



# In-Stream Lime Dosing for Treatment of Acid Mine Drainage

West Virginia Department of  
Environmental Protection

Office of Abandoned Mine Lands

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# Milky Way Galaxy



# Earth

**70% Water**

**<1% Available**

US Dept of State Geographer

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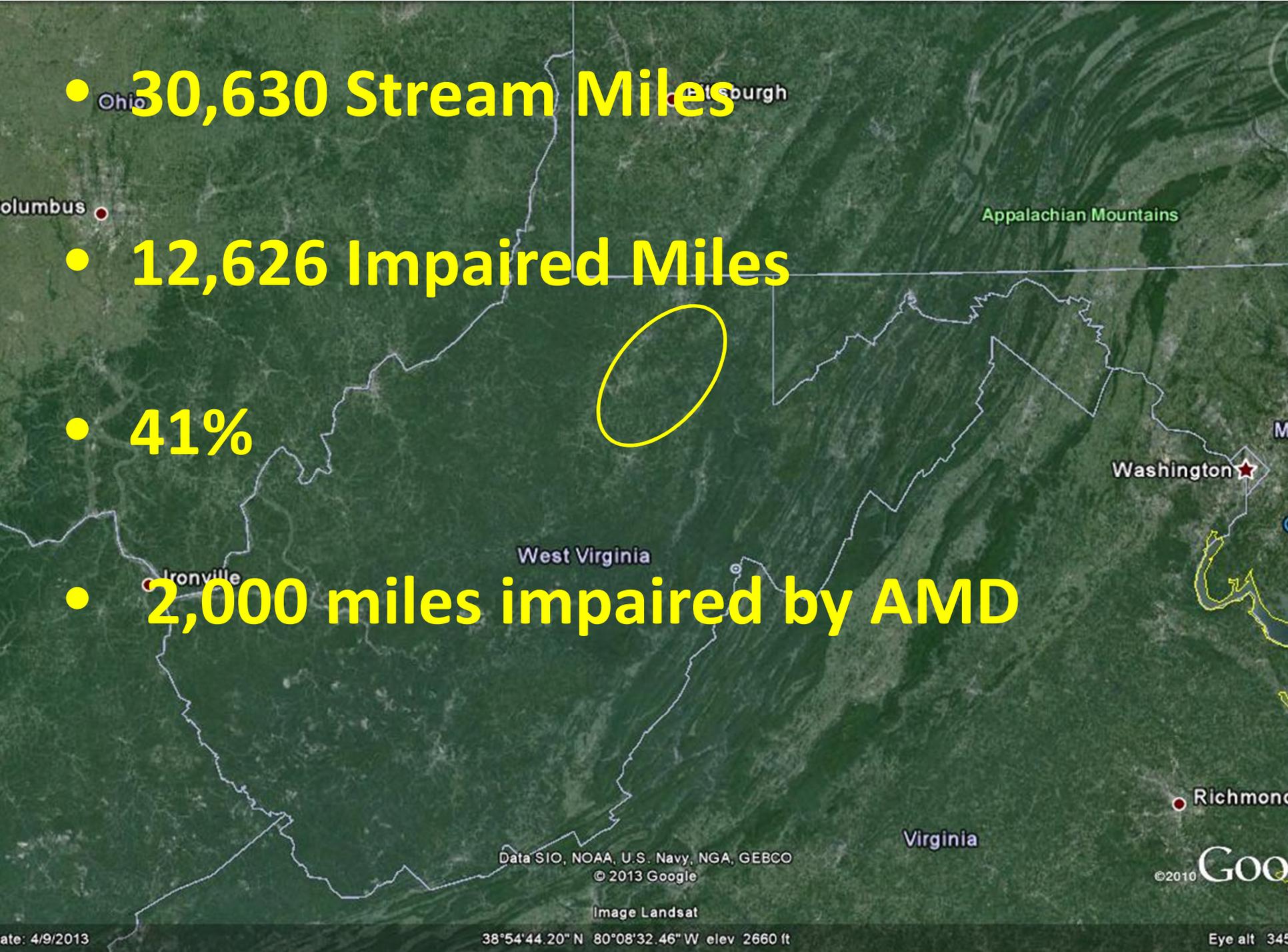
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

38°57'33.80" N 95°15'55.74" W elev 1015 ft

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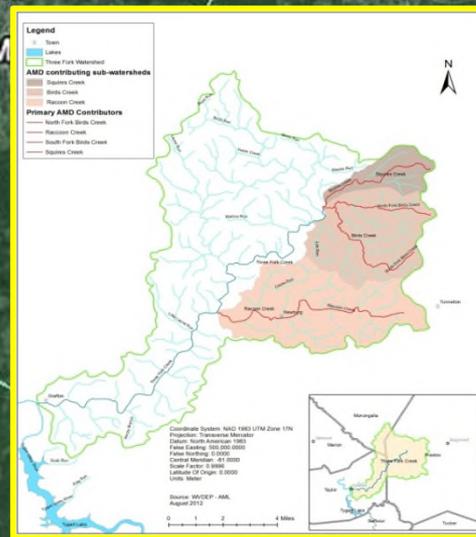
- **30,630 Stream Miles**
- **12,626 Impaired Miles**
- **41%**
- **2,000 miles impaired by AMD**



Monongalia

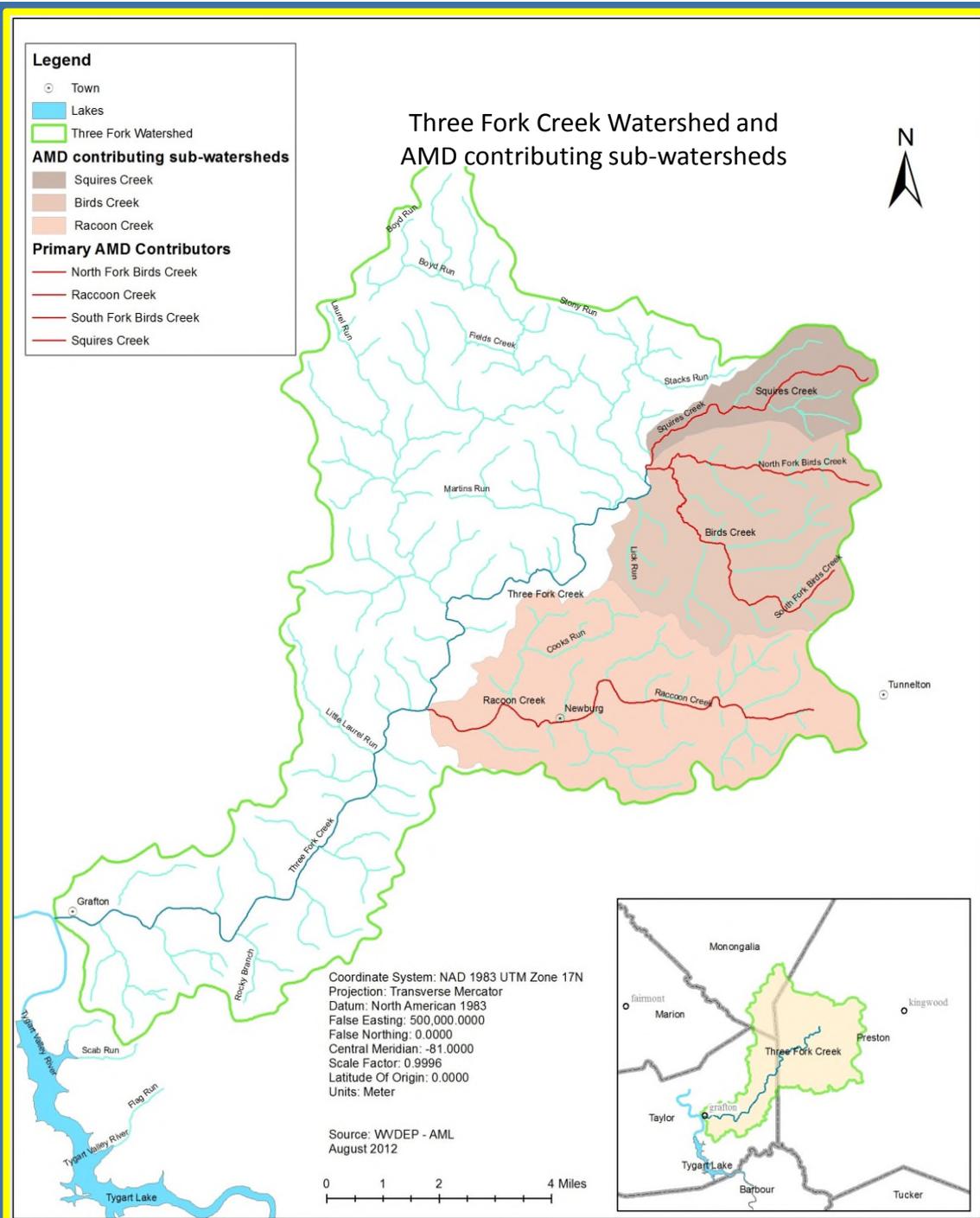
Preston

Taylor



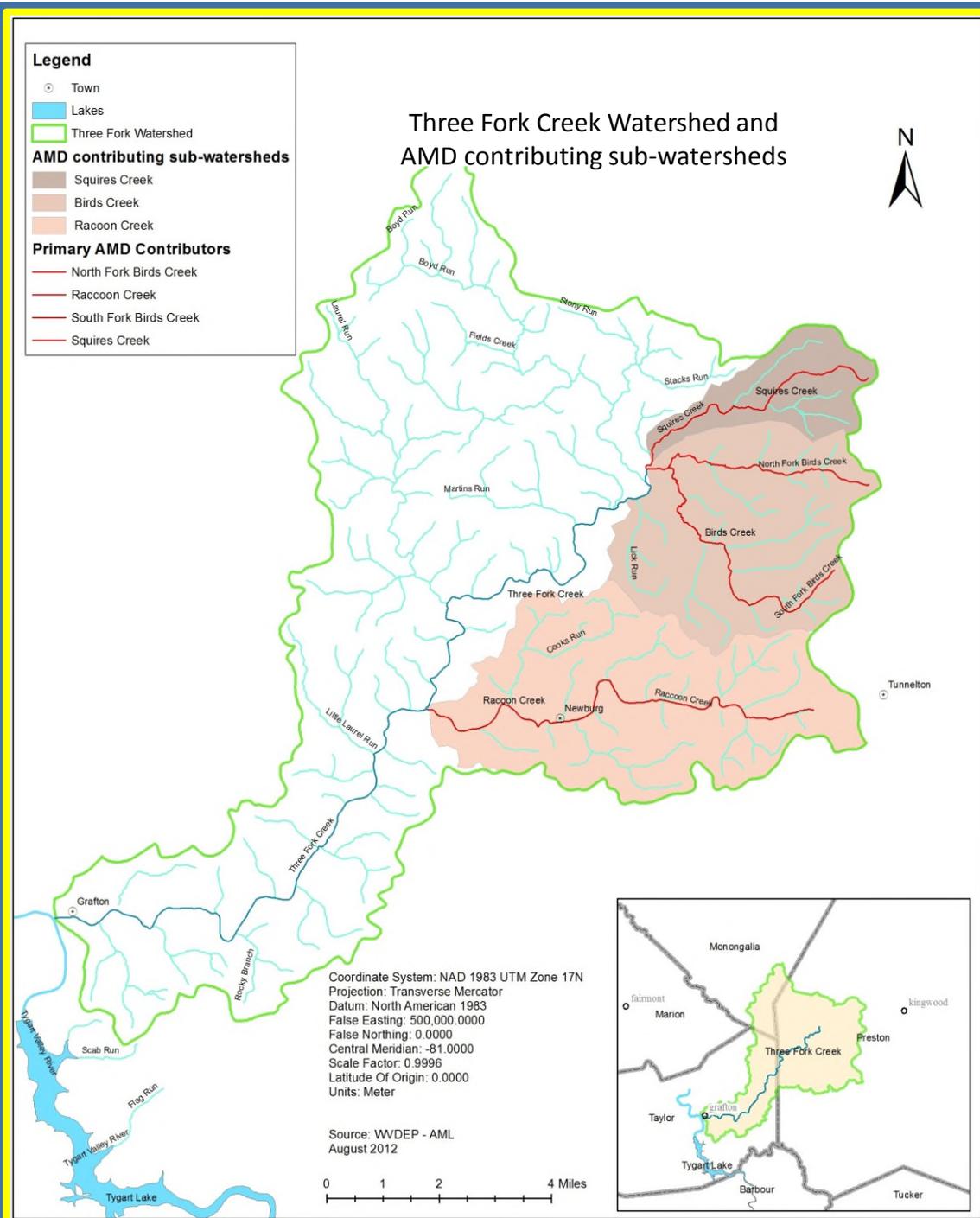
# Three Fork Creek Watershed

- Formed by the confluence of:
  - Squires Creek
  - Birds Creek
  - Fields Creek
- ~20 miles from confluence to mouth
- Drains 103 square miles



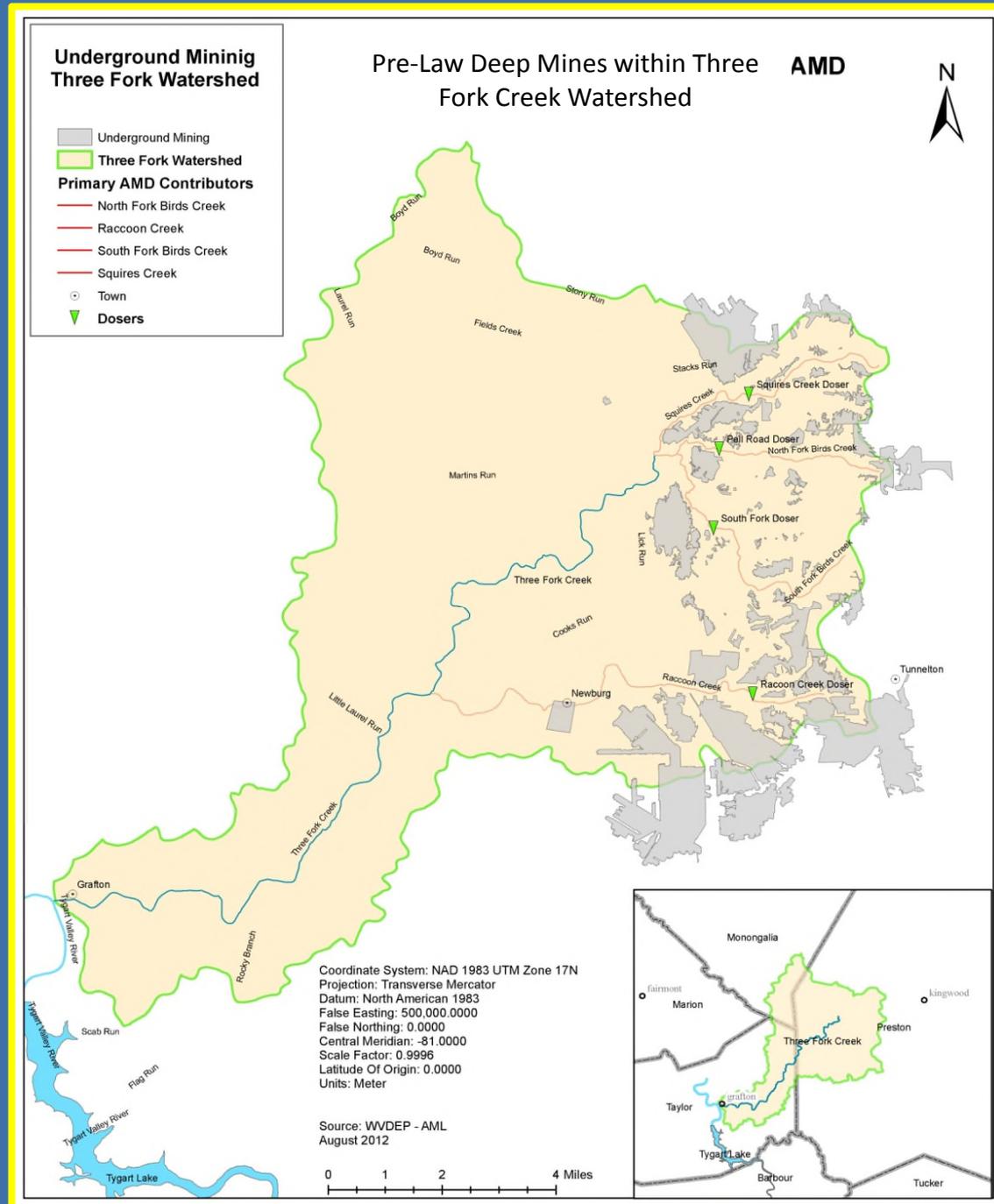
# Main AMD Contributors

- Squires Creek
- North Fork Birds Creek
- South Fork Birds Creek
- Raccoon Creek



# Historical Mining

- Headwaters extensively mined since the mid 1800's
- Approximately 9,100 acres of mine pools drain into Three Fork Creek
- Mined seams include:
  - Upper Freeport
  - Middle Kittanning
  - Bakerstown



# Mine Drainage Chemistry

Median pH - 2.9

Max pH - 5.2

Min pH - 2.4

Av. Total AL mg/L - 15.2

Max AL mg/L - 64

Min AL mg/L - 0.12

Av. Total Fe mg/L - 21.5

Max Fe mg/L - 145

Min Fe mg/L - 0

# Impaired Tributaries

Acid and Iron Laden Tributary



Aluminum Laden Tributary





# Importance of Project

- **High Visibility**
- **Impact on Aquatic Life**
- **Impact on Recreation**
- **Impact on Local Economy**

# Restoration Goal

**To return Three Fork Creek Mainstem to its designated usage by decreasing the water quality impairment of multiple pre-SMRCA (Surface Mining Control and Reclamation Act of 1977) coal mine discharges in the watershed**

# Objectives

- **Improve water chemistry and aesthetics to support recreational water activities in Three Fork Creek Mainstem**
- **Restore benthic macro-invertebrates and fish in Three Fork Creek Mainstem**

# At-Source Treatment

- Various types constructed
- Multiple locations
- No measurable watershed-wide improvement



# In-Stream Treatment

## 1995-Middle Fork River

- Limestone Sand Fines
- 38 miles of mainstem restored
- 89 miles of tributaries restored



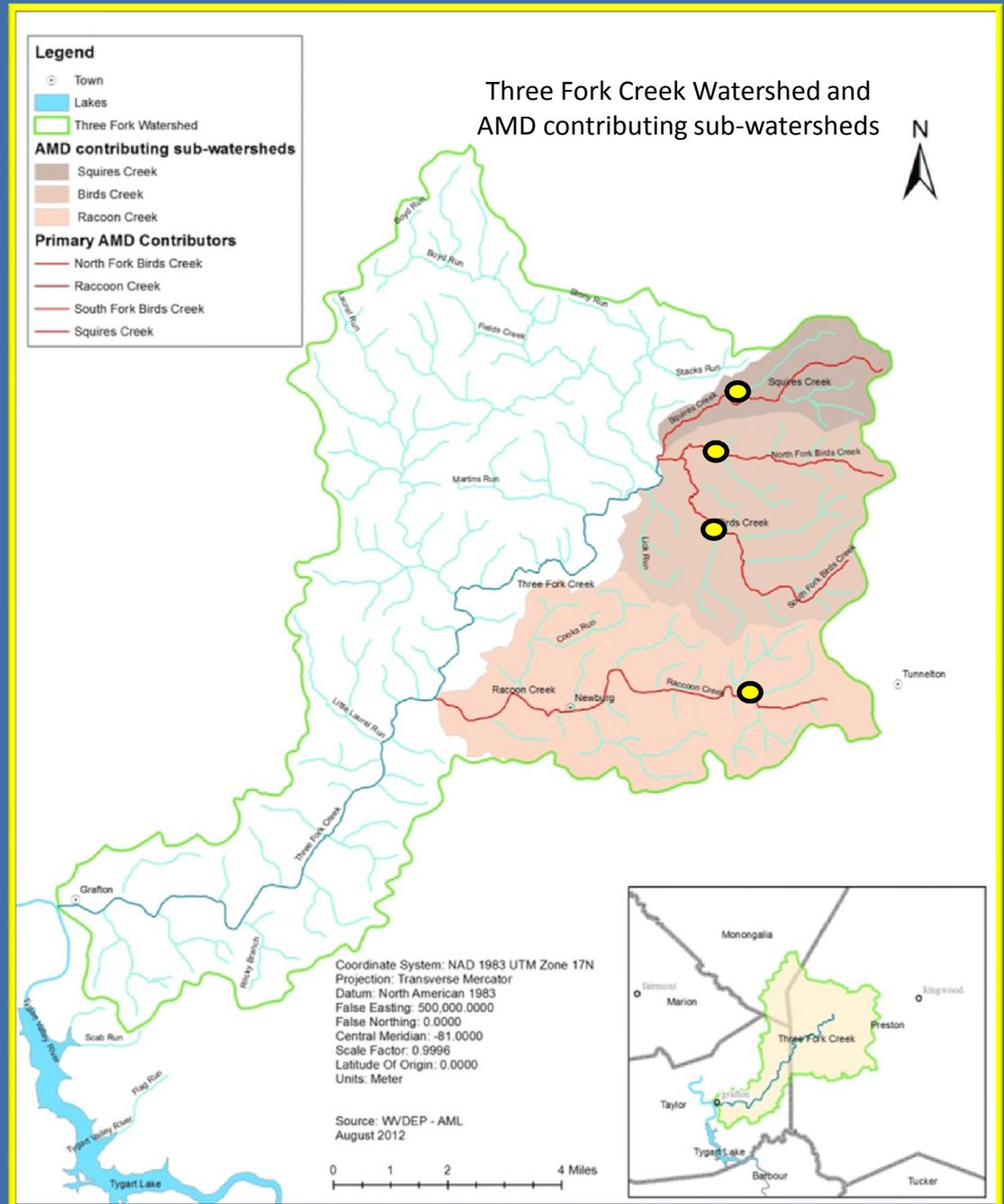
## 1994-Blackwater River

- Lime doser
- Limestone drum station
- 12 stream miles restored

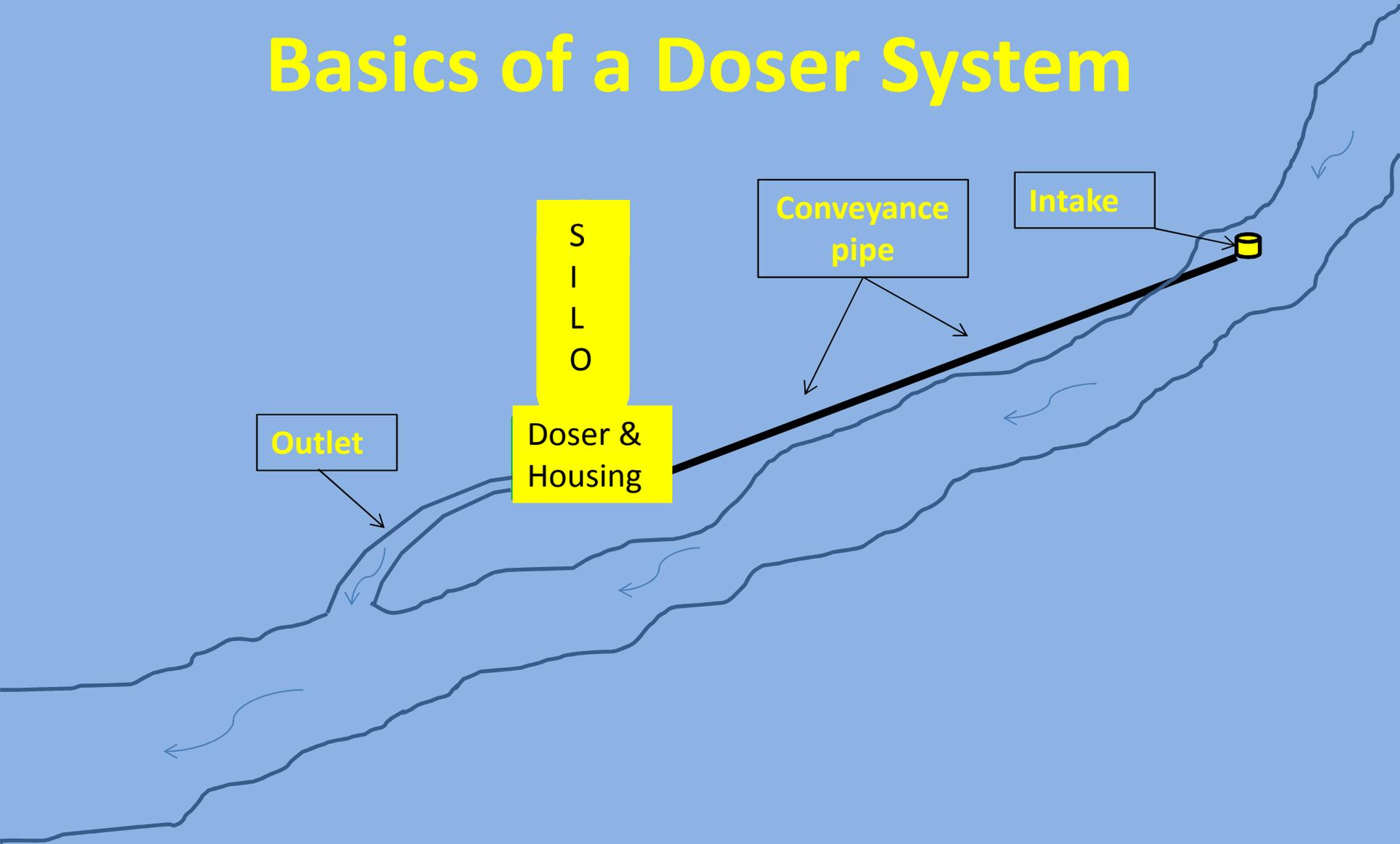


# Lime Doser Locations

- Squires Creek
- North Fork Birds Creek
- South Fork Birds Creek
- Raccoon Creek



# Basics of a Doser System

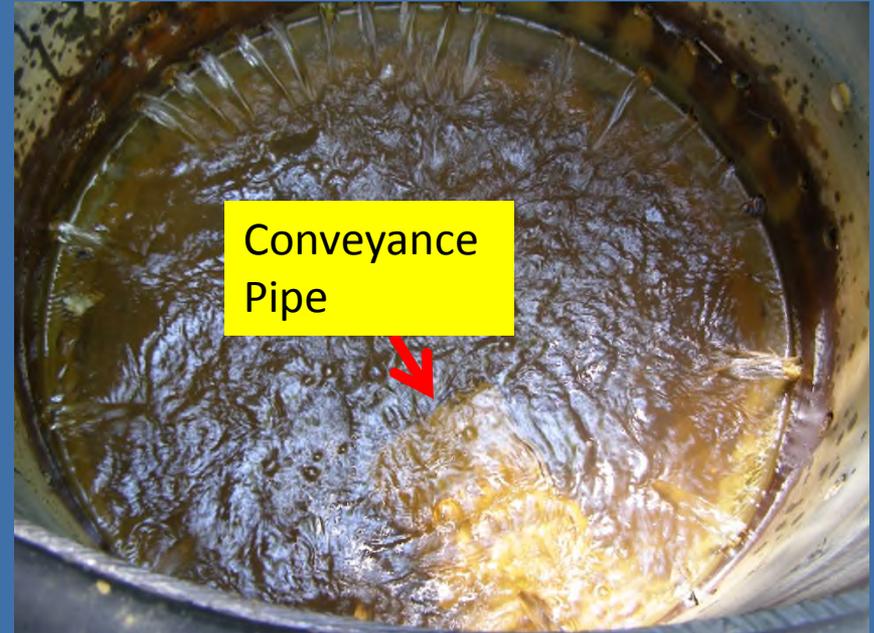


# Intake

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



# Three Fork Creek Cost and Funding

- \$750,491 to construct ~ \$200,000/doser
- Funded through the AMD Set-Aside Account
- \$17,811/month average operational cost first year (started in May)
- \$14,838/month average operational cost second year
- \$19,291/month average operational cost third year

# Operation and Maintenance Issues

- **Stream Flow and Chemistry**
- **Storm Events**
- **Climate**
- **Debris**



# Results

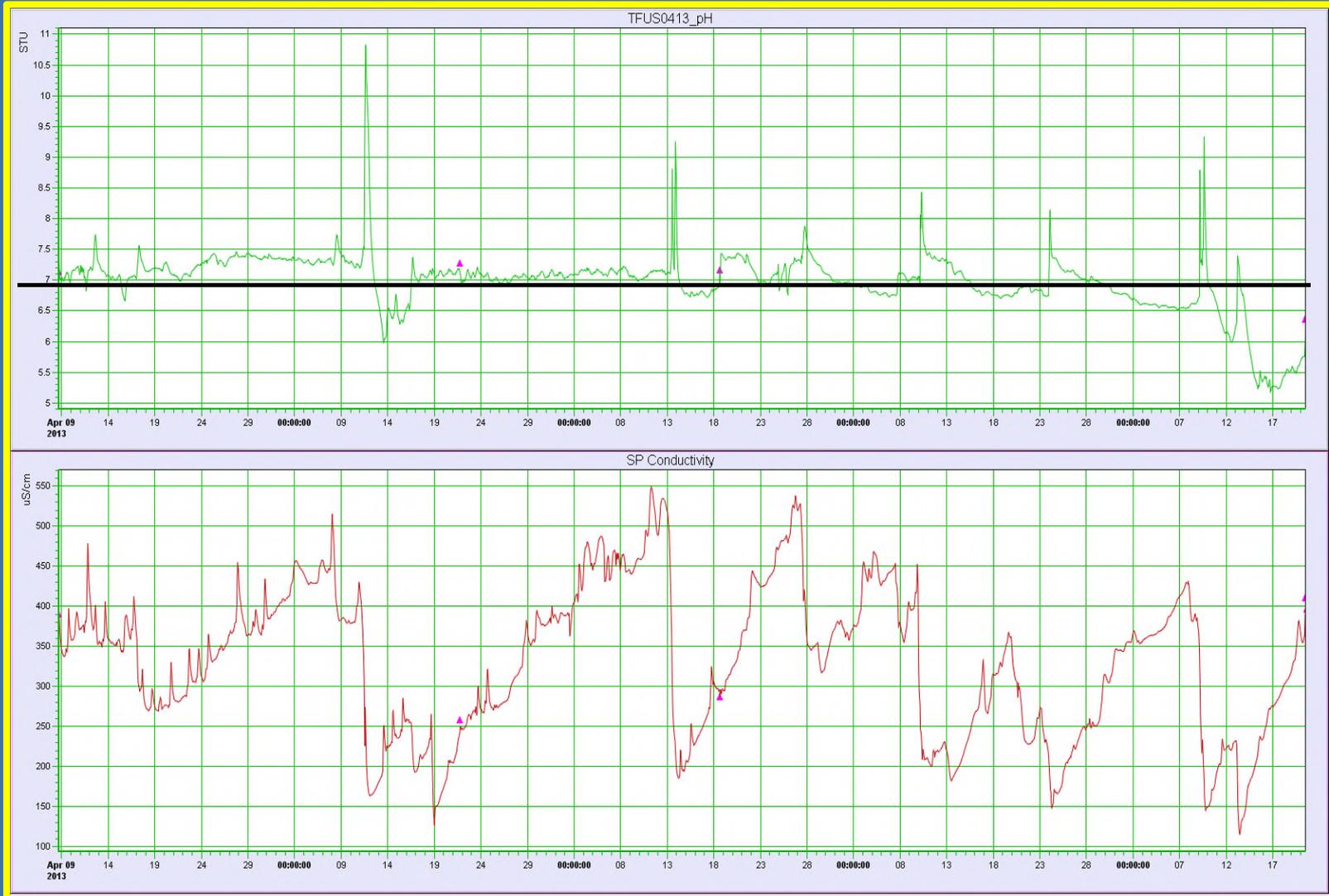
# Water Chemistry of Mainstem

- Prior to dosing alkalinity failed to exceed acidity within Three Fork Creek
- Since dosing alkalinity consistently exceeds acidity
- Prior to dosing pH ranged between 4.4 and 5.1
- After dosing ranged between 6.9 and 7.08

# Three Fork Creek pH at Mile 17.4

## Apr-Aug 2013

7.0 pH



# Benthic Surveys

Compared 2012 to 2009

- 0.4 Miles
- 5.7 Miles
- 9.62 Miles
- 17.4 Miles



# Benthic Survey Results



- **# Total Taxa Increased at Every Site**
- **# EPT Increased at Every Site**

# Fish Surveys



## Partnering:

- Office of Water Resources
- Office of Abandoned Mine Lands
- Save The Tygart Watershed Group

# Fish Survey Results

## DEP Pre Dosing Survey September 2010

- **1 Green Sunfish**

## DEP Post Dosing Survey August 2012

- **1,605 Fish**
- **21 Species**

**Rock Bass**



**River Chub**



**Smallmouth Bass**



**Walleye**



# Aesthetics and Embeddedness

- Iron staining gradually dissipated from downstream to upstream
- No change in embeddedness at the two lower sample sites
- Embeddedness increased at the two upper sample points nearest the dosers.

# 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



**Were Objectives Met  
For  
Three Fork Creek  
Mainstem?**

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- **Restore** benthic macro-invertebrates and fish in Three Fork Creek Mainstem

• **30,630 Stream Miles**

• **12,626 Impaired Miles**



**Earth**

# The Beginning

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