
# WEST VIRGINIA WATER RESEARCH INSTITUTE

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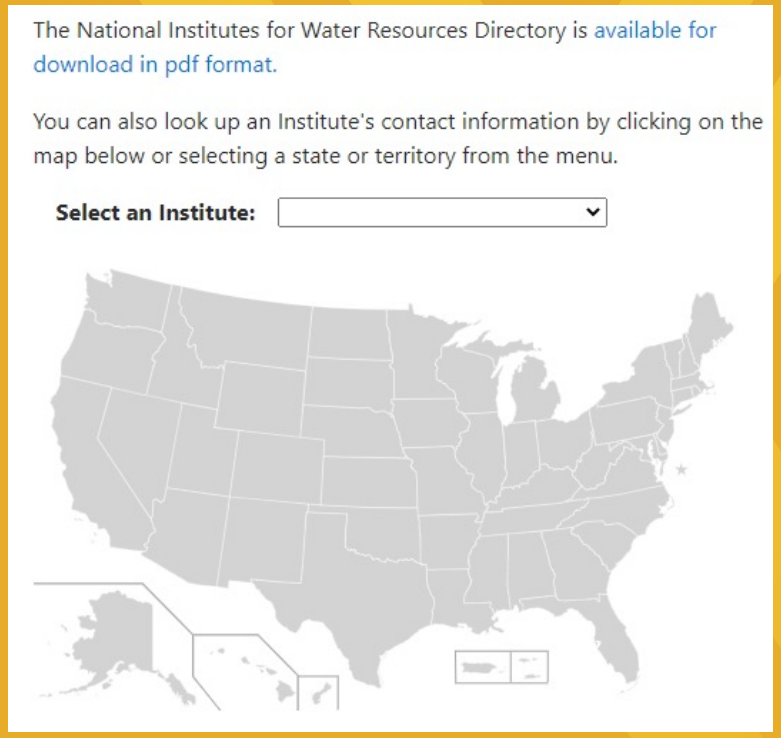
# Water Resources Research Act Program

**The Water Resources Research Act Program**, authorized by section 104 of the Clean Water Act, is a Federal-State partnership which:

- Plans, facilitates, and conducts research to aid in the resolution of State and regional water problems
- Promotes technology transfer and the dissemination and application of research results
- Provides for the training of scientists and engineers through their participation in research
- Provides for competitive grants to be awarded under the Water Resources Research Act

# The National Institutes for Water Resources

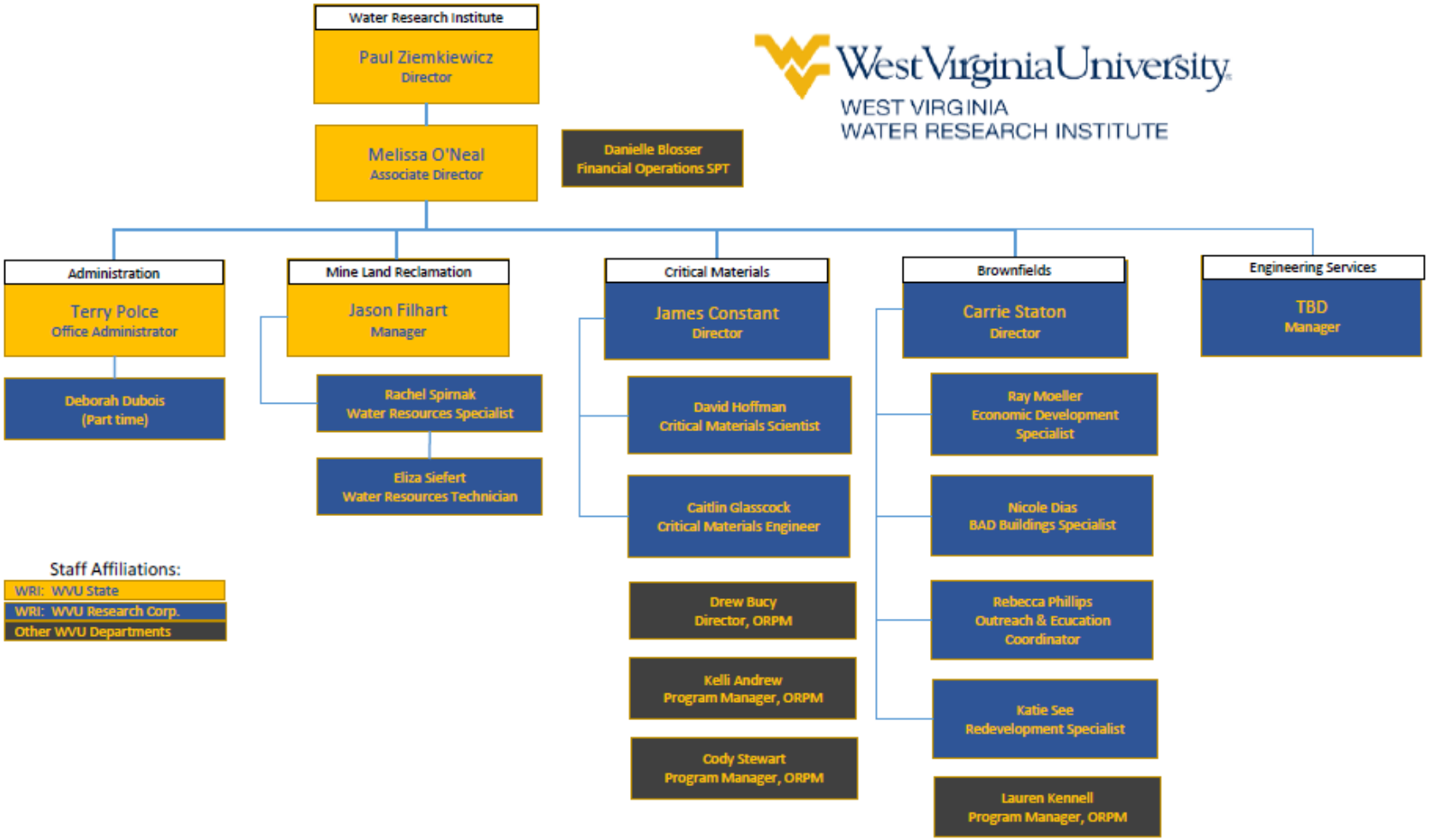



https://water.usgs.gov/wrri/index.php

There are 54 Water Resources Research Institutes or Centers, one in each of the 50 states as well as the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam.

The Water Resources Research Institute for each state or territory is located at its "1862" land-grant university or at another college or university designated by the governor or state legislature. The Institute in Guam is a regional institute serving Guam, The Federated States of Micronesia, and the Commonwealth of the Northern Mariana Islands. The Institute in Hawaii also serves American Samoa.


https://wvwri.wvu.edu/

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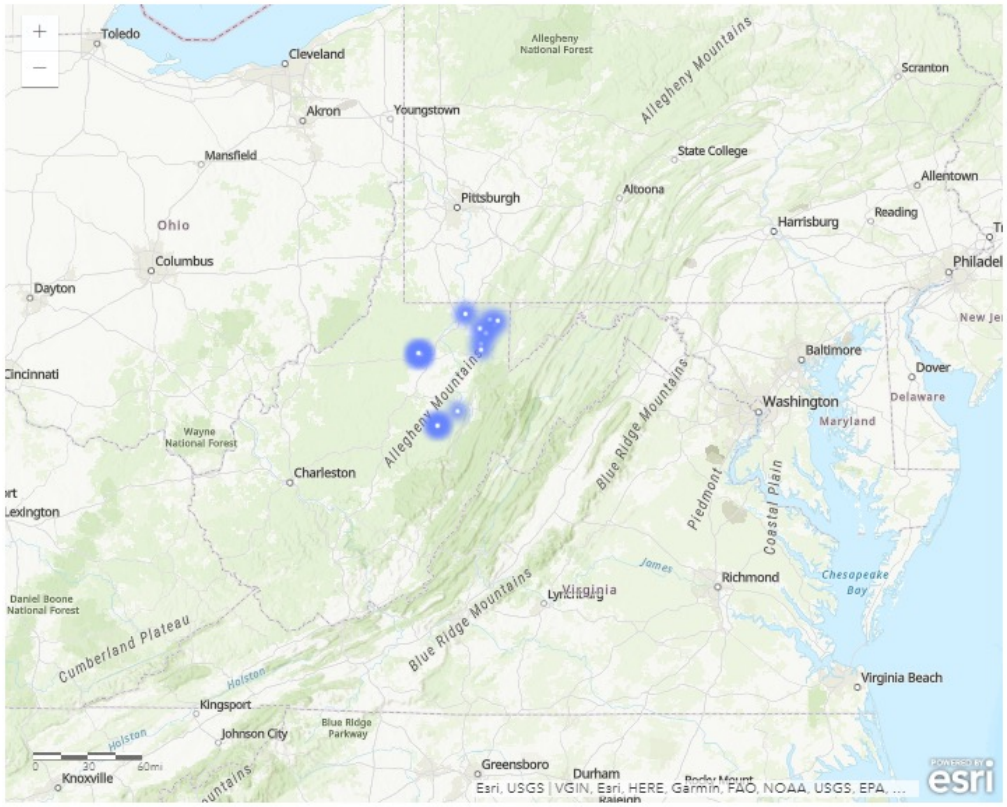
# Mine Reclamation – National Mine Land Reclamation Center (NMLRC)

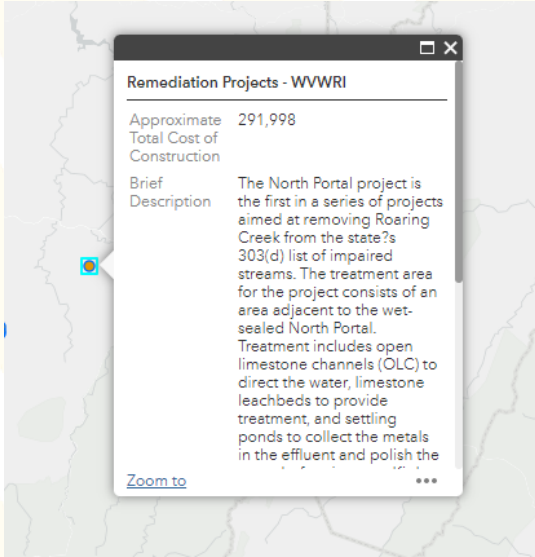
In 1988 Congress recognized the need for an organization to specifically address the outstanding reclamation problems and authorized formation of the National Mine Land Reclamation Center (NMLRC).

The NMLRC has become an internationally-recognized leader in the area of acid mine drainage (AMD). Among technologies initiated, refined or demonstrated by the NMLRC, the following are now in practice within the industry, state and federal agencies:

# Mine Land Reclamation in WV




22 Passive Treatment Remediation Projects



WV 308: Assessment and Quantification of Water Treatment Systems to meet WV Water Quality Standards; $88,890

# Positive Relationships WVDEP Office of Special Reclamation

In August of 2011, rulings in United States District Courts held that the West Virginia Department of Environmental Protection (WVDEP) was required to obtain Clean Water Act section 402 NPDES permits and meet prevailing water quality standards for one hundred seventy one (171) Bond Forfeiture sites. As part of the judgment, the DEP is required to provide a site inventory and sampling data, a priority ranking of sites, a summary of the costs to achieve compliance, and a schedule detailing the corrective actions.

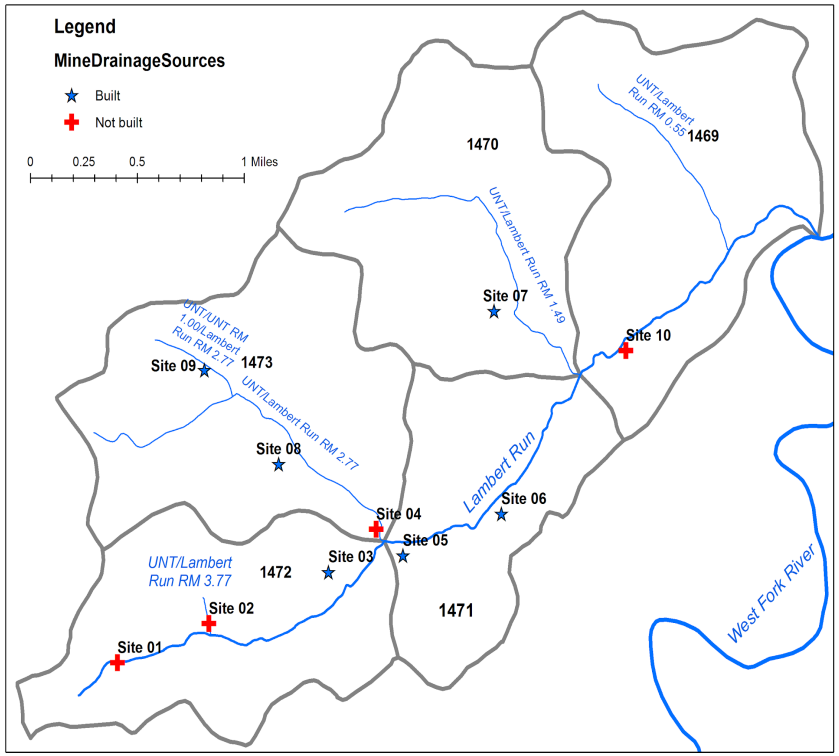
WV 308: Assessment and Quantification of Water Treatment Systems to meet WV Water Quality Standards; $88,890

135 Sites evaluated and ranked based on water chemistry

36 Sites were not evaluated (due to No Discharge; Already NPDES permitted; Completed; or Under Construction

Final new capital costs totaled **$33,122,958.35** and operation and maintenance costs were **$5,547,227.85**

# Success: Lambert Run




| SWS | Required reduction | Source | Source load | Reduction | Cost | Notes |
|---|---|---|---|---|---|---|
| 1469 | 2,689 | Site 10 | 6,447 | 5,158 | $289,816 | |
| 1470 | 53,329 | Site 7 | 87,976 | 87,976 | | Discharge from Site 7 has been rerouted to SWS 1471 and treated. 71% of the iron load is captured in the treatment system. |
| 1471 | 1,744 | (Site 7) | 25,393 | 22,854 | $65,252<br>$150,000 | Additional projects will reduce the remaining load from Site 7 by 90%, down to approximately 3% of its original load |
| 1472 | 3,755 | Site 2 | 6,571 | 5,382 | $188,730 | |
| 1473 | 4,470 | Site 4 | 3,401 | 2,721 | $74,431 | Additional reductions in the SWS will occur as wetlands continue to develop at Site 8 |
| **Totals** | **65,987** | | **129,788** | **124,091** | **$768,229** | |

| Fiscal year | Project | Performance period |
|---|---|---|
| 2020 | Site 7, phase 1 | 7/1/20-9/30/23 |
| 2021 | Site 2 | 7/1/21-9/30/24 |
| 2022 | Site 4 | 7/1/22-9/30/25 |
| 2023 | Site 10 | 7/1/23-9/30/26 |
| 2024 | Site 7, phase 2 | 7/1/24-9/30/27 |

Mouth of Lambert Run 2007

Mouth of Lambert Run 2016

| Site | FY | §319 | Match | Matching source |
|---|---|---|---|---|
| 3 | 2004 | $106,654 | $78,489 | OSM |
| 5 | 2004 | $146,334 | $97,614 | OSM |
| 8 | 2004 | $142,024 | $99,159 | OSM |
| 9 | 2004 | $233,043 | $425,703 | Mitigation agreement |
| 6 | 2009 | $149,721 | $100,000 | OSM |
| 7 | 2011 | $384,376 | $256,622 | State funds, OSM |

WVDEP funded 319 projects require a 40% match; match funds are secured through OSMRE, Stream Restoration, and foundation funds.

WV 342: Watershed Scale Approaches to AMD Remediation: Martin Creek and Sandy Creek; $1,138,000

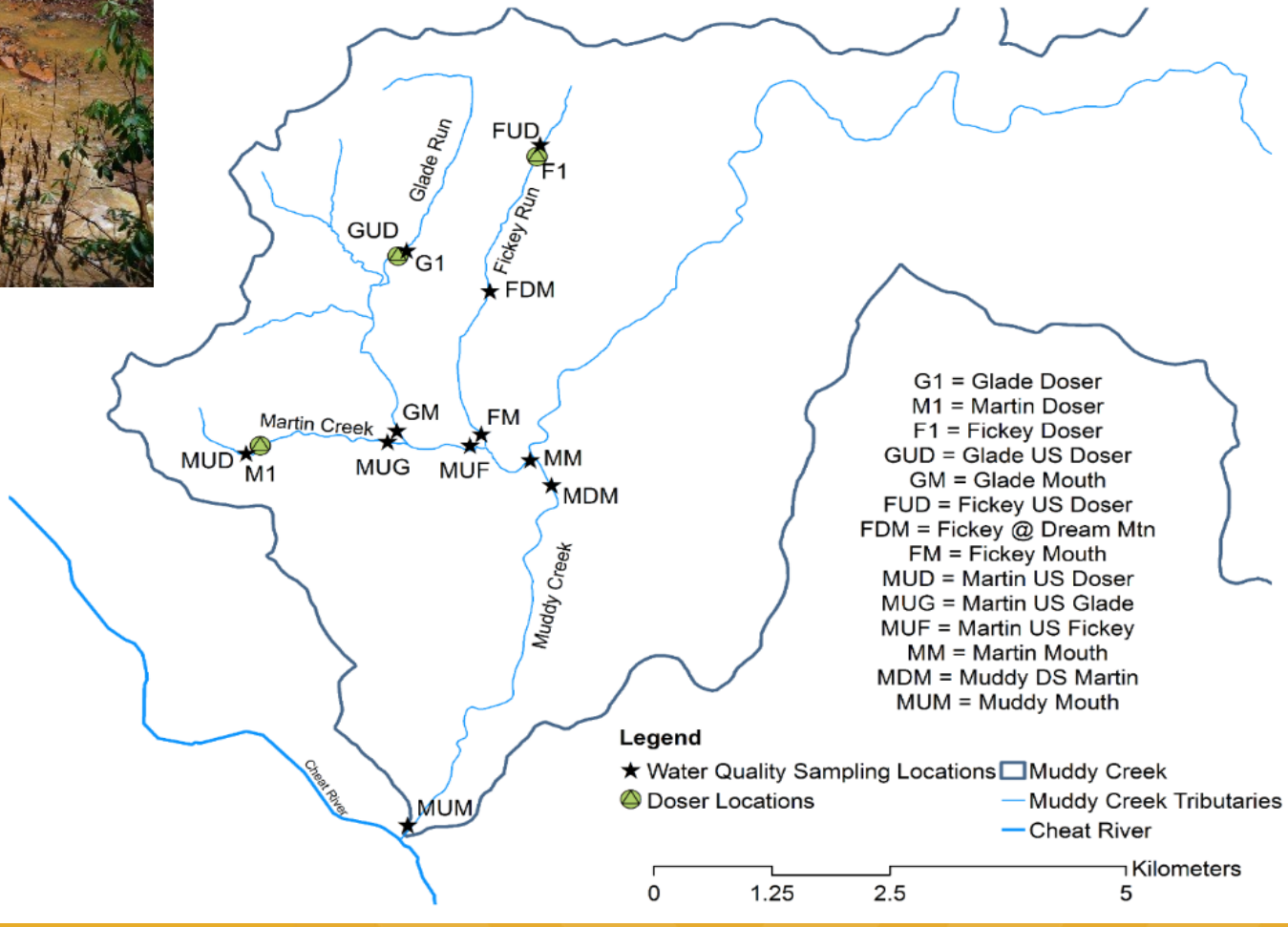
Projected 20-year costs for the two options indicate that in-stream dosing on Martin Creek would save $5,076,844 or a 55% cost reduction while in-stream dosing on Sandy Creek would save $482,757 or a cost reduction of 8%.

| **Martin Creek** | At-source treatment | In-stream treatment |
|---|---|---|
| O&M cost projection (years) | 20 | 20 |
| Annual O&M | $ 218,084 | $ 145,533 |
| Total Capital Cost | $ 4,825,824 | $ 1,200,000 |
| Total O&M | $ 4,361,684 | $ 2,910,664 |
| Total cost | $ 9,187,508 | $ 4,110,664 |
| **Projected stream mile recovery*** | **0** | **3.4** |
| | | |
| **Sandy Creek** | | |
| O&M cost projection (years) | 20 | 20 |
| Annual O&M | $ 189,568 | $ 223,708 |
| Total Capital Cost | $ 2,609,587 | $ 1,444,032 |
| Total O&M | $ 3,791,369 | $ 4,474,166 |
| Total cost | $ 6,400,955 | $ 5,918,198 |
| **Projected stream mile recovery**** | **0** | **10.8** |

* With completion of the T&T AMD project

** With addition of a passive treatment unit at Barlow Portal

# WV 342: Watershed Scale Approaches to AMD Remediation: Martin Creek and Sandy Creek; $1,138,000

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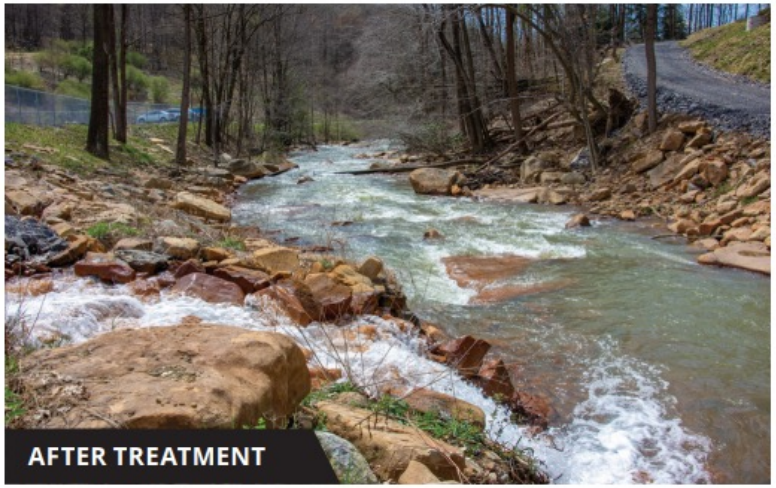
Southwestern Energy
WVDEP
Friends of Cheat
WVWRI

# Muddy Creek Watershed Restoration Project

First watershed-based National Pollutant Discharge Elimination System (NPDES) permit ever issued in the country.

WVDEP – AML
Save The Tygart Watershed Association
WVWRI

# Three Fork Creek Restoration Project

Construction Costs $750,491

*Squires Creek doser*

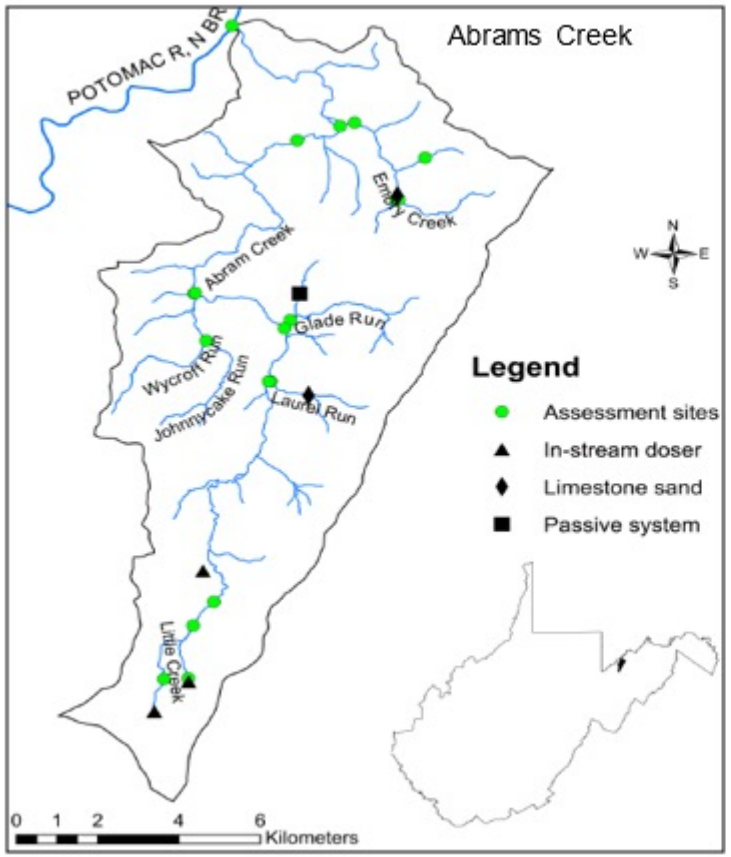
Table 2. Data from 13 pre-construction samples and 8 post construction samples

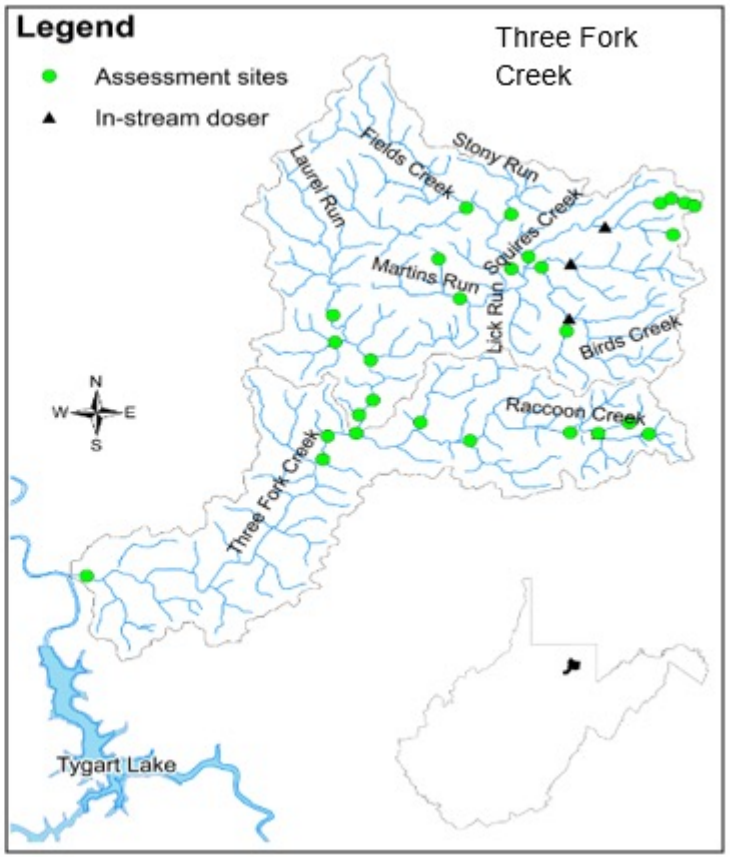
| Site Description/Location | Median pH | Average Hot Acidity (mg/l as CaCO3) | Average Alkalinity (mg/l as CaCO3) |
|---|---|---|---|
| South Fork Birds Creek near mouth | 3.8 | 95.56 | 0.82 |
| South Fork Birds Creek near mouth | 7.32 | 12.69 | 31.02 |
| North Fork Birds Creek at mouth | 3.9 | 55.05 | 0.90 |
| North Fork Birds Creek at mouth | 4.93 | 15.69 | 18.20 |
| Birds Creek at mouth | 3.9 | 85.07 | 0.80 |
| Birds Creek at mouth | 6.67 | 10.54 | 18.80 |
| Squires Creek at mouth | 3.35 | 101.58 | 0.82 |
| Squires Creek at mouth | 6.45 | 16.94 | 25.74 |
| Raccoon Creek upstream of Little Raccoon Creek | 3.3 | 134.37 | 0.82 |
| Raccoon Creek upstream of Little Raccoon Creek | 4.74 | 34.69 | 12.23 |
| Raccoon Creek at mouth | 4.1 | 96.15 | 1.71 |
| Raccoon Creek at mouth | 6 | 9.77 | 7.78 |
| Three Fork Creek downstream of Birds Creek | 4.4 | 52.86 | 1.07 |
| Three Fork Creek downstream of Birds Creek | 7.03 | 6.79* | 15.83 |
| Three Fork Creek downstream of Raccoon Creek | 4.8 | 30.69 | 3.07 |
| Three Fork Creek downstream of Raccoon Creek | 6.9 | 7.62* | 15.88 |
| Three Fork Creek at Thornton | 4.9 | 28.87 | 3.68 |
| Three Fork Creek at Thornton | 7.1 | 3.69* | 17.75 |
| Three Fork Creek near mouth | 5.1 | 21.87 | 2.30 |
| Three Fork Creek near mouth | 7.08 | 5.36* | 19.59 |

*Raccoon Creek prior to dosing*

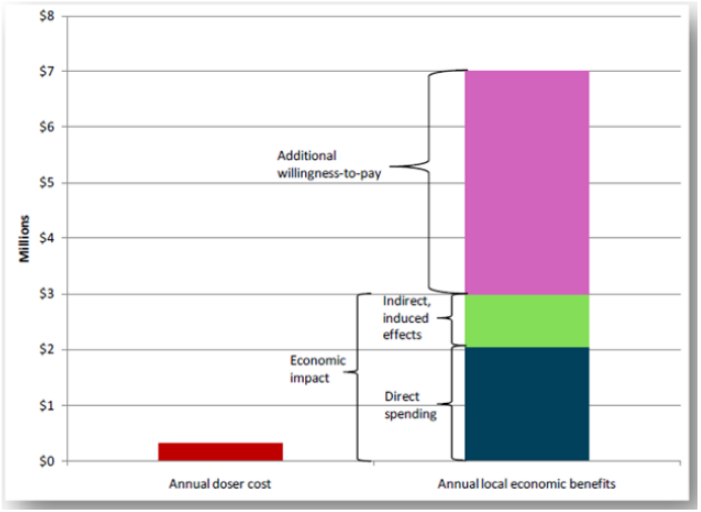
*Raccoon Creek after dosing*

# WV 349: Quantifying the success and long-term ecological and socioeconomic benefits of watershed-scale AMD remediation efforts within West Virginia

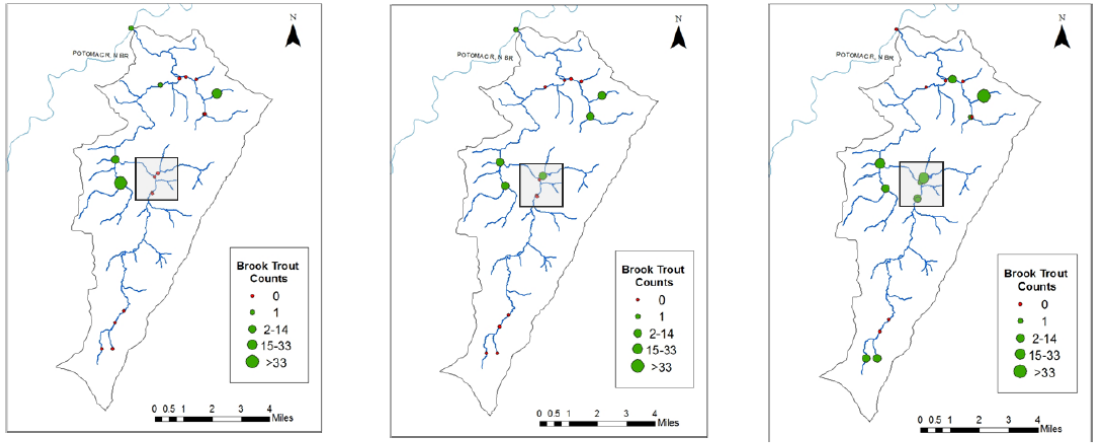


# WV 349: Quantifying the success and long-term ecological and socioeconomic benefits of watershed-scale AMD remediation efforts within West Virginia

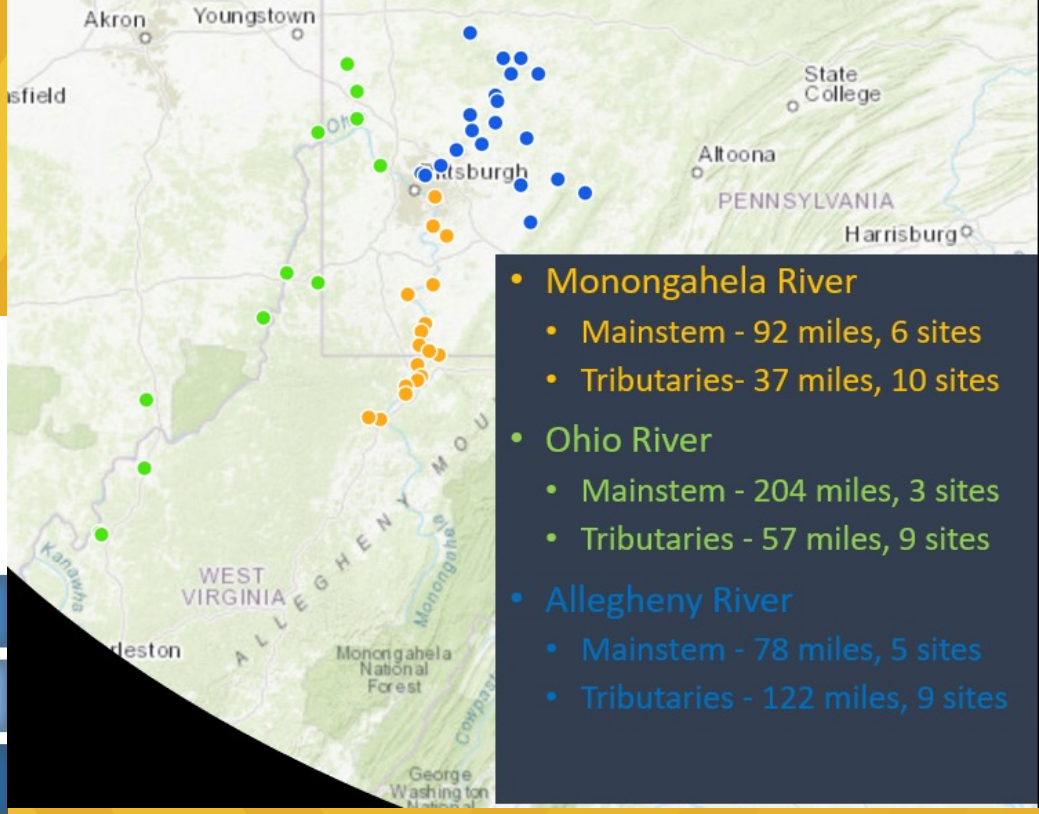



Summary of ecosystem service benefits from AMD remediation compared to annual doser costs.




*Brook Trout (Salvelinus fontinalis) counts from Abrams Creek in 2008: pre-restoration (left); 2013: 3 years post (center); and 2017: 7 years post (right).*

Our results show that watershed-scale restoration leads to many ecological improvements and regional-scale processes play a large role in ecosystem recovery.




3RQ

THREE RIVERS QUEST

- **42 sites** in the Upper Ohio Basin sampled monthly by 3RQ **Research Team**
  - Over **590 river miles** monitored monthly

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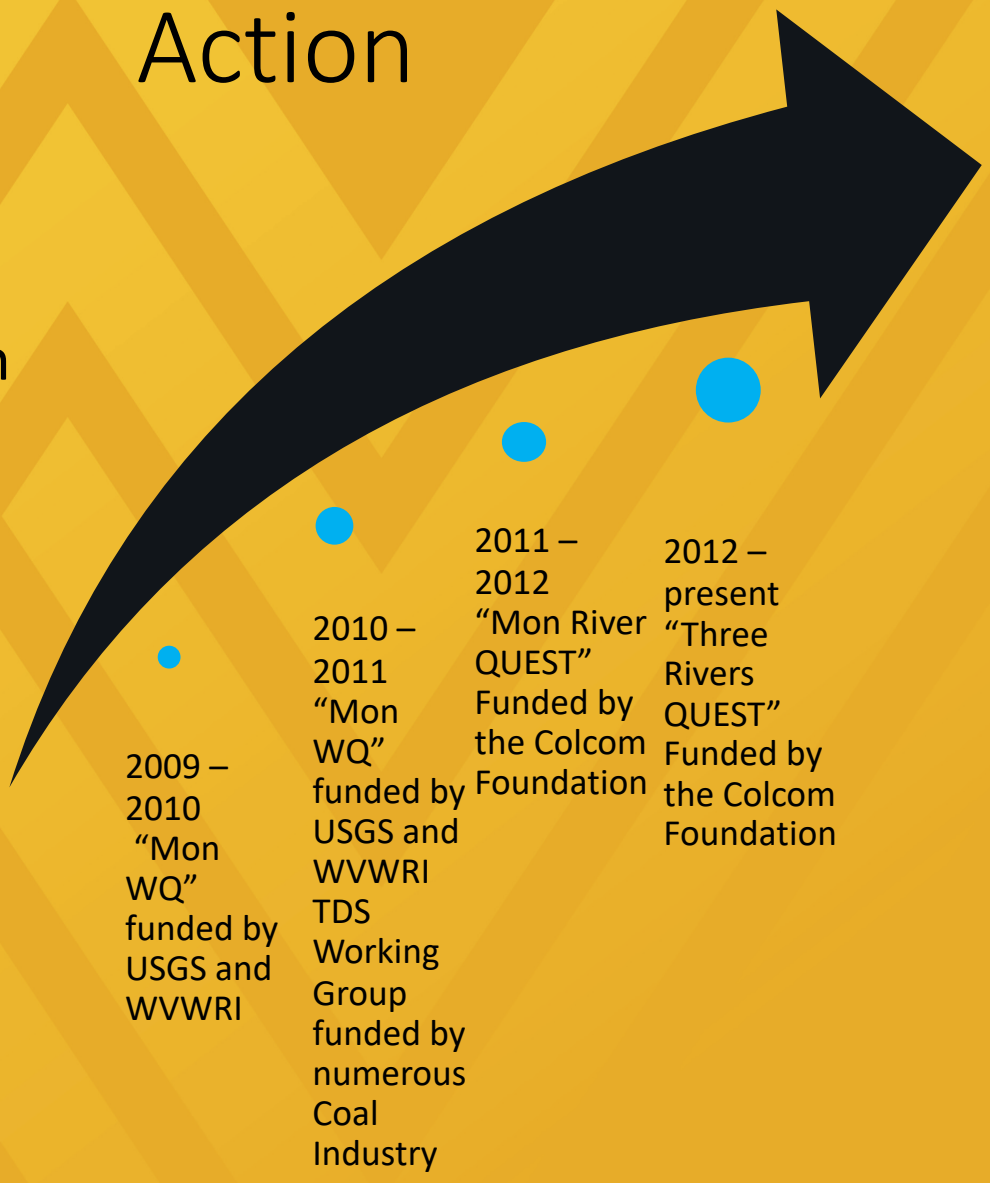
# Problem

High TDS events in late summer/early fall 2008

- Lead to a shut down of some municipal water intakes when the river exceeded the EPAs secondary drinking water standards of 500 parts per million (or mg/L) of TDS
- Complaints from industrial and residential river users
  - Dunkard Creek fish kill September 2009
  - Evidence that TDS was increasing

# Action

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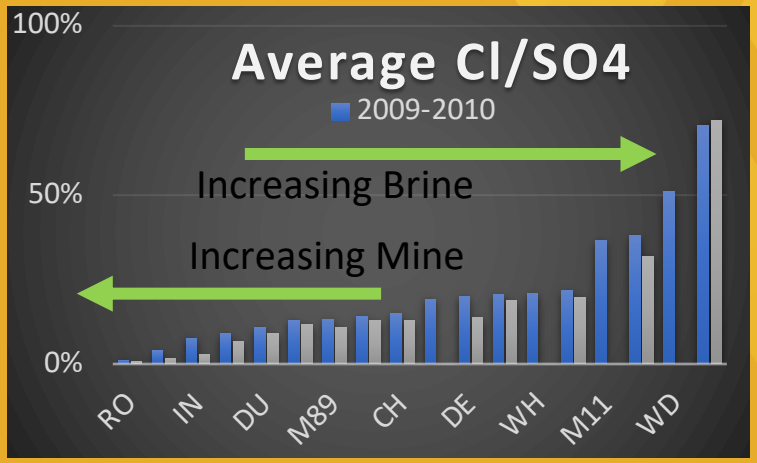
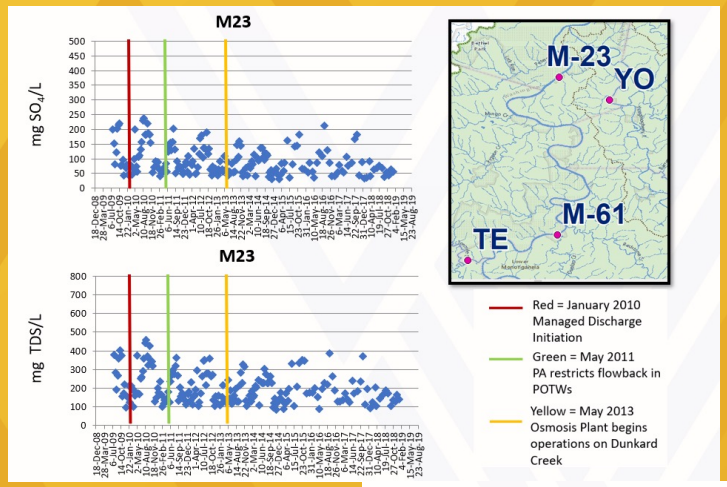
# Findings/Results

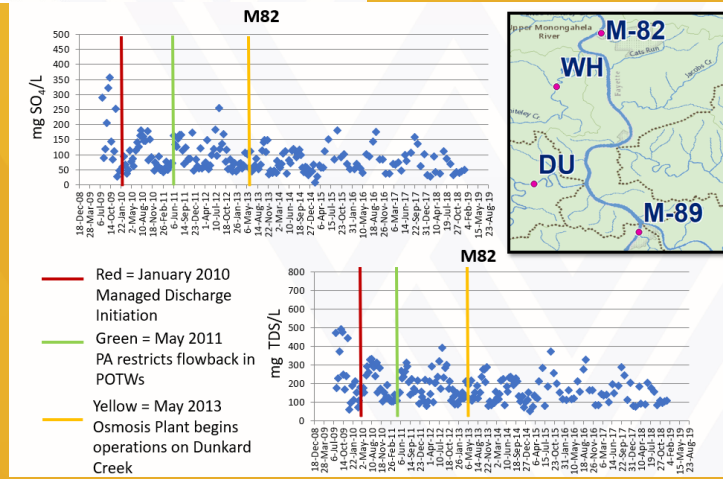
- The ratio to chloride to sulfate ions looks like a good way to distinguish water from coal mines from frac water.
- Overall the ten-year average is slightly lower than year one (2009-2010) of monitoring.
- Coal mining influence increases to the left; Frac water influence increases to the right.
- Established total discharge management plan as a result of the preliminary study.
- Ten year report is under development.




# Significance

Total Discharge Management goes into effect in January 2010; TDS remains below 500 mg/L.

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# Success: TDS Working Group

The objective of the proposed TDS Industry Working Group is to thoroughly explore option 1 above, to develop an efficient strategy for protecting the region's streams and rivers while sustaining the economic viability of the industry.

## Success Story: Three Rivers QWEST Addresses Sulfate Salts

In 2009, the West Virginia Water Research Institute (WVWRI) at West Virginia University began monitoring the quality of Monongahela River. In December 2010, the Pennsylvania Department of Environmental Protection (PADEP) declared the Monongahela River impaired for potable water use due to the presence of sulfate salts. While sulfate compounds generally do not make water unsafe for humans, they can affect taste and interfere with industrial processes that require cleaner water.

Noticing a strong correlation between low river flows and high sulfate levels, WVWRI called for collaboration with the coal industry because their high output treatment facilities were making significant contributions to the river's sulfate levels and thus to total dissolved solids (TDS) concentrations. A novel problem-solving approach, spearheaded by WVWRI, combined water science with stakeholder collaboration and sought to restore the river in less time than the traditional regulatory process. Coal industry officials willingly shared water quality and quantity data (discharge volumes and TDS concentrations). Using this data in combination with a computer program showing maximum discharges for each treatment plant derived from the river's flow, a collaborative and strictly voluntary discharge management system was implemented. By 2010, the program was in effect, and sulfate concentrations in the Monongahela River began to decrease. As a result, the U.S. Environmental Protection Agency approved PADEP's decision to remove the Monongahela River from the "impaired for potable water use" listing in late 2014.

The data necessary for the implementation of this program, as well as the validation of its success, is part of a voluntary, science-based, non-regulatory, watershed-wide program known as the Three Rivers QUEST (3RQ). This program, largely funded through the Colcom Foundation and the U.S. Geological Survey, includes bi-weekly monitoring throughout the Upper Ohio River Basin. Current monitoring partners include Duquesne University, Wheeling Jesuit University, and the Iron Furnace Chapter of Trout Unlimited. Local organizations enhance the dataset tremendously through their field or continuous monitoring efforts by providing conductivity data on tributaries feeding into the Monongahela River.

For more information contact the 3RQ Program Manager, Melissa O'Neal (moneal@mail.wvu.edu) or visit 3riversquest.org/.

Justin Fillhart, technician, samples the Monongahela River. *(Photo by Glenn Waldron)*

Monongahela River *(Photo by Melissa O'Neal)*

*Water sustains life*
*Understand, protect, restore*
*You are part of life*
*~ Marie Filteau, Mat-su Borough*

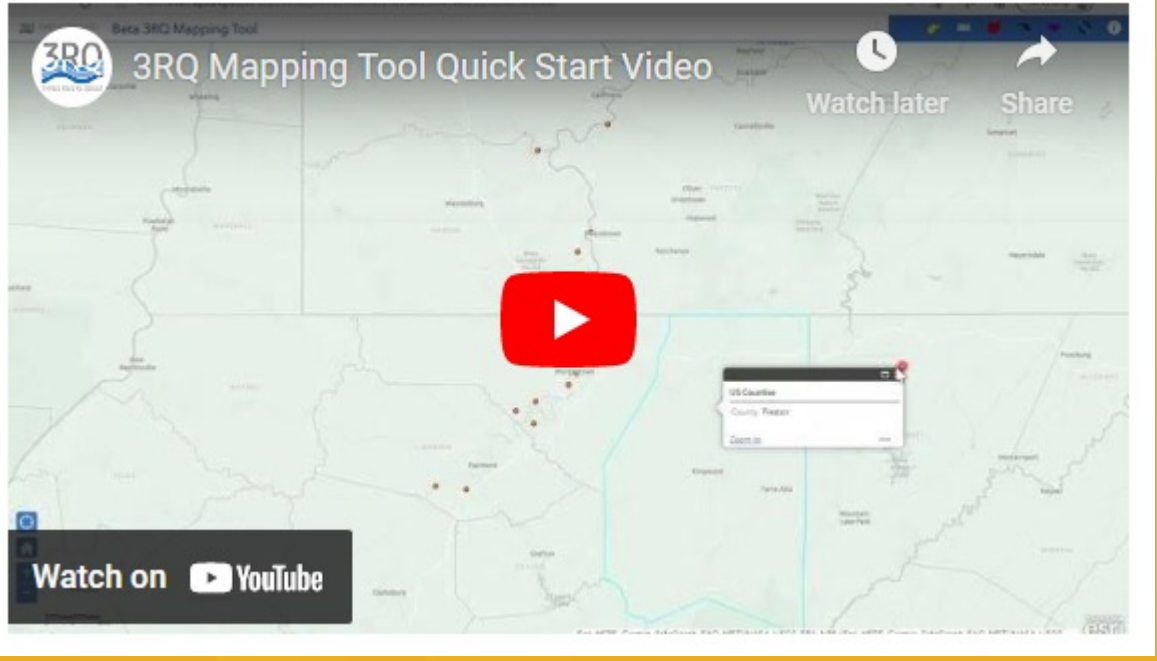
# 3RQ Mapping Tool

## EXPLORE NOW

To use the 3RQ Mapping Tool, simply click the button below. No logins or downloads are required. Please be aware that the tool may take a few moments to load initially.

Launch the Tool

https://3riversquest.wvu.edu/resources/3rq-mapping-tool

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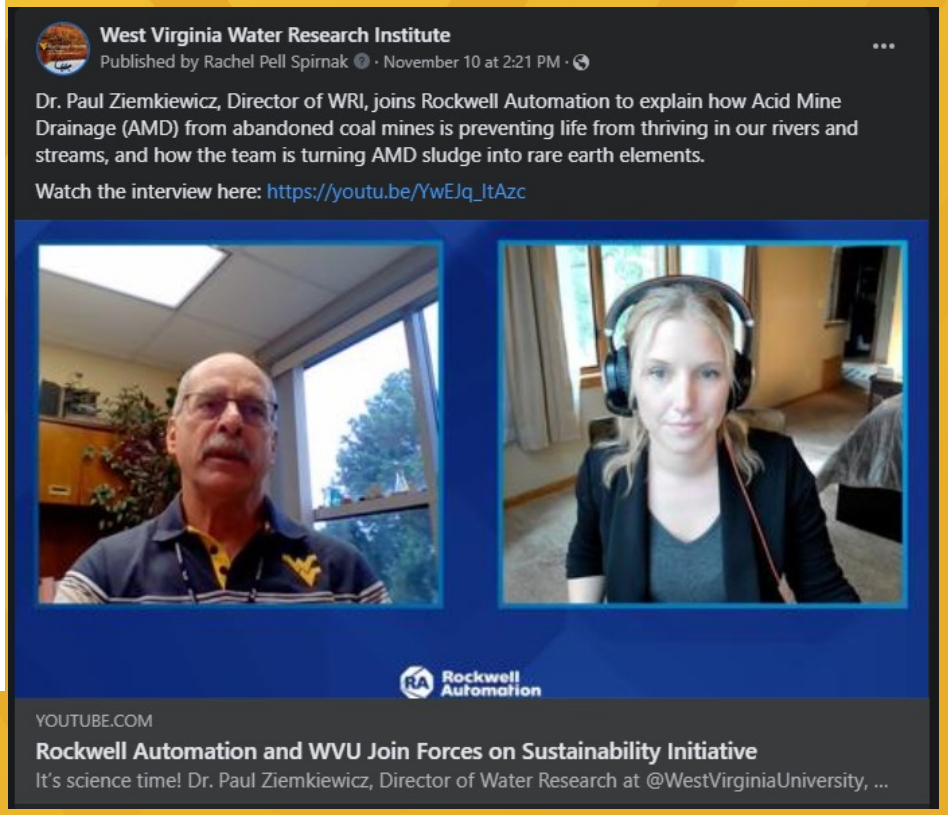
# WVWRI Director Provides Testimony to Energy Committee on Recovery of Rare Earth Elements from Acid Mine Drainage

Friday, April 01, 2022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