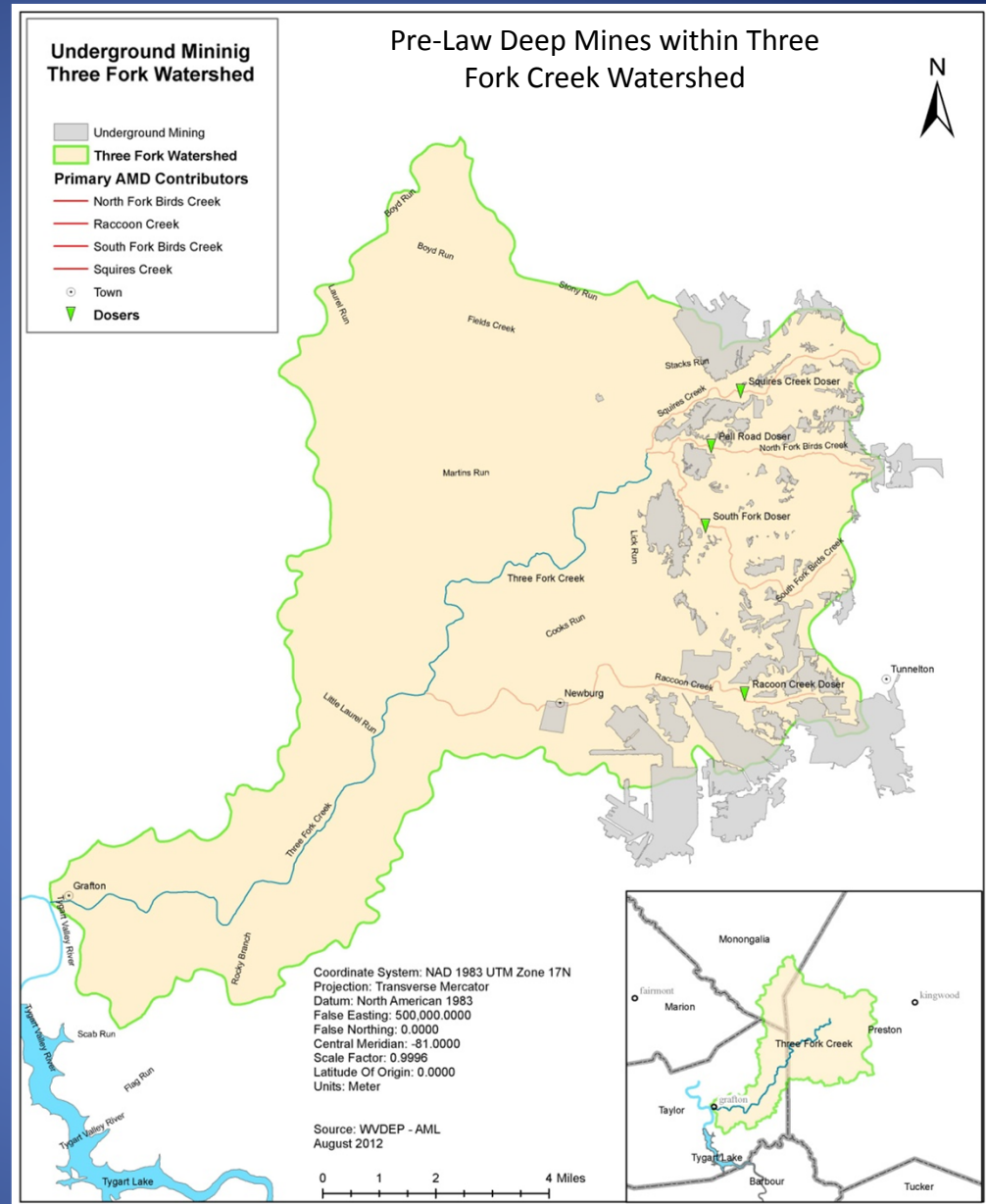
Three Fork Creek Watershed

- Located in Preston, Taylor and Monongalia Counties
- Headwaters predominantly in Preston county
- Drains 103 square miles
- ~20 miles from confluence to mouth
- Flows into the Tygart Valley River of the Monongahela River Basin
- Second Highest Contributor of AMD in the Monongahela River Basin



Sources of AMD within Three Fork Creek

- 4 tributaries contribute the majority of AMD to Three Fork Creek
 - Raccoon Creek
 - Squires Creek
 - North Fork Birds Creek
 - South Fork Birds Creek
- Headwaters located in Preston County have been mined extensively since the mid 1800's
- Approximately 9,100 acres of mine pools drain into Three Fork Creek
- Mining took place in the Upper Freeport, Middle Kittanning and Bakerstown coal seams.



AMD within Three Fork Creek

106 water quality samples collected by AML staff at 26 locations in Squires Creek and Raccoon Creek from seeps and portal discharges showed the following:

<u>Median pH - 2.9</u>	<u>Av. Total AL mg/L - 15.2</u>	<u>Av. Total Fe mg/L - 21.5</u>
<u>Max pH - 5.2</u>	<u>Max AL mg/L - 64</u>	<u>Max Fe mg/L - 145</u>
<u>Min pH - 2.4</u>	<u>Min AL mg/L - 0.12</u>	<u>Min Fe mg/L - 0</u>

Passive Treatment

WV AML program has constructed 47* forms of Passive treatment on 33 AML sites statewide (Excluding Limestone Channels). Frequently these systems initially performed as designed, but the performance rarely achieved the results or longevity predicted because of...

- Low pH with Elevated Metals
- High Flows
- Limited Space Availability

* Passive treatment systems include 8 ALD's, 2 ALB's, 11 SAPS, 4 Limestone Bed's, 13 Wetlands, 4 Compost/Limestone Wetlands, 1 Alkaline Pond, 1 Aerobic Treatment pond, 1 Buried limestone Leach Bed, 1 Steel Slag Holding Basin and 1 Injection Treatment

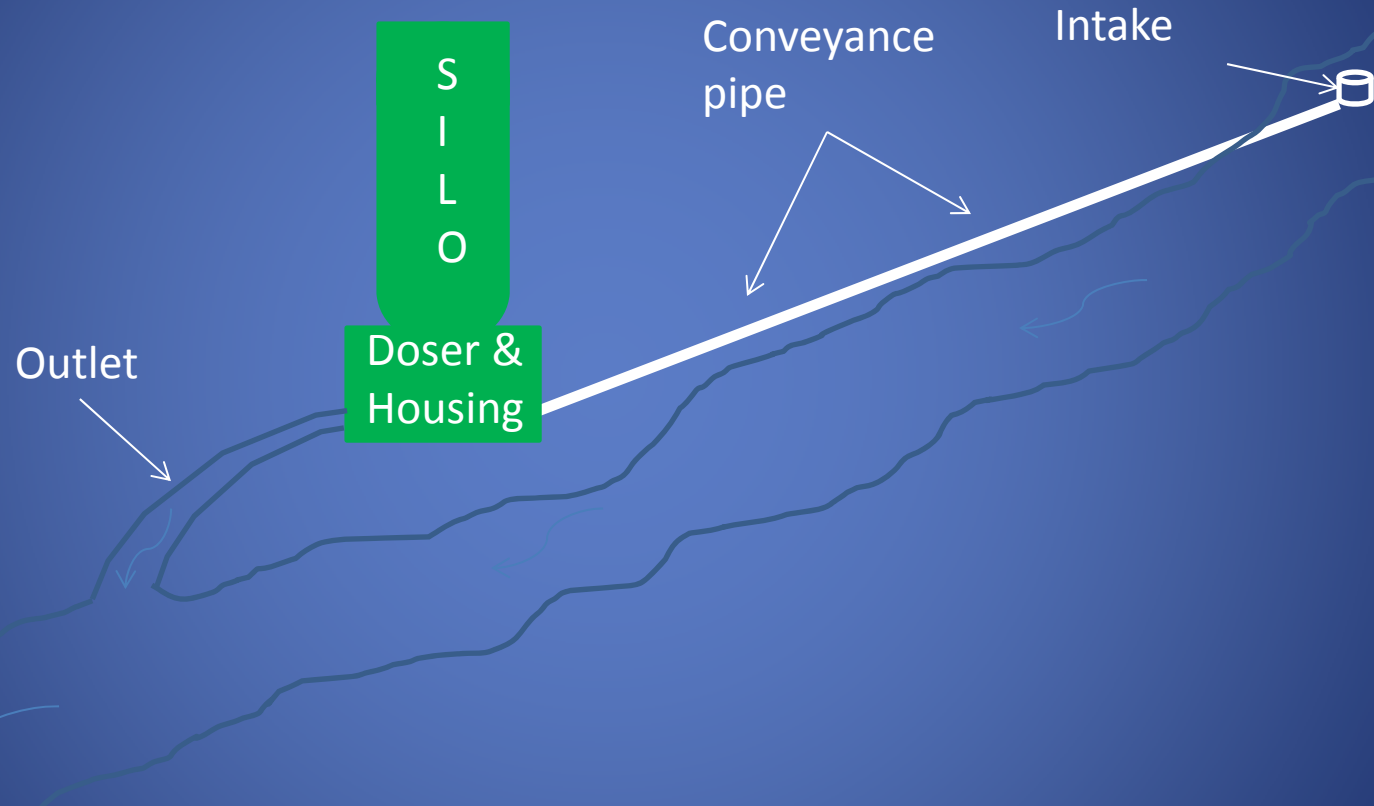
AML Use of Active Treatment for AMD

- Blackwater River Doser and Drum Station constructed in 1994. pH prior to construction was frequently less than 5 and since construction the pH has been maintained near 7 and has recovered 12 miles of the Blackwater River.
- Middle Fork River Limestone Fines Dumping Project initiated in 1995. pH prior to dumping was frequently less than 4 and since construction the pH has been maintained near 7 and has recovered approximately 30 miles of the mainstem and 89 miles of tributaries.
- These Systems allow the AML program to treat an entire watershed with the strategic placement of alkaline additions.

Deciding factors for the use of active treatment on Three Fork Creek

- AMD discharges too numerous to treat passively
- Water Quality not conducive to passive treatment
- Narrow valleys and steep hills limit amount of available and usable ground for construction of passive systems
- Previous success with Middle Fork and Blackwater
- Strategic placement of dosers would allow for treatment of the entire watershed

Basics of a doser system

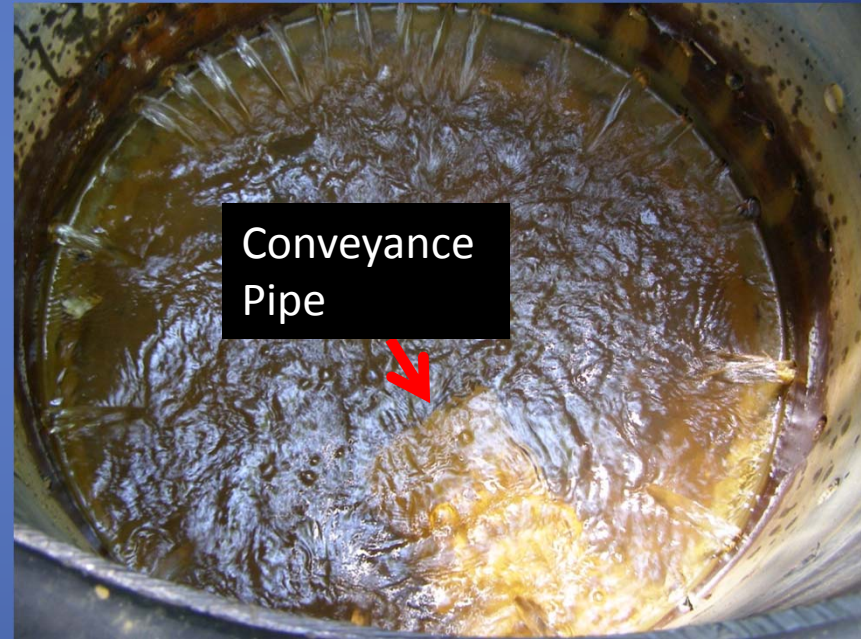


Intake

Raccoon Creek intake



Inside of Raccoon Creek intake



Doser Units

**Auger System on North Fork
Birds Creek**



**Tipping Bucket on South Fork
Birds Creek**



Outlets

South Fork Outlet



Raccoon Creek Outlet



Silos and lime delivery

North Fork Doser

- 30 ton silo
- Large truck landing developed adjacent to doser



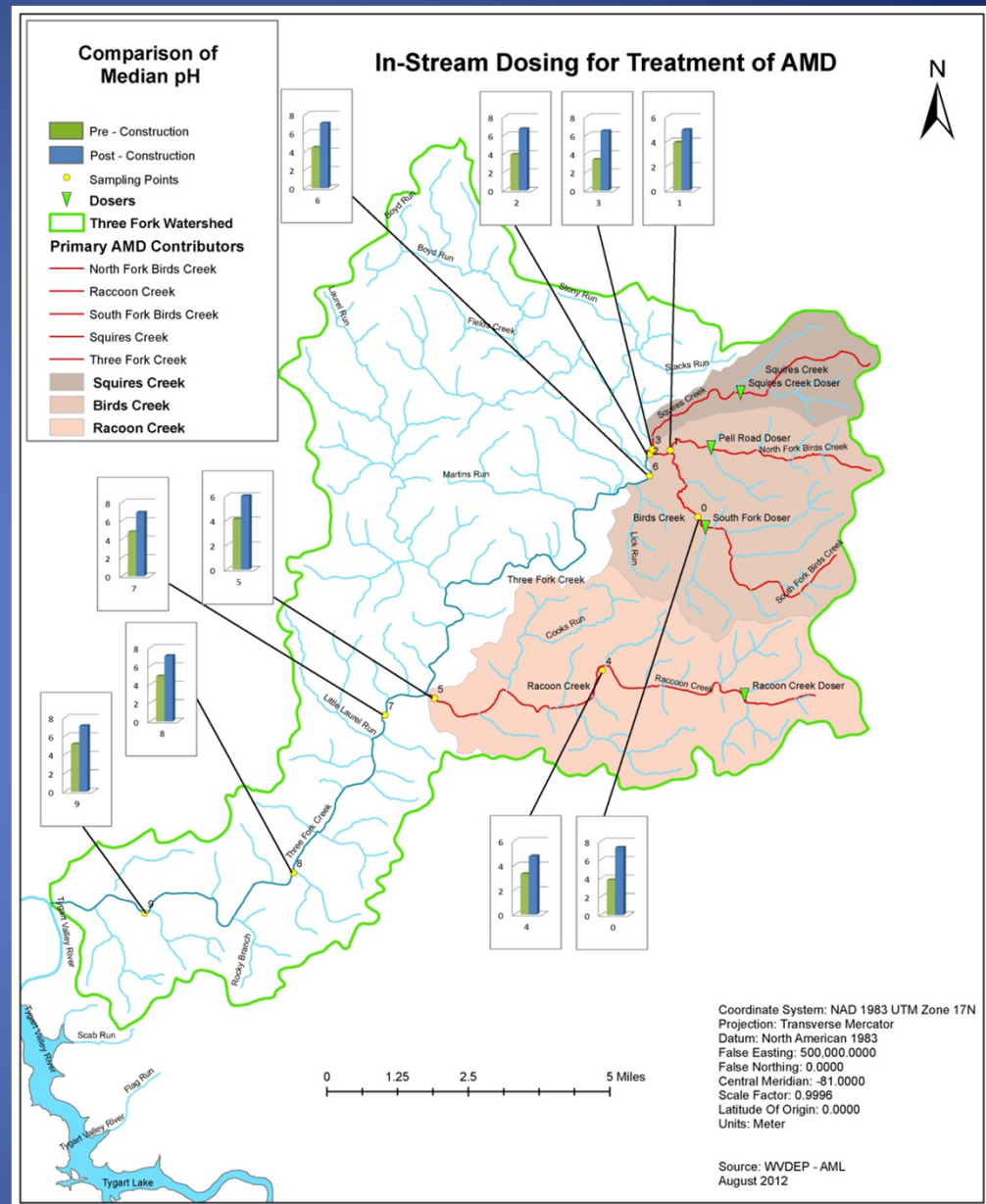
Squires Creek Doser

- 100 ton silo
- Calcium Oxide is blown in from landing above doser



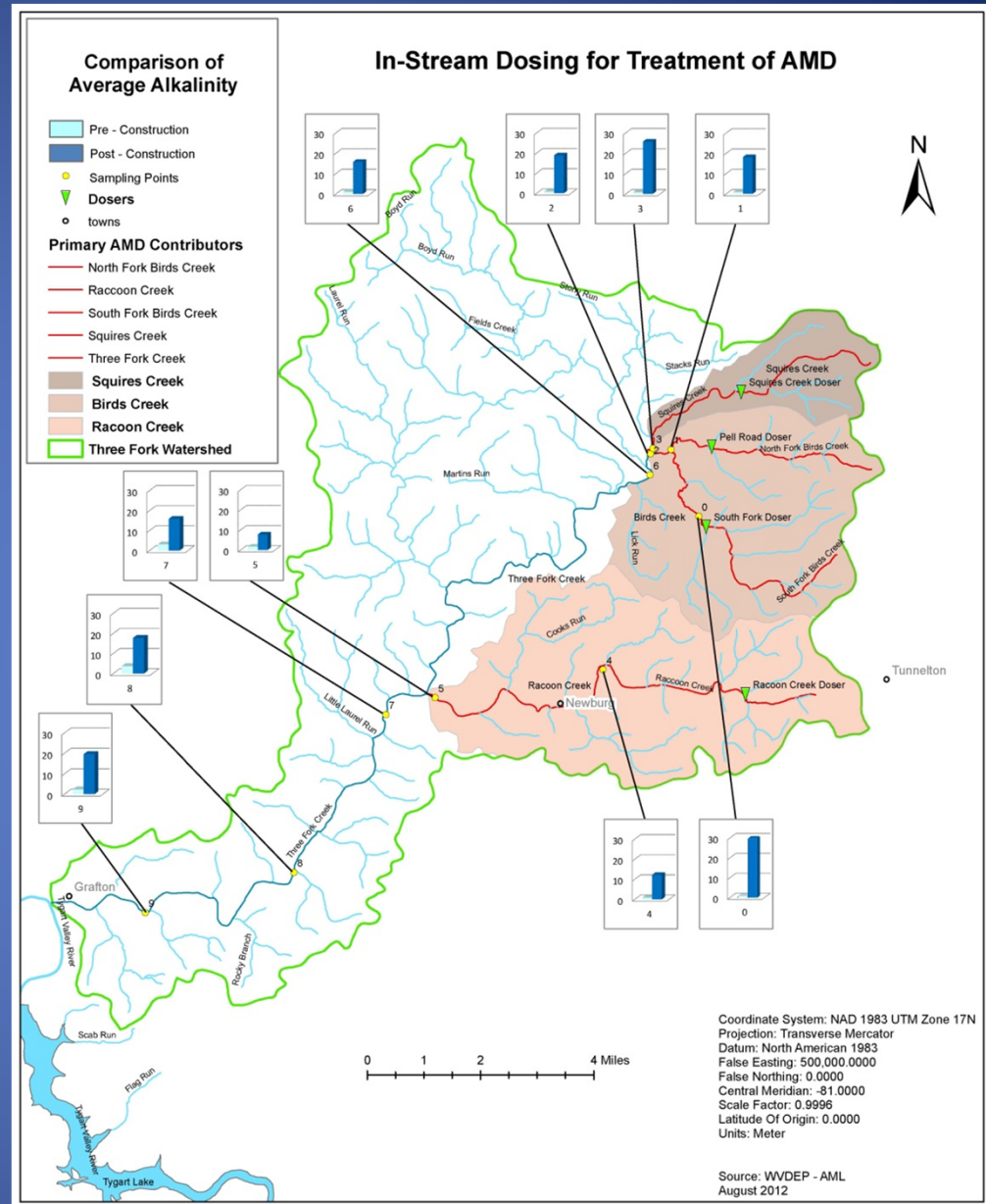
Median pH before and after dosing

- Median pH within Three Fork Creek prior to dosing ranged between 4.4 and 5.1
- Median pH after dosing has ranged between 6.9 and 7.08
- Tributary pH is much more variable with median pH at or very near 6



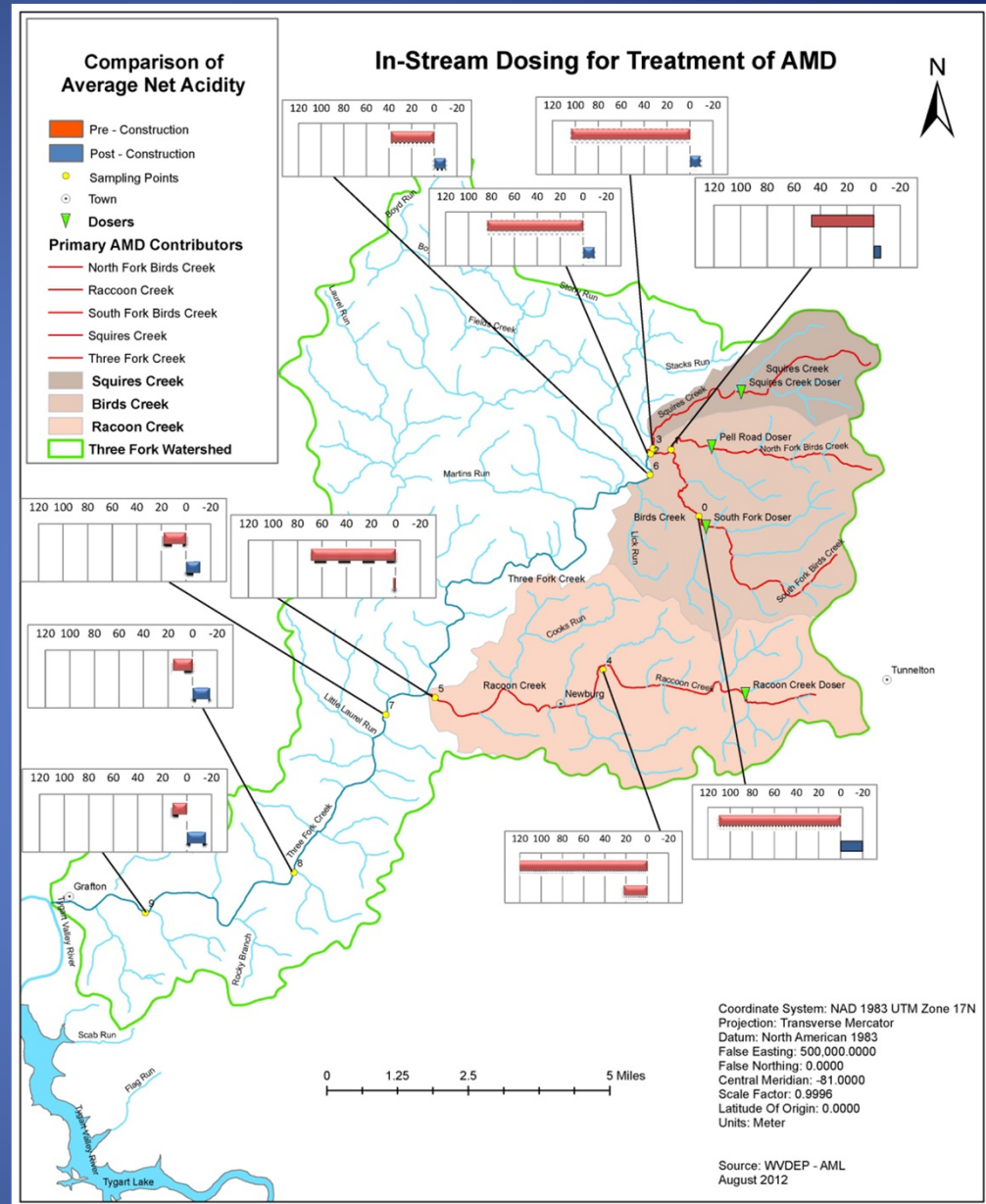
Average Alkalinity before and after dosing

- Alkalinity failed to exceed acidity prior to dosing within Three Fork Creek
- Since dosing alkalinity now consistently exceeds acidity



Average Net Acidity before and after dosing

- Prior to dosing Three Fork Creek and its tributaries display net acidic conditions.
- Since dosing, Three Fork Creek and all but one tributary display net alkaline conditions



Benthic Survey Results

Stream Name and Mile Point from Mouth	Date of Sample	WVSCI	# EPT	# Total taxa	Narrative Score
Three Fk (0.4)	2009	16.7	1	5	Impaired-Severely
Three Fk (0.4)	2012	74.1	8	15	Not Impaired - Good
Three Fk (5.7)	2009	42.5	2	5	Impaired-Moderately
Three Fk (5.7)	2012	59.5	5	9	Impaired-Slightly
Three Fk (9.62)	2009	50.4	2	5	Impaired-Slightly
Three Fk (9.62)	2012	40.0	4	11	Impaired-Moderately
Three Fk (17.4)	2009	48.2	3	8	Impaired-Slightly
Three Fk (17.4)	2012	58.4	6	14	Impaired-Slightly

Aquatic Survey

DEP Pre Dosing Survey

September 2010

- 1 Green Sunfish was caught

DEP Post Dosing Survey

August 2012

- 1,605 fish were caught representing 21 species of predator and prey fishes at the four sample locations

DEP Post Dosing Survey Continued

- 0.4 mile from mouth: 887 fish, 16 species
- 5.7 miles from mouth: 200 fish, 11 species
- 9.62 miles from mouth: 82 fish, 11 species
- 17.4 miles from mouth: 436 fish, 3 species
- Species of fish caught included: smallmouth bass, saugeye, green sunfish, rock bass, river chub, northern hog sucker, bluntnose minnow, central stoneroller, spotfin shiner, sand shiner, rosyface shiner, greenside darter, fantail darter, Johnny darter, blackside darter, logperch, yellow bullhead catfish, blacknose dace, striped shiner, white sucker,
- Several Juvenile fish captured indicated that successful reproduction is occurring

Post Dosing Aesthetics and Embeddedness

- Iron staining has been migrating upstream
- Positive feedback from locals
- Randomized pebble count or Embeddedness survey found that no change was observed at the two lower sample points and embeddedness had increased at the two upper sample points nearest the dosers.
- Embeddedness at the two upper sample points consisted of a mixture of algal growth, organic debris, metals precipitate, and true inorganic silt particles (apparently a by-product of treatment)
- Extremely low flow also likely contributed to the observed increase.

Squires Creek near mouth

Prior to dosing



Since dosing



Raccoon Creek near mouth

Prior to dosing



Since Dosing



Birds Creek Near Mouth

Prior to dosing



Since dosing



Three Fork Creek near Thornton

Prior to dosing



Since Dosing



Three Fork Creek Near Mouth

Prior to Dosing



Since Dosing

