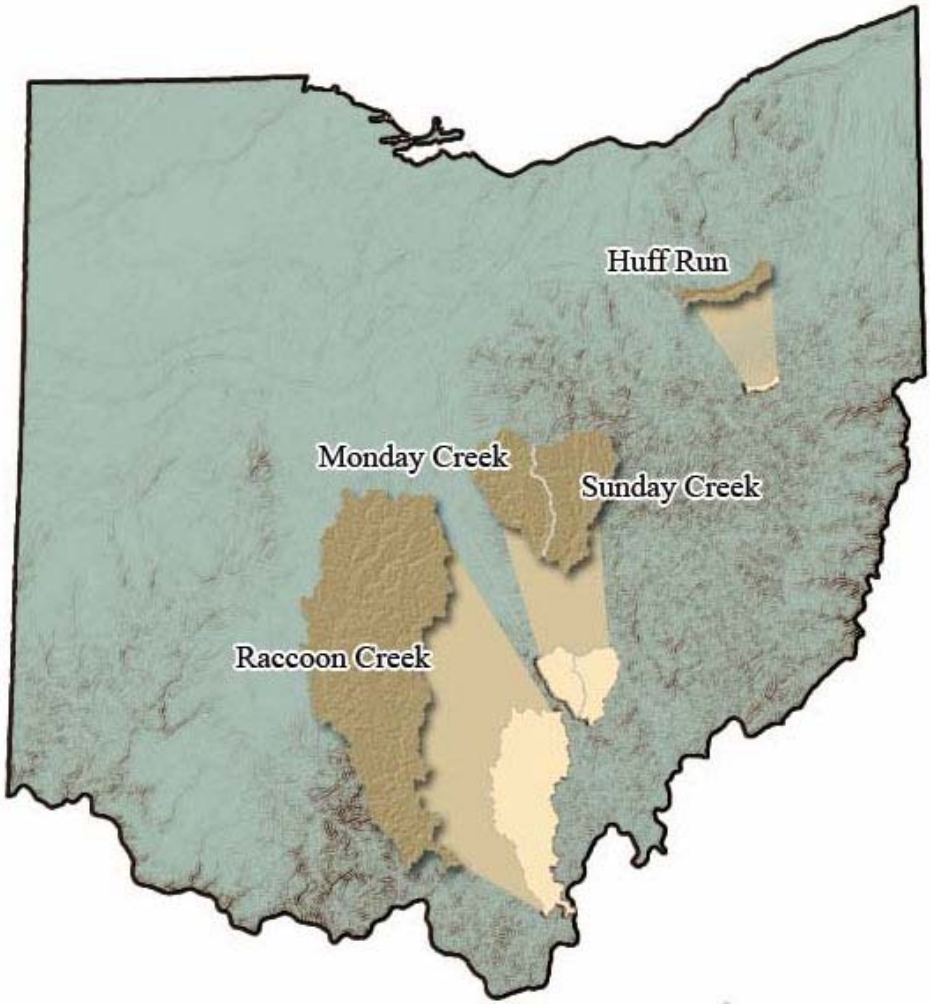
# 2006 Nonpoint Source (NPS) Monitoring Project for Acid Mine Drainage

An Evaluation of Water Quality, Biology, and Acid Mine Drainage Reclamation in Four Watersheds: Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run.

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9-28-07

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**Section IV – NPS entry form report 2006**

*Section IV shows the completed NPS data entry form for each individual AMD project in pdf format. These reports include all information gathered about the site description, contact, monitoring plan, design and reclamation information, average water quality data (pH, net acidity, and discharge) at long-term monitoring stations, complete list of pre and post reclamation water quality and biology data, and if applicable; photos, water quality and biology reports, and site map. These reports are available to download as pdf reports from the NPS monitoring website [www.watersheddata.com](http://www.watersheddata.com) under the 'Reports Tab'.*

## Acknowledgements

The NPS Monitoring Project for Acid Mine Drainage has been a collective effort by many people. This project would not have come together without the dedication and support of others. I would like to thank and acknowledge the following people for their input and contributions towards this project:

Ohio Department of Natural Resources – Division of Mineral Resources Management (ODNR-MRM) - Harry Payne, Mitch Farley, Bill Jonard, Jim Gue, Mary Ann Borch, and Cheryl Socotch for funding, data collection, guidance, and being a supporter and partner in this project. I would like to also thank Amy Mackey (ODNR-DMRM intern) for data entry and sampling.

Watershed Groups –
Raccoon Creek: Ben McCament and Brett Laverty.
Monday Creek: Rebecca Black, Mike Steinmaus, and Matt Miller.
Sunday Creek: Cara Hardesty, Lisa King, Kaabe Shaw, Elizabeth Kruse, Emily Boyer.
Huff Run: Maureen Wise, Michelle Shively, and Terri Sponagaule
I would like to thank the watershed groups for their cooperation and patience in this project for doing everything from data collections, trainings, gathering historical data, and data entry on top of their own busy work schedules.

Rural Action's Summer VISTA – 2006 field crews: James Massey, Julie Gillem, Rachel Cook, and Rachel Byer – MAIS training and data collection

Ohio University - Kelly Johnson – MAIS training, data collection, method development, and guidance.

Midwest Biodiversity Institute (MBI) –Chris Yoder, Tracy Mormon, Chad Kinney, and the biological data collection crews.

Voinovich Center – Darren Cohen (GIS), Taeil Kim (program designer), Jared Vorakvich (web design), Lindsey Siegrist (report layout), Kyoung Lim (assistant programmer), Scott Miller (Senior Project Leader), and Ed Rankin (Biologist).

Voinovich students – Warren Brooks, Michelle Shively, Lindsey Siegrist, Kezi Ikoro, Ben O'fori, Natasha Koufas, Anselm Bradford - Data collection, entry, and checking, report template design, tutorial, and web layout.

## Abstract

The Voinovich School of Leadership and Public Affairs at Ohio University has created an evaluation system to track changes in chemical and biological data for the following watersheds: Monday Creek, Sunday Creek, Raccoon Creek, and Huff Run. The annual monitoring and reporting system was developed for Ohio Department of Natural Resources Division of Mineral Resources Management (ODNR-DMRM) to track progress towards the targets of the state's 2005 NonPoint Source (NPS) management plan for acid mine drainage (AMD). The overall goal of the NPS management plan for AMD is to by 2010, 30% of known acid mine impaired streams are in attainment with Warmwater Habitat (WWH).

The NPS annual reporting website (www.watersheddata.com) integrates water quality and biology data from watershed groups' online ArcIMS database with project status details, maps, graphs, charts, photos, and printable reports to address the progress toward AMD reclamation. Water-quality and biology trends are compared through time at long-term monitoring stations and acid load reductions are measured at AMD reclamation project discharges. Incremental changes in pH, acidity, fish abundance and diversity are reported downstream of AMD reclamation projects at identified river mile markers.

Total number of stream miles impaired by acid mine drainage at baseline condition (1994 -2001) is 341, to reach the NPS goal for mining issues, 102 (30% of 341) stream miles need to meet Full Warmwater Habitat status by 2010. As of 2005, 23.3 stream miles of the 175 miles accessed in 2005 now meet Full attainment of the Warmwater Habitat Status. In addition to tracking the overall NPS goal smaller incremental water-quality change were also tracked, pH values show 85 miles of stream improved from not meeting the pH 6.5 water quality standard during the baseline time period to now meeting in 2005.

Continual tracking of pH, acidity, and biological indicator MAIS were evaluated during 2006. Incremental changes from year to year can be tracked using these indicators.

Acidity and pH values have improved during 2006, pH show 88 miles of stream meet the pH 6.5 water quality target in 2006. The biological indicator, MAIS, were measured in 2005 and 2006, there were slight increases and decreases seen with each watershed. No notable increases in the MAIS score were recorded. In 2006, 72 miles of stream were accessed for IBI and ICI, however no changes in attainment status were documented. Incremental changes were seen within each watershed, the most notable increases were seen in the Monday Creek Watershed at sites MC00180 (downstream of Snake Hollow), MC00800 (downstream of Rock Run), and SY00050 (Sycamore Hollow downstream of Essex Mine).

## Introduction

The Nonpoint Source (NPS) Monitoring Project was created by the Voinovich School of Leadership and Public Affairs at Ohio University and funded by the Ohio Department of Natural Resources Division of Mineral Resources Management (ODNR-MRM). This project was developed to address the targets set forth for Abandoned Mine Drainage in the State of Ohio's Non Point Source (NPS) Management Plan 2005-2010.
www.epa.state.oh.us/dsw/nps/NPSMP/ET/amdjumppage.html
Abandoned Mine Drainage is one of the six NPS pollutants listed as a key issue to address in Ohio to improve water quality.

The number one existing target in Ohio's NPS management plan for AMD is, "By 2010, 30% of known acid mine impaired streams are in attainment with Warm water Habitat (WWH) aquatic life uses through increasing pH, decreasing metals and sediment loading, and minimizing degradation of primary headwater habitat." Three sub-targets have been developed to aid in addressing the overarching existing target:

1. By 2010, 20 completed and federally approved Abandoned Mine Drainage Abatement and Treatment (AMDAT) Plans for acid mine drainage (AMD) impaired watersheds.
2. By 2010, 10 AMD impaired watersheds have implemented some or all of the reclamation actions recommended in the endorsed AMDAT.

3. By 2006, report annually on a comparison between acidity and pH concentrations upstream and downstream of AMD project sites and long-term monitoring stations, as compared to acidity and pH reference sites within the Western Allegheny Plateau Ecoregion.

As a result of the NPS Monitoring Project funded by ODNR-MRM, an on-line reporting system, www.watersheddata.com, has been created to track environmental changes in four watersheds: Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run. These four watersheds represent where active AMD reclamation is occurring. Chemical water quality and biological data trends have been evaluated at the AMD project level, watershed level, and collectively to address the targets described above for the State's NPS management plan.

This website provides a center repository of information relating to the AMD targets listed in the State's NPS Management Plan 2005-2010, entry forms for AMD projects, downloadable reports on AMD projects, Watersheds, and NPS management plan targets, and ArcIMS database systems; where water quality and biology data can be viewed, entered, edited, mapped and downloaded for each of the four watersheds.

## Reports

The NPS monitoring reporting system (www.watersheddata.com) provides four levels of reports: Level I report found in Section I reports on progress toward the State's NPS management plan target goals, Level II reports found in Section II provides a comprehensive Watershed level report showing accumulative chemical and biological effects from mining reclamation, Level III reports found in Section III lists a summary report of each individual acid mine drainage reclamation project detailing project specifics (i.e. load reductions, costs, etc…), and Level IV reports found in Section IV shows the AMD project form report showing the raw data collected from watershed groups through the website using the NPS entry form report for 2006.

**Section I – NPS target and goals**

*Section I contains an evaluation of four watersheds: Raccoon Creek, Monday Creek, Sunday Creek and Huff Run with respect to meeting the State's NPS management target and goals.*

To address the overarching number one target of the State's Nonpoint Source Pollution management plan relating to acid mine drainage, the following activities were conducted. Baseline condition for water quality and biology were established for four watersheds where active reclamation projects are occurring; Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run. Each of these watersheds has had extensive biological and chemical evaluations conducted by the Ohio EPA during different years. Sunday and Monday Creek's baseline conditions were derived from the 2001 TMDL biological data collected. Huff Run's baseline condition was taken from the Ohio EPA 1997 sampling event. Raccoon Creek's baseline condition, being the largest of the four watersheds, was derived from various sources (Ohio EPA and USGS) during the period of 1994- 2000. From the baseline biological data, stream miles were tallied for mining impaired streams to estimate a number of stream that are impacted by abandoned mining. Of the 762.8 named streams in these four watershed 569.08 miles were assessed during the baseline period (1994-2001) and was determined that 341 miles are impacted by abandoned mining practices. Therefore to set a numeric stream mile attainment goal according to the Target #1 described in the State's NPS management plan, 102 stream miles (30% of 341 stream miles) is the goal for these four watersheds to restore to WWH.

**Target #1: "By 2010, 30% of known acid mine impaired streams are in attainment with Warm Water Habitat (WWH) aquatic life uses through increasing pH, decreasing metals and sediment loading, and minimizing degradation of primary headwater habitat."**

Water quality stations were analyzed in 2005 and 2006 for biology in Sunday Creek, Monday Creek, Raccoon Creek, and Huff Run watersheds. The total number of AMD stream miles evaluated was 175 in 2005 and 72 in 2006. Comparing the same stream segments from baseline to 2005–2006 shows the change in stream use attainment and narrative conditions, from a biologists' perspective (these changes are not official use attainment status changes made by the Ohio EPA). The biological condition of 23.3 stream miles changed from Non-supportive and Partial attainment to Full WWH use attainment. Although, this number is the ultimate number that is tracked in terms of the NPS management plan Target #1, there are many other significant incremental changes. These changes are tracked and described in this report; for example, attainment use changes from Non-supportive to Partial attainment, narrative description changes, acid and metal loading reductions, pH and acidity improvements, and increases in number of fish and diversity. These incremental changes may not allow a stream segment to change use attainment status, but they do track progress toward the overarching goal and therefore have been tracked at the acid mine drainage project level reports and at the watershed level reports.


Huff Run


Monday Creek


Raccoon Creek


Sunday Creek

Table 1. Summary of the NPS targets for each of the four watersheds evaluated in 2005 to 2006: Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run.

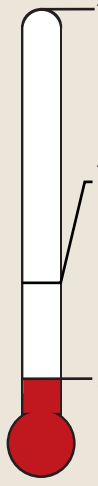
| Watershed | Total number of completed projects | Total costs | Total acid load reduction lbs/day | Total stream miles improved in 2005 to meet WWH Full attainment | Goal of number of stream miles to meet WWH Full attainment by 2010 |
|---|---|---|---|---|---|
| Raccoon Creek | 9 | $6,765,130 | 5,339 | 23.3 | 57.0 |
| Monday Creek | 8 (plus 5 subsidence projects) | $2,860,325 | 2,570 | 0 | 25.0 |
| Sunday Creek | 2 subsidence project | $139,066 | 0 | 0 | 18.0 |
| Huff Run | 7 | $3,269,239* | 83 | 0 | 2.97 |
| **Total** | **26** | **$13,033,760** | **7,992** | **23.3** | **102.97** |

**excludes Linden, Acid Pit #1, and Huff Run AML project design costs and Huff Run AML construction costs.*

## Reductions

**Total acid load reductions = 7,992 lbs/day**

## Attainment Miles



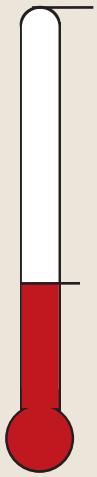
Total AMD impaired stream miles (RC, MC, SC, Huff Run) = **341 stream miles**

Target #1 indicates 30% attainment of impaired streams by 2010 =**102 miles**

Number of stream miles changed from Non-attainment or Partial attainment to Full WWH attainment for 2006 is = **23.3 miles**

*(175 miles assessed in 2005)*
*(72 miles assessed 2006)*

## Completion



Sub-target 2
Total projects proposed in these four Watersheds AMDATS = **69**

Total projects complete = **26**

## Costs

**Total reclamation costs = $13,033,760**

**Sub-Target 1: "By 2010, 20 completed and federally approved Abandoned Mine Drainage Abatement and Treatment (AMDAT) Plans for AMD impaired watersheds".**

• Eleven Acid Mine Drainage Abatement and Treatment (AMDAT) plans have been completed (Map 1): Huff Run, Moxahala Creek, Sunday Creek, Monday Creek, Federal Creek, Raccoon Creek Headwaters, Middle Basin Raccoon Creek, Little Raccoon Creek, Leading Creek, Robinson Run, and Yellow Creek.

• One AMDAT plans is currently in progress: Upper Rush Creek (Map 1).

• To address sub-target 1, "complete 20 AMDAT plans by the year 2010", 11 watersheds have been selected as priority watersheds to write an AMDAT plan. These 11 watersheds were selected from a list of approximately 20 mining impacted watersheds in Ohio that were identified from these various sources; OEPA 2004 and 2006 integrated report, ODNR-MRM 2002 map showing impairment magnitudes from mining, ODNR's 1974 Land Reborn report (high and medium priority), and OEPA TMDL reports. In order to prioritize these 11 watersheds as candidates for the AMDAT plan, water quality data and information from ODNR-DMRM project officers, Ohio EPA surface water quality database, Ohio EPA TMDL personnel, and US Forest Service personnel were used to determine the extent of mining and its need for further study. Table 2, summarizes this information (page 4 & 5).

## Map 1. Status of AMDAT Plans in Ohio 2007

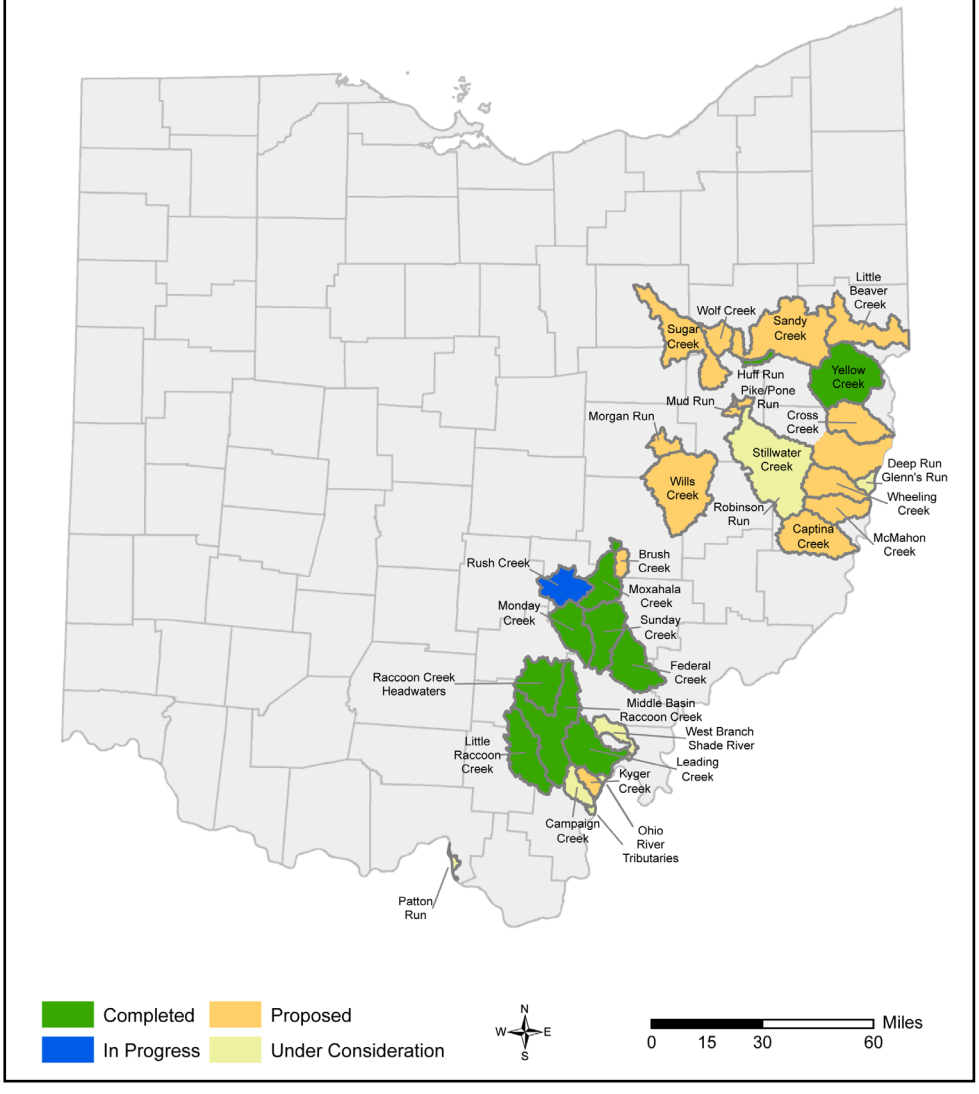


Table 2. Supporting information to determine AMDAT plan needs in Ohio watersheds

| Watershed Name | Personal contact information | Water quality data and source | Recommended for an AMDAT plan (Y or N) |
|---|---|---|---|
| Duck Creek | Bill Jonard (ODNR-DMRM) - Sediment issues present not acid mine drainage issues. | 184 acres of strip mine land | No |
| Wills Creek | Ed Rankin and Chris Yoder biology data indicated AMD stressors in Buffalo Creek | OEPA Database: 1999 showed high conductivity in Buffalo Fork, Leatherwood Creek, Rannells Creek, Miller Creek, and Collins Fork no pH values were collected | Yes |
| Captina Creek | Mike Mozena (ODNR-DMRM) recommended for an AMDAT plan | OEPA database: as of 2000 pH values meeting standards | Yes |
| Stillwater | | OEPA database: no pH values collected, sporadic conductivity ranges | Need more data |
| Little Beaver Creek | Cheryl Socotch (ODNR-DMRM) recommended for an AMDAT plan | OEPA Database: 1999 high conductivity, no pH values collected in Honey and North Fork of Little Beaver Creek | Yes |
| Sugar Creek | | OEPA database: 1998 South Fork Sugar Creek (RM 0.27) pH 5.04, Trib. to Indian Trail Creek (RM 6.08) pH 5.18, and Cherry Run (RM 0.22) pH 5.54 | Yes |
| Tuscarawas Tributaries<br>White Eyes<br>Evans<br>Pike Run<br>Pome Run<br>Wolf Creek<br>Mud Run<br>Trib. to Morgan Run | Kelly Capuzzi (OEPA) provided initial water quality information – TMDL in preparation | Full WWH<br>Full WWH<br>pH 5.93<br>pH 5.42<br>pH 3.67<br>High TDS, Fe, mining<br>pH 5.3-5.7 | No<br>No<br><br><br><br>Yes |
| Salt Creek | Kelly Capuzzi (OEPA) TMDL in preparation – not recommended for an AMDAT plan | | No |
| Pine Creek | Pam Stachler (USFS) – not recommended for an AMDAT plan, isolated mining issues in Kimble Creek | OEPA database: 2000 Kimble Creek pH 2.46 | No |
| West Branch Shade River | Matt Raymond (ODOT) – recommended for and AMDAT plan | | Need more data |
| Meigs Creek | Jen Bowman (Voinovich Center) – high sediment loads, no acidity, under active reclamation by Consol | | No |

Table 2. (continued) Supporting information to determine AMDAT plan needs in Ohio watersheds

| Watershed Name | Personal contact information | Water quality data and source | Recommended for an AMDAT plan (Y or N) |
|---|---|---|---|
| McMahon Creek | Mike Mozena (ODNR-DMRM) –Recommended for an AMDAT plan, specifically Little McMahon Creek | OEPA database: 1983 Kings Run pH 4.0, 2.8, 3.0, 3.2, Trib. to Little McMahon Creek (RM 2.28) pH 3.9 | Yes |
| Wheeling Creek | Mike Mozena (ODNR-DMRM) –Recommended for an AMDAT plan: Fall Run, Steep Run, Cox Run, Jug Run, Crabapple Creek, Sloan Run | OEPA database: 1999 Wheeling Creek (RM 12.3) high conductivity downstream of Fall Run and at the mouth of Fall Run no pH values were collected | Yes |
| Short Creek | Hal Miller (ODNR-DMRM) extensive mining throughout, have been developing projects in the area, no coordinator. | OEPA database: 1999-2000 Short Creek (RM 4.96)high conductivity, no pH data collected | Yes |
| Cross Creek | | OEPA database: 1983 Dry Fork pH 3.7 and Trib to Cross pH 2.8 | Yes |
| Symmes Creek | Pam Stachler (USFS) – not recommended for an AMDAT plan, isolated mining issues | | No |
| Sandy Creek | | OEPA database: 1992 Nimishillen Ck (RM 6.72) pH 5.5, high conductivity and 1987 Huford Run pH 3.8 | Yes |
| Kyger Creek | Barb Flowers – localized AMD with sediment issues | OEPA database: 1982 Jessie pH 4.5 Turkey Run pH 4.3 | Yes |
| Campaign Creek | Barb Flowers (ODNR-DMRM) recommended for an AMDAT plan | | Need more data |
| Ohio River Tributaries<br>Stories Run<br>Patton's Run<br>Glenn's Run<br>Deep Run | Barb Flowers (ODNR-DMRM) recommended Stories Run, Mike Mozena (ODNR-DMRM) recommended Patton's, Glenn's, and Deep Run) | | Need more data |
| Brush Creek | Max Luehrs (OSM) and Bill Jonard (ODNR-DMRM) – severe AMD impacted (Muskingum Tributary) | | Yes |

**Sub-Target 2: "By 2010, 10 AMD impaired watersheds have implemented some or all of the reclamation actions recommended in the endorsed AMDAT".**

As of 2006, the following six watersheds are implementing reclamation actions endorsed in their AMDAT plan: Little Raccoon Creek, Headwaters of Raccoon Creek, Middle Basin of Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run. Leading Creek, Federal Valley and Moxahala continue to plan reclamation activities and make efforts to secure funding for projects in 2007 and beyond.

**Sub-Target 3: "By 2006, report annually on a comparison between acidity and pH concentrations upstream and downstream of AMD project sites and long-term monitoring stations, as compared to acidity and pH reference sites within the Western Allegheny Plateau Eco-region".**

This report and website (www.watersheddata.com) were created to provide ODNR-DMRM, watershed groups, watershed professionals, Ohio EPA, USEPA and all of Ohio's citizens an annual report of the reclamation efforts resulting in water quality and biological changes in Ohio's streams due to mine reclamation. This report is available on the website under the reports tab. This annual reporting system will be linked to Ohio's Non-Point Source Pollution Management Plan and will continue to be updated year to year.

**Section II – Watershed reports**

*Section II contains four watershed level NPS reports detailing the chemical and biological data trends from baseline condition to 2006.*

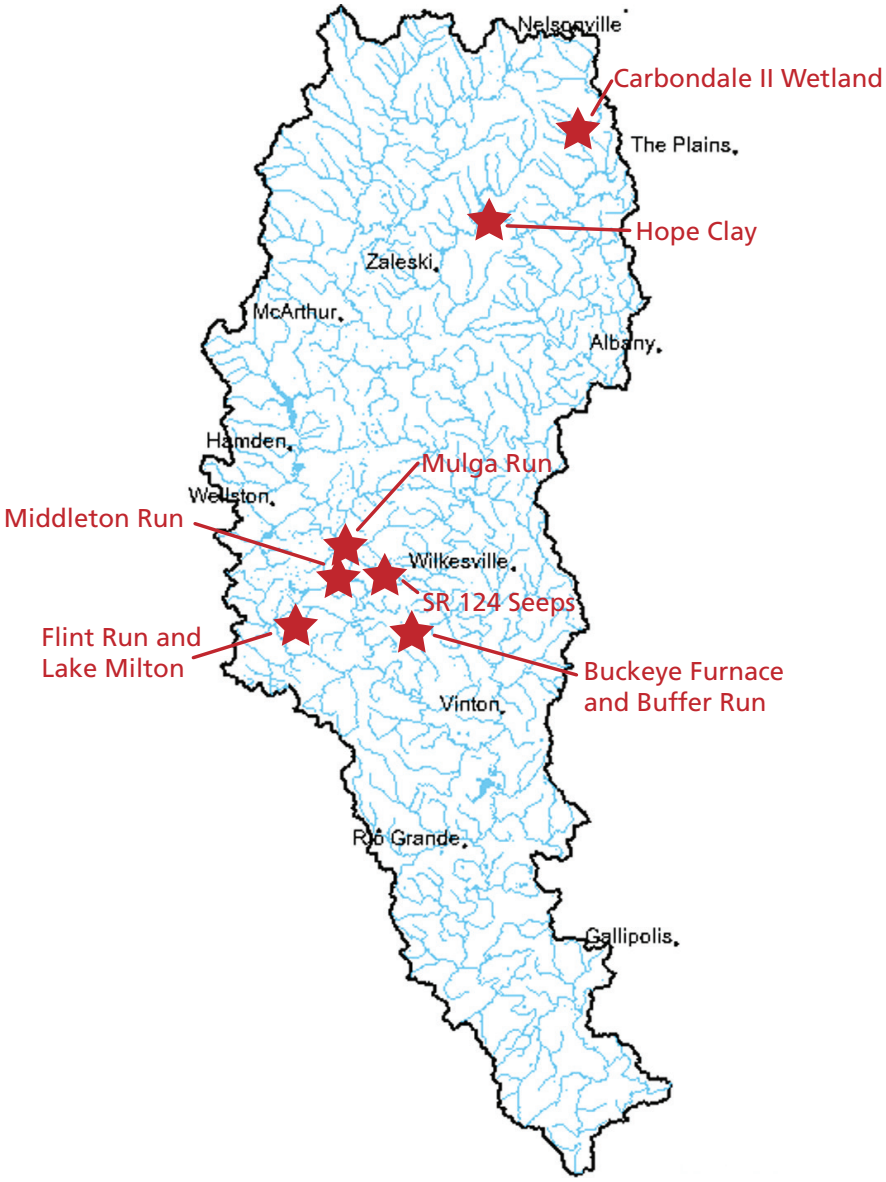
1. Raccoon Creek Watershed
2. Monday Creek Watershed
3. Sunday Creek Watershed
4. Huff Run Watershed

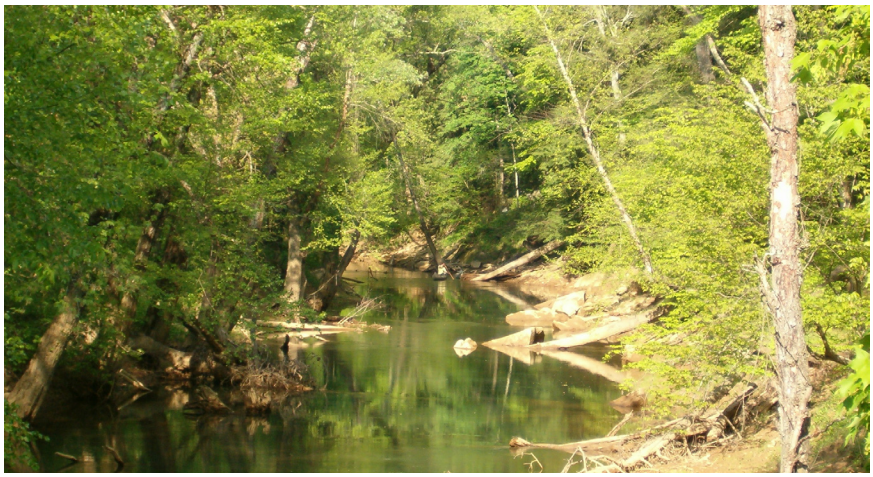
• The Raccoon Creek Watershed Project is a local partnership working towards conservation, stewardship, and restoration of the watershed for a healthier stream and community. The partnership consists of multiple agencies and individuals working to restore and promote the waters of Raccoon Creek. Encompassing over 683 square miles, the watershed lies in portions of six southeast Ohio Counties (Athens, Hocking, Meigs, Vinton, Jackson and Gallia). Raccoon Creek is one of Ohio's longest streams, measuring 112 miles draining into the Ohio River in Gallia County. Major sources of impairment to the stream include acid mine drainage (AMD), drainage from wastewater treatment facilities, and industrial discharges. By and large, AMD contributes to the vast majority of pollution issues in the watershed.

• The watershed currently has over 25,610 acres of underground coal mines and 21,550 acres of surface coal mines within its boundaries. About 110 acres of abandoned coal refuse piles also lie in the watershed. These abandoned mines and refuse piles leach thousands of pounds of sulfuric acid and metals into the creek daily, significantly degrading the water quality of streams. In the late 1990's representatives from several partnering agencies, including the Institute for Local Government and Rural Development (ILGARD), Ohio Department of Natural Resources, Division of Mineral Resource Management, and Ohio EPA, prioritized sites that contributed the most AMD pollution to Raccoon Creek and began to implement restoration strategies on these sites. Because the watershed is so large, three major sub-shed divisions are used to break up the region into more manageable sections. These consist of the Headwaters, Little Raccoon, and the Middle Basin sub-sheds. Each of these sections has priority AMD projects. Some of these projects have been completed, some are in progress, and some are anticipated future projects.

• Headwaters

• The major priority sites in the headwaters sub-shed include East Branch, where several impacted tributaries contribute to significant acid and metal loadings in Raccoon Creek. Brushy Creek and the Mainstem of Raccoon



*Raccoon Creek near Moonville, Photo by Ben McCament*

Creek above Brushy Creek are also priority AMD abatement sites.

• Little Raccoon

• Flint Run is the largest contributor of AMD in the Little Raccoon Creek watershed. A majority of this (90%) is attributed to a 240-acre site in the headwaters. This site, called Broken Aro, previously housed a coal preparation facility and mine tailings dump. Other major AMD contributors in this basin include Mulga Run, Buffer Run and Goose Run.

• Middle Basin

• Major acid contributors in the middle basin include Rock Camp and Pierce Run. Rock Camp is the most consistent contributor of AMD, and has net acidic water regardless of flow. Pierce Run has experienced some net alkaline flows; it is thought that this might result from current mining operations in the area.

• Watershed Outreach

• In addition to the technical work of AMD remediation, other activities in the watershed are geared toward meeting goals of stewardship and conservation in the region. Annual litter pick-ups, tree-plantings and canoe-floats all encourage residents to become stewards of our watershed. School programs for youths help educate students about water quality, acid mine drainage, and the value of clean water. In addition, a new community group has formed to address access issues for canoers and kayakers who wish to paddle on the creek.

For further updates on the progress in Raccoon Creek,
please visit our webpage at:
**www.raccooncreek.org**

## Reductions

**Total acid load reduction = 5,339 lbs/day**

**Total metal load reduction = 878 lbs/day**

*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Attainment Miles

Total stream miles assessed impacted by mine drainage = **190 miles**

Target #1 indicates 30% attainment of impaired streams by 2010 = **57 miles**

2006 progress = **23.3 miles** meeting Full WWH attainment

*(48 miles assessed in 2006)*

## Completion and Costs

Sub-target 2
Total projects proposed in three Raccoon Creek Watershed
AMDATS = 25

Total projects complete = 9

Design = $1,356,135
Construction = $5,408,995

**Total Costs through 2006 = $6,765,130**

# Timeline of the Raccoon Creek Watershed
# Project Milestones & AMD Projects

This timeline shows the history of the Raccoon Creek Watershed Partnership, started almost two Decades ago by a group of concerned local citizens. Today, the partnership consists of multiple state and local agencies and private citizens. AMD projects have been administered through the Vinton Soil and Water Conservation District and Ohio University's Voinovich Center (ILGARD), with funding from various state and federal grants but mostly from Ohio EPA's 319 program and ODNR-MRM's AMD program.

**1980s** Formation of Raccoon Creek Improvement Commitee (RCIC): Grassroots citizens group to address water quality issues in Raccon Creek

**Early 1990s** RCIC invites citizens from all six counties to join efforts

**Late 1990s** Formation of Raccoon Creek Watershed Partnership, a loosely based partnership of agencies to address technical AMD issues

**1999** State Route 124 Strip Pit and Buckeye Furnace Project completed

**2000** Little Raccoon Creek AMDAT completed
Watershed Coordinator position funded for six years

**2001** Headwaters AMDAT completed
State Route 124 seeps project completed

**2003** Mulga Run project completed
Middle Basin AMDAT completed
Completed management plan for Raccoon Creek Watershed

**2004** Carbondale II project completed

**2005** Middleton Run-Salem Road project completed

**2006** Raccoon Creek Water Trail Association formed
Mission to Establish a water trail on Raccoon Creek

Flint Run and Lake Milton Projects completed
Watershed Coordinator three year extension funded

**2007** Raccoon Creek Watershed Partnership formed 501 (c) 3

## Projects Completed July 1, 2006 – June 30, 2007

| | |
|---|---|
| **Flint Run East** | **$1,697,808** |
| **Lake Milton** | **$1,377,536** |
| total | **$3,075,344** |

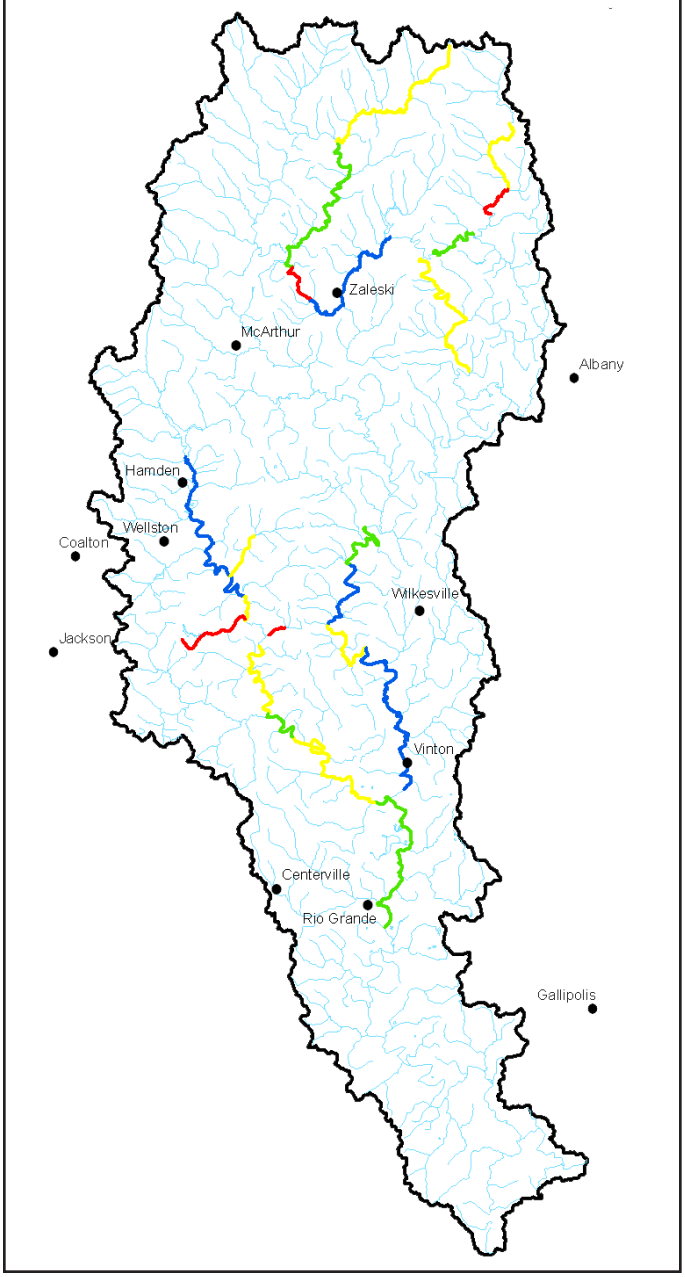
## Load Reductions

| | Flint Run | Lake Milton | |
|---|---|---|---|
| Acid Load | 803 lbs/day | 1,288 lbs/day | **2,091 lbs/day** |
| Metal Load | 107 lbs/day | 103 lbs/day | **210 lbs/day** |

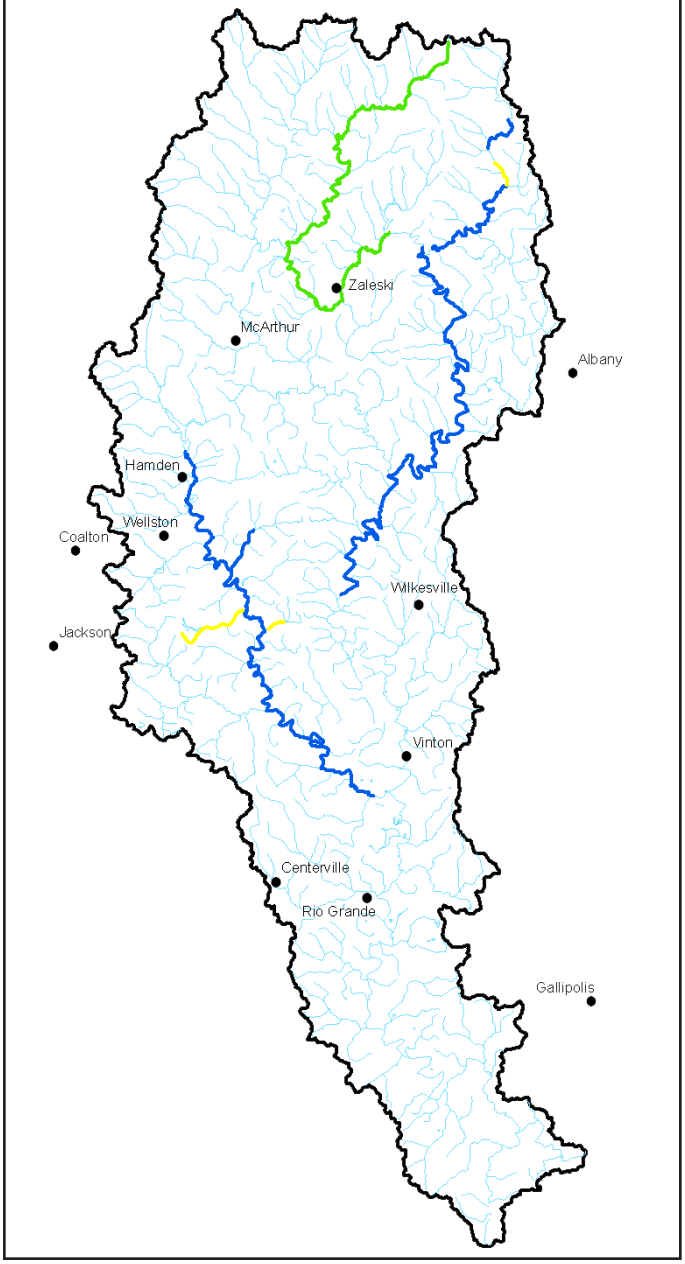
## Cumulative BMP's installed

| Treatment Installed | Flint Run | Lake Milton |
|---|---|---|
| Succesive Alkaline Producing Systems (SAPS) | 32,500 *square feet* | 16,000 *square feet* |
| Open Limestone Channel | 13,650 *linear feet* | 2,300 *linear feet* |
| Steel Slag Leach Bed | 32,500 *square feet* | 74,000 *square feet* |
| Earthwork | 56 *acres* | |
| Erosion Control | 13,000 *linear feet* | |
| Dewatering Existing Impoundments | 12,827,200 *gallons of water* | |
| Sediment Pond | 87,400 *square feet* | |
| Fresh Water Storage Pond | 84,800 *square feet* | |
| Limestone Leach Bed | 10,400 *square feet* | |
| Wetland, passive | 4,800 *square feet* | |
| Water Treatment in Lake Milton | | 50 *million gallons* |
| Repair Dam with Slurry Wall | | 75,000 *square feet* |

## Raccoon Creek baseline pH



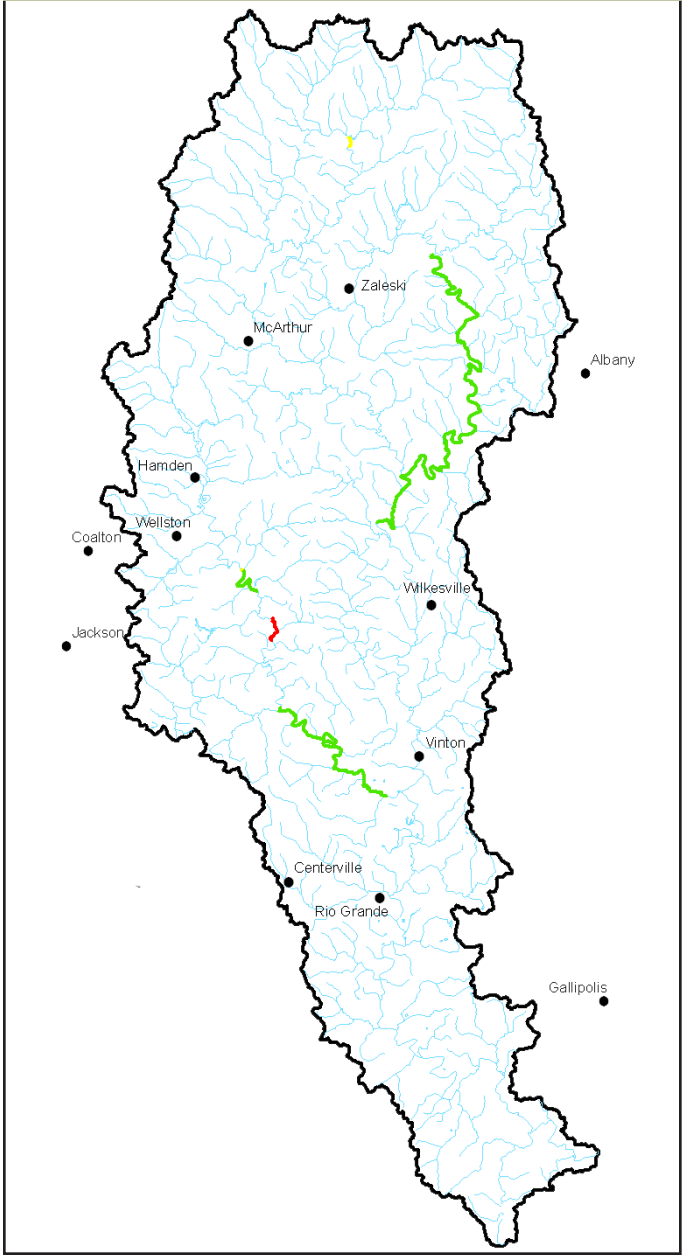

## Raccoon Creek 2006 pH



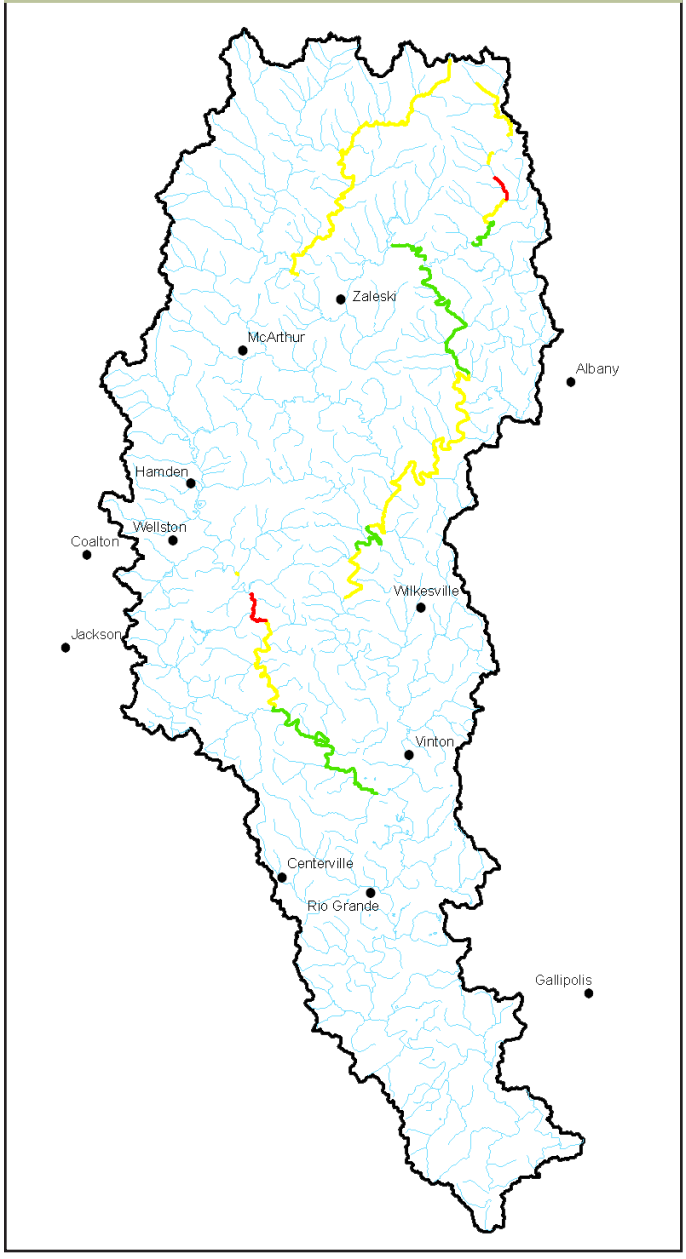

Lab pH
- < 4
- 4 - 5.4
- 5.5 - 6.4
- > 6.4

In Raccoon Creek pH values have improved throughout the watershed from baseline conditions (1994-2001) to 2006. Raccoon Creek mainstem, Hewett Fork and Little Raccoon Creek average pH values have increased from a range of 4.0-5.4 to 5.5-6.5. Sixty eight miles of stream are meeting water quality standards of pH >6.5 along the mainstem, Hewett Fork, and Little Raccoon Creek. Flint Run and Buffer Run pH values improved at their mouths.

## Raccoon Creek 2005 MAIS




## Raccoon Creek 2006 MAIS




Macroinvertebrate Aggregated Index for Streams

- 0 - 7
- 8 - 11
- 12 - 15
- > 15

MAIS samples were collected throughout Raccoon Creek in 2006, these stations has been established as annual monitoring stations for macroinvertebrates. These sites will be used to track incremental changes in future years.

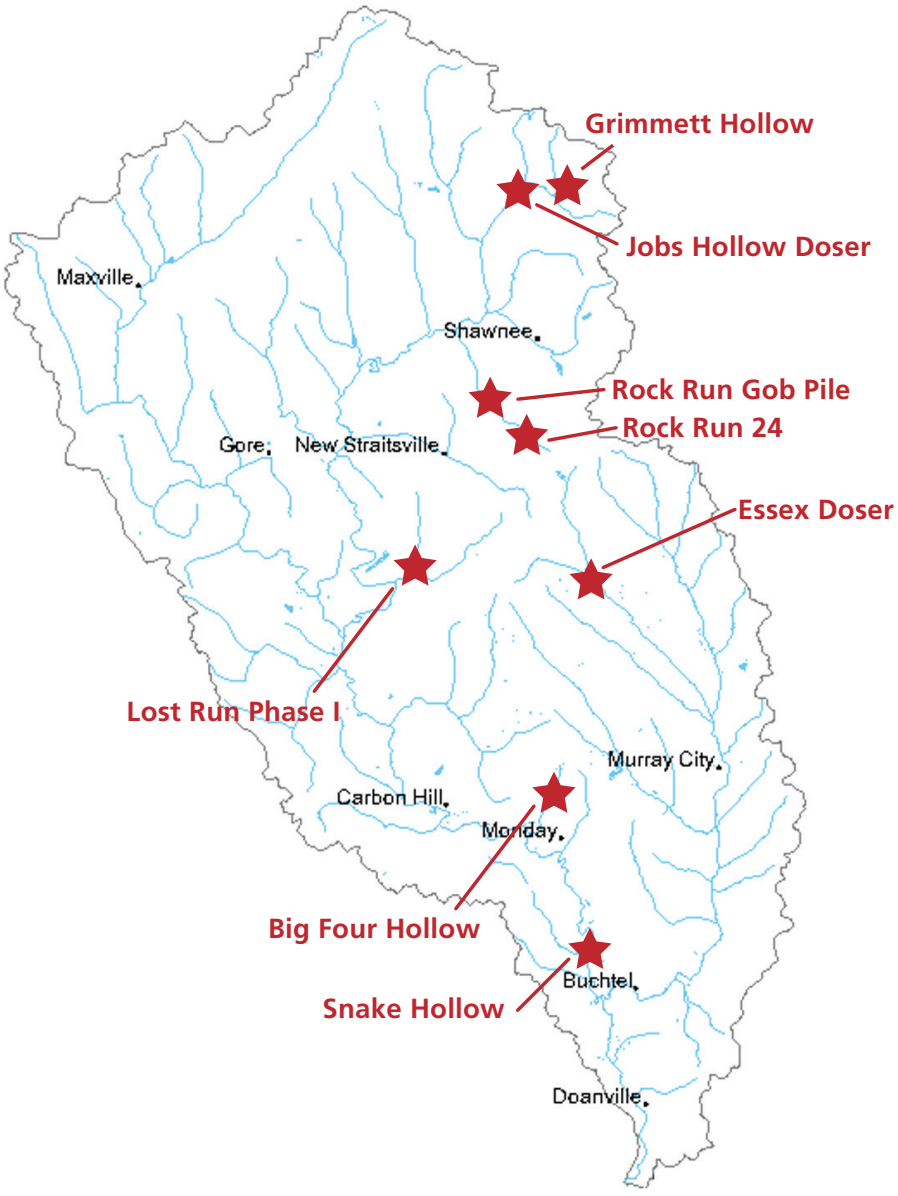
• Monday Creek, located in the Appalachian Region of southeastern Ohio, is a 27-mile long tributary of the Hocking River, the latter which flows directly into the Ohio River. The Monday Creek Watershed drains a 116 square-mile area, with streams winding through portions of Athens, Hocking, and Perry Counties.

• Our project is a collaborative partnership of officials and residents of the Monday Creek watershed, along with more than 20 other organizations and state and federal agencies. Our shared goal is to restore the watershed for the benefit of local communities. Large portions of Monday Creek and its tributaries are dead due to acid mine drainage (AMD) left behind from a century of coal mining.

• Since 1994, our partnership has worked together to identify water quality problems, conduct field research and site characterization, and prioritize and plan on-going restoration activities. The MCRP has completed the reclamation of the Rock Run gob pile in southern Perry County through an EPA Section 319 grant and is beginning another project in the headwaters of Jobs Hollow through 319.

• In 1997-1998, we identified issues to be addressed for the long-term improvement of the watershed, and to the benefit of local communities. These issues, along with goals, objectives, action strategies, and progress indicators are discussed in detail in the Monday Creek Comprehensive Management Plan.

• To learn more about the Monday Creek Restoration Project, visit our website at www.mondaycreek.org or call 740-394-2047




Monday Creek Restoration Project

298,935,000 gallons per year eliminated from entering into the deep mines as the result of conducting five stream capture closure projects in Monday creek

## Reductions

**Total acid load reduction = 2,570 lbs/day**

**Total metal load reduction = 378 lbs/day**

*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Attainment Miles

Total stream miles assessed impacted by mine drainage = **83 miles**

Target #1 indicates 30% attainment of impaired streams by 2010 = **25 miles**

**2006 progress = 0 miles** meeting Full WWH attainment

*(33 miles assessed in 2006)*

## Completion

Sub-target 2
Total projects proposed in 1999 AMDAT = **13**

Total projects complete = **8 (plus 5 subsidence closures)**

## Costs

Design $213,077
(excluding Snake Hollow)
Construction $2,647,248

**Total costs through 2006 = $2,860,325**

## Monday Creek Stream Capture Projects

Project status: Five subsidence closures projects were completed from 1995-2004

| Project Name | Year project complete | Acres captured | Agencies funding | Estimated gallons/yr of water diverted from entering the deep mine. |
|---|---|---|---|---|
| Majestic Mine | 1999 | 100 | ODNR-DMRM | 36,860,000 |
| Salem Hollow | 2000 | 60 | ODNR-DMRM | 22,116,000 |
| Murray City | 2004 | 5 | ODNR-DMRM | 1,843,000 |
| Goose Run | 1995 | 506 | ODNR-DMRM | 186,512,000 |
| Snow Fork | 1999 | 140 | ODNR-DMRM | 51,604,000 |

Five stream captures located in the Monday Creek Watershed were closed and completed from 1995 to 2004. A total of 811 acres surface drainage area drained year round into the deep mines and as a result of closing these subsidence holes, 298,935,000 gallons per year were diverted from entering into the deep mine thus abating the generating of acid mine drainage.

## Projects Completed July 1, 2006 – June 30, 2007

| | |
|---|---|
| **Essex Doser** | **$319,720** |
| **Lost Run Phase I** | **$510,00** |
| total | **$829,720** |

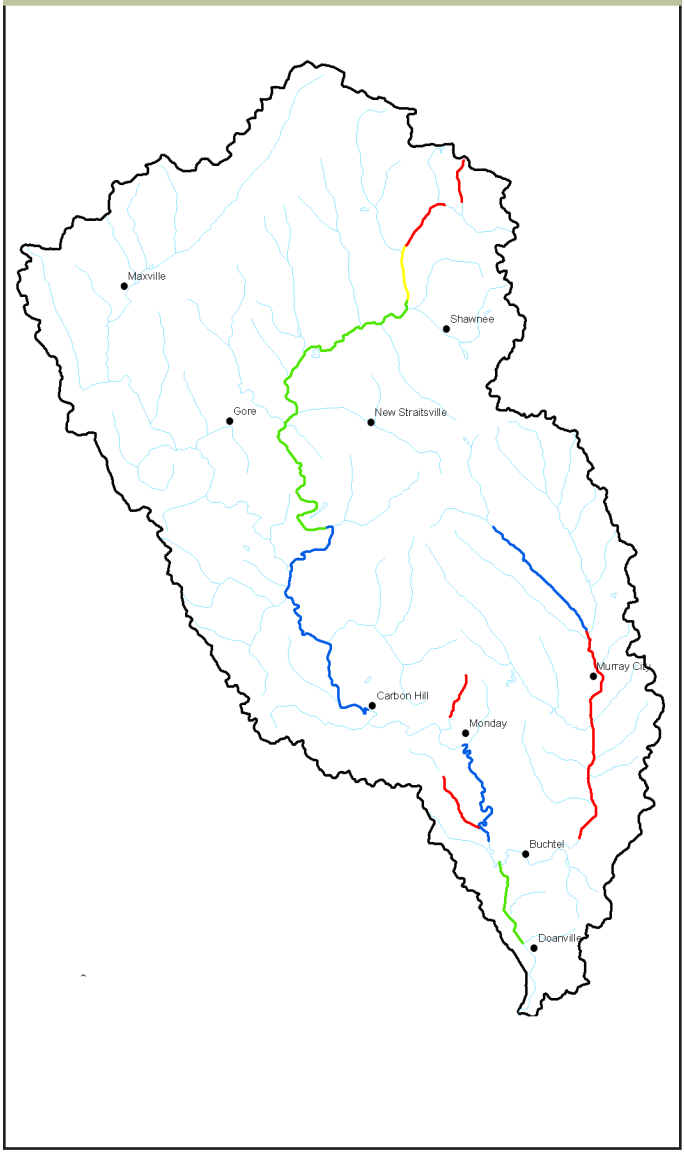
## Load Reductions

| | **Essex Doser** | **Lost Run Phase I** |
|---|---|---|
| Acid Load | 724 lbs/day | NA |
| Metal Load | 200 lbs/day | NA |

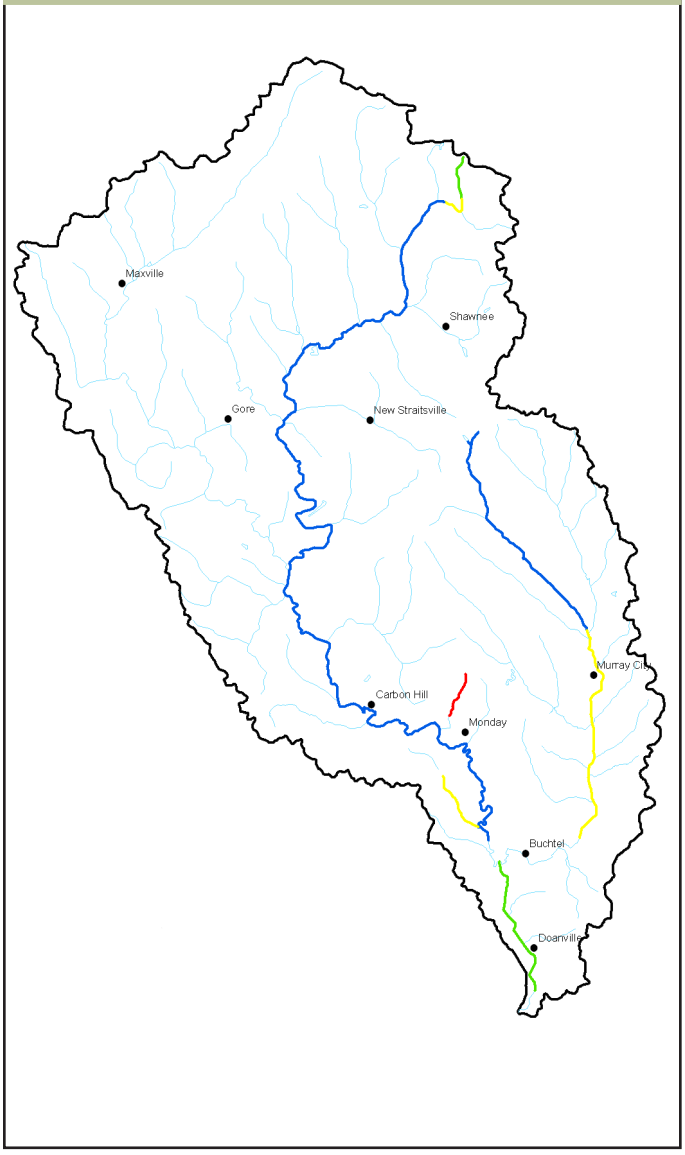
## Cumulative BMP's installed

| **Treatment Installed** | |
|---|---|
| Doser | 1 |
| Open Limestone Channel | 3,540 *linear feet* |
| Limestone Leech Bed | 13,700 *square feet* |

## Monday Creek baseline pH



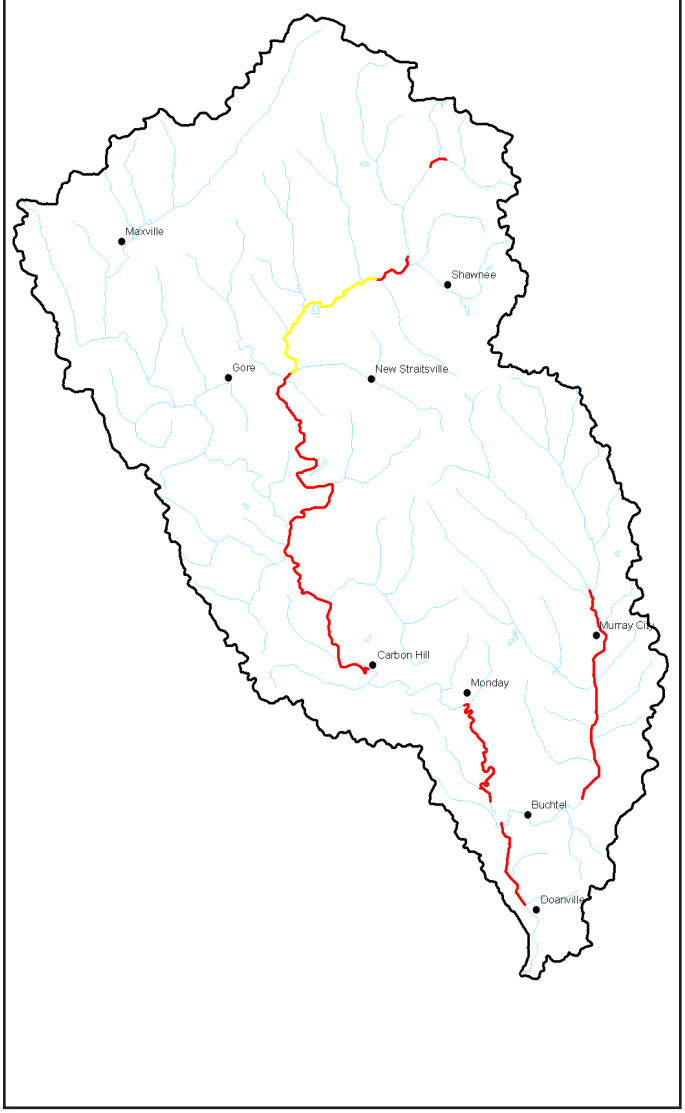

## Monday Creek 2006 pH



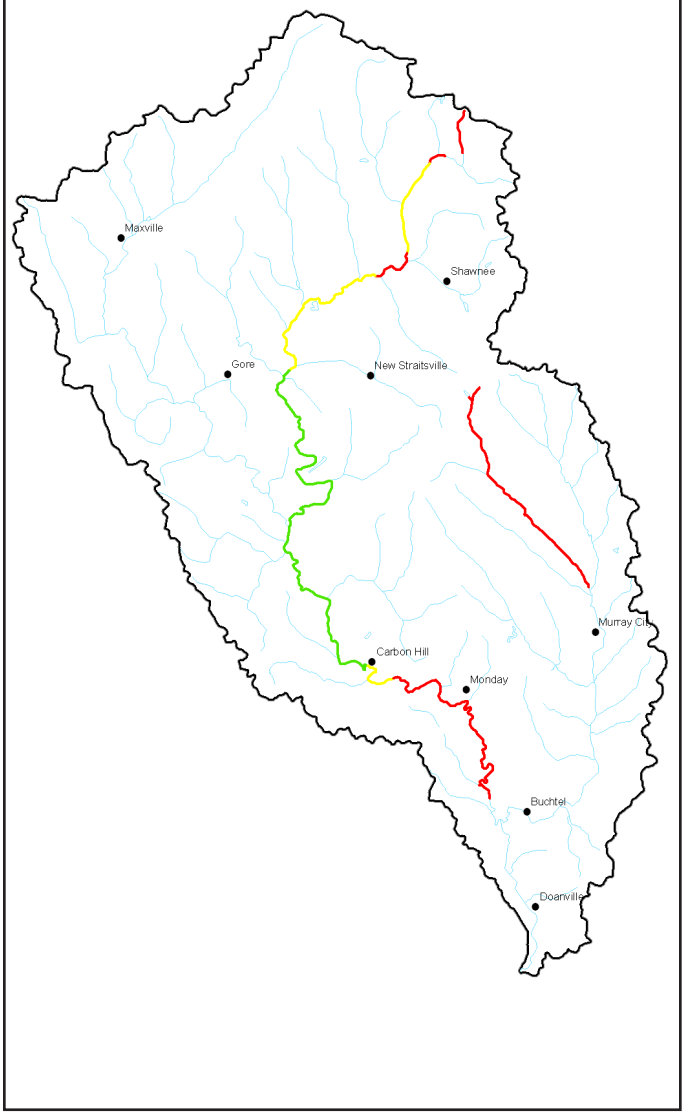

Lab pH
- < 4
- 4 - 5.4
- 5.5 - 6.4
- > 6.4

In Monday Creek pH values have improved throughout the watershed from baseline conditions (2001) to 2006. Twenty-three steam miles along the mainstem of Monday Creek now meet water quality standards (>6.4) from Snake Hollow to headwaters of Jobs Hollow. In Snow Fork pH has improved from Buchtel to Murray City. For three miles in the headwaters of Snow Fork, Essex mine to Murray City pH now meets water quality standards (>6.4).

## Monday Creek baseline MAIS




## Monday Creek 2006 MAIS




Macroinvertebrate Aggregated Index for Streams

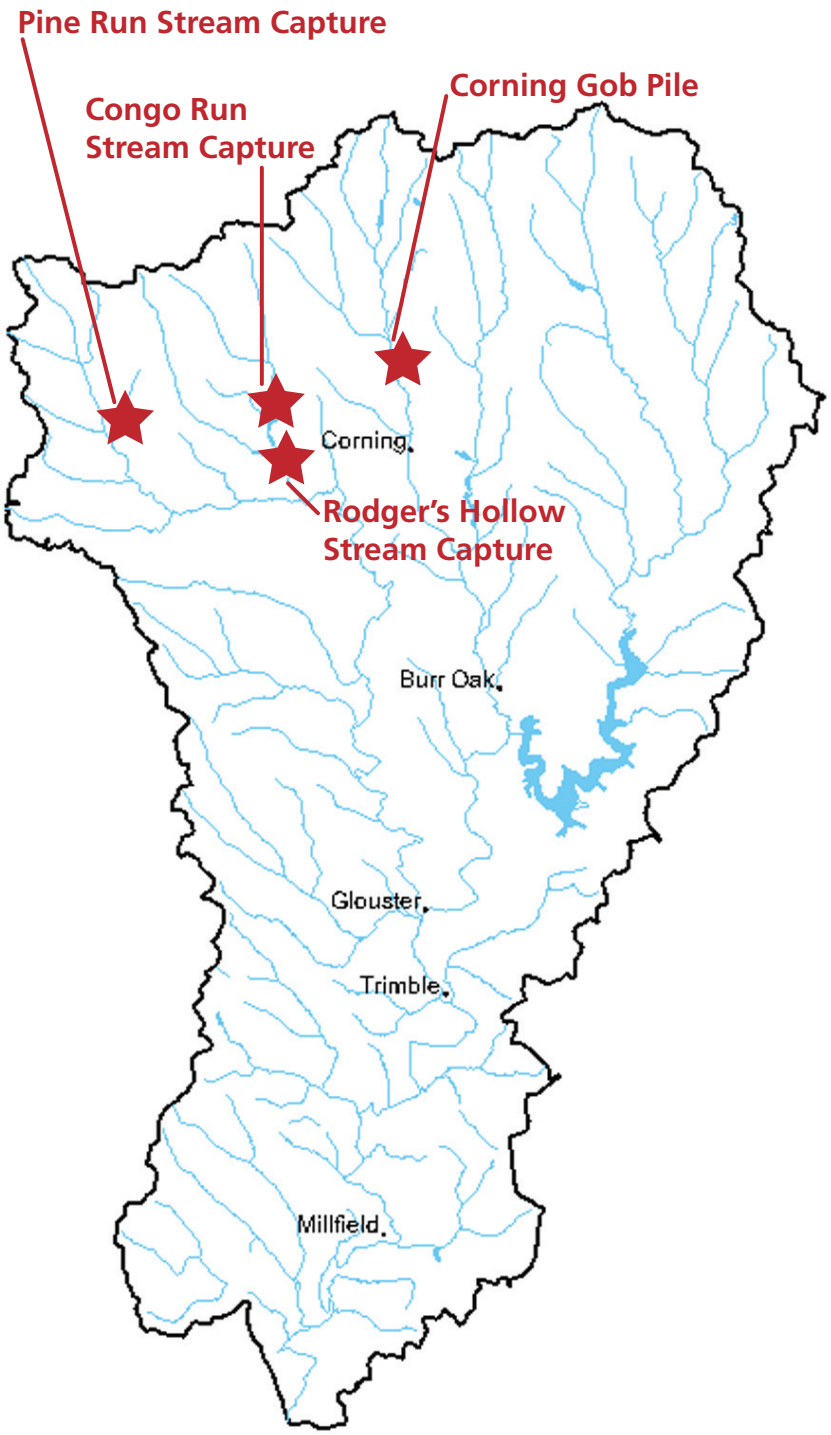
- 0 - 7
- 8 - 11
- 12 - 15
- > 15

Monday Creek aquatic use attainment has not changed over the past five years however smaller incremental changes in fish and bugs have improved downstream of reclamation projects. The MAIS scores have increased from baseline conditions (2001) to 2006 for 15.44 miles along the mainstem from Snake Hollow up to Rock Run. During baseline conditions the MAIS scores ranged from 0-11, these scores increased into the range 8-15. These increases in the biological integrity are related to the reclamation projects occurring in these sub-watersheds.

• The Sunday Creek Watershed Group emerged from local residents' concerns for the health of the Sunday Creek. Currently, we are a project of Rural Action. The Sunday Creek Watershed group office is located on 69 High St. Glouster Ohio 45732. The phone number is 740-767-2225 and our web page is http://www.sunday-creek.org. Our most active partners are: Ohio Department of Natural Resources the divisions of Mineral Resource Management and Soil and Water Conservation; Ohio Environmental Protection Agency; Office of Surface Mining; Ohio University; ILGARD; Hocking College; Trimble and Miller School District; Rural Action's Environmental Learning Program and Sustainable Forestry; Local Village Councils; Local Township Trustees; Little Cities of Black Diamonds; Buckeye Trail Group; Moose Lodge; Wayne National Forest; Burr Oak State Park.

• Our mission statement, as adopted by the Sunday Creek Watershed Group in 2000; "The Sunday Creek Watershed Group is committed to restoring and preserving water quality through community interaction, conservation, and education; in pursuit of a healthy ecosystem capable of supporting bio-diversity and recreation."

• The Sunday Creek Watershed is located in the Appalachian foothills, in the unglaciated part of Ohio. It is mostly rural with many small villages throughout, and the majority of the land is privately owned. The Sunday creek watershed starts in the East Branch, north of Rendville and the West Branch at Shawnee. The creek follows SR 13 through Corning, Glouster, Millfield and it goes into the Hocking River right in Chauncey. The watershed covers 139 square miles crossing Athens (38.8%), Perry (42.84%), Morgan (18.35%), and Hocking (0.01%) Counties. According to the Ohio Department of Natural Resources, in 1994, land cover classification for Sunday Creek consisted of 78% wooded, 17% agricultural, 2.4% brush, 1% urban, 1% open water, 0.3% barren, and 0.2% non-forested wetland (Map 2: land use/land cover). The U.S. Forest Service manages approximately 15% of the total acreage.




Sunday Creek Watershed Group

• In the fall of 1999, Jim Hart began putting together a list of other local residents interested in water quality in the Sunday Creek watershed. A group of over 20 people attended the first meeting, which was held in the Trimble High School library. At the beginning, the group focused on organization, establishing a mission, and getting a sense of the community's concerns for the Sunday Creek. In 2000, the group partnered with Rural Action and got its first full time Americorp VISTA. That year we received an EPA 319 planning grant to develop a management plan. With that grant we completed a State Endorsed Management Plan and an Acid Mine Drainage Abatement Plan with additional funding from ODNR-MRM. In 2002, we received a six year ODNR Soil and Water Conservation Watershed Coordinator grant. In 2003 we began our first EPA 319 2002 implementation grant. Currently we are in the last year of our second (2004) EPA 319-implementation grant. We also received an Appalachian Clean Stream Initiative Grant from OSM. All of this funding has been made possible with our strong partnership and match funding from the ODNR division of Mineral Resource Management. We have finished our first acid mine drainage remediation project at Congo Run, a subsidence closure. The SCWG is currently coordinating major reclamation projects in the West Branch of Sunday Creek and Headwaters. We have also completed 17 upgrades of septic systems, planted thousands of trees, cleaned up over 200 tons of garbage, and educated thousands of students.

## Reductions

| Project Name | Year Completed | Acres Captured | Agencies funding | Estimated water diverted from entering the deep mine |
|---|---|---|---|---|
| Congo Run CR-15 | 2004 | 72 | ODNR-DMRM | **24,000,000** gallons/yr |
| Pine Run | 2007 | 138 | ODNR-DMRM | **50,867,000** gallons/yr |

Two stream captures located in the Sunday Creek Watershed were closed and completed from 2004-2007. A total of 210 acres surface drainage area drained year round into the deep mines and as a result of closing these subsidence holes 74,867,000 gallons per year were diverted from entering into the deep mine thus abating the generating of acid mine drainage.

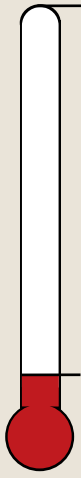
## Attainment Miles

Total stream miles assessed impacted by mine drainage = **59 miles**

Target #1 indicates 30% attainment of impaired streams by 2010 = **18 miles**

**2006 progress = 0 miles**
meeting Full WWH attainment
*(20 miles assessed in 2006)*

## Completion



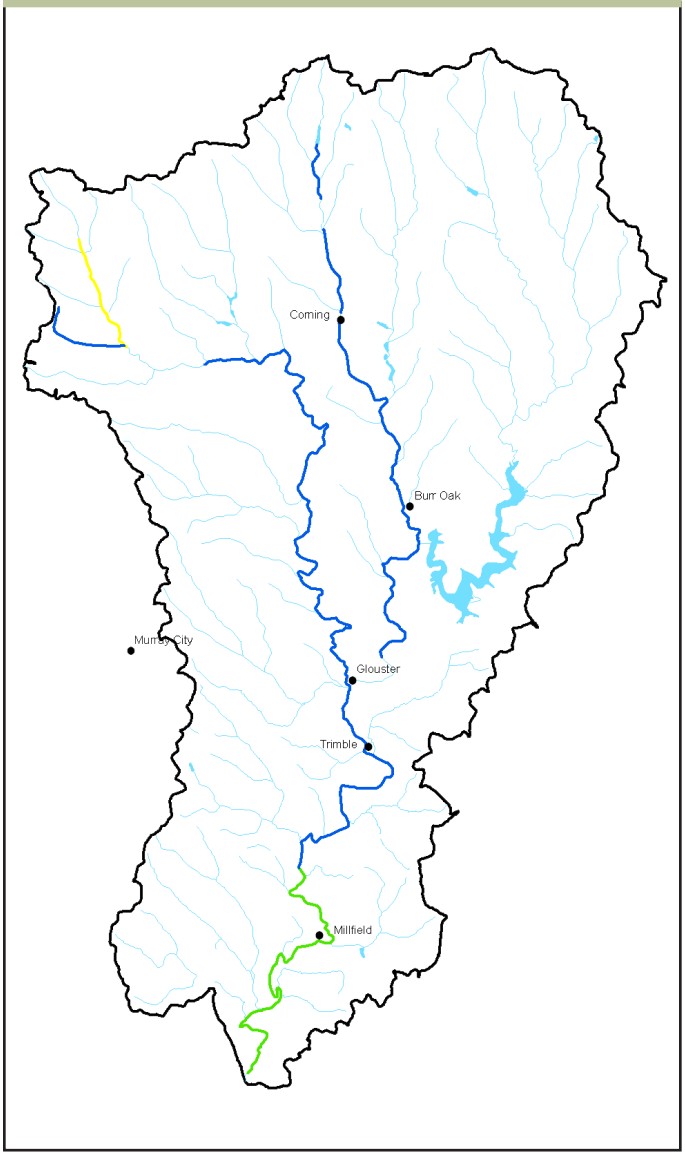
Sub-target 2
Total projects proposed in Sunday Creek Watershed AMDATS =**23**

Total projects complete =
**2 subsidence closure project**

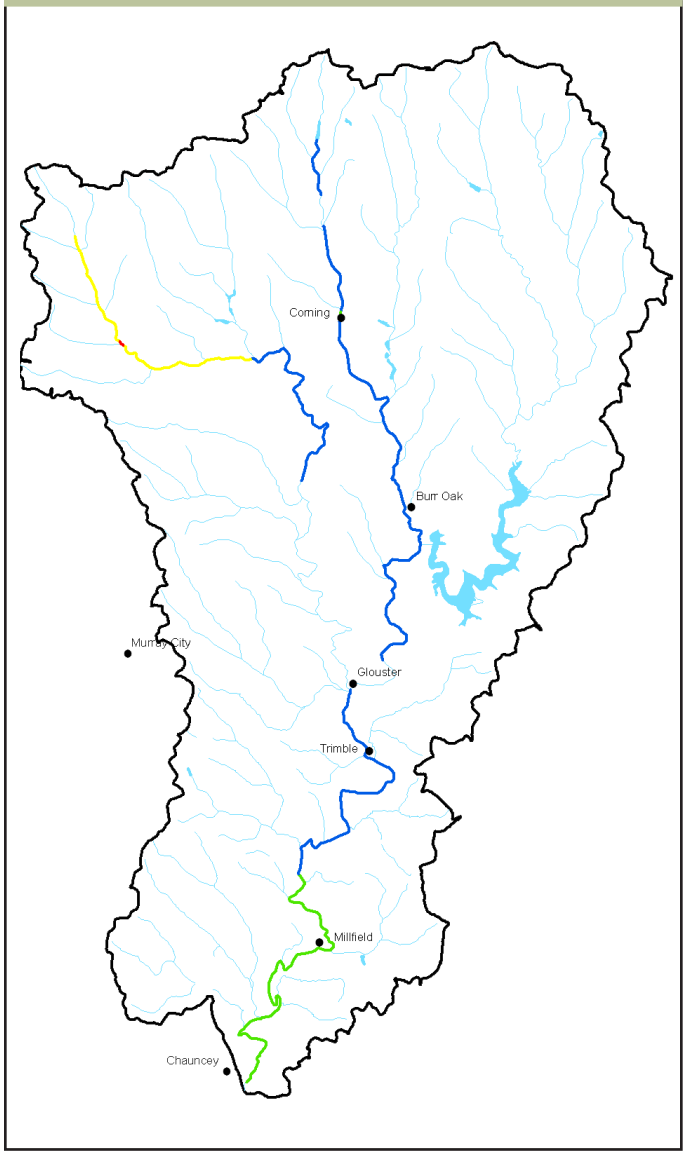
## Costs

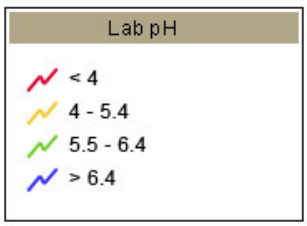
**Total costs = $139,066**
(excluding Congo Run CR-15 design)

## Sunday Creek baseline pH



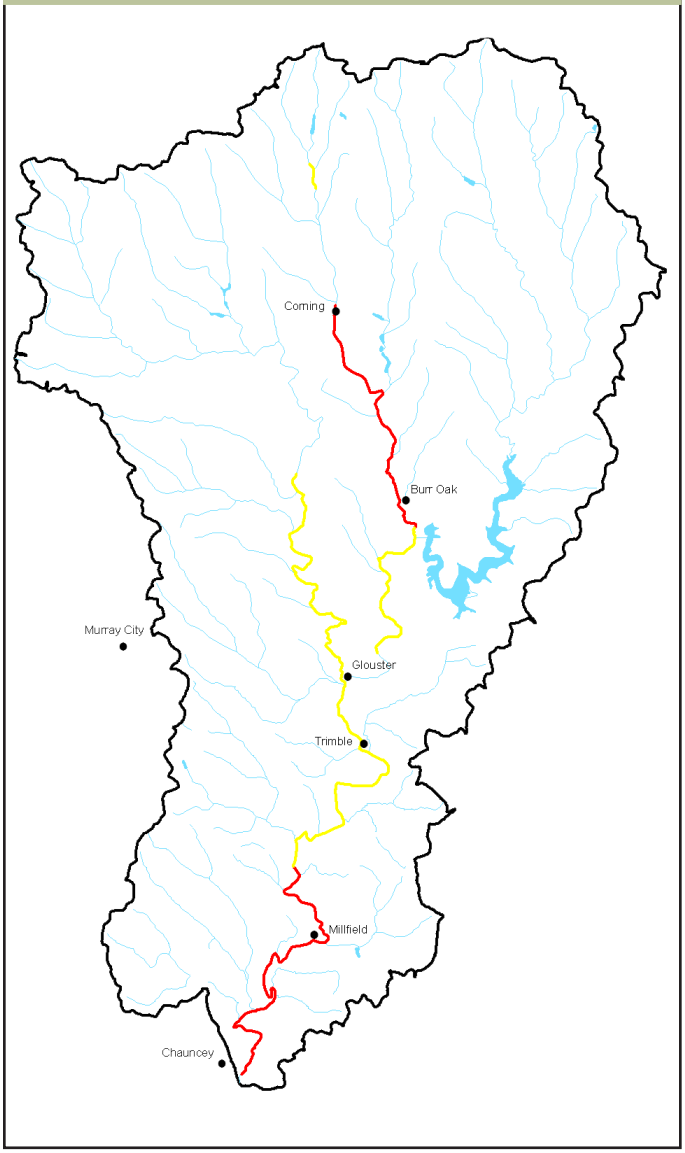

## Sunday Creek 2006 pH



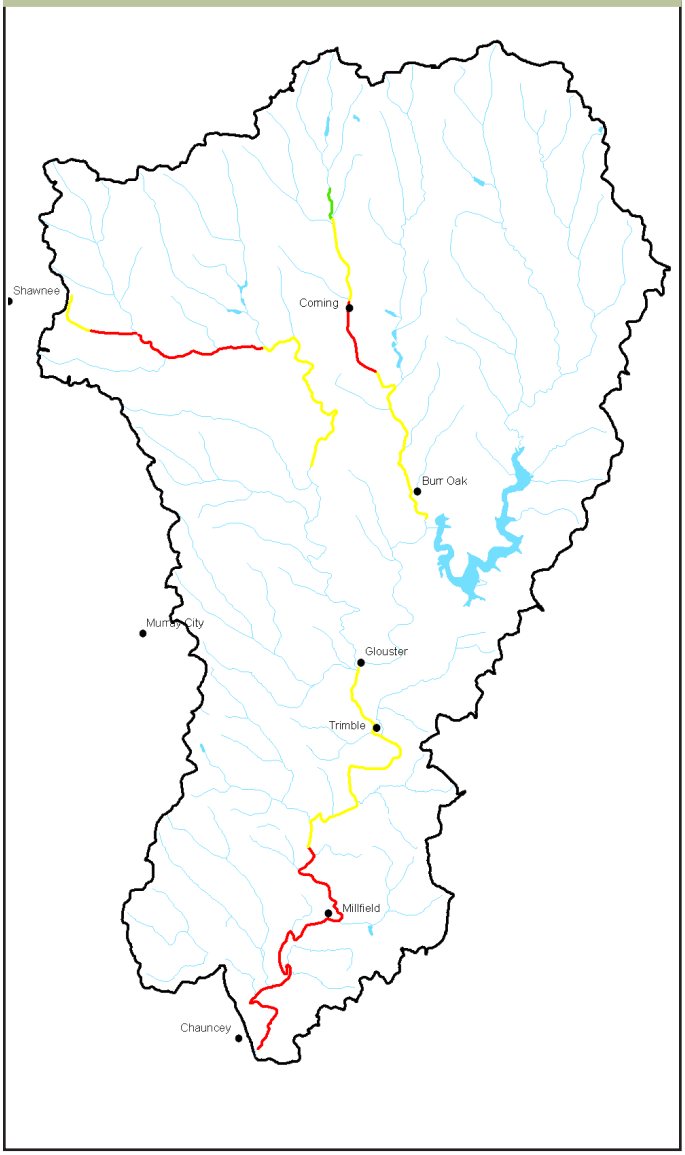




Water quality along the West Branch Sunday Creek has been degrading since baseline conditions in 2001. Values of average pH dropped from >6.4 to 4.0-5.4 range in 2005 and 2006. These pH values have dropped showing poorer water quality downstream of Drakes. The subsidence features in Rodger's Hollow have increased in size and have been continuing to funnel more water into the deep mines that then drain seep outlets in Drakes. After the Rodger's Hollow project is complete, these seep discharges in Drakes are expected to decrease, improving water quality along the West Branch of Sunday Creek. Sunday Creek mainstem downstream of Truetown continues to show pH values of less than 6.5.

## Sunday Creek Baseline MAIS



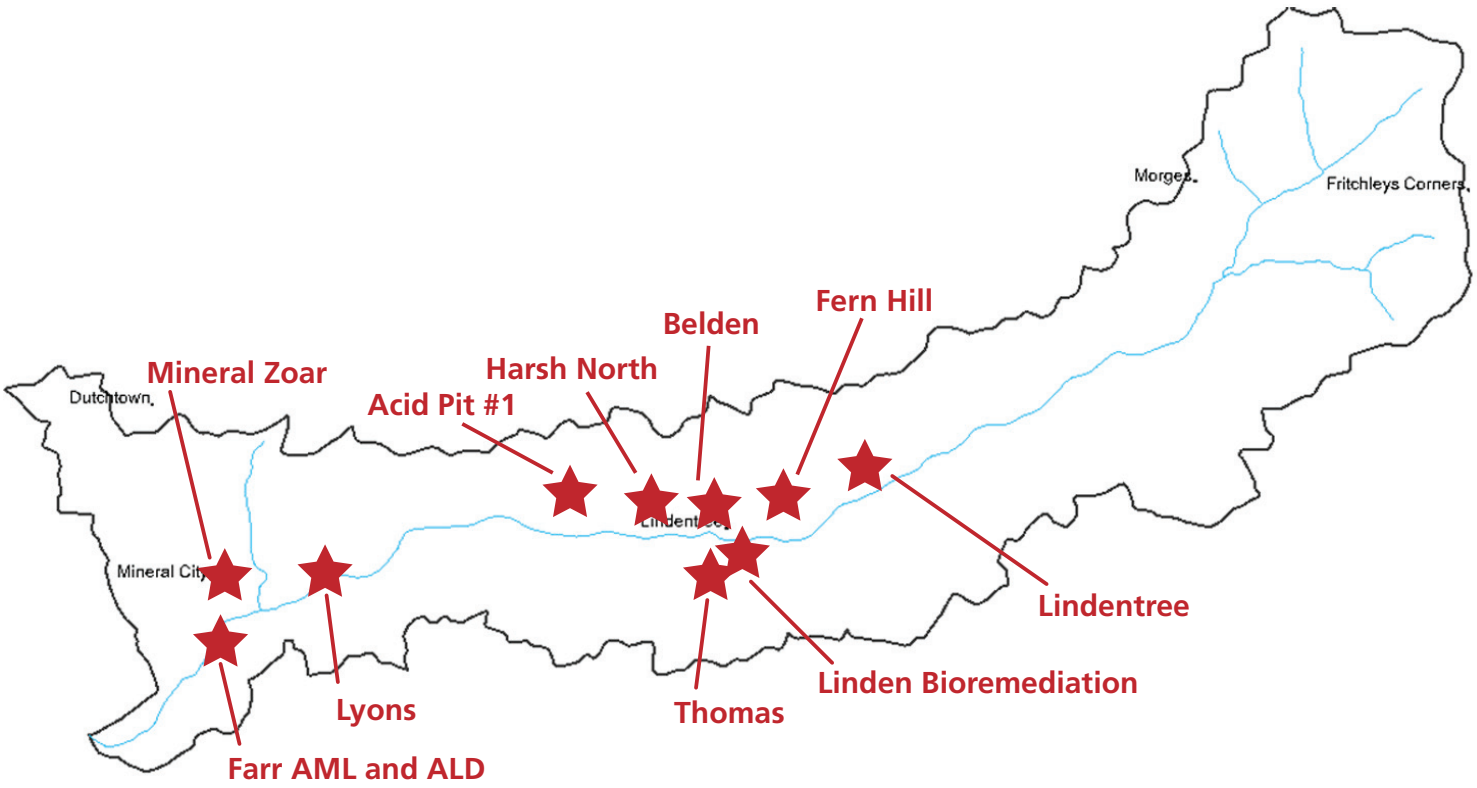

## Sunday Creek 2006 MAIS




Macroinvertebrate Aggregated Index for Streams

- 0 - 7
- 8 - 11
- 12 - 15
- > 15

Macro invertebrates were sampled using the MAIS index in 2006. No changes have been recorded from 2005 to 2006, as restoration projects are completed, an increase in MAIS scores are expected.




• Huff Run flows from the Morges community in Carroll County, into Tuscarawas County and has its confluence in the Conotton Creek just South of Mineral City, Ohio. Huff Run is 9.9 miles long with a 13.9 square mile watershed. Almost all land east of State Route 542 (about 2/3 of the watershed) has been mined for coal and some limestone and clay. Because much of the land mined was not reclaimed, the watershed is plagued with the resulting acid mine drainage. Other pollution issues in the watershed include illegal dumping, poor riparian buffers, raw sewage entering the stream, oil and gas impacts, and agricultural impacts.

• The Huff Run Watershed Restoration Partnership Inc. (HRWRP) was founded in 1996 by a group of concerned citizens. The HRWRP has partnered with ODNR/MRM, Rural Action, OEPA, Crossroads RC&D, OSM and others to fulfill their mission statement which is "To restore the Huff Run watershed by improving water quality and enhancing wildlife habitat, through community support and involvement."

• The Farr Anoxic Limestone Drain, the first passive treatment system in the watershed, was constructed in 2000. Also, HRWRP can boast of building the first bioremediation system in Ohio with their Linden Restoration Project. They also were awarded a US EPA Targeted Watershed Grant in 2005 for their Belden Successive Alkaline Producing System. At their 10 year anniversary, seven restoration projects have been completed with funding obtained for five more.

• To learn more about the HRWRP, visit their website at www.huffrun.org or call 330-859-1050 to reach their office.

## Reductions

Total acid load reduction = 83 lbs/day

## Attainment Miles

Total stream miles assessed impacted by mine drainage=9.90 miles

Target #1 indicates 30% attainment of impaired streams by 2010 =**2.97 miles**

2006 progress = **0 miles** meeting Full WWH attainment, *however* **3.90 miles changed from Non-supportive to Partial Attainment**

*(9.90 miles assessed in 2006)*

## Completion

Sub-target 2
Total projects proposed Huff Run Watershed AMDATS = **8 projects**
Total projects complete = **7 projects**

## Costs

Design $649,784 (excluding Linden, Acid Pit #1, and Huff Run AML project)
Construction $2,619,455 (excluding Huff Run

**Total costs=$3,269,239**

## Cumulative BMP's installed

| Treatment Installed | Quantity |
|---|---|
| Surface Reclamation | 22.2 acres |
| Limestone J-trench | 4,725 linear feet |
| Gob Pile Reclamation | 6.0 acres |

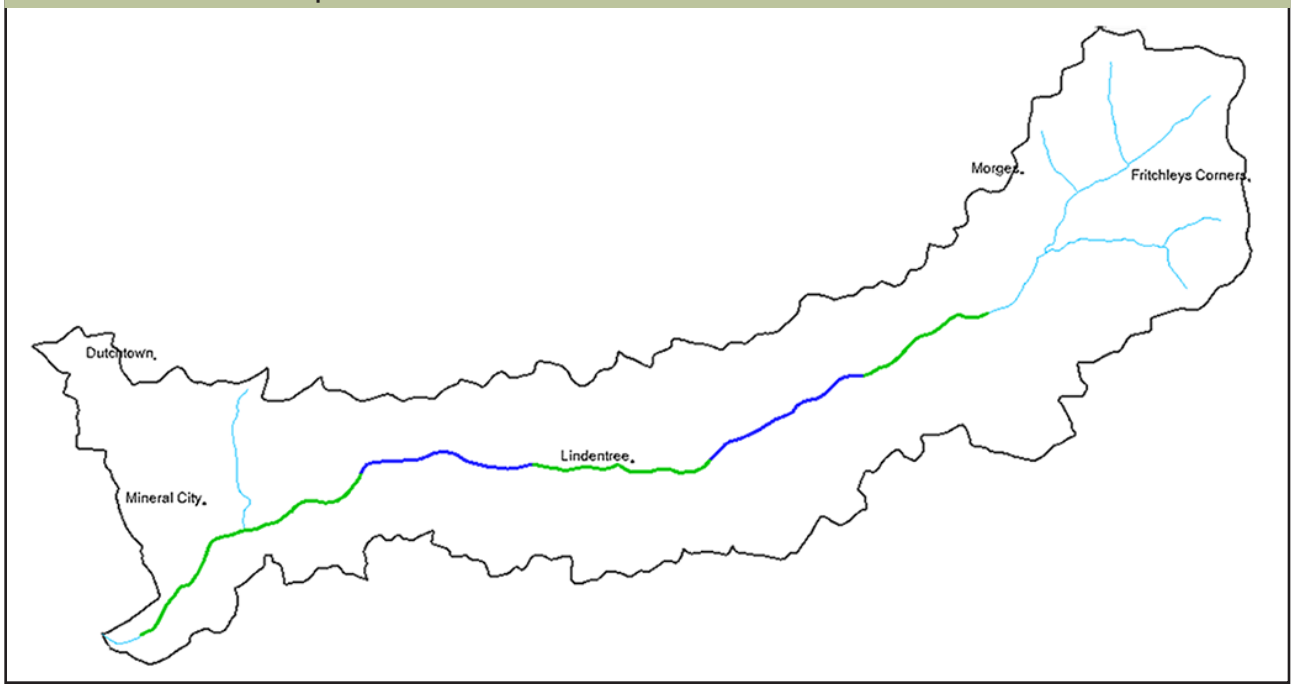
## Projects Completed July 1, 2006 – June 30, 2007

**Harsha North** total cost: **$793,095**

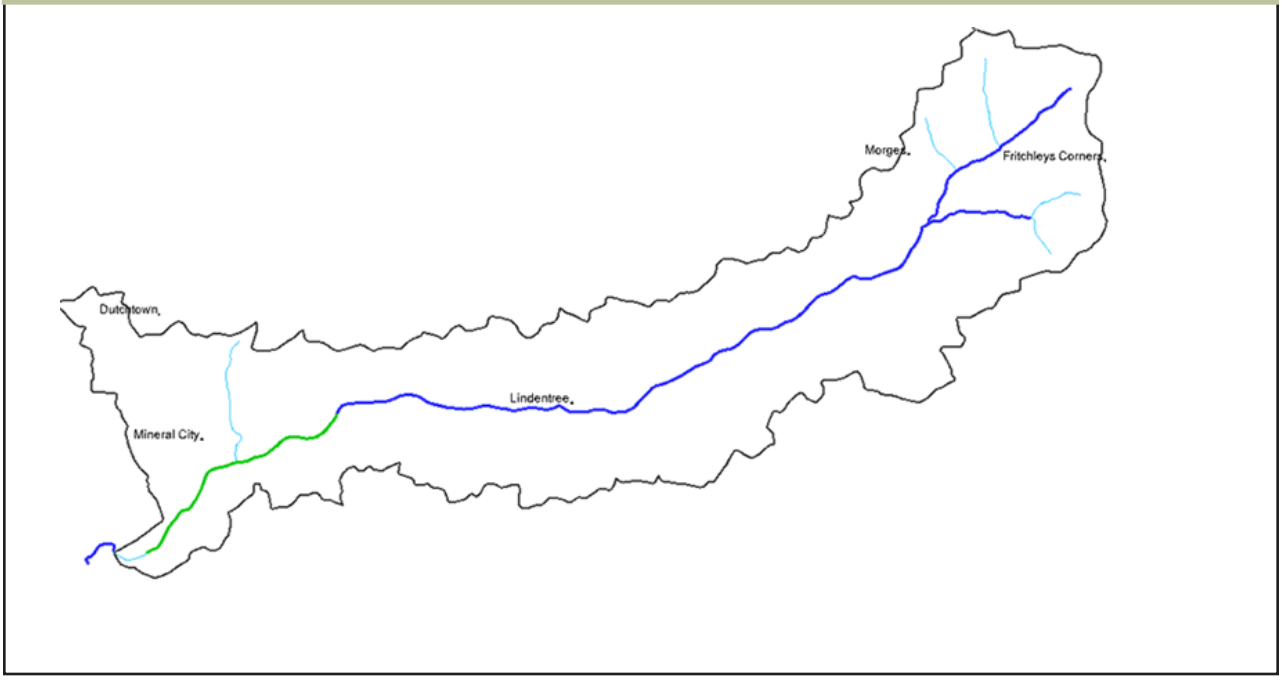
## Load Reductions

| | Acid Load Reduction | Metal Load Reduction |
|---|---|---|
| **Harsha North** | **NA** | **NA** |

## Huff Run baseline pH



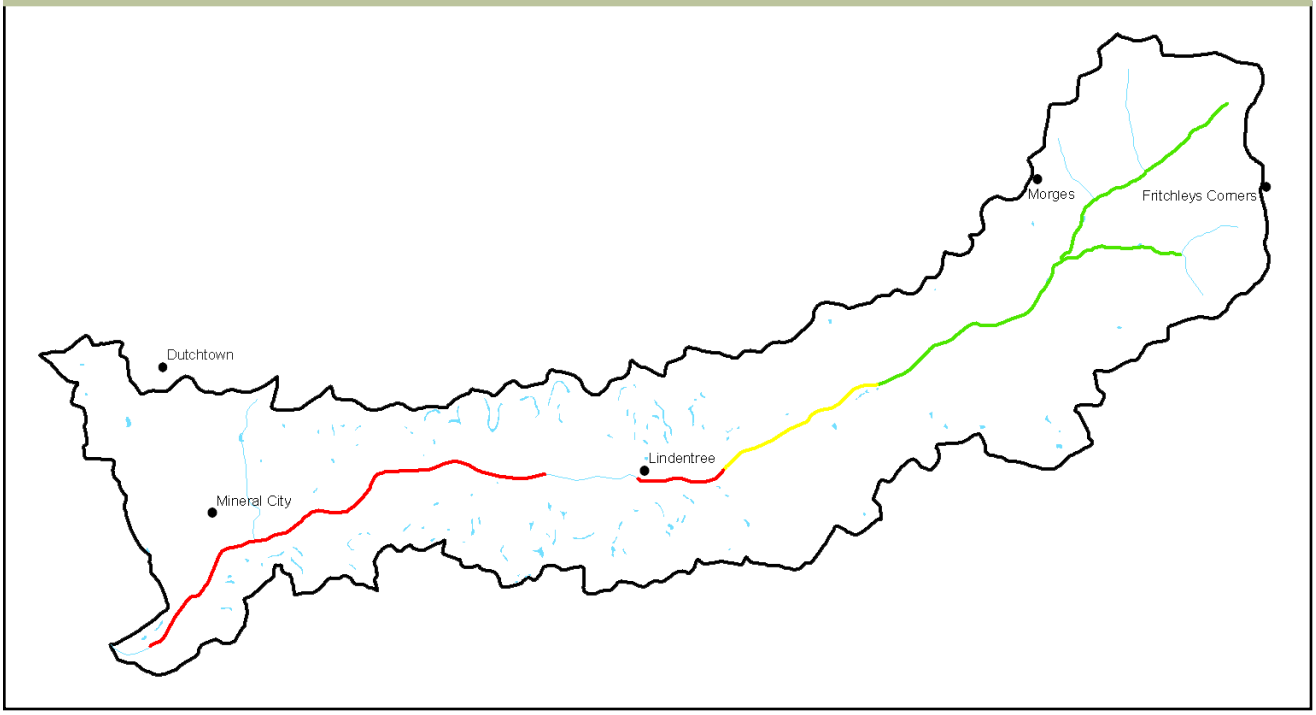

## Huff Run 2005 pH



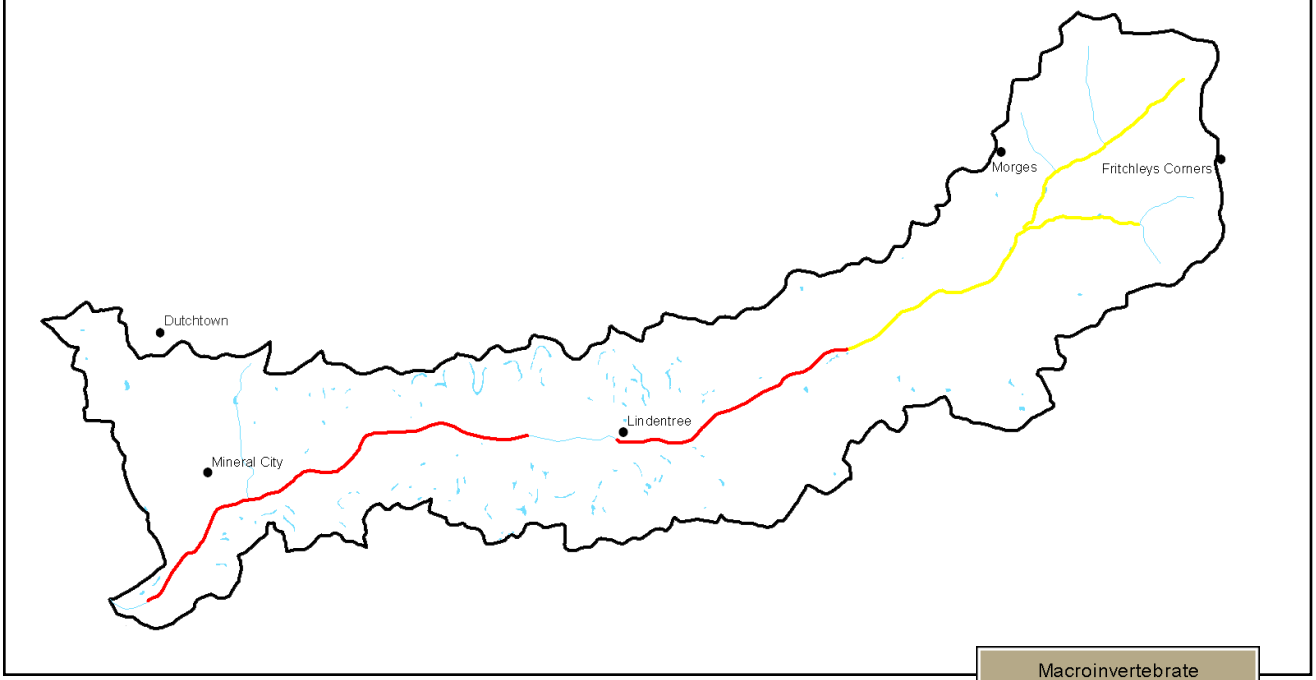

Lab pH
- < 4
- 4 - 5.4
- 5.5 - 6.4
- > 6.4

Huff Run pH values have improved from baseline conditions (1985-1998) to 2005. Two mainstem sections totaling 2.3 miles have improved pH values from the range 5.5 -6.4 to now meeting water quality standards pH >6.5.

## Huff Run 2005 MAIS




## Huff Run 2006 MAIS




Macroinvertebrate Aggregated Index for Streams

- 0 - 7
- 8 - 11
- 12 - 15
- > 15

Huff Run aquatic life use has improved from baseline conditions (1985-1998) to 2005. Aquatic life use has changed from WWH Non-supportive to WWH Partial Attainment along 3.9 mile in Huff Run. In 2006 the MAIS scores decreased in the headwaters slightly.

## Section III – AMD project reports

### Raccoon Creek Watershed comprehensive acid mine drainage projects progress report for 2006.

*Section III contains individual AMD project reports displaying photos of the project site, a description of the project, water quality data at the site and its impact to the receiving stream, and acid/metal loading reductions as a result of the project.*

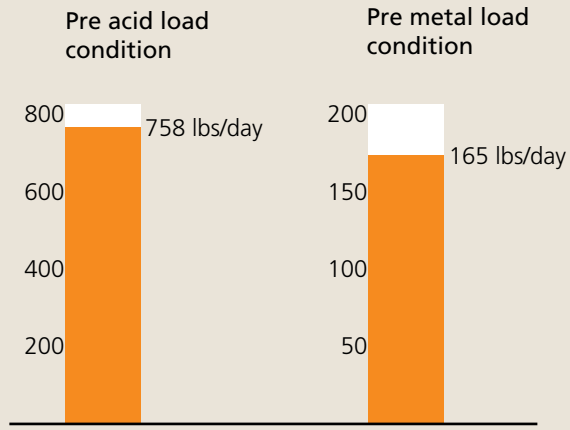
List of acid mine drainage reclamation projects reported on in the 2006 NPS monitoring report:

1. Carbondale II Wetland
2. Hope Clay
3. Mulga Run
4. Middleton Run
5. State Route 124 Seeps
6. Flint Run
7. Lake Milton
8. Buckeye Furnace/Buffer Run

Project Status: Complete 4/1/2004 ODNR Project Number: AT-Wl-05

## Pre-construction

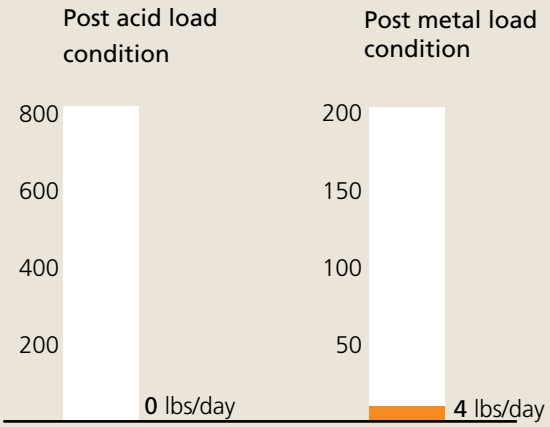
*Carbondale East Seep, Photo by Brett Laverty*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Carbondale II Project Doser, Photo by JT Kneen*



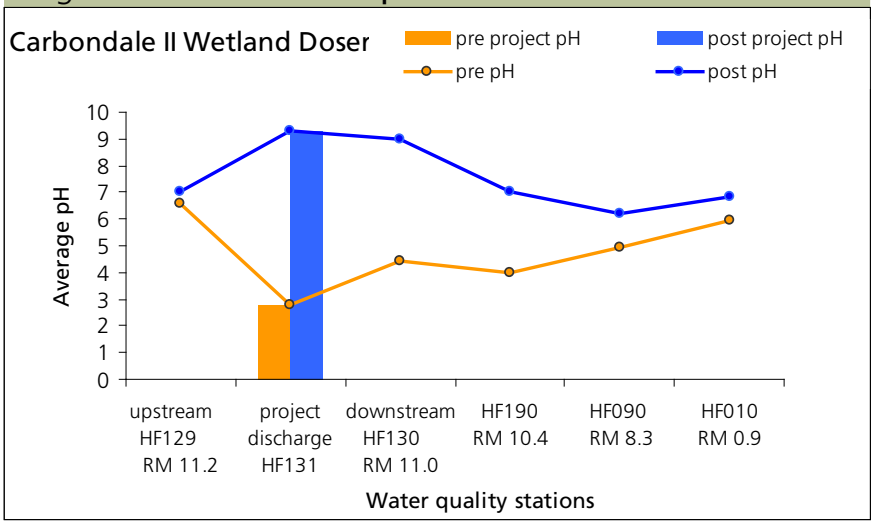

*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

Carbondale II Wetland is located in Section 30 of Waterloo Township in Athens County and lies within the 14-digit HUC unit #05090101030010. The site is seven acres and located in the subwatershed Hewett Fork of Raccoon Creek Watershed. The design was completed by ATC Associates for $48,023. The treatment approach for this site was to install an Aqua-fix lime-dosing unit. The major considerations in this design were the metal precipitates discharge into Hewett Fork because of the limited space for storage ponds on site. The goal of the design was to reduce 100 percent of the acid load discharging from the Carbondale mine seeps. The project goal was met by 100 precent. One problem encountered at this site was the dosing material performance. Initially lime kiln dust was used, but the material bridges in the dosing unit. The material was switched to calcium oxide, a more expensive material but greater neutralizing potential. Therefore the doser now has the ability to over-treat and neutralize acid mine drainage from downstream sources. Construction was complete April 1, 2004, by Law General Contracting for a cost of $389,637. The major responsibility of the construction company was to remove existing metal retention wetlands and install the doser and a concrete mixing channel. The funding source for the project design was ODNR-DMRM, and for construction the sources were ODNR-DMRM, OEPA, and OSM-ACSI. Figures 3 and 4 (shown on page 3) estimate approximately 758 lbs/day of acid were reduced from entering into Hewett Fork as a result of this AMD reclamation project. In addition to 100 precent of the acid load reduction there is an addition of approximately 186 lbs/day of alkalinity to Hewett Fork both as dissolved and solid unused calcium oxide. Dissolved metal load reduction occurring at this site was approximately 161 lbs/day. The metals precipitate as a result of the high pH water and become part of the substrate in the receiving stream.

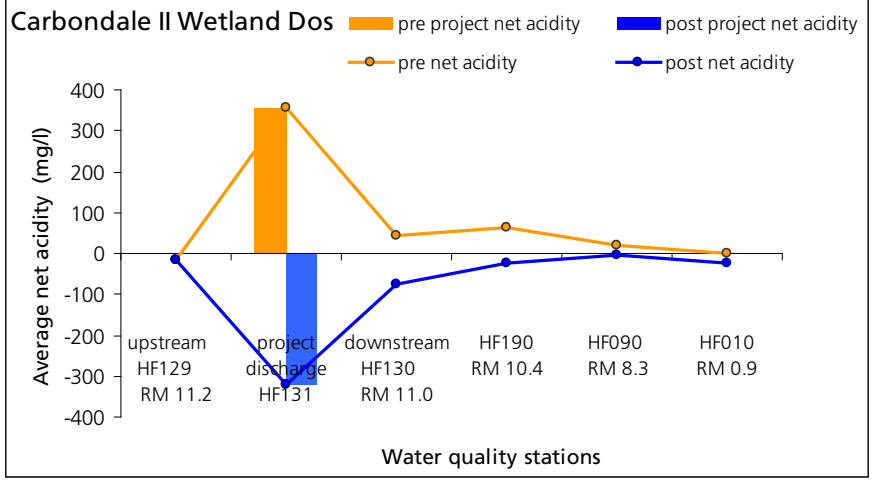
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

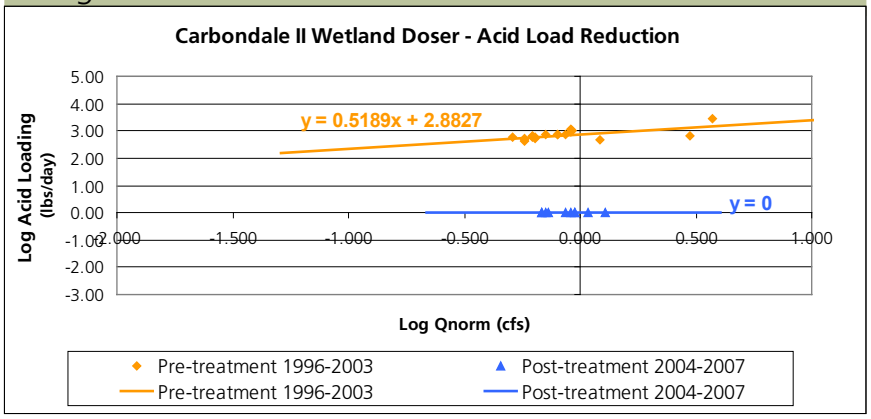



As a result of the Carbondale II Wetland Doser project, the pH and net acidity has improved downstream of the reclamation site for 11 miles. Pre-construction data showed, pH in the range of 2.8 – 5.9 downstream of the project. However, after installation of the Carbondale II Wetland Doser, post-construction data shows pH in the range of 6.2 – 9.3 downstream of the project discharge. The net acidity concentrations decreased, showing net alkaline conditions continuing for 11 miles downstream to station HF010.

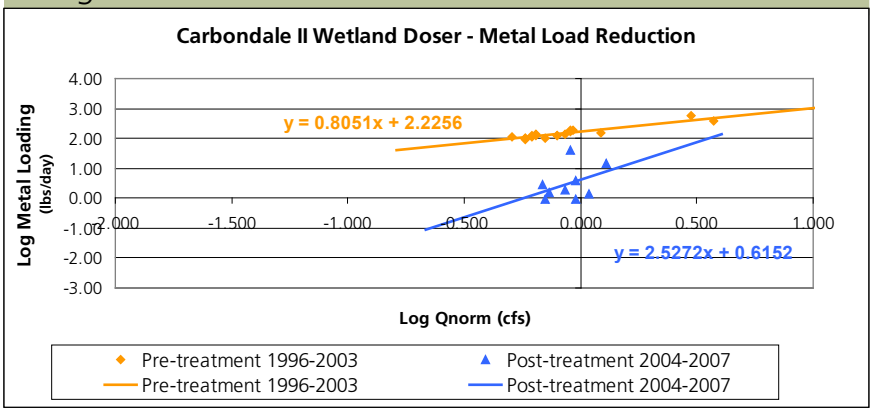
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 6/1/1996 to 5/1/2003 for pre-construction and from 6/1/2004 to 6/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction



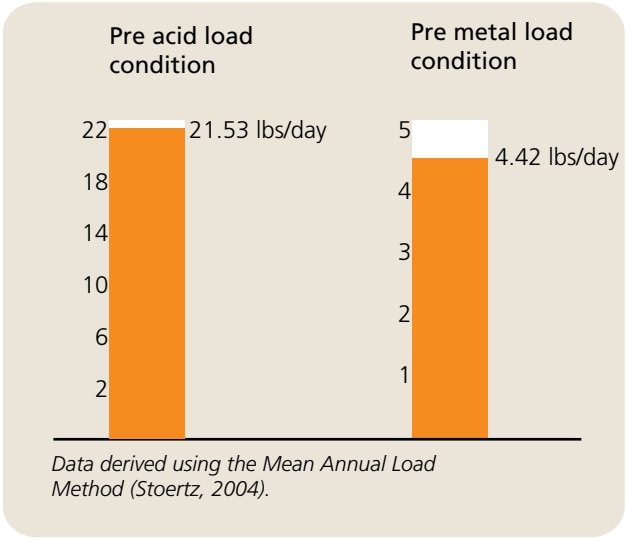

Average discharge measurements were used to calculate load reductions using the Mean Annual Load Method (Stoertz, 2004) instead of deriving the mean annual discharge from the drainage area because the discharge from the Carbondale II Wetland site is controlled primarily by deep mine drainage and not surface drainage.

*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete 6/1/2005 ODNR Project Number:

## Pre-construction

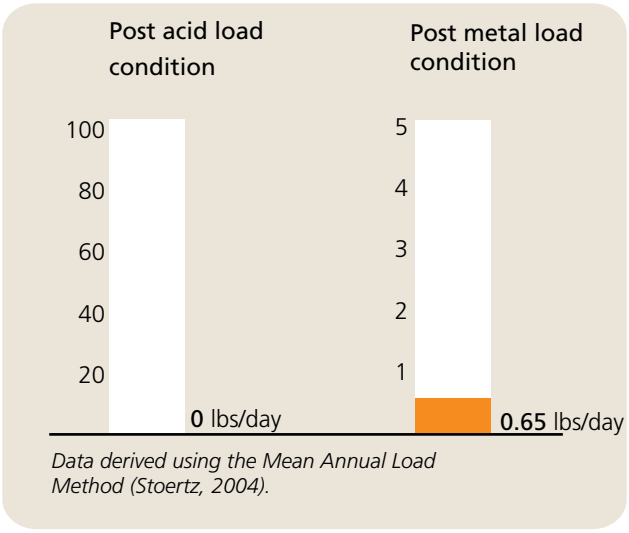
*Unreclaimed gob pile*
*Photo by Raccoon Creek Watershed Partnership*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Regraded and resoiled gob pile*
*Photo by Ben McCament*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

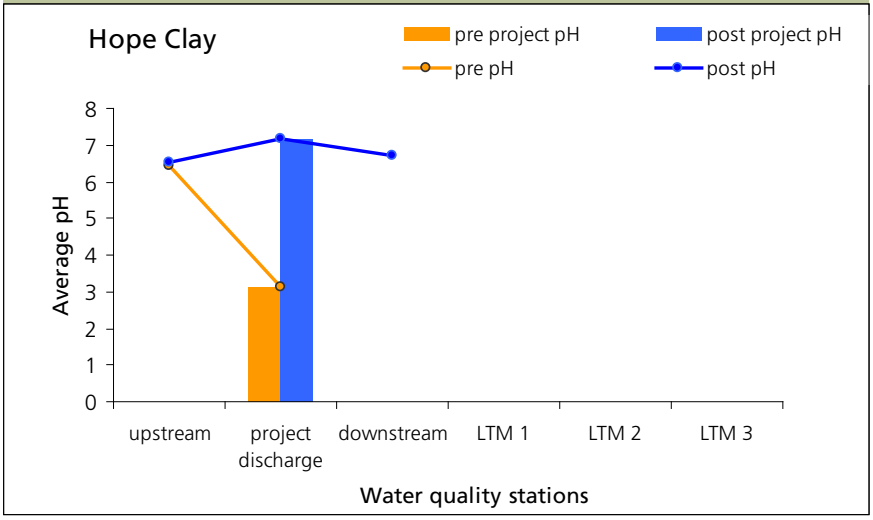
Hope Clay is located in Section 23 of Brown Township in Vinton County and lies within the 14-digit HUC unit #05090101020060. The project discharge was measured at the Hope Clay Project tributary. The design was completed by ODNR-DMRM for $5,000. The treatment approach for this site was to install an open limestone channel (OLC) and to conduct basic reclamation. The major consideration for this site was erosion control. The goal of the design was 100 percent acidity reduction and erosion control. The project goal was met by 100 percent.

The construction was complete June 1, 2005, by Hocking College Environmental Program for a cost of $67,000. The major responsibility of the Hocking College Environmental Program was to conduct site reclamation. The funding sources for this project were ODNR-DMRM and OSM ACSI for construction. Approximately 21.53 lbs/day of acid and 3.77 lbs/day of metals were prevented from entering into Raccoon Creek as a result of this AMD reclamation project.

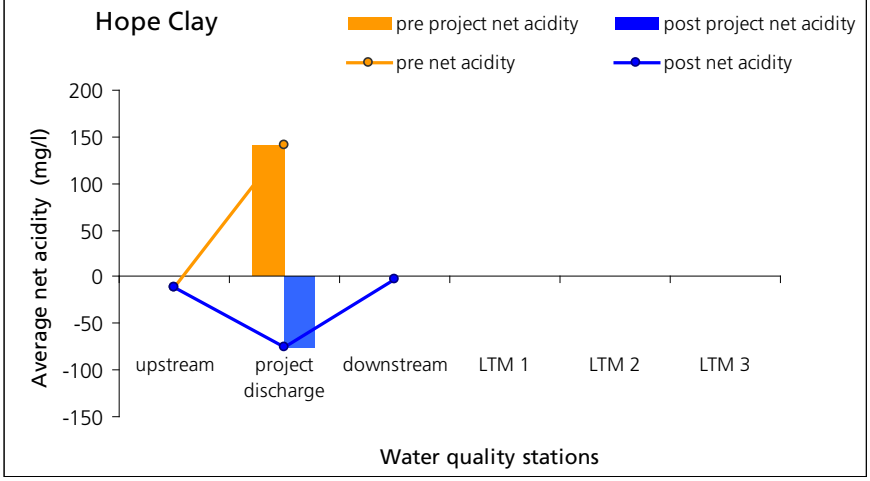
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

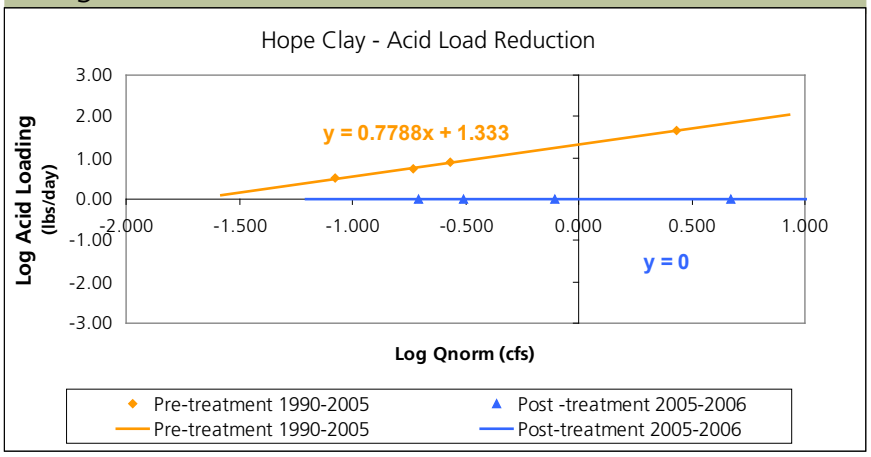



As a result of the Hope Clay Project, pH and net acidity have improved downstream of the reclamation site for less than one mile. Pre-construction data showed pH at 3.3 at the project discharge. However, after installation of the Hope Clay Project, post-construction data shows pH in the range of 6.7 – 7.1 at the discharge and downstream. The net acidity concentrations decreased 100 percent at the project discharge showing net alkaline conditions downstream to station MSBM004.

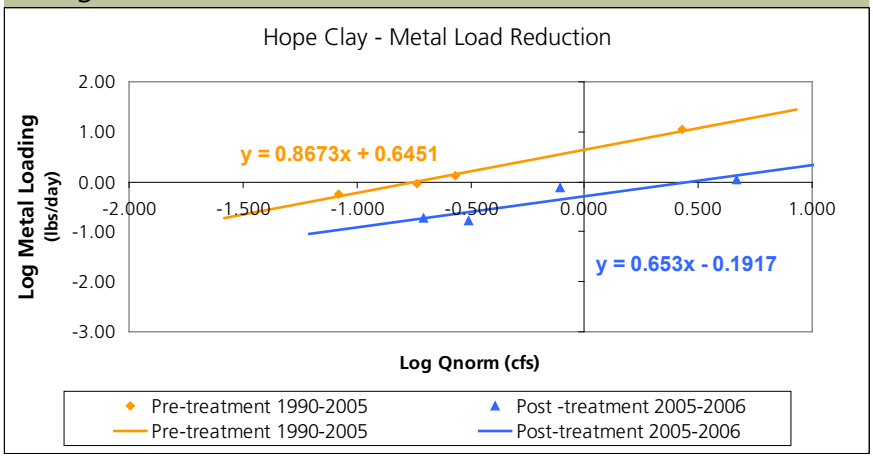
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1/1/1990 to 5/31/2005 for pre-construction and from 6/1/2005 to 12/31/2006 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction

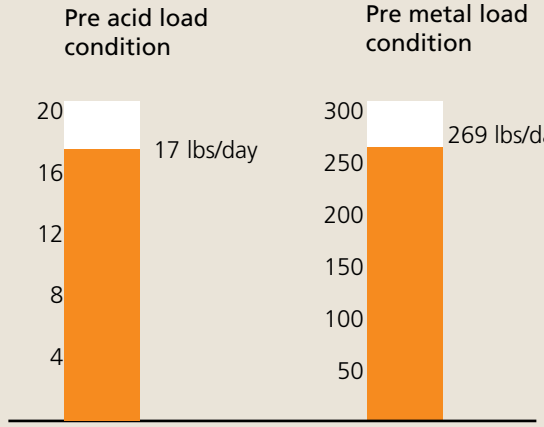



*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete 8/30/2004 ODNR Project Number: JK-Ml-51

## Pre-construction

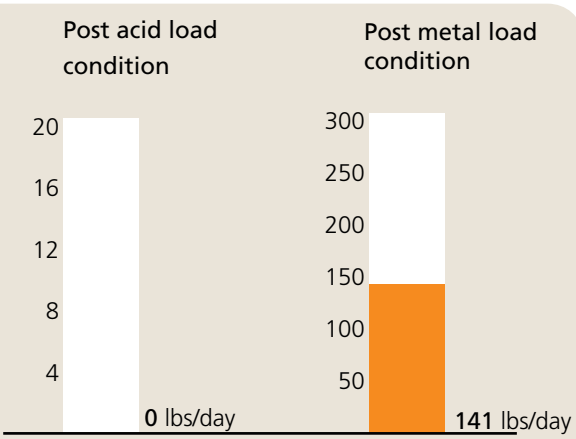
*Underground mine entrance*
*Photo by Brett Laverty*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Jaymar Steel Slag Leach Bed*
*Photo by Brett Laverty*



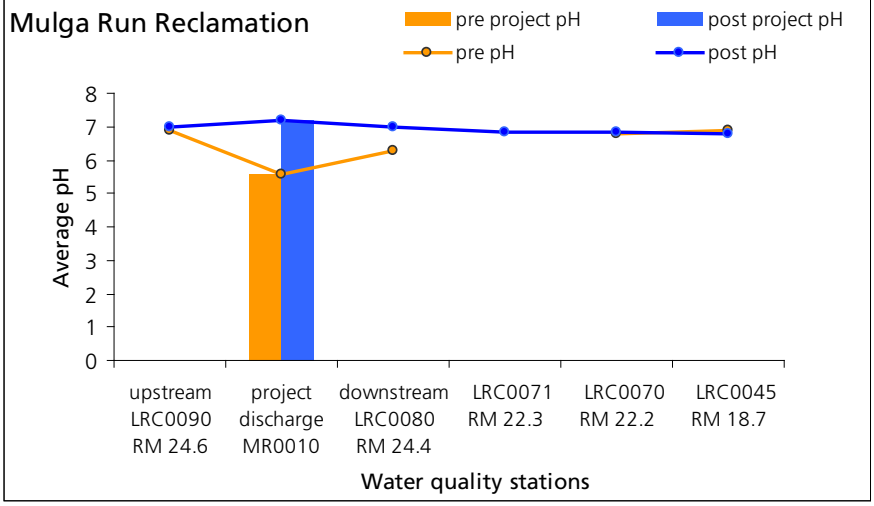

*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

Mulga Run Reclamation Project is located in Section 10 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The site is 6.8 acres and is located in the Little Raccoon Creek subwatershed. The design was completed by ATC Associates for $247,127. The treatment approach for this site was to install two steel slag leach beds and conduct a wetland enhancement project. The major consideration for this design was to attempt to treat entire basin with steel slag leach beds and wetland instead of treating all acid mine drainage sites in the basin. Mulga Run discharge was sometimes net alkaline; however, the site was also capable of producing acid spikes (3000 lbs/day) throughout the year. The goal of the design was to reduce 100 percent of the acid spikes and create consistent net alkaline water discharging into Little Raccoon Creek. The project goal was met by 100 present. One problem encountered during the project was one section of the township road and a private residence height was increased to reduce the flood risk adjacent to the project site. Construction was complete August 30, 2004, by Stockmeister Enterprises for a cost of $440,783. The major responsibility of the construction company was to complete all reclamation activities described in the project design. The funding source, for this the project design were Ohio EPA and ODNR-DMRM and for construction the sources were ODNR-DMRM, OEPA and OSM-ACSI. Figure, 3 and 4 (shown on page 3) estimate approximately 17 lbs/day of acid and 128 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

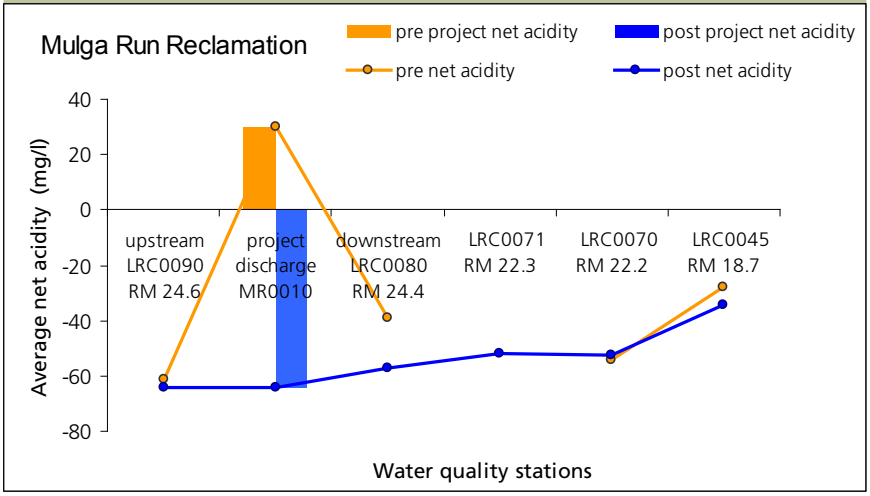
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

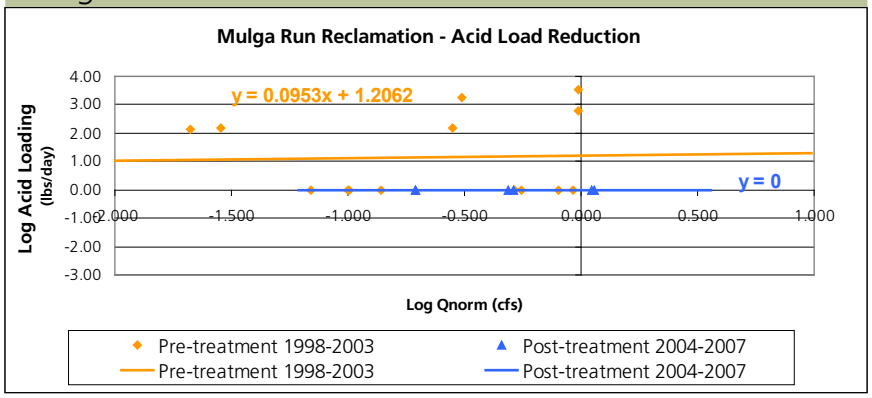



As a result of the Mulga Run Reclamation project, the pH and net acidity has improved downstream of the reclamation site for 2.1 miles. Pre-construction data showed pH in the range of 5.5 – 6.9 downstream of the project. However, after installation of the Mulga Run Reclamation project, post-construction data shows pH in the range of 6.8 – 7.1 downstream of the project discharge. The net acidity concentrations decreased, showing net alkaline conditions continuing for 5.7 miles downstream to station LRC0045.

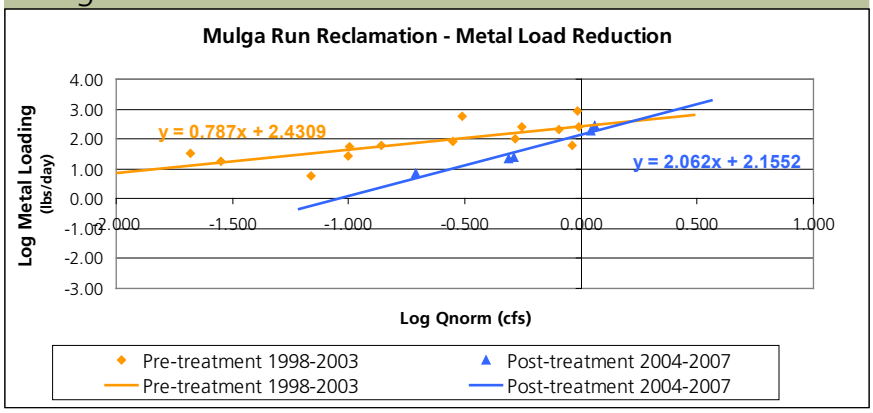
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1/1/1998 to 8/1/2003 for pre-construction and from 9/1/2004 to 06/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction



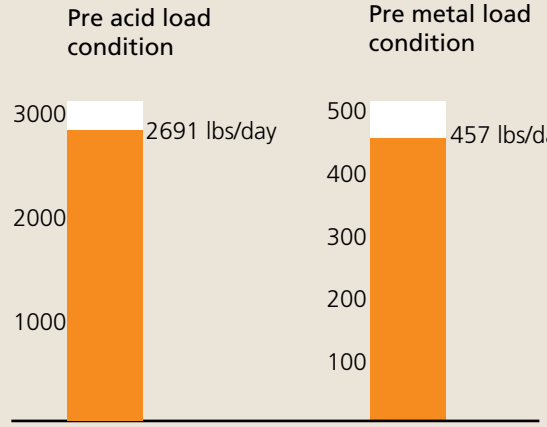

The trendline in Figure 3 for pre-treatment acid loading is not well-defined due to the sporadic chemical water quality conditions at the Mulga Run site. Sometimes net alkaline conditions were present, and sometimes acid spikes were produced (3000 lbs/day). The goal of this project was to decrease acidity and eliminate the acid spikes from entering into Little Raccoon Creek. Figure 3 shows these variations during the pre-treatment time period and shows 100 percent acid load reduction during post-treatment.

*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete 11/15/2005 ODNR Project Number: JK-MI-55

## Pre-construction

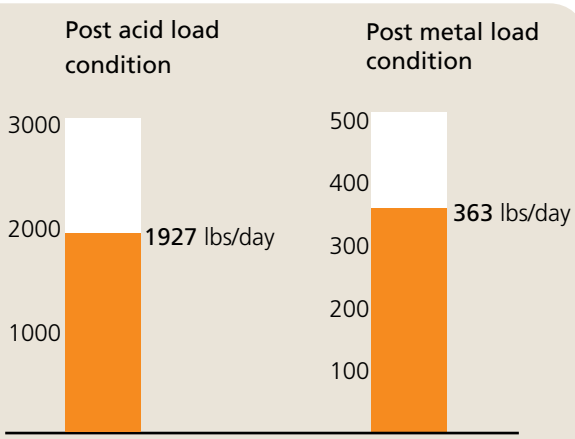
*Exposed mine pit floor*
*Photo by Brett Laverty*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Middleton Run limestone channels*
*Photo by Ian Hughes*



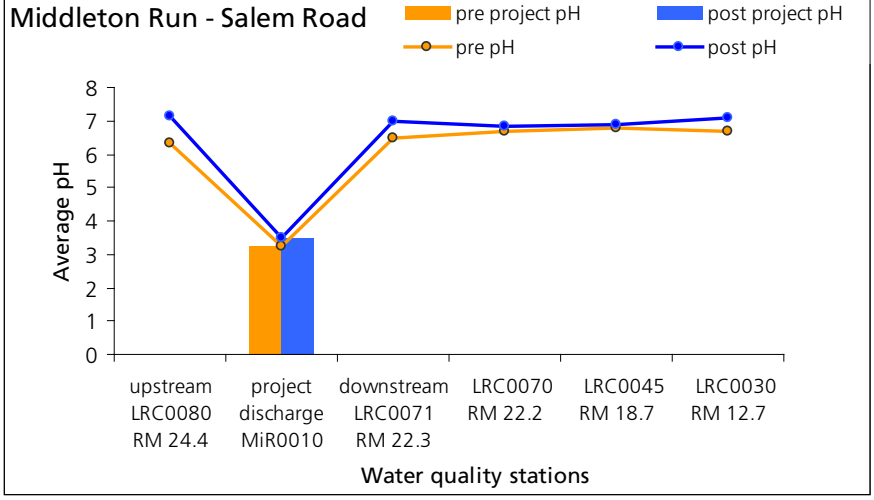

*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

Middleton Run/Salem Road Project is located in Section 15 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The site is 60 acres and is located in the Little Raccoon Creek subwatershed. The design was completed by GAI Consultants Inc. and Bergmann Associates for $193,283. The treatment approach for this site was to install open limestone channels, steel slag channels, reclamation, and a limestone leach bed. The major consideration for this design was to eliminate all water storage, create contours for positive drainage, cover toxic materials, and generate alkalinity. The goal of the design was to reduce 100 percent of the acidity loading discharging into Little Raccoon Creek. The acidity has been reduced by 29 percent from the project discharge. Construction was complete November 15, 2005, by Stockmeister Enterprises Inc. for a cost of $687,913. The funding source, for the project design and construction were ODNR-DMRM and Ohio EPA. Figures 3 and 4 (shown on page 3) estimate approximately 764 lbs/day of acid and 94 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

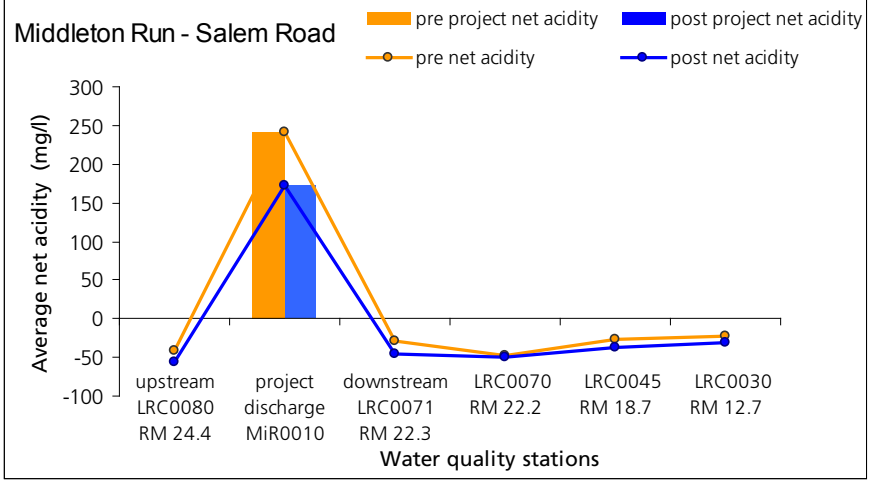
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

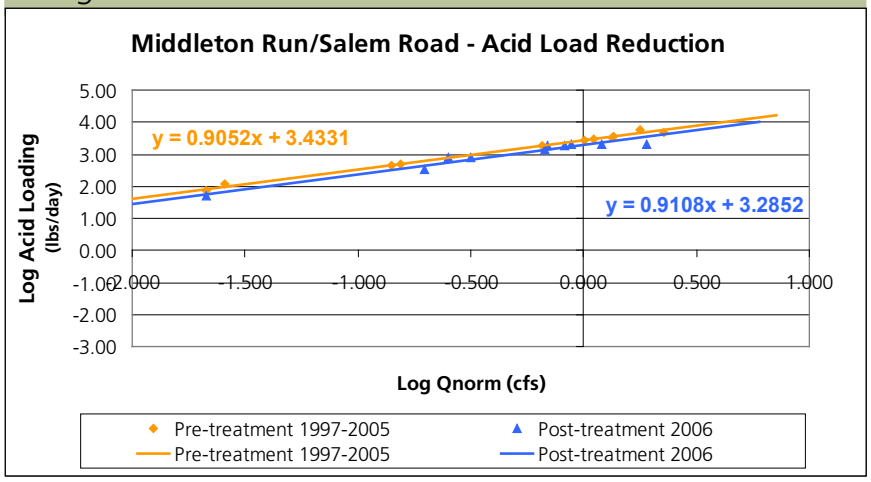



As a result of the Middleton Run/Salem Road project, the pH and net acidity has improved downstream of the reclamation site for 11 miles. Pre-construction data showed pH in the range of 3.2 – 6.7 downstream of the project. However, after installation of the Middleton Run/Salem Road reclamation project, post-construction data shows pH in the range of 3.5 – 7.0 downstream of the project discharge. The net acidity concentrations decreased by 29 percent at the project discharge creating net alkaline conditions continuing for 11 miles downstream to station LRC0030.

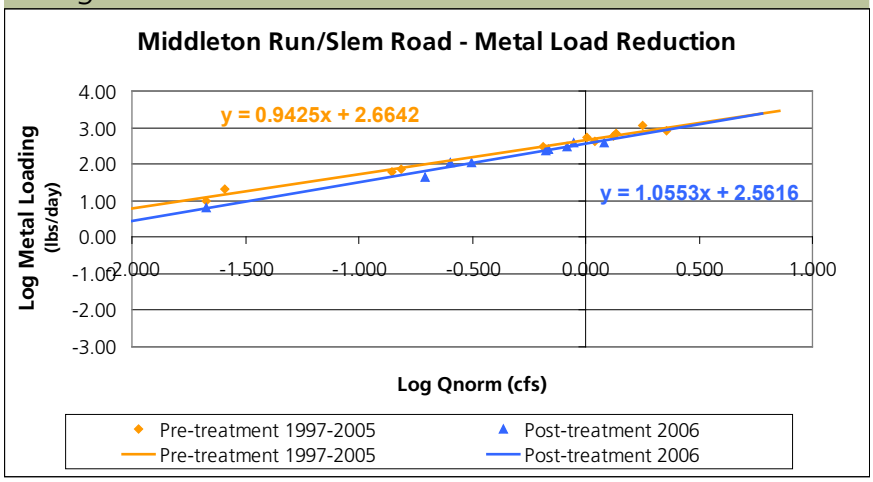
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1/29/1997 to 3/7/2005 for pre-construction and from 1/31/2006 to 6/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction

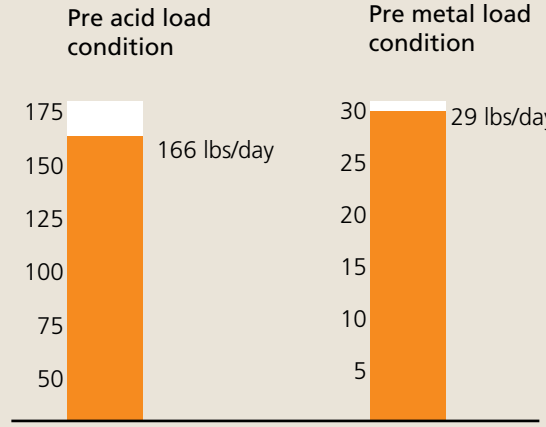



*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete 6/18/2001 ODNR Project Number: JK-Ml-47

## Pre-construction

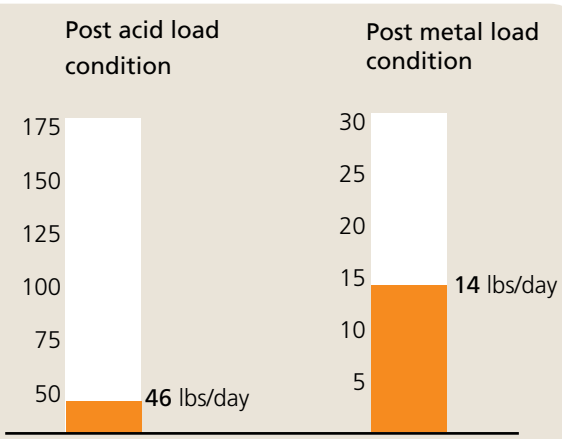
*Between pond and seep*
*Photo by Brent Miller*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Sr 124 hillside limestone channel*
*Photo by Chip Rice*



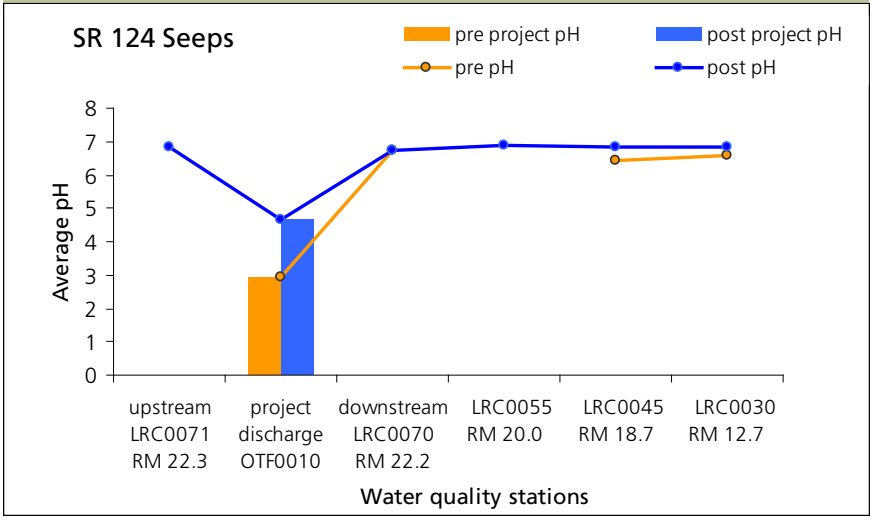

*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

State Route (SR) 124 Seeps Project is located in Section 15 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The site is 7 acres and is located in the Little Raccoon Creek subwatershed. The design was completed by ATC Associates Inc. for $80,000. The treatment approach for this site was to install several open limestone channels and conduct basic reclamation. The major consideration for this design was to establish positive drainage, remove several highwall impoundments, cover toxic materials, establish vegetations, and add alkalinity through the limestone channels. The goal of the design was to remove acidity from entering into Little Raccoon Creek. The project goal was met by100 percent. Construction was complete June 18, 2001, by Oldtown Coal Company for a cost of $315,490. The major responsibility of the construction company was to complete all reclamation activities described in the project design. The funding source, for the project design and construction were ODNR-DMRM and Ohio EPA. Figures 3 and 4 (shown on page 3) estimate approximately 116 lbs/day of acid and 15 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

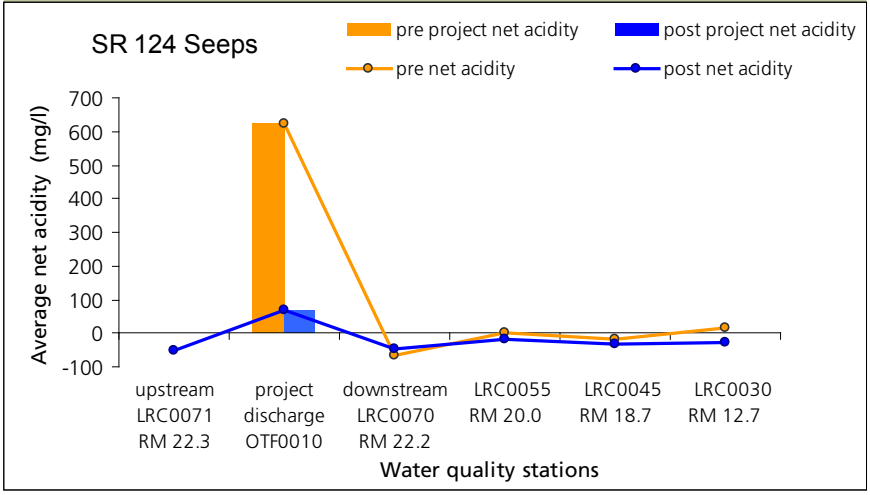
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post- construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

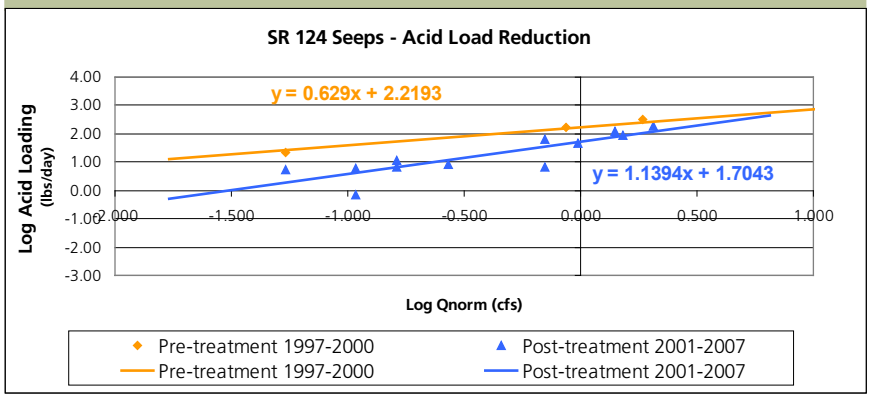



As a result of the SR 124 Seeps project, the pH and net acidity has improved downstream of the reclamation site for 9.5 miles. Pre-construction data showed pH in the range of 2.9 – 6.7 downstream of the project. However, after installation of the SR 124 Seeps project, post-construction data shows pH in the range of 4.6 – 6.8 downstream of the project discharge. The net acidity concentrations decreased 89 percent at the discharge showing net alkaline conditions continuing for 9.5 miles downstream to station LRC0030.

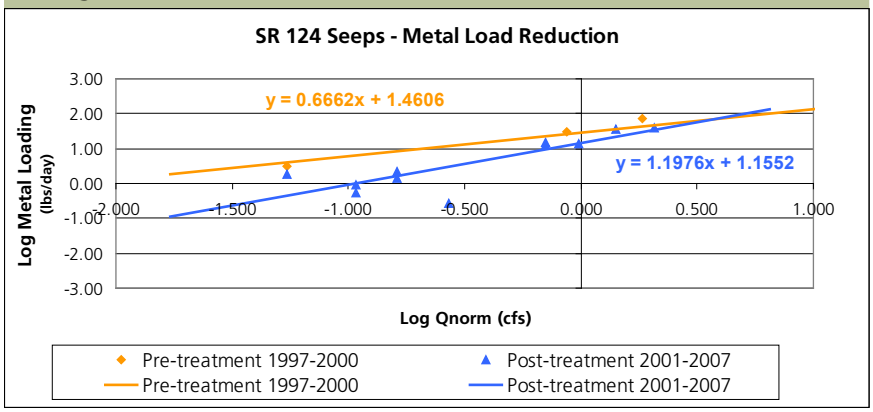
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 2/1/1997 to 11/27/2000 for pre-construction and from 6/19/2001 to 8/1/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction

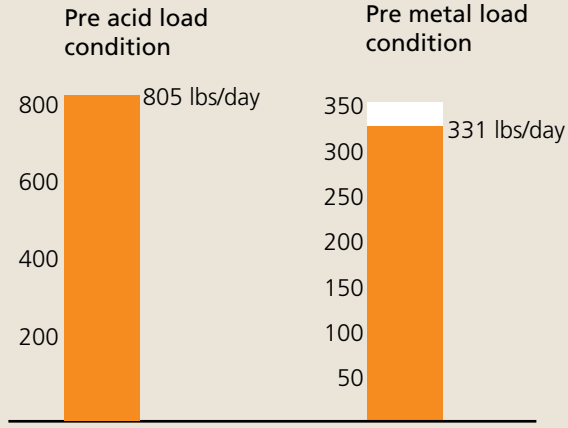



*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete 8/1/2006 ODNR Project Number: Jk-Ml-34

## Pre-construction

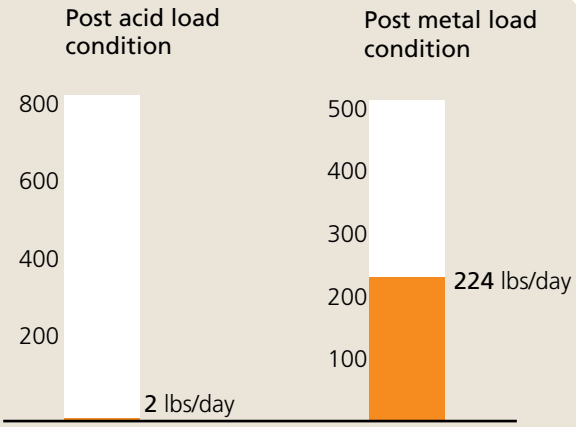
*Flint Run East site discharge*
*Photo by Ben McCament*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction


*Air photo of Flint Run site near completion*
*Photo by Ben McCament*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

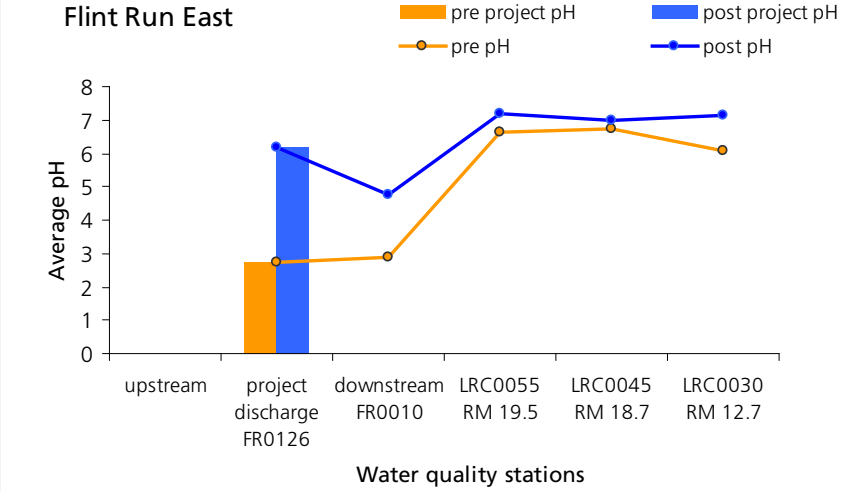
Flint Run East is located in Section 28 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The project site is 56 acres and is located in Little Raccoon Creek next to Lake Milton. Flint Run East project is Phase I of the Flint Run Reclamation Project Lake Milton is Phase II. The project discharge was measured at the tributary draining the Flint Run East treatment site. The design was completed by RD Zande for a cost of $241,702. The treatment approach for this site was to dewater the strip pits and install passive acid mine drainage treatment systems. The major consideration during the design process was to reduce groundwater infiltration into the valley coal refuse pile. The goal has been met 100%. Construction was complete Aug. 1, 2006, by Berridge Reclamation for a cost of $1,456,106. The major responsibility of the construction company was to complete the reclamation and install passive treatment systems. The funding sources for this project were ODNR-DMRM for the design and ODNR-MRM, EPA-319 and OSM ACSI for construction. Figure 3 to 4 (shown on page 3) estimate approximately 803 lbs/day of acid and 107 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

| Treatment Installed | Quantity & Units |
|---|---|
| Earthwork | 56 *acres* |
| Erosion Control | 13,000 *linear feet* |
| Dewatering Existing Impoundments | 12,827,200 *gallons of water* |
| Sediment Pond | 87,400 *square feet* |
| Steel Slag Leach Bed | 32,500 *square feet* |
| Fresh Water Storage Pond | 84,800 *square feet* |
| Limestone Leach Bed | 10,400 *square feet* |
| Wetland, passive | 4,800 *square feet* |
| Succesive Alkaline Producing Systems (SAPS) | 32,500 *square feet* |
| Open Limestone Channel | 13,650 *linear feet* |

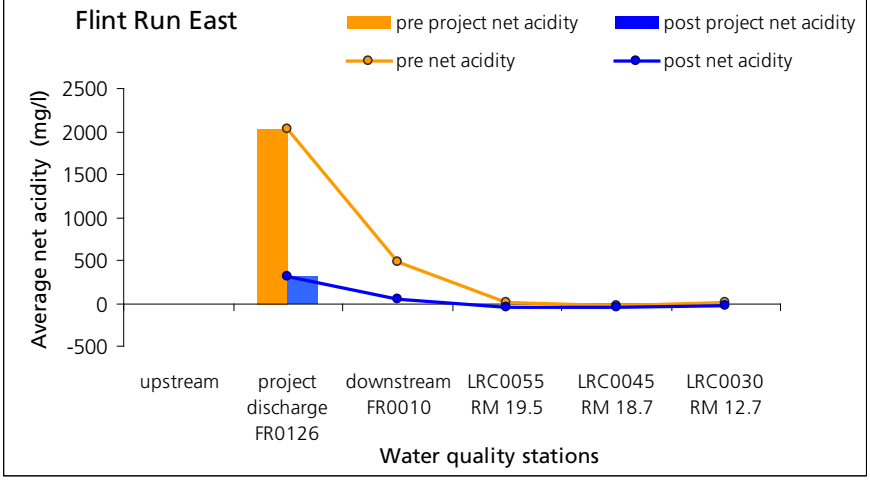
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

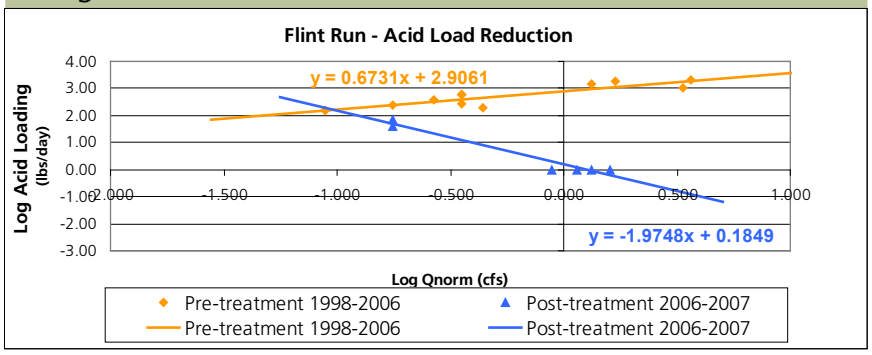



Initial results from the Flint Run East Project indicate, pH and net acidity have improved downstream of the reclamation site for 7.0 miles. Pre-construction data showed pH in the range of 2.9 – 6.7 at the project discharge and downstream. However, after installation of the Flint Run East Project, post-construction data shows pH in the range of 4.8 – 7.2 at the discharge, and downstream. The net acidity concentrations decreased 84 percent at the project discharge showing net alkaline conditions for 7.0 miles downstream to station LRC0030.

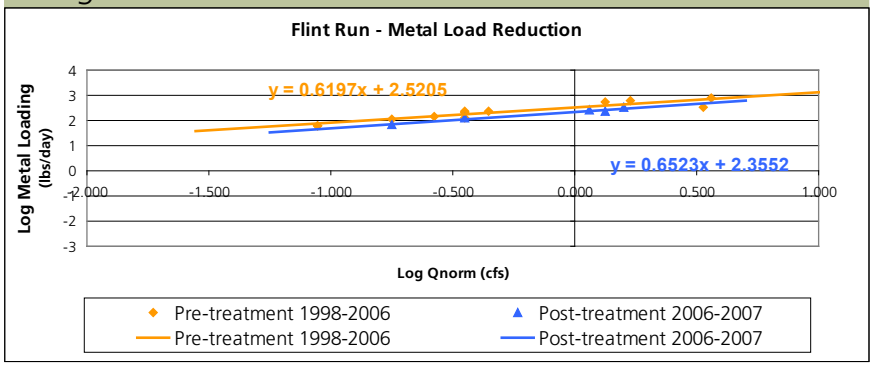
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1/1/1975 to 5/31/2006 for pre-construction and from 6/1/2006 to 6/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction

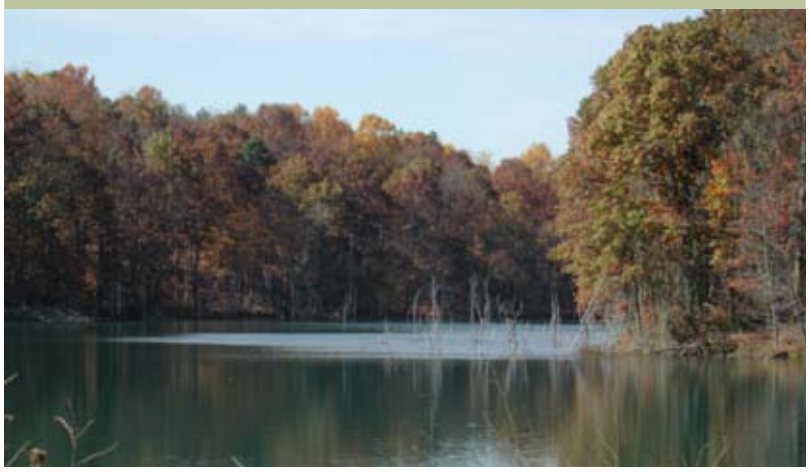



*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

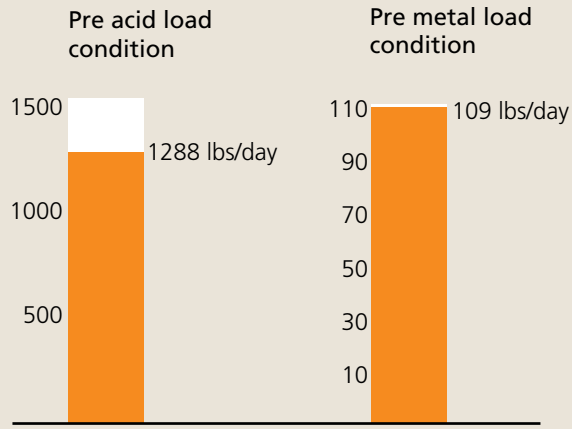
Project Status: Complete 9/5/2006

ODNR Project Number: Jk-Ml-113

## Pre-construction



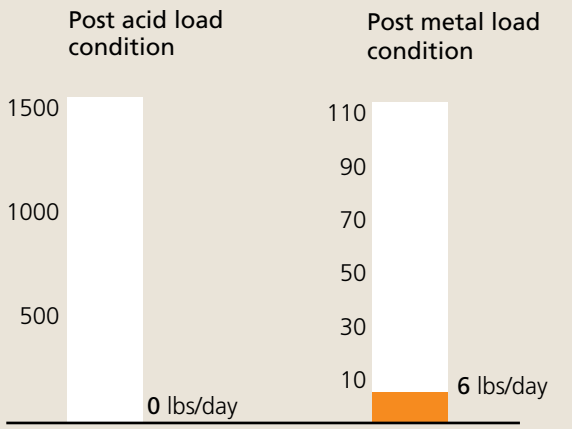
*Lake Milton - 25 acre acidic lake*
*Photo by Ben McCament*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Steel slag bed downstream Lake Milton*
*Photo by Ian Hughes*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

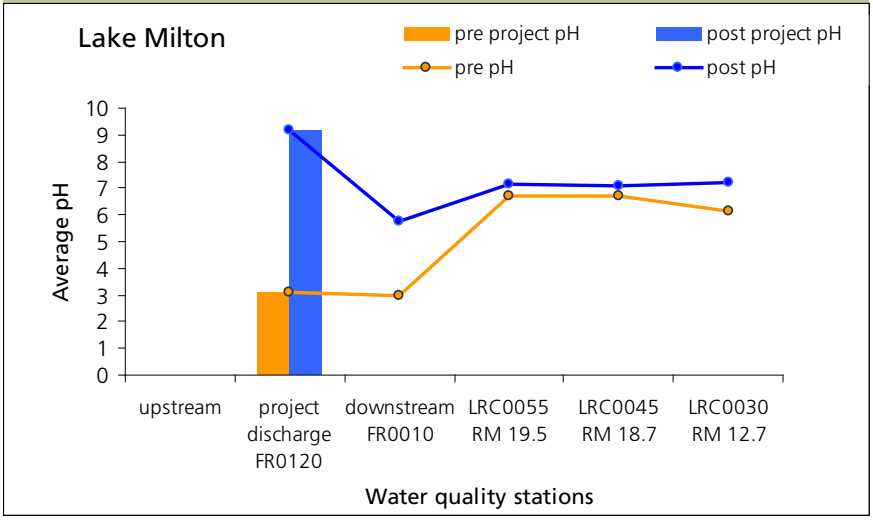
| Treatment Installed | Quantity & Units |
|---|---|
| Water Treatment in Lake Milton | 50 *million gallons* |
| Open Limestone Channel | 2,300 *linear feet* |
| Steel Slag Leach Bed | 74,000 *square feet* |
| Succesive Alkaline Producing Systems (SAPS) | 16,000 *square feet* |
| Repair Dam with Slurry Wall | 75,000 *square feet* |

Lake Milton is located in Section 28 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The project site is 155 acres and is located in Little Raccoon Creek next to the Flint Run East Project. The Lake Milton Project is Phase II of the Flint Run Reclamation Project, Flint Run East was Phase I. The project discharge was measured at the outlet from hothouse lake. The design was completed by Bergmann Associates and GAI Consultants Inc. for a cost of $416,000. The treatment approach for this site was to repair the Lake Milton dam and to install a Successive Alkaline Producing System (SAPS) and a steel slag leach bed. The major consideration during the design process was the crucial need to treat the acid mine drainage in Upper Lake Milton to drain to Lake Milton before running into the steel slag bed downstream of Lake Milton. The goal of the design is to reduce 600 lbs/day of acid loading. Problems occured with the valves in 2007, therefore this project only worked intermittently until Sept. 2007. Construction was complete September 5, 2006 by Stockmeister Enterprises Inc. for a cost of $961,536. The major responsibility of the construction company was to complete the reclamation and install passive treatment systems. The funding sources for this project were ODNR-MRM, EPA-319 and OSM ACSI for both the design and construction. Figures 3 to 4 (shown on page 3) estimate approximately 1288 lbs/day of acid and 103 lbs/day of metals were reduced from entering into Little Raccoon Creek while the system was operating properly. Further evaluation will be completed next year.

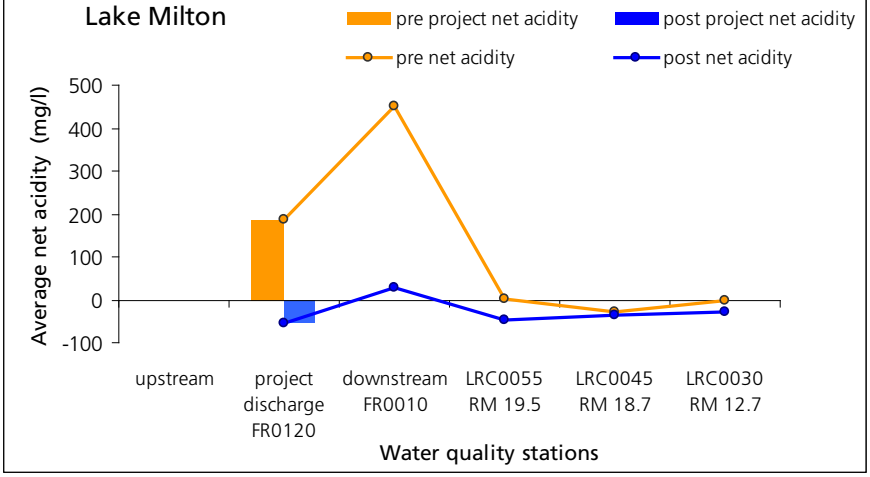
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre-construction. The graphs below show pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream downstream of the project discharge. Post-construction data are currently being collected and will be evaluated next year to show pH, acidity and acid and metal load reductions.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

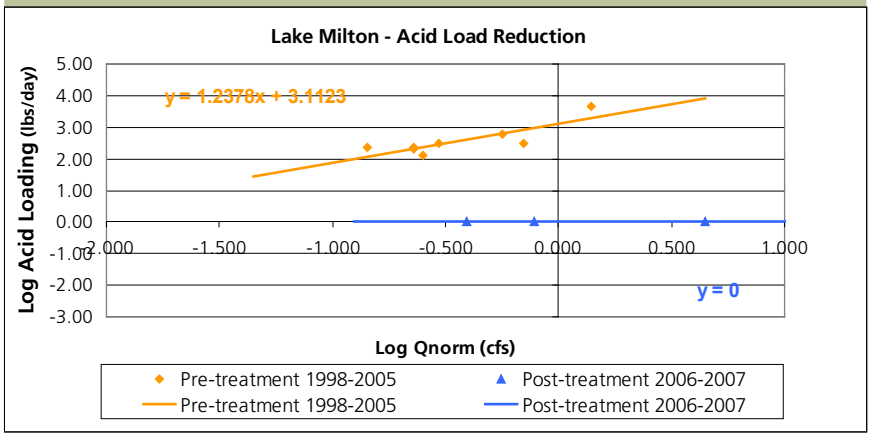



As a result of the Lake Milton project the pH and net acidity has improved downstream of the reclamation site for 7.0 miles. Pre-construction data shows pH in the range of 3.0–6.7 downstream of the project. However, after installation of the Lake Milton Project, post-construction data shows pH in the range of 5.8–9.2 downstream of the project discharge. The net acidity concentrations decreased, showing net alkaline concentration for 7.0 miles downstream to station LRC0030.

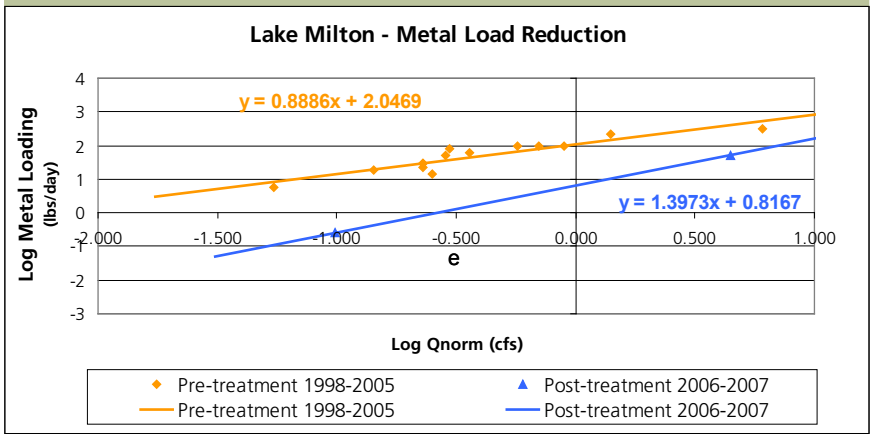
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1/1/1975 to 10/15/2006 for pre-construction and from 10/16/2006 to 6/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction

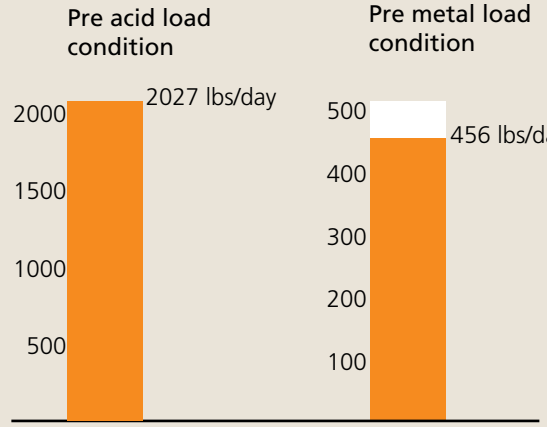



*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete 6/20/1999 ODNR Project Number: JK-MI-18

## Pre-construction

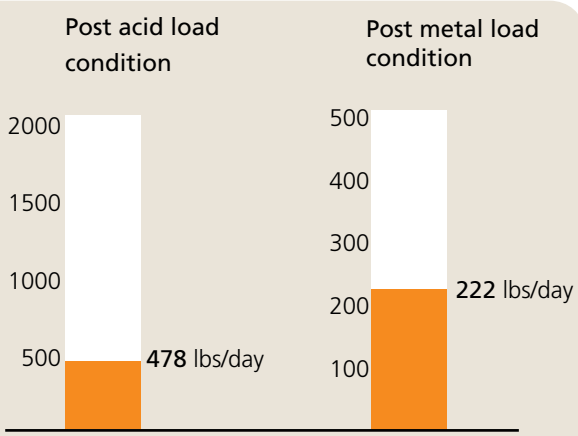
*Mine waste in valley*
*Photo by Raccoon Creek Partnership*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Successive Alkaline Producing System (SAPS)*
*Photo by Ben McCament*



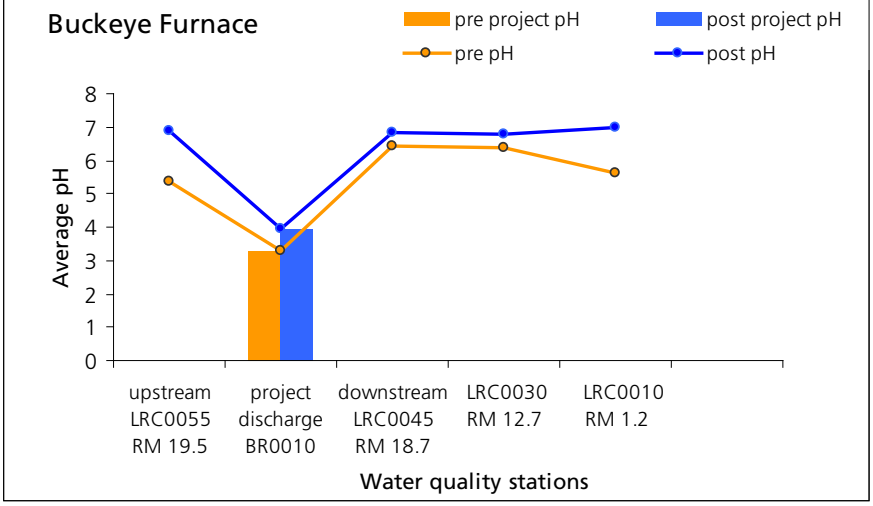

*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

Buckeye Furnace and Buffer Run Project is located in Section 25 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The site is 65 acres and is located in the Little Raccoon Creek subwatershed. The design was completed by BBC&M Engineering Inc. for $125,000. The treatment approach for this site was to eliminate strip pits, reclaim the gob pile, and install a Successive Alkaline Producing System (SAPS) a passive treatment system. The major considerations for this project was mostly source control and but also constructing a passive treatment system. The goal of the design was to reduce 75 percent of the acidity discharging into Little Raccoon Creek. The acidity has been reduced by 46 %. Construction was complete June 20, 1998, by Earth Tech Inc. for a cost of $1,090,530. The major responsibility of the construction company was to complete all reclamation activities described in the project design. The funding source for the project design was ODNR-DMRM, and for construction the sources were ODNR-DMRM, OEPA and OSM. Figures 3 and 4 (shown on page 3) estimate approximately 1549 lbs/day of acid and 234 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

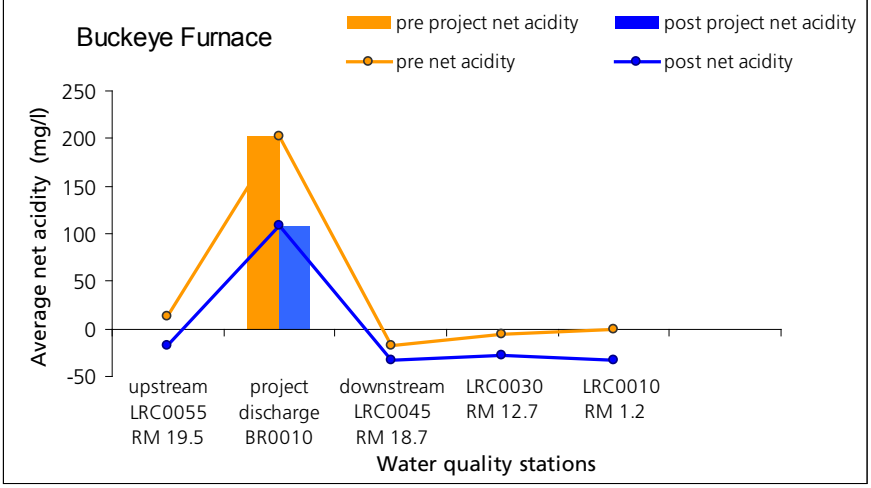
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

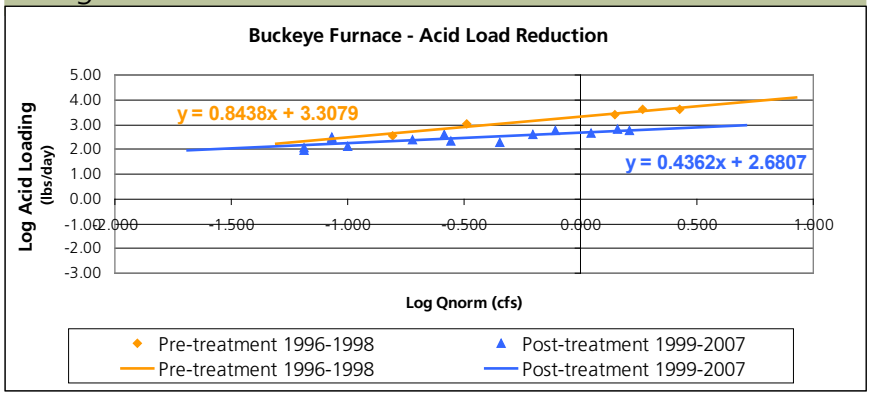



As a result of the Buckeye Furnace and Buffer Run project, the pH and net acidity has improved downstream of the reclamation site for18 miles. Pre-construction data shows pH in the range of 3.3 – 6.4 downstream of the project. However, after installation of the Buckeye Furnace and Buffer Run reclamation project, post-construction data shows pH in the range of 3.9 – 7.0 downstream of the project discharge. The net acidity concentrations decreased, showing net alkaline conditions continuing for 18 miles downstream to the mouth of Little Raccoon Creek station LRC0010.

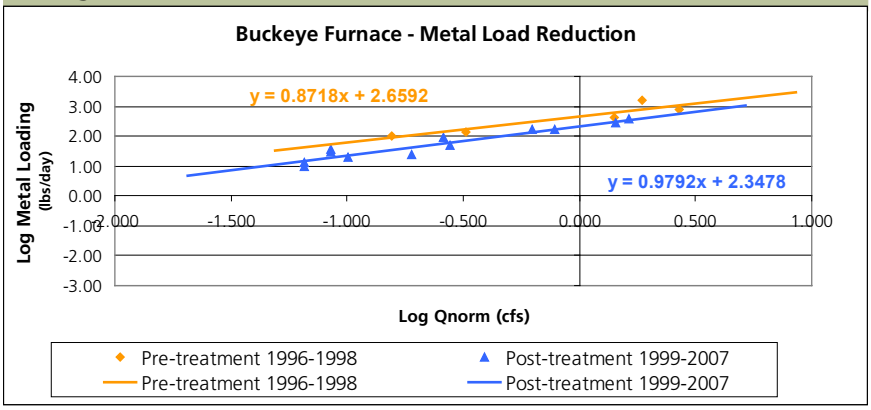
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1/1/1996 to 3/25/1998 for pre-construction and from 6/23/1999 to 6/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction




*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

## Section III – AMD project reports

## Monday Creek Watershed comprehensive acid mine drainage projects progress report for 2006.

*Section III contains individual AMD project reports displaying photos of the project site, a description of the project, water quality data at the site and its impact to the receiving stream, and acid/metal loading reductions as a result of the project.*

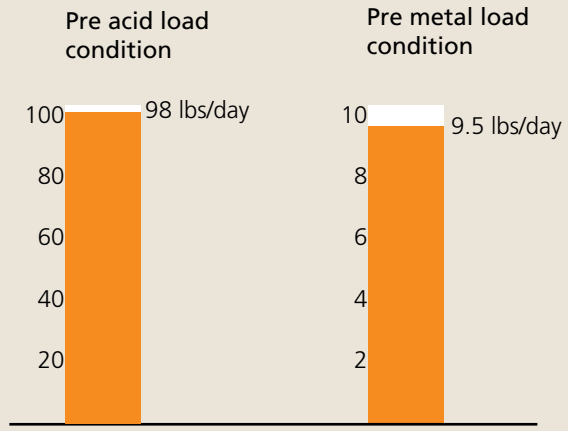
List of acid mine drainage reclamation projects reported on in the 2006 NPS monitoring report:

1. Grimmett Hollow
2. Jobs Hollow Doser
3. Rock Run Gob Pile
4. Rock Run 24
5. Big Four Hollow
6. Essex Doser
7. Snake Hollow
8. Lost Run Phase I

Project Status: Complete 12/31/2003 ODNR Project Number: PR-SI-14

## Pre-construction

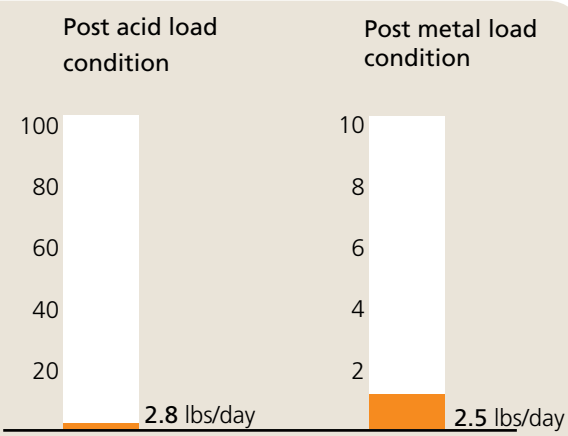
*Grimmett Hollow*
*Photo by Monday Creek Restoration Project*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Grimmett Hollow*
*Photo by Monday Creek Restoration Project*



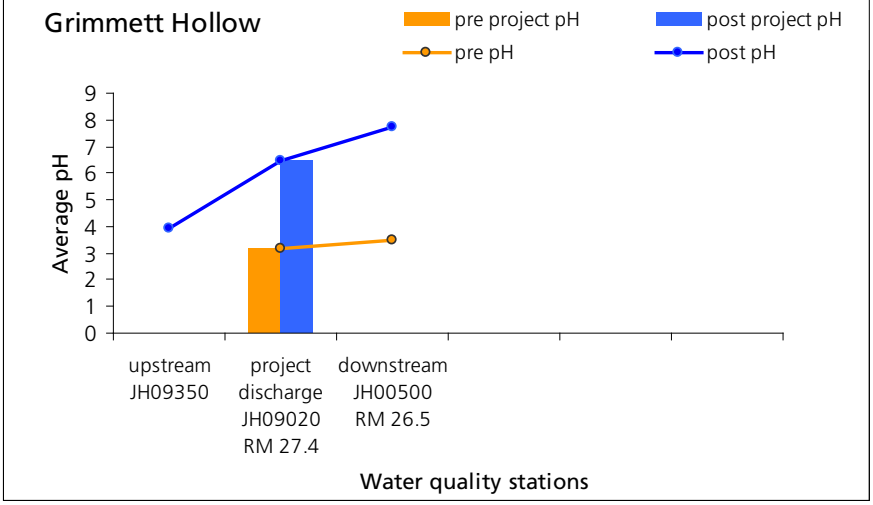

*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

Grimmett Hollow is located in Section 4 of Salt Lick Township in Perry County and lies within the 14-digit HUC unit #05030204060010. The project site is five acres and located on Grimmett's Property in the headwaters of Jobs Hollow, the project discharge is measured at the bridge on CR223. The design was completed by Red Wing Engineering for $19,000. The treatment approach for this site was to enhance an existing 1.3-acre wetland with two rock dams (300 linear feet), incorporated with alkaline material (LKD) as well as install (500 linear feet) open limestone channels (OLC) at seep locations and regrade, soil and vegetate a gob pile (0.15 acres). A stream was routed away from the gob pile via the open limestone channel. The goal of the design was to decrease acidity by 13.6 tons per year. The project goal was met by 100 percent. Major considerations encountered during the design process were the diffuseness of the AMD sources; numerous seep discharges in the basin, gob pile and spoil deposited in wetland; and a stream flowing through the gob pile. Construction was complete Dec. 31, 2003 by Perry Reclaiming Inc. for a cost of $160,000. The major responsibility of the construction company was to install the rock dams, install the OLCs, reclaim the gob pile, and re-route the stream. The funding sources for this project were ODNR-MRM and EPA-319 for both design and construction. Figure 3 and 4 (shown on page 3) estimate approximately 95 lbs/day of acid and 7 lbs/day of metals were prevented from entering into Jobs Hollow and Monday Creek as a result of this AMD reclamation project.

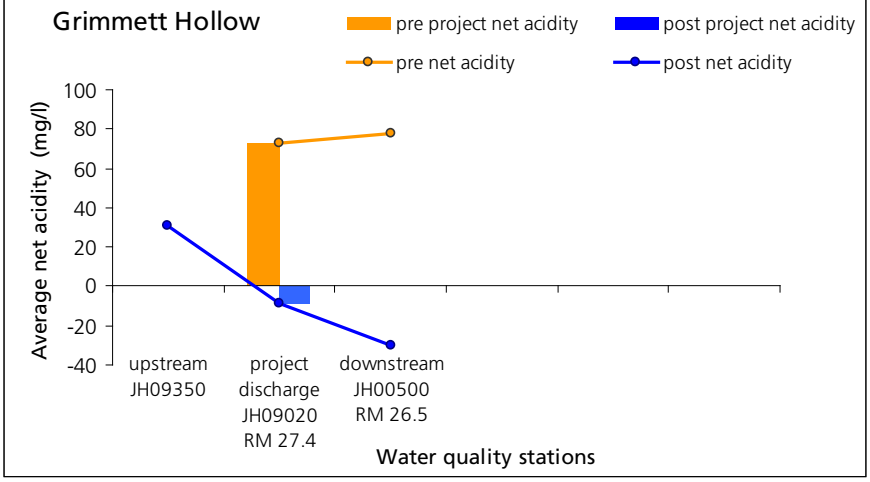
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

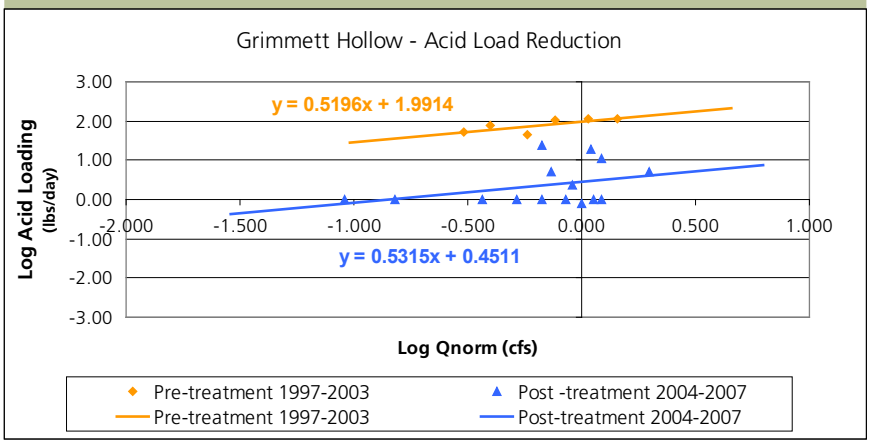



As a result of the Grimmett Hollow Project, pH and net acidity have improved downstream of the reclamation site for 0.75 miles. Pre-construction data showed pH in the range of 3.1 – 3.5 at the project discharge and downstream. However, after installation of the Grimmett Hollow Project, post-construction data shows average pH in the range of 6.5 – 7.7 at the discharge and downstream. The net acidity concentrations decreased 100 percent at the project discharge showing net alkaline conditions for 0.75 miles downstream to station JH00500.

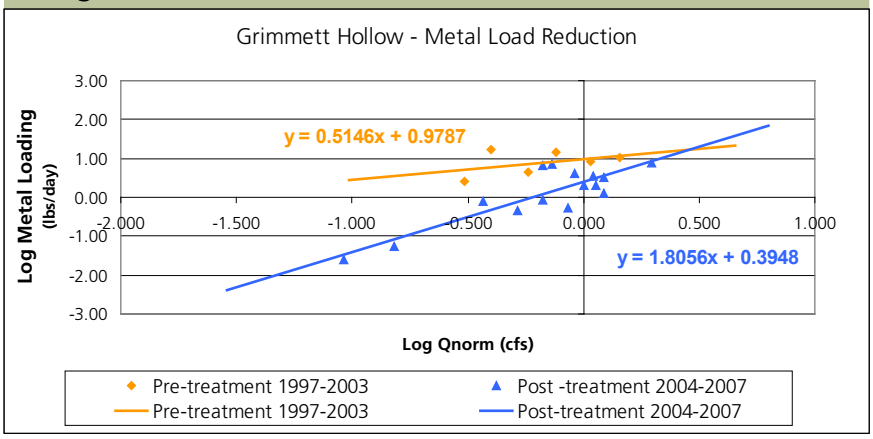
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 10/1/1997 to 7/31/2003 for pre-construction and from 1/1/2004 to 6/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction

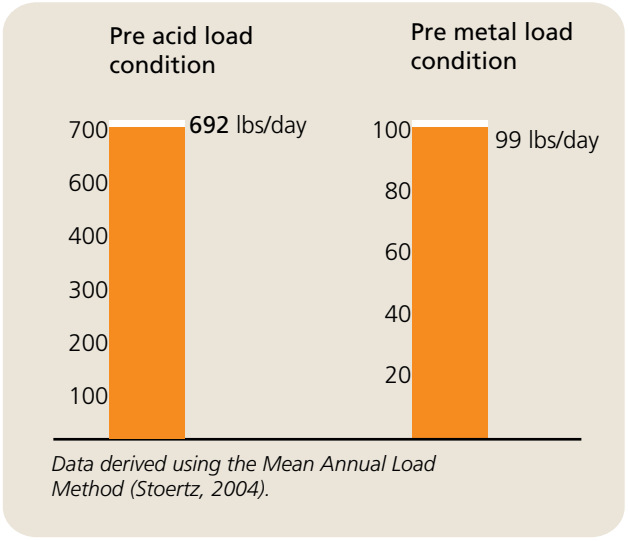



*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete: 7/20/04 ODNR Project Number: PR-SI-13

## Pre-construction

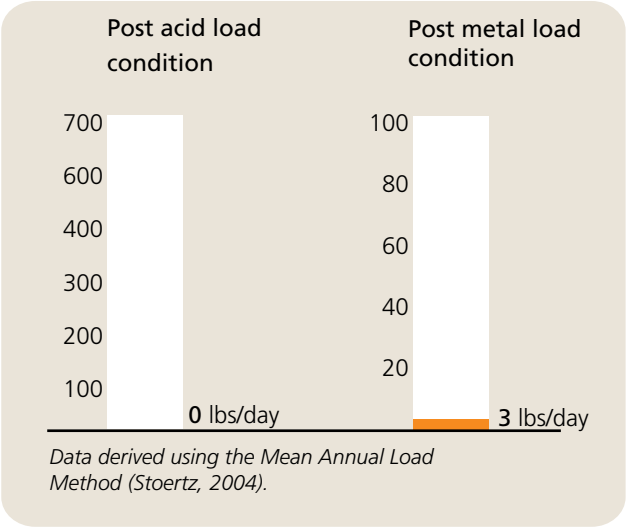
*Jobs Hollow*
*Photo by Monday Creek Restoration Project*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Jobs Hollow Doser*
*Photo by Monday Creek Restoration Project*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

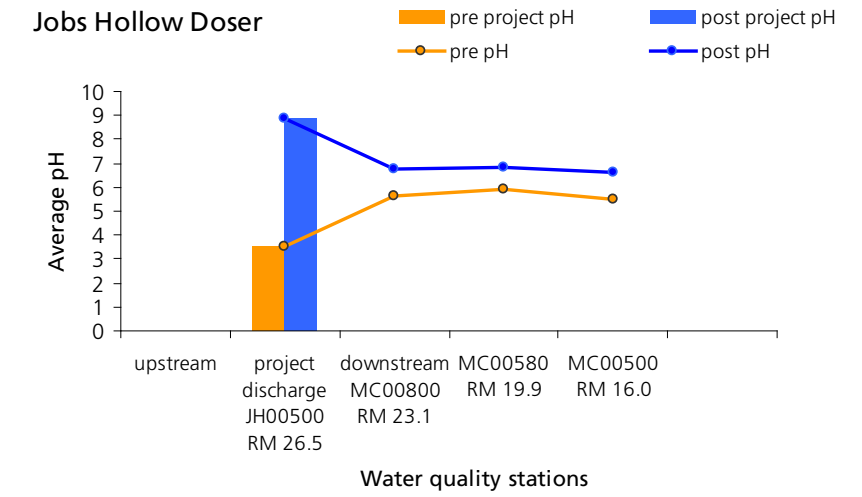
Jobs Hollow Doser is located in Section 5 of Salt Lick Township in Perry County and lies within the 14-digit HUC unit #05030204060010. The site is located in the headwaters of Monday Creek Watershed downstream of Jobs Hollow at the bridge on Portie Flamingo Road (CR 12). The design was completed by ATC Associates for $ 66,916.50. The treatment approach for this site was to install a lime doser. The goal of the design was to decrease acid load from the headwaters of Monday Creek by 54 percent. The project goal was met 100 percent. One major consideration encountered during the design process was that the dosing unit is located adjacent to an intermittent tributary of Monday Creek. Therefore a retention pool was created to create a constant supply of water to the doser. Construction was complete July, 20, 2004 by Tuson Inc. for a cost of 319,066.50. The major responsibility of the construction company was to install the dosing unit and a create a retention pool to supply water to the doser. Funding sources for this project were ODNR-MRM, OSM-ACSI and OEPA-319 for design and ODNR-DMRM and OSM-ACSI for construction.

Figure 3 and 4 (shown on page 3), approximately 692 lbs/day of acid was reduced from entering into Monday Creek as a result of this AMD reclamation project. In addition to the acid loading reduction measured at this site, there are approximately 338 lbs/day of alkaline addition to the headwaters of Monday Creek. Dissolved metal load reduction occurring at this site was approximately 97lbs/day. The metals precipitate as a result of the high pH water and become part of the substrate.

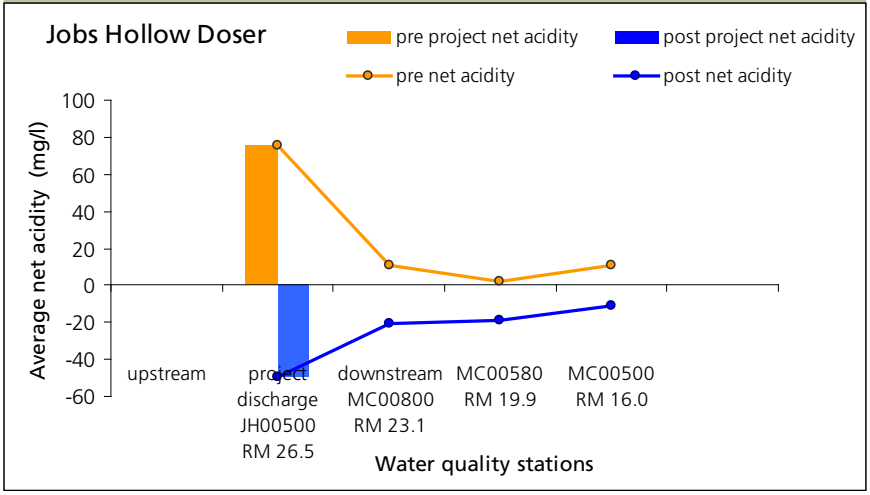
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post- construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

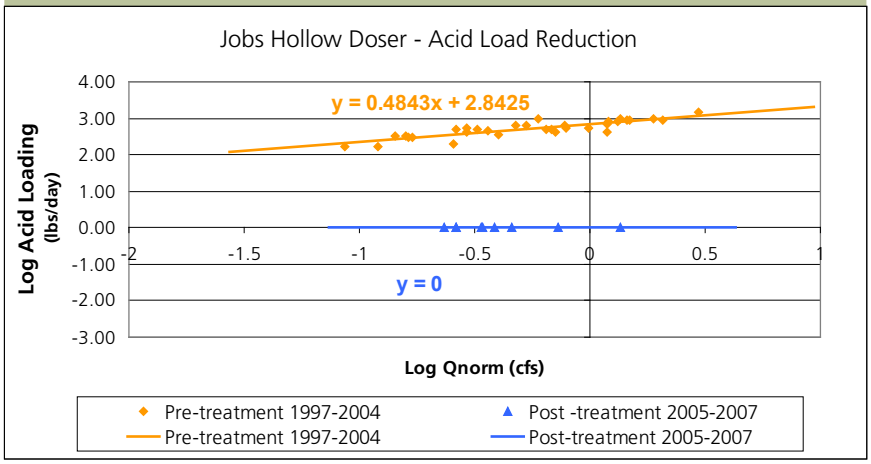



As a result of the Jobs Hollow Doser project, the pH and net acidity have improved downstream of the reclamation site for 10 miles. Pre-construction data showed pH in the range of 3.5 – 5.9 downstream of the project. However, after installation of the Jobs Hollow Doser, post-construction data shows pH in the range of 6.6 – 8.8 downstream of the project discharge. The net acidity concentrations decreased, showing net alkaline conditions continuing for 10 miles downstream to station MC00500 (LTM 2).

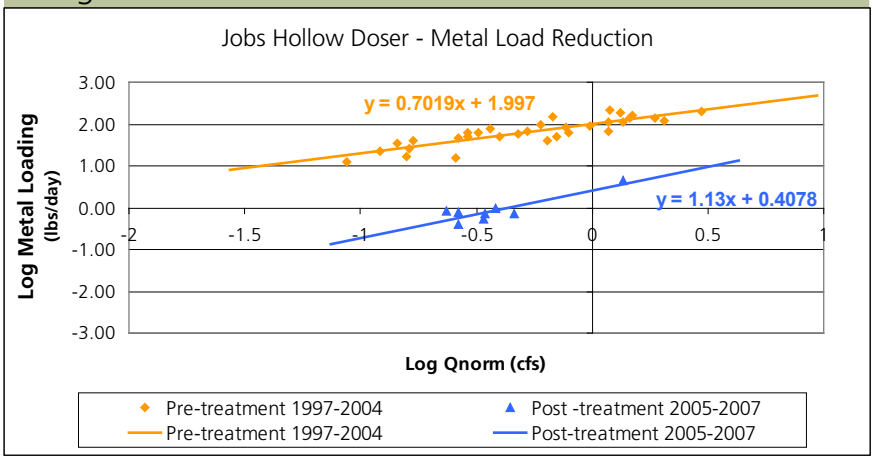
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 10/1/1997 to 5/1/2004 for pre-construction and from 6/1/2005 to 6/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction



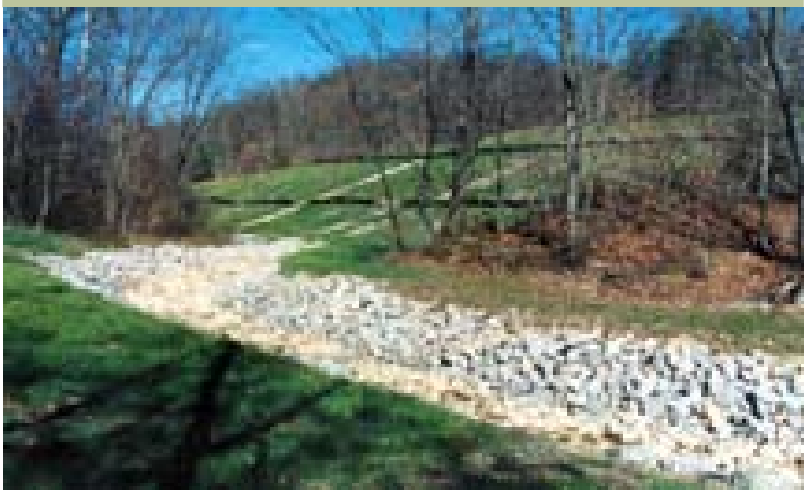

*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete 9/1/1999 ODNR Project Number: PR-Co-08

## Pre-construction

*Rock Run Gob Pile*
*Photo by Monday Creek Restoration Project*

## Post-construction



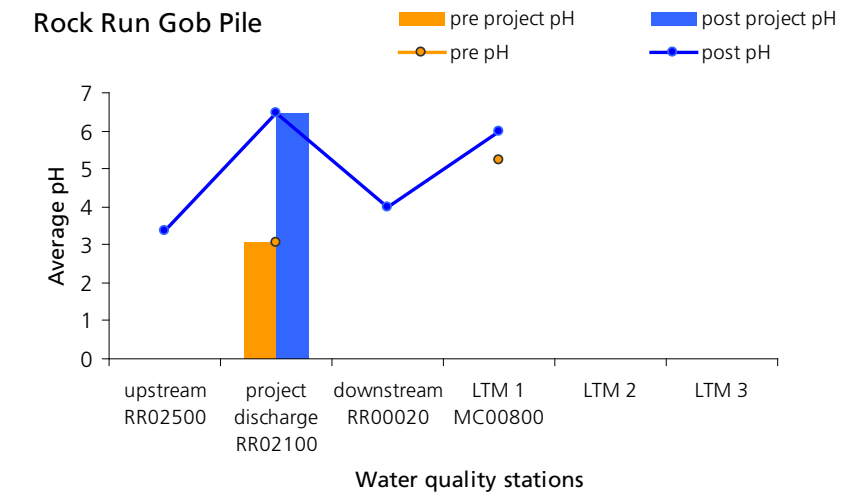
*Rock Run Gob Pile*
*Photo by Monday Creek Restoration Project*

Rock Run Gob Pile is located in Section 20 of Coal Township in Perry County and lies within the 14 digit HUC unit #05030204060010. The Rock Run Gob Pile is stretched over 17 acres and was located on the north side of the Rock Run tributary. The design was completed by ODNR-DMRM and Damariscotta for $15,000. The treatment approach for this site was to cover the 17 acre gob pile using standard reclamation methods, covering the gob with a layer of FGD, and installing a 3,200 Sq. ft. Successive Alkalinity Producing System (SAPS) to treat the acid mine drainage emitting from a deep mine at the back of the property. The goal of the design was to reclaim the gob pile and reduce metals and acid loadings from the mine drainage. The project goal was met by reducing acidity to net alkaline conditions at station RR02100 and increasing the pH. Major considerations encountered during the design process was the mine drainage exiting the SAPS (approximately 10% of the water exiting the site) couldn't be separated from the gob pile reclaim. The valley was too small to accommodate and separate the run off from the SAPS treatment cells so a OLC was lined to carry the drainage off site after treatment. Construction was complete 9/1/1999 by Stimmel Brothers Construction for a cost of $274,500. The major responsibility of the construction company was to reclaim the gob pile, install the SAPS, and install the lined OLC. The funding sources for this project were for both the design and construction: ODNR-DMRM, EPA-319, and OSM-ACSI.

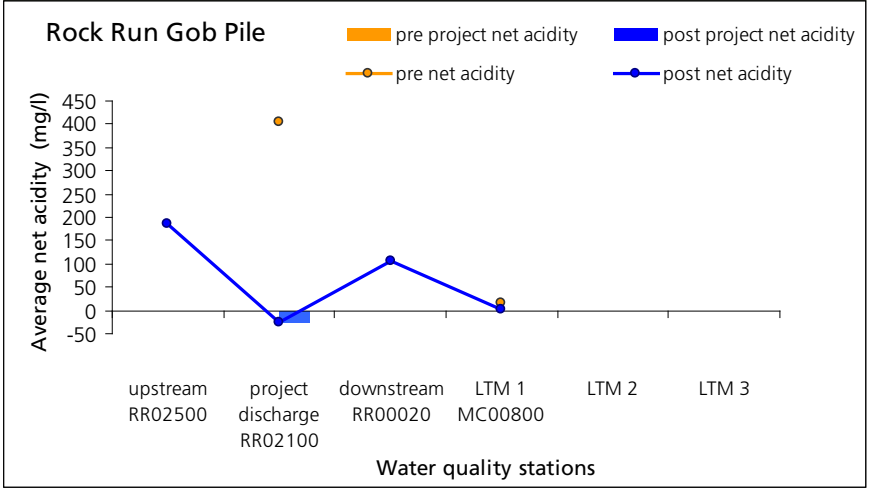
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity



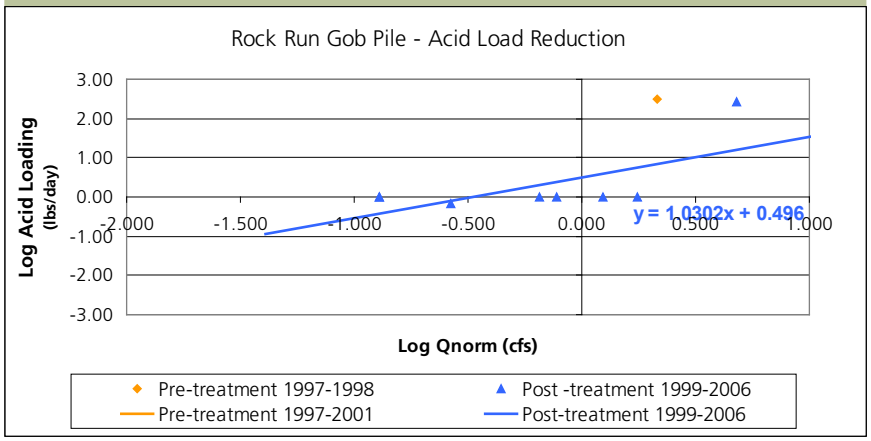

As a result of the Rock Run Gob Pile Project, pH and net acidity have improved further downstream at site MC00800 approximately 0.75 miles. At the first station downstream of Rock Run Gob Pile, water quality didn't show improvement due to other sources of acid mine drainage entering into the Rock Run tributary. Pre-construction data shows pH in the range of 3.0 – 5.2 at the project discharge and downstream. However after reclamation of the Rock Run Gob Pile Project, post-construction data shows pH in the range of 3.9– 6.2 at the discharge and downstream. The net acidity concentration decreased resulting in net alkaline water at the project discharge.

*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

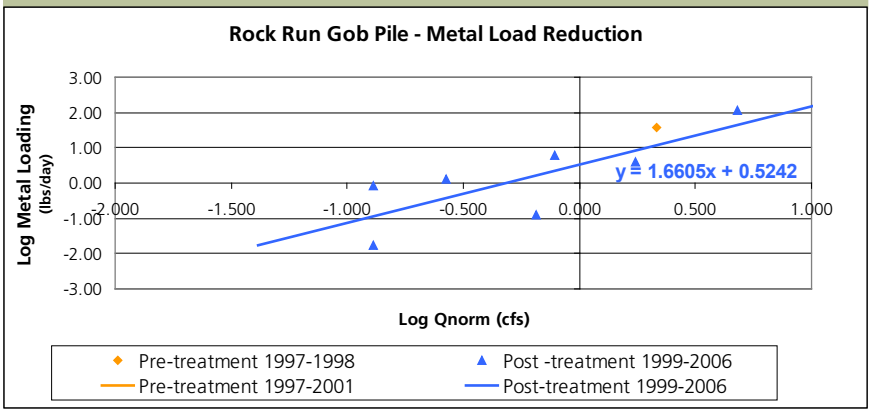
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre-, and post-construction at the project discharge from 9/1/1997 to 12/31/2004 for pre-construction and from 1/3/2005 to 12/31/2006 for post-construction.

### Figure 3. Acid Load Reduction



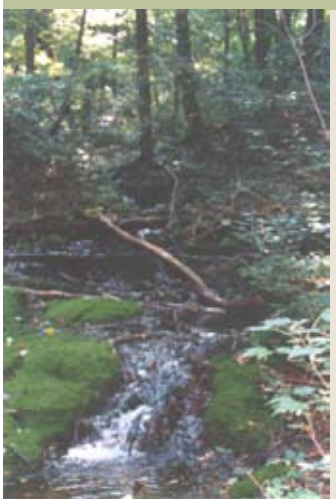

### Figure 4. Metal Load Reduction



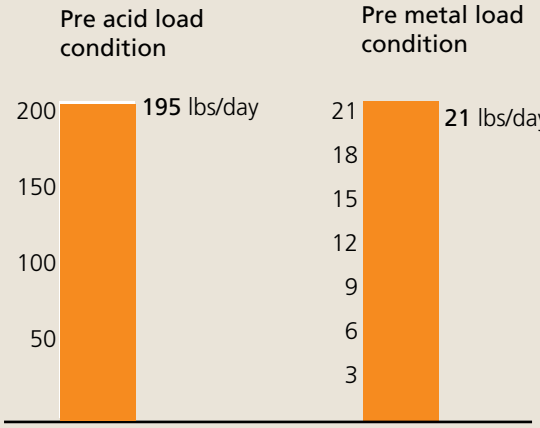

*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete 9/30/2001 ODNR Project Number: PR-Sl-

## Pre-construction



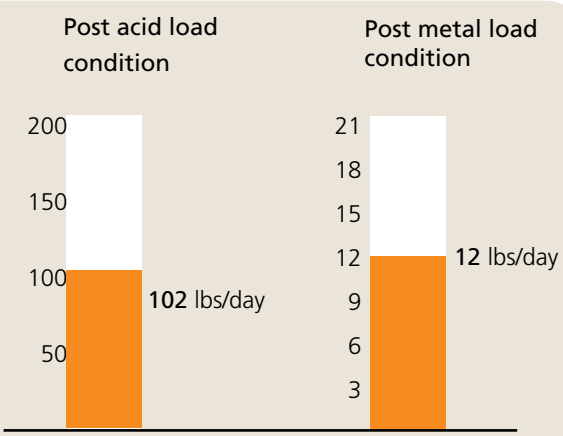
*Rock Run 24*
*Photo by Monday Creek Restoration Project*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Rock Run 24*
*Photo by Monday Creek Restoration Project*



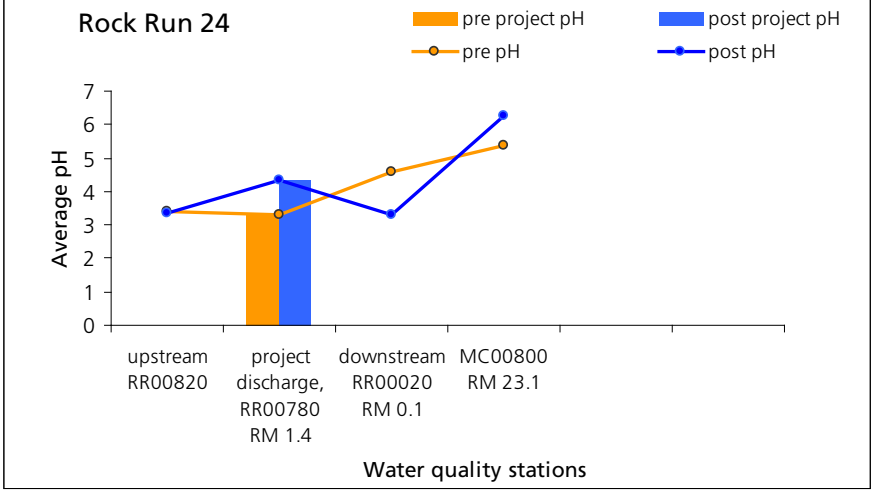

*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

Rock Run 24 is located in Section 20 of Coal Township in Perry County and lies within the 14-digit HUC unit #05030204060010. The site is located on the north side of the headwaters of Rock Run tributary. The design was completed by Red Wing Engineering for $25,840. The treatment approach for this site was to install 800 linear feet of open limestone channel (OLC). The goal of the design was to reduce acidity concentration by 36 percent. The project goal was met 100 percent at station MC00800 and 75 percent at the project discharge RR00780. Major considerations encountered during the design process were landowners concerns and less than 10 percent slope for OLC. The original design was changed from a Reverse Alkaline Producing System (RAPS) to an OLC due to private landowner and U.S. Forest Service liability issues (i.e. flooding). Construction was complete Sept. 17, 2001, by Burr Oak Excavating for a cost of $71,281. The major responsibility of the construction company was to install the OLC at Rock Run 24 and OLC at the toe of the Rock Run gob pile. The funding sources for this project were ODNR-DMRM and OSM-ACSI for both the design and construction. Figure 3 and 4 (shown on page 3) estimate approximately 93 lbs/day of acid and 9 lbs/day of metals were prevented from entering into Rock Run tributary and Monday Creek as a result of this AMD reclamation project.

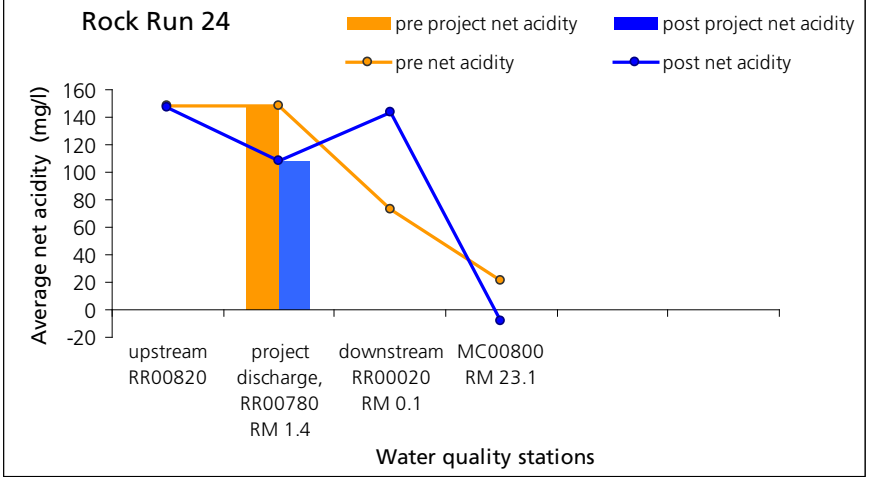
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

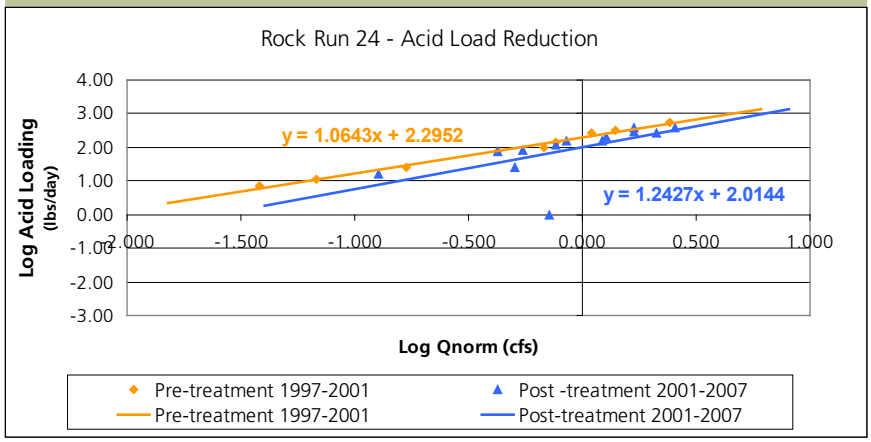



As a result of the Rock Run 24 Project, pH and net acidity have improved further downstream at site MC00800 approximatley 0.75 miles. At the first station downstream of Rock Run 24, water quality didn't show improvement due to other sources of acid mine drainage entering into the Rock Run tributary. Pre-construction data showed pH in the range of 3.3 – 5.4 at the project discharge and downstream. However after installation of the Rock Run 24 Project, post-construction data shows pH in the range of 4.3 – 6.3 at the discharge and downstream. The net acidity concentration decreased 27 percent at the project discharge, which resulted in a 100 percent decrease to net alkaline conditions at the downstream LTM 1 station MC00800.

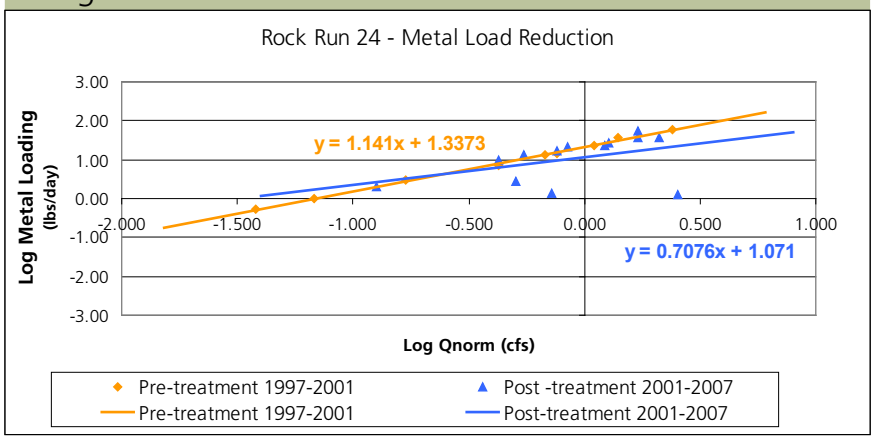
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 10/1/1997 to 9/17/2001 for pre-construction and from 10/1/2001 to 06/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction

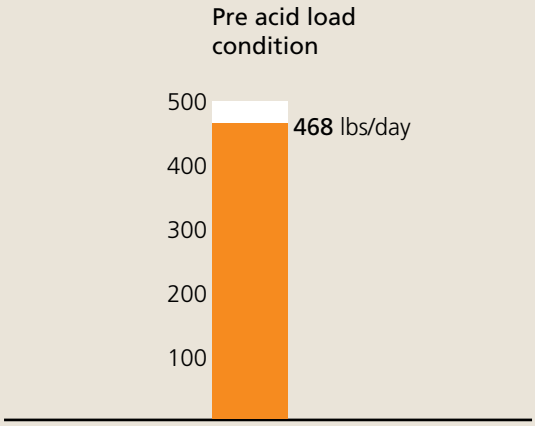



Approximately 93 lbs/day of acid and 9 lbs/day of metals were prevented from entering into Rock Run tributary and Monday Creek as a result of this AMD reclamation project. Average discharge measurements were used to calculate load reductions using the Mean Annual Load Method (Stoertz, 2004) instead of deriving the mean annual discharge from the drainage area because the discharge from the Rock Run 24 site is controlled primarily by deep mine drainage and not surface drainage.

*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

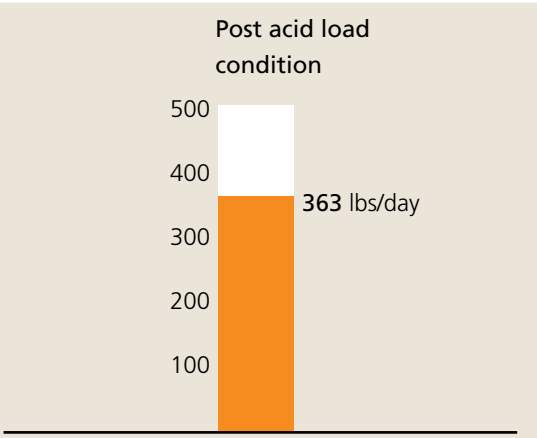
Project Status: Complete 10/29/2004 ODNR Project Number: HC-Wr-20

## Pre-construction




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

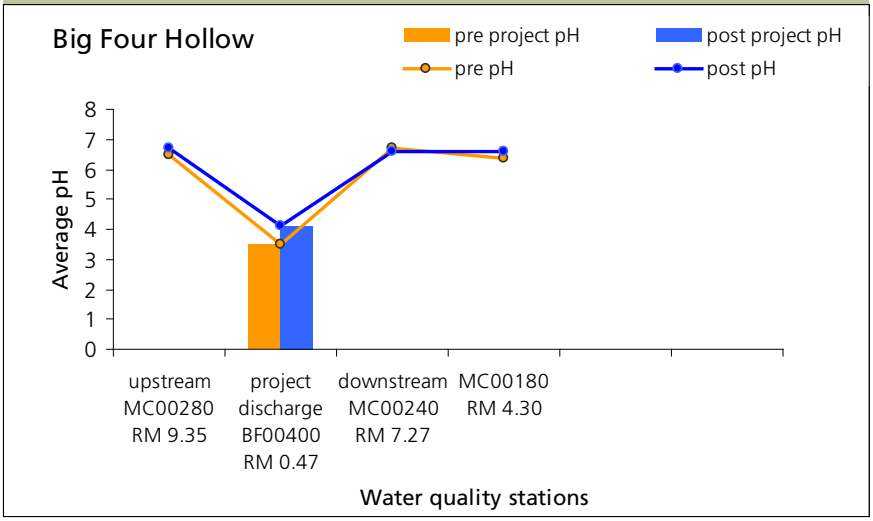
*Big Four Hollow*
*Photo by Monday Creek Restoration Project*

Big Four Hollow is located in Section 14 of Ward Township in Hocking County and lies within the 14-digit HUC unit #05030204060030. The project site covers 285 acres of a 410 acre sub-watershed (Big Four Hollow) draining to Monday Creek. The design was completed by USFS and TN & A for $19,000. The treatment approach for this site was to install two limestone leach beds (3000 sq. ft) and approximately 1,400 linear feet of limestone channel (OLC). The goal of the design was to reduce acidity concentration, not metals. The goal of the project was to decrease acidity by 82% at station BF00400, only 25% of the acidity concentration has been decreased at site BF00400. Construction was complete Sept. 17, 2001, by Pangea for a cost of $320,000. The major responsibility of the construction company was to install leach beds and OLCs. The funding sources for this project were USFS for the design and MCRP, ODNR-DMRM and USFS for construction. Figure 3 and 4 (shown on page 3) estimate approximately 104 lbs/day of acid and 0 lbs/day of metals were prevented from entering into Monday Creek as a result of this AMD reclamation project. This project was designed to reduce acidity, not metals.

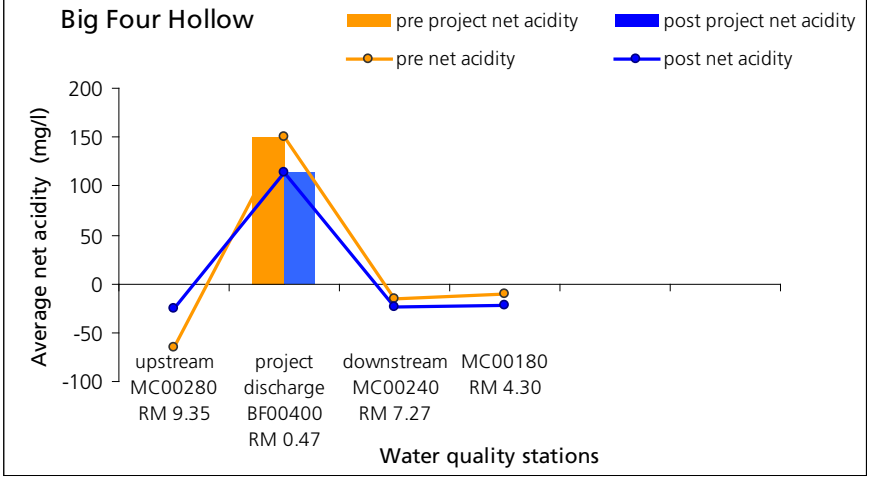
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

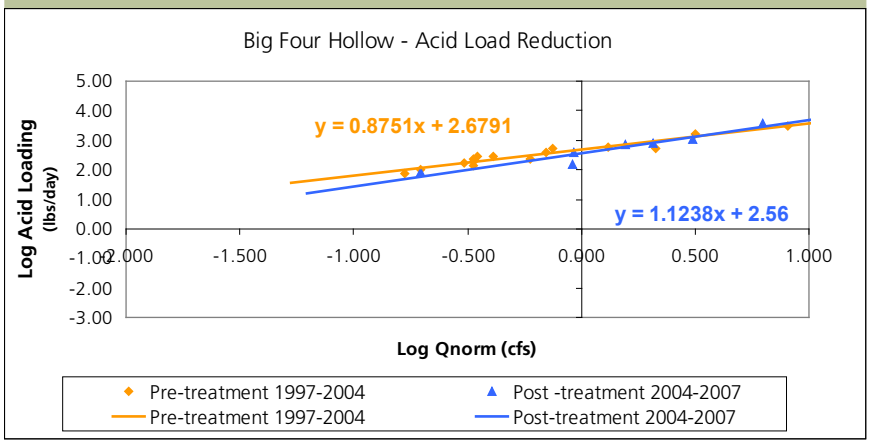



As a result of the Big Four Hollow Project, pH and net acidity have improved downstream for approximately 0.75 miles. Pre-construction data showed pH in the range of 3.4 – 6.7 at the project discharge and downstream. However, after installation of the Big Four Hollow Project, post-construction data shows pH in the range of 4.1 – 6.6 at the discharge and downstream. The net acidity concentration decreased 25 percent at the project discharge.

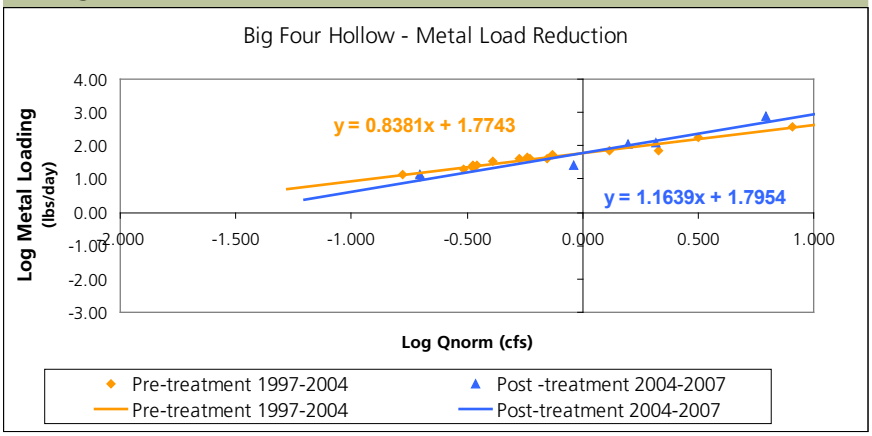
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 9/1/1997 to 7/30/2004 for pre-construction and from 11/1/2004 to 06/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction

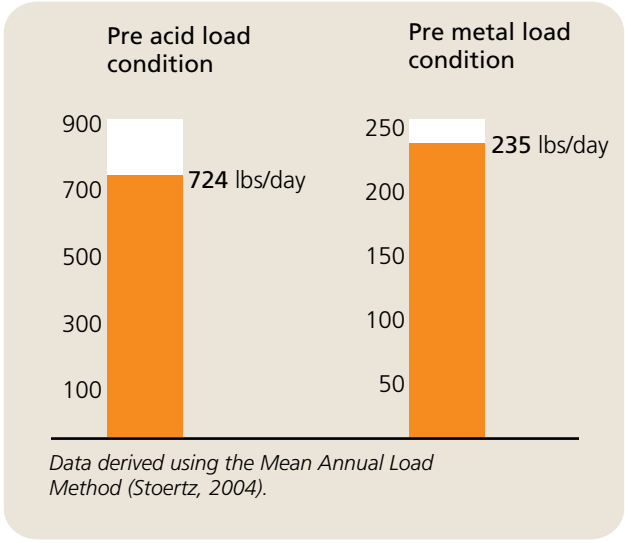



*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete 3/31/2006 ODNR Project Number: HC-Wr-03

## Pre-construction

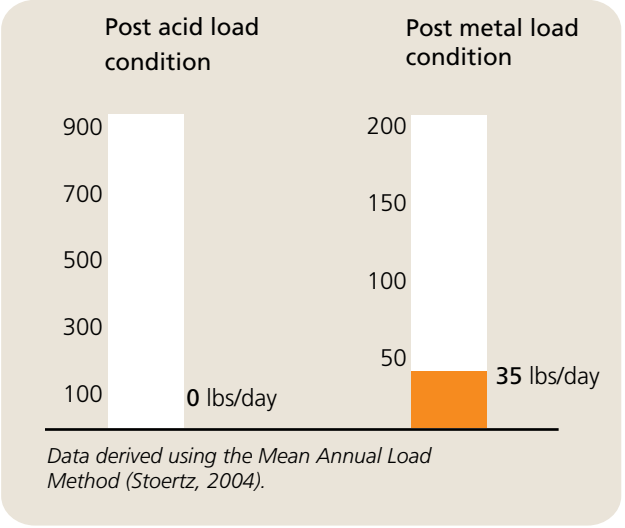
*Essex Doser*
*Photo by Monday Creek Restoration Project*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Essex Doser*
*Photo by Monday Creek Restoration Project*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

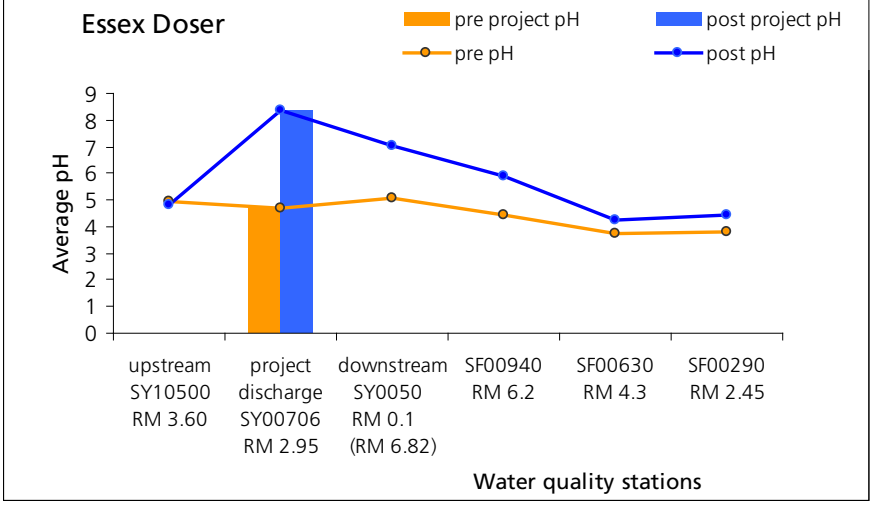
Essex Doser is located in Section 18 of Ward Township in Hocking County and lies within the 14 digit HUC unit #05030204060040. The site is located along Sycamore Hollow, State Route 216. Sycamore Hollow is a tributary to Snow Fork. The design was completed by ATC Associates for a cost of $32,320. The treatment was to install a lime doser. A problem encountered during design was that the funding for this project was originally intended to address Murray City Seeps. However the village of Murray City would not sign a right-of-entry form, so the project was moved to Essex Mine, further upstream of Murray City. The goal of the design was to neutralize acidity discharging from Essex Mine. The project goal, as indicated from initial post-construction sampling, has been met 100 percent. Further evaluation of this site will be completed next year after more data has been collected. A major consideration encountered during the design was the close proximity of the doser to State Route 216. Construction was complete March 31, 2006, by AWT Services Inc. for a cost of $287,400. The major responsibility of the construction company was to install the doser. The funding sources for this project were ODNR-DMRM and EPA-319 for both the design and construction.

Figure 3 & 4 (shown on page 3) estimate approximately 724 lbs/day of acid was reduced from entering into Sycamore Hollow and Snow Fork as a result of this AMD reduction project. In addition to the acid loading reduction measured at this site, there was approximately 955 lbs/day of alkaline addition to the headwaters of Sycamore Hollow. Dissolved metal load reduction occurring at this site was approximately 200 lbs/day. The metals precipitate as a result of the high pH water and became part of the substrate.

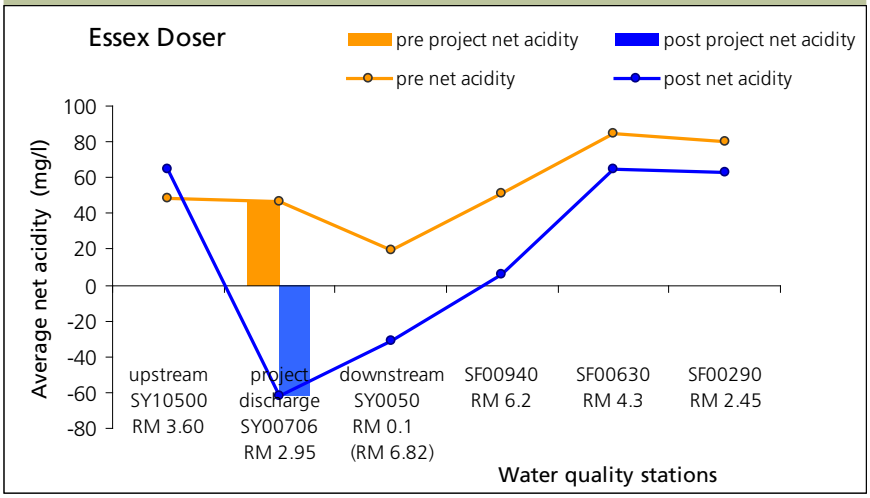
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post- construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

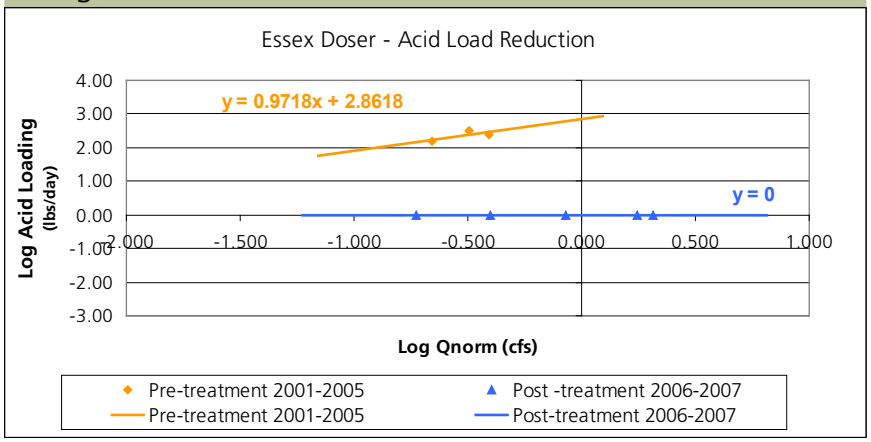



As a result of the Essex Doser Project, pH and net acidity have improved downstream approximately 6.0 miles. Pre-construction data showed pH in the range of 3.7 – 5.1 at the project discharge and downstream. After installation of the Essex Doser Project, initial post-construction data (one sampling event) shows pH values are in the range of 4.2 – 8.4 at the discharge and downstream. The net acidity concentration decreased 100 percent at the project discharge, resulting in net alkaline conditions on the mainstem of Sycamore Hollow.

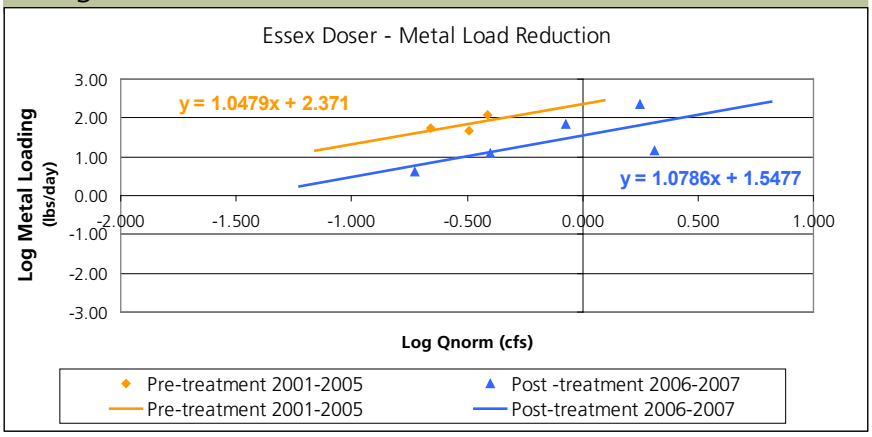
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre-, and post-construction at the project discharge from 2/26/1998 to 9/11/2001 for pre-construction and from 1/3/2005 to 06/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction

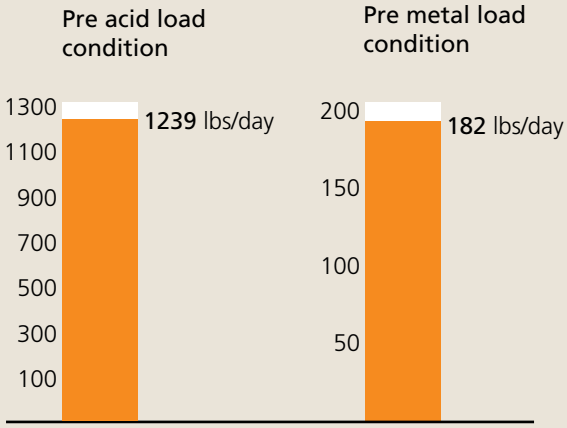



*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete 12/31/2004 ODNR Project Number: HC-Wr-19

## Pre-construction

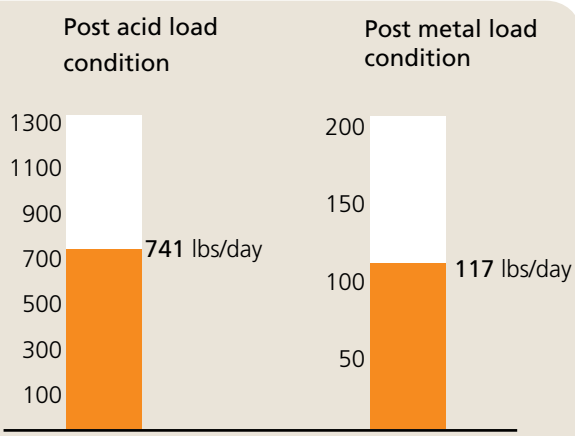
*Snake Hollow*
*Photo by Monday Creek Restoration Project*




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

## Post-construction

*Snake Hollow*
*Photo by Monday Creek Restoration Project*



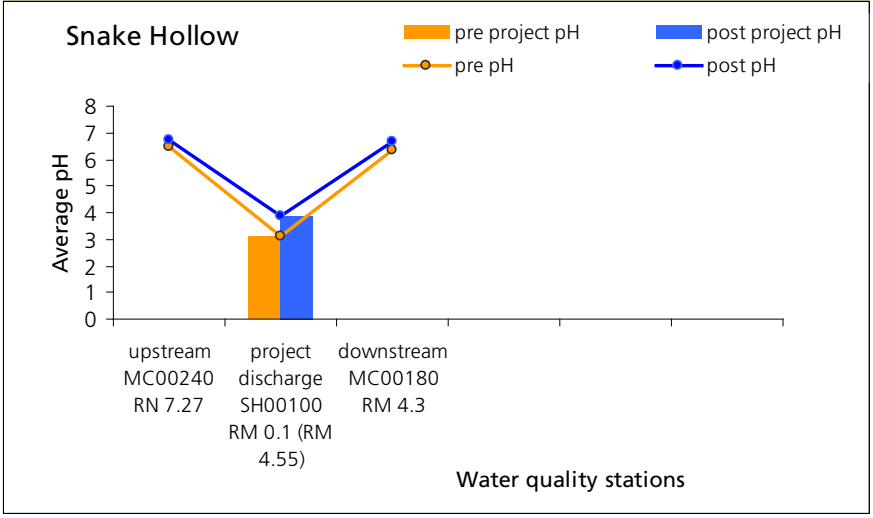

*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

Snake Hollow is located in Section 18 of York Township in Athens County and lies within the 14-digit HUC unit #05030204060030. The site encompasses the entire Snake Hollow subwatershed, approximately 500 acres in size. Snake Hollow is a tributary to Monday Creek. The design was completed by the U.S. Forest Service (Wayne National Forest). The treatment approach for this site was to construct approximately two miles of limestone channels (OLC) and two slag leach beds, close nine subsidence holes and two portals and enhance the existing one acre wetland with limestone rock dams. The goal of the design was to reduce acid and metals concentrations discharging into Monday Creek. The project goal was met, acidity and metal concentrations were reduced in Monday Creek, 498 lbs/day of acid load and 65 lbs/day of metal loads. A major consideration encountered during the design was the documented capture of the Indiana Bat. A problem encountered during the design process was that access road costs doubled. Construction was complete Dec. 31, 2004, by Environmental Quality Management for a cost of $740,000. The major responsibility of the construction company was to install OLCs and leach beds, close subsidence holes and enhance existing wetland. The funding sources were ODNR-DMRM and USFS for both design and construction. Figures 3 and 4 (shown on page 3) estimate approximately 498 lbs/day of acid and 65 lbs/day of metals were prevented from entering into Monday Creek as a result of this AMD reclamation project.

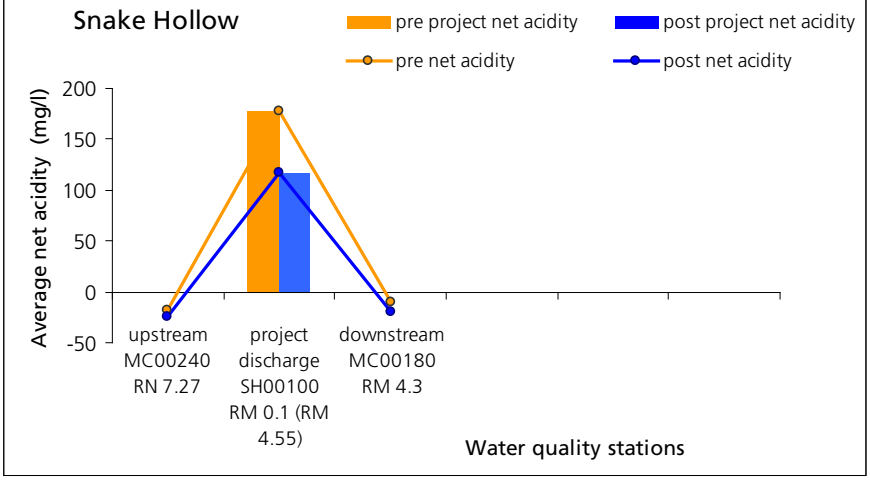
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity

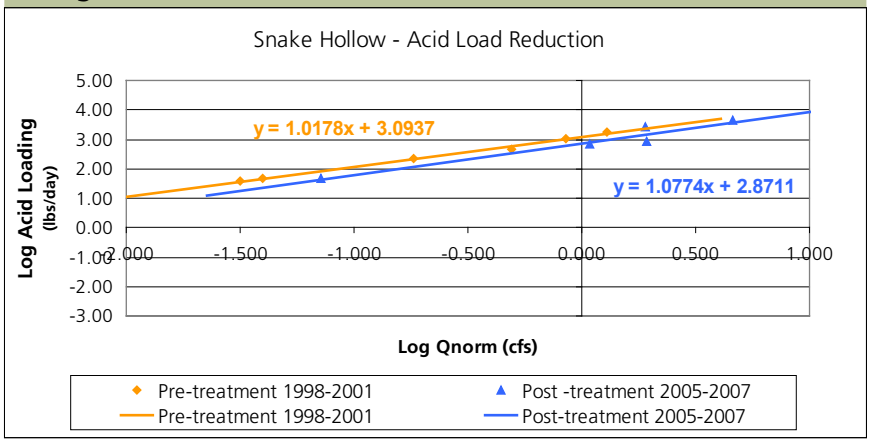



As a result of the Snake Hollow Project, pH and net acidity have improved downstream at site MC00180 approximately 0.25 miles. Pre-construction data showed pH in the range of 3.1 – 6.3 at the project discharge and downstream. After installation of the Snake Hollow Project, post-construction data shows pH in the range of 3.9 – 6.7 at the discharge and downstream. The net acidity concentration decreased 34 percent at the project discharge, which resulted in net alkaline conditions (-20.0 mg/l) on the mainstem of Monday Creek at the downstream station MC00180.

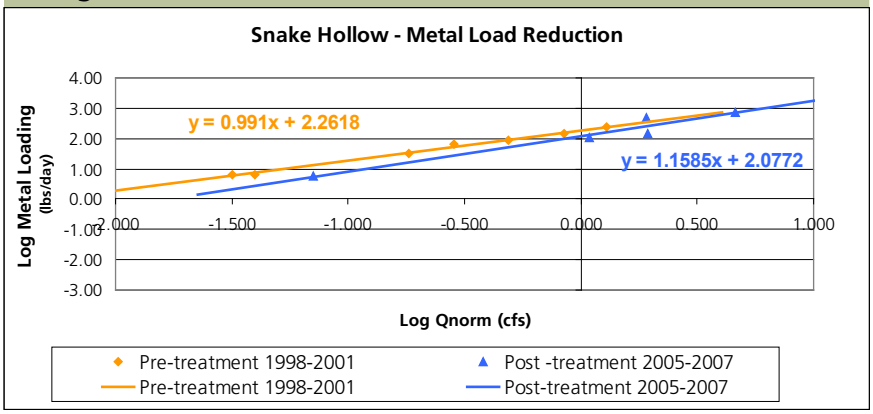
## Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004), acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre-, and post-construction at the project discharge from 2/26/1998 to 9/11/2001 for pre-construction and from 1/3/2005 to 06/30/2007 for post-construction.

### Figure 3. Acid Load Reduction




### Figure 4. Metal Load Reduction




*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

Project Status: Complete: 10/31/2006 ODNR Project Number: HC-Wr-30

## Pre-construction

*Lost Run Seep (1W2 Seep)*
*Photo by Fuller, Mossbarger, Scott, May Engineers, Inc. (FMSM)*

## Post-construction

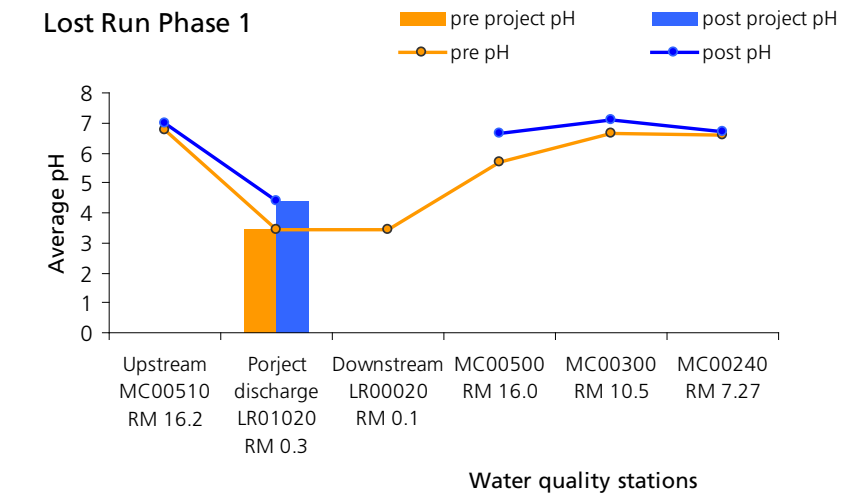
*Lost Run Open Limestone Channel (1W5)*
*Photo by Monday Creek Restoration Project*

Lost Run Phase I is located in Section 36 of Ward Township in Hocking County and lies within the 14 digit HUC unit #05030204060010. The site is located at the mouth of the first tributary to the west in the Lost Run subwatershed. Project area is less than five acres. Lost Run is a tributary to Monday Creek at river mile 16.08. The design was completed by Ohio Department of Natural Resources – Division of Mineral Resources Management ($35,000). The treatment consisted of constructing a 13,700 square foot limestone leach bed and installing 3,540 linear feet of limestone channels to treat acid mine drainage from five locations. The goal of the design was to reduce acid and metal concentrations discharging into Monday Creek. Construction was complete 10/31/2006 by Tucson Inc. for a cost of $475,000. Problems with the limestone leach bed were encountered summer of 2007. The system is scheduled for modification and repair August 2007. Water quality monitoring will resume after repairs are completed. Initial pH and acidity readings were recorded in March of 2007, further evaluation of this site will be completed next year after more data has been collected. The funding sources for this project were for the design was ODNR-DMRM and for construction was MCRP, ODNR-DMRM and Ohio EPA 319.

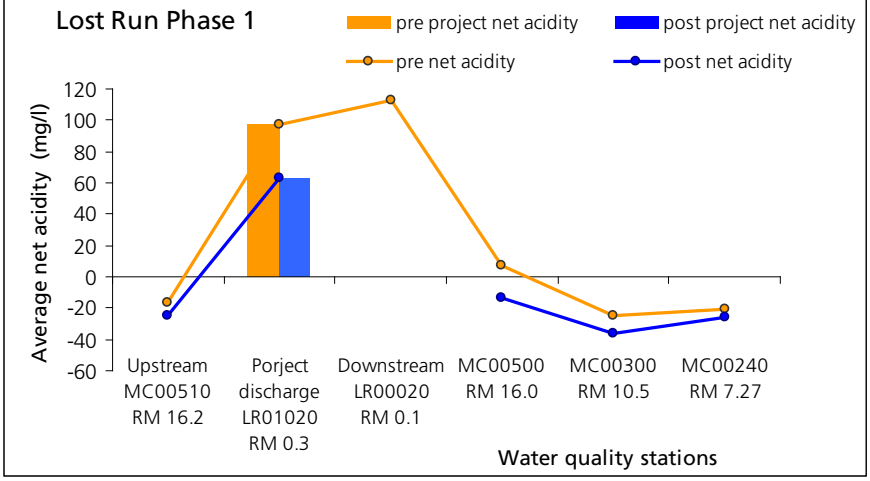
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity




As a result of the Lost Run Phase I Project, pH and net acidity have improved downstream approximately 6.0 miles. Pre-construction data shows pH in the range of 3.4 – 6.6 at the project discharge and downstream. After installation of the Lost Run Phase I Project, initial post-construction data (one sampling event) shows pH in the range of 4.4 – 7.1 at the discharge and downstream. The net acidity concentration decreased 35% at the project discharge. This project will be evaluated further next year after more post construction data has been collected to show acid and metal load reductions.

## Section III – AMD project reports

## Sunday Creek Watershed comprehensive acid mine drainage projects progress report for 2006.

*Section III contains individual AMD project reports displaying photos of the project site, a description of the project, water quality data at the site and its impact to the receiving stream, and acid/metal loading reductions as a result of the project.*

List of acid mine drainage reclamation projects reported on in the 2006 NPS monitoring report:

1. Congo Run Stream Capture (CR-15)
2. Rodger's Hollow Stream Capture
3. Pine Run Stream Capture
4. Corning Gob Floodplain

Project Status: Complete 7-9-2004 ODNR Project Number: PR-Mn-13

Pre-construction

*Stream capture at highwall*
*Photo by Bill Jonard*

Post-construction

*New channel created above old stream capture*
*Photo by Bill Jonard*

## Post-Construction Estimated Effects

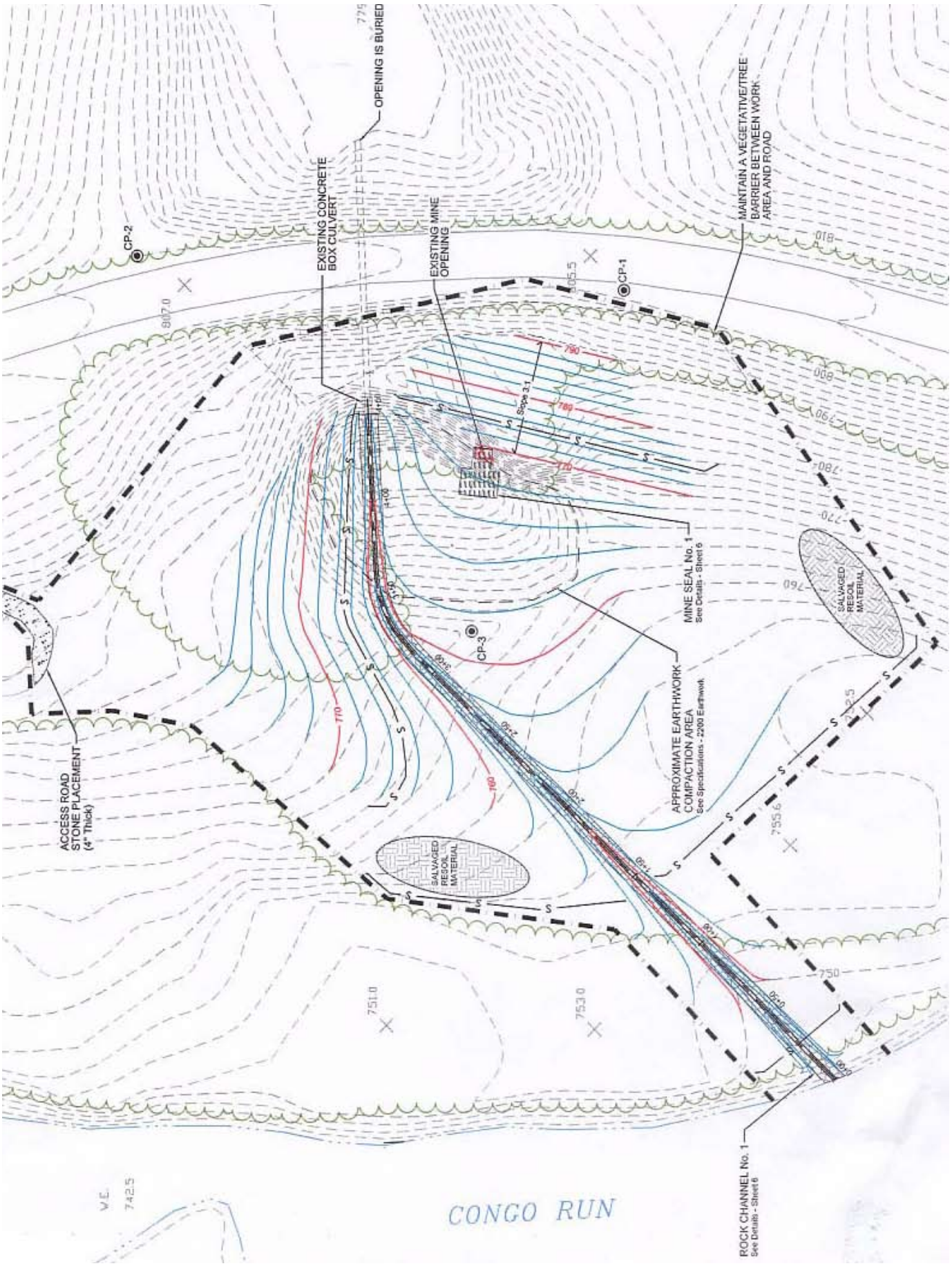
Estimated amount of water diverted from generateing acid mine drainage.

**Gallons/yr = 24,000,000**

Estimated amount of alkalinity loading added to the streams, thus providing buffering capacity to the watershed.

**Alkalinity load = 60 lbs/day**

Congo Stream Capture (CR-15) is located in Section 17 of Monroe Township in Perry County and lies within the 14-digit HUC unit #05030204070030. The site is located in Congo Run subwatershed near the town of Congo. The deep mine opening and stream capture is located east of the Congo Strip Lakes and southwest of the town of Congo. The design was completed by ODNR-DMRM. The treatment approach was to seal the mine entry at the abandoned highwall and fill in the pit to allow the stream discharge, of the 72-acre drainage area, to reach Congo Run. The goal of the design was to close the stream capture hole and return 100 percent of the stream flow to Congo Run, thus allowing clean surface water to return to Congo Run and preventing 24 million gallons/yr of water from entering the deep mine and becoming acid mine drainage at surrounding deep mines discharges. The project goal was met by 100 percent. Construction was complete July 9, 2004, by Perry Reclaiming for a cost of $35,522.60. The major responsibility of the construction company was to perform tasks outlined in the plans and specifications to eliminate the stream capture and create a channel to carry flows to Congo Run. The funding sources for this project were ODNR-DMRM for the design and OSM-ACSI for construction.


OPENING IS BURIED
EXISTING CONCRETE BOX CULVERT
EXISTING MINE OPENING
MAINTAIN A VEGETATIVE/TREE BARRIER BETWEEN WORK AREA AND ROAD
CP-2
CP-1
CP-3
MINE SEAL No. 1
See Details - Sheet 6
APPROXIMATE EARTHWORK COMPACTION AREA
See Specifications - 2200 Earthwork
SALVAGED RESOIL MATERIAL
ACCESS ROAD STONE PLACEMENT (4" Thick)
ROCK CHANNEL No. 1
See Details - Sheet 6
CONGO RUN
Slope 3:1

Project Status: Funded - expected completion 12/31/2007 ODNR Project Number: PR-Mn-16

Pre-construction

*One of Rodger's Hollow secondary stream captures under dry conditions*
*Photo by Sunday Creek Watershed Group*

Pre-construction

*One of Rodger's Hollow primary stream captures during wet conditions*
*Photo by Sunday Creek Watershed Group*

## Post-Construction Estimated Effects

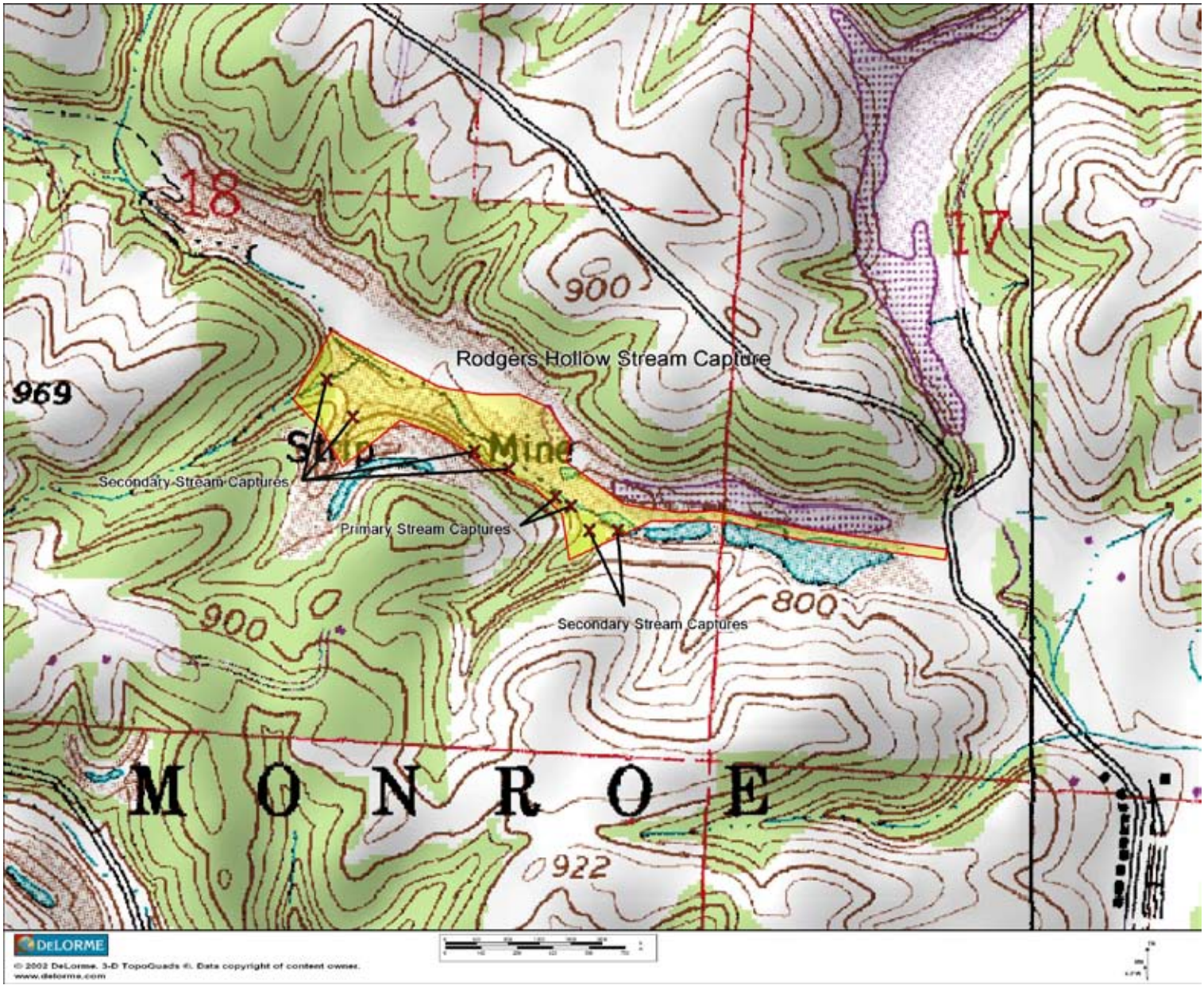
Expected amount of water to return to the stream and divert from entering the deep mine and generating acid mine drainage is:

**Gallons/yr = 63,576,000**

Expected amount of alkalinity loading added to the streams providing buffering capacity to the watershed:

**Alkalinity load = 758 lbs/day**

Rodger's Hollow Stream Capture is located in Section 17 of Monroe Township in Perry County and lies within the 14-digit HUC unit #05030204070030. The site is located in Congo Run subwatershed north of Drakes. There are two primary and four secondary stream captures. The design was completed by Fuller, Mossbarger, Scott, May Engineers, Inc. for a cost of $105,527. The treatment approach is to close primary and secondary stream captures and divert the channel using natural stream design concepts, away from the existing location, which is an unstable abandoned coal pit along a highwall. Currently 1,600 acres (2.5 square miles) of surface water drains into the deep mine complex, creating acid mine drainage at down-dip seep discharges in Drakes. The goal of the design is to return 100 percent of stream water back into Congo Run, thus adding alkalinity to Rodger's Hollow and Congo Run and reducing acid mine discharges in Drakes. (WB 35, 36, 49) Expected completion for this project is Dec. 2007. The bid process for the construction is expected winter/spring 2007. The funding source for the project design was ODNR-DMRM.


18
17
900
969
Rodgers Hollow Stream Capture
Secondary Stream Captures
Primary Stream Captures
Secondary Stream Captures
800
900
M O N R O E
922
DeLORME

Project Status: Completed- 4/30/2007 ODNR Project Number: PR-SI-15

Pre-construction

*Pine Run Subsidence under wet conditions*
*Photo by Sunday Creek Watershed Group*

Post-construction

*Pine Run newly constructed channel*
*Photo by Sunday Creek Watershed Group*

## Post-Construction Estimated Effects

Expected amount of water to return to the stream and divert from entering the deep mine and generating acid mine drainage is:

**Gallons/yr = 50,867,000**

Expected amount of alkalinity loading added to the streams thus providing buffering capacity to the watershed is:

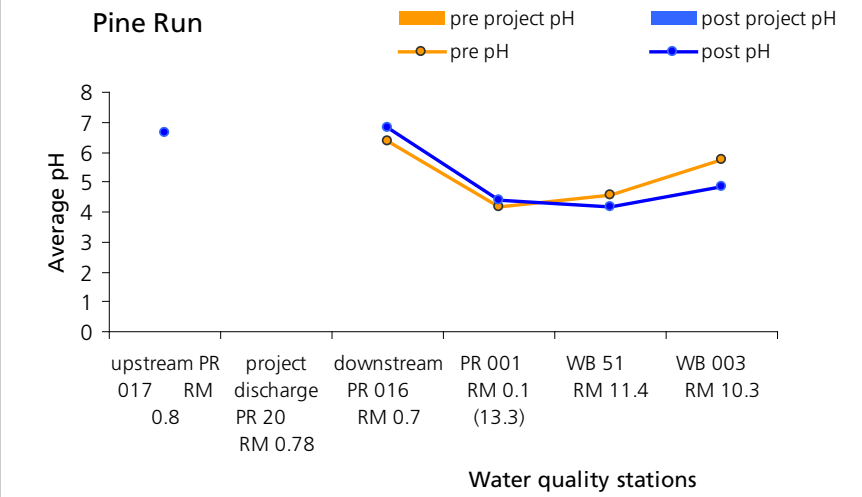
**Alkalinity load = 46 lbs/day**

Pine Run Stream Capture is located in Section 14 of Salt Lick Township in Perry County and lies within the 14-digit HUC unit #05030204070030. The site is located in Pine Run subwatershed near Sulphur Springs. There are three subsidence features at the project site. The design was completed by ODNR-DMRM for a cost of $36,544. The treatment approach is to create a natural stream channel for fresh water, divert flow into a new channel and to close stream captures and subsidence features to reduce flow into the deep mine. Currently 138 acres of surface water drains into the deep mine complex creating acid mine drainage that discharges, down-dip at mine portals and seeps. The goal of the design is to prevent stream flow into the mine complex Py-76 to reduce flow at down-dip discharges and add alkaline water into Pine Run. Major considerations for this design were to minimize impact to large trees, use a natural stream design and minimize impact on a county road. The construction for this project was completed by Maiden and Jenkins for a cost of $67,000. The major responsibility of the construction company was to close three subsidence features and create natural channel for positive drainage to Pine Run. The funding sources for this project are ODNR-DMRM for design and OEPA 319 and ODNR-DMRM for construction.

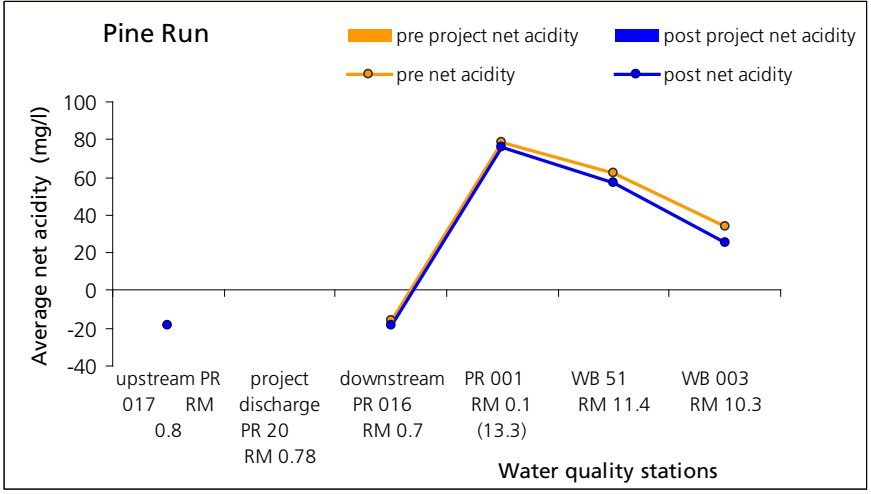
## Water quality report

Water quality data was collected at multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the main-stem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

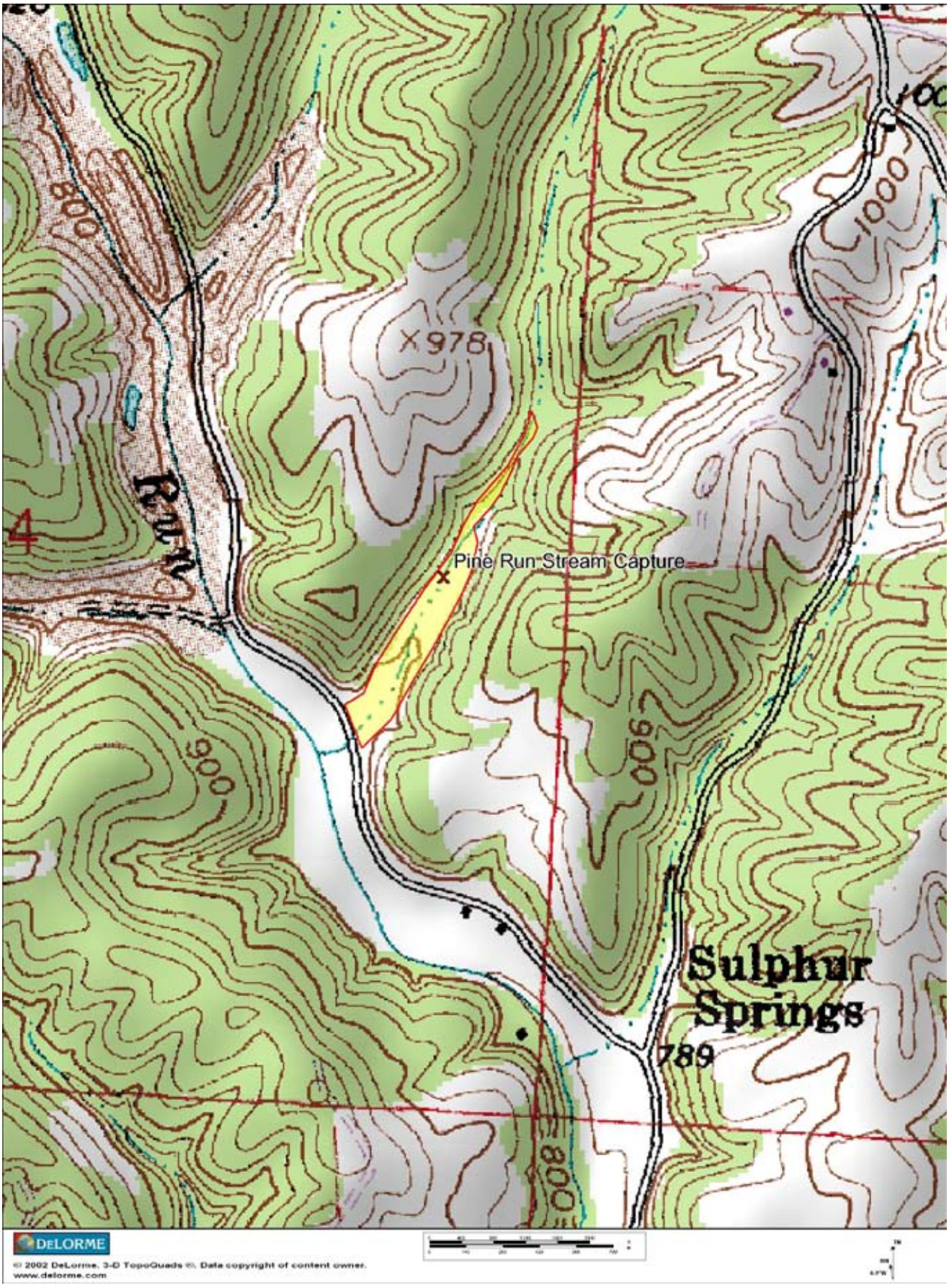
### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity




As a result of the Pine Run stream capture project, an estimated 50,867,000 gallons/year will be diverted into Pine Run and not into the deep mine Py-76. A slight increase in pH and alkalinity have been measured downstream of the project tributary. Pre-construction data shows pH in the range of 4.16 – 6.4 downstream of the project. After closure of the subsidence holes and returning water in Pine Run, initial post-construction data (one sampling event) shows pH in the range of 4.4 – 7.8 down-stream of the project. This success of this project will be evaluated further next year at down-dip mine seep PR 003. This seep is thought to be linked to the py-76 mine complex, a decrease in volume and, possibly, acidity is expected.


Pine Run Stream Capture
Sulphur Springs
789
978
800
900
1000
DeLORME
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www.delorme.com

Project Status: Funded expected completion 12/31/2007 ODNR Project Number: PR-Mn-12

Pre-construction

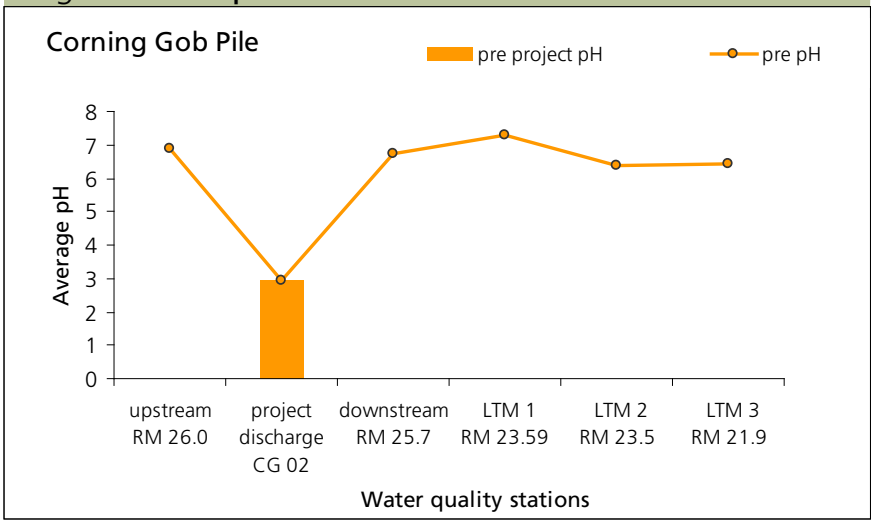
*Coal Refuse along stream bank*
*Photo by Bill Jonard*

Corning Gob Pile is located in Section 4 of Pleasant Township in Perry County and lies within the 14 digit HUC unit #05030304070010. The project site is 5 acres and is located in the Headwaters of Sunday Creek north of Rendville. Project discharge was measured at the pond discharge from coal refuse area. The design will be completed by ODNR-DMRM. The treatment approach for this site is to remove all coal refuse located in the floodplain and along the stream bank of Sunday Creek. The major consideration for this project will be to not impact the stream configuration, re-establish a floodplain, move refuse to higher elevation and cover with soil to reduce contact with air and water. The goal of the design is to reduce metal loadings from headwaters of Sunday Creek. The project goal will be evaluated after completion. Construction is expected to be completed December 31, 2007. Funding for this project will be ODNR-DMRM in house design in conjunction with Federal AML Program site and Ohio EPA 319 for construction.

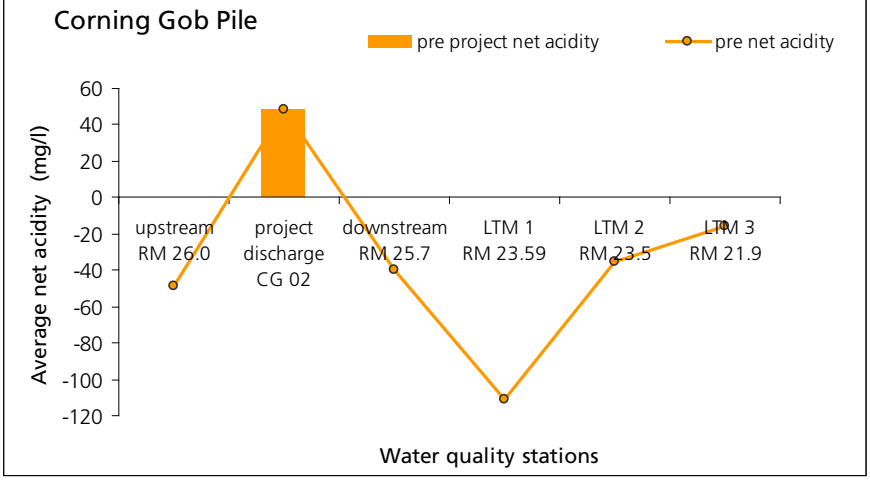
## Water quality report

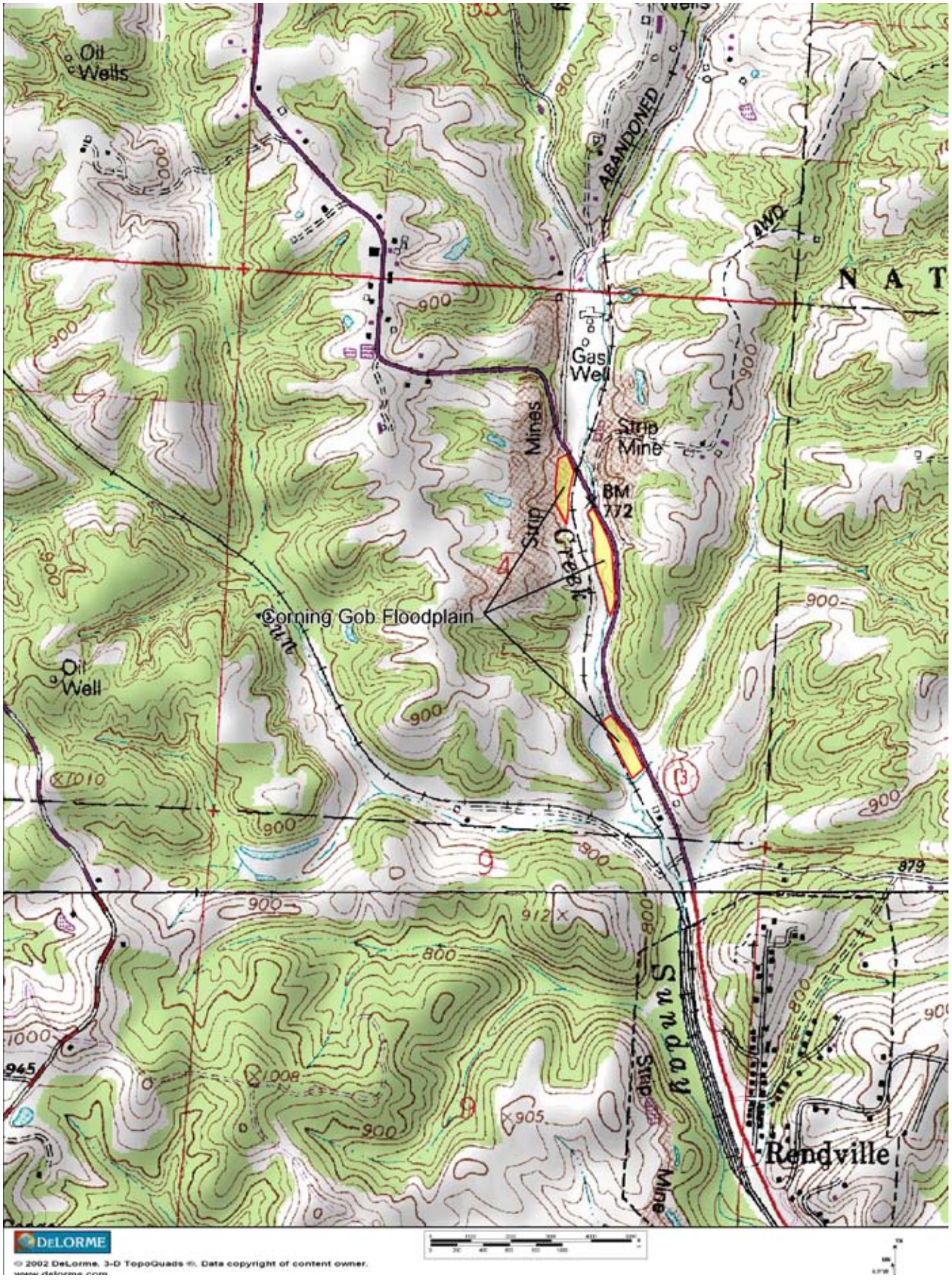
Water quality data was collected at the project discharge as well as multiple stations downstream pre- construction. The graphs below show pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream downstream of the project discharge.

### Figure 1. Pre pH




### Figure 2. Pre Acidity




Oil Wells
ABANDONED
4WD
Gas Well
Strip Mines
Strip Mine
BM 772
Strip Creek
Corning Gob Floodplain
Oil Well
Sunday
Strip Mine
Rendville
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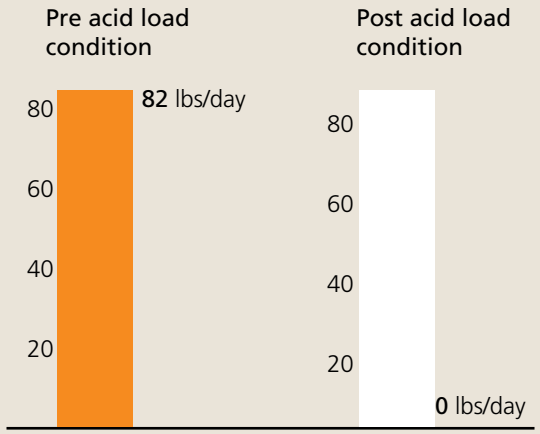
## Section III – AMD project reports

### Huff Run Watershed comprehensive acid mine drainage projects progress report for 2006.

*Section III for the Huff Run Watershed contains one comprehensive reports listing completed and funded AMD projects; displaying photos of the project site, a description of the project, water quality data change at the mouth of Huff Run (station HRR08/HR 32) and the impact of all the reclamation projects from the period 1976-1997 for pre-construction to 1997-2006 for post construction. Acidity and pH graphs have been generated for Farr, Acid Pit #1, and Lyons using available data.*

List of acid mine drainage reclamation projects reported on in the 2006 NPS monitoring report:

1. Huff Run AML project
2. Farr project
3. Linden Bioremediation project
4. Acid Pit #1 (Phase I ) project
5. Lindentree project
6. Harsha North project
7. Lyons project
8. Fern-Hill HR-42 project
9. Belden project
10. Thomas project
11. Mineral Zoar Road AMD project




*Data derived using the Mean Annual Load Method (Stoertz, 2004).*

*Mouth of Huff Run used for these numbers*
*Graph based on 2005 data*

Huff Run is located in Sandy Township in Tuscarawas County and Rose Township in Carroll County. The watershed has a 14 square mile drainage area and flows ten miles long before discharging into Conotton Creek. The completed projects in Huff Run are evaluated collectively at the mouth of Huff Run (Station HRR08/HR 32). Since 1999 seven projects have been completed and are shown on the following pages. The designs and construction were completed by a variety of companies. The funding sources for these projects for both design and construction was ODNR-DMRM, Ohio EPA 319, and OSM Clean Streams. Figure 3 and 4, estimate approximately 82 lbs/day of acid and 0 lbs/day of metals were reduced from entering Huff Run as a result of these AMD reclamation projects.

**List of construction projects completed since 1999:**

1. Huff Run AML 1999
2. Farr 2003
3. Linden Bioremediation 2003
4. Acid Pit #1 2004
5. Lindentree 2005
6. Lyons 2005
7. Harsha North 2006

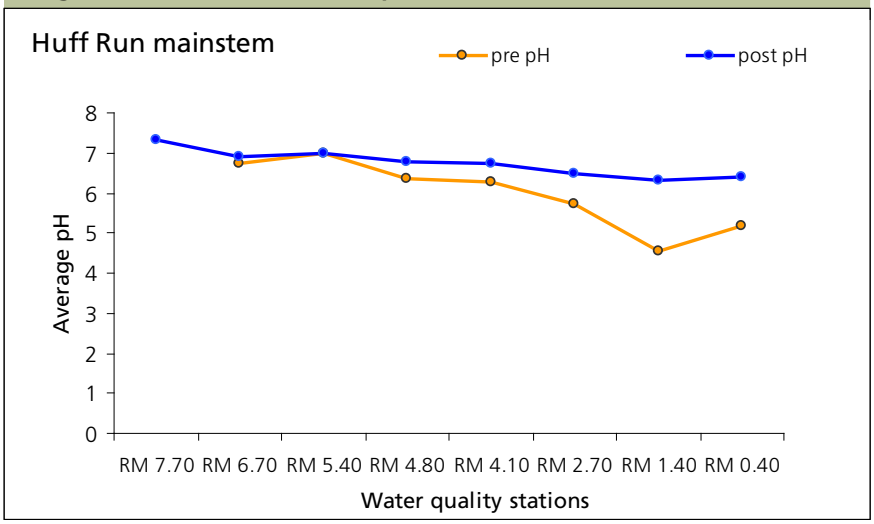
**List of funded projects to be complete within the next two years:**

1. Thomas
2. Belden
3. Fern Hill HR-42
4. Mineral Zoar

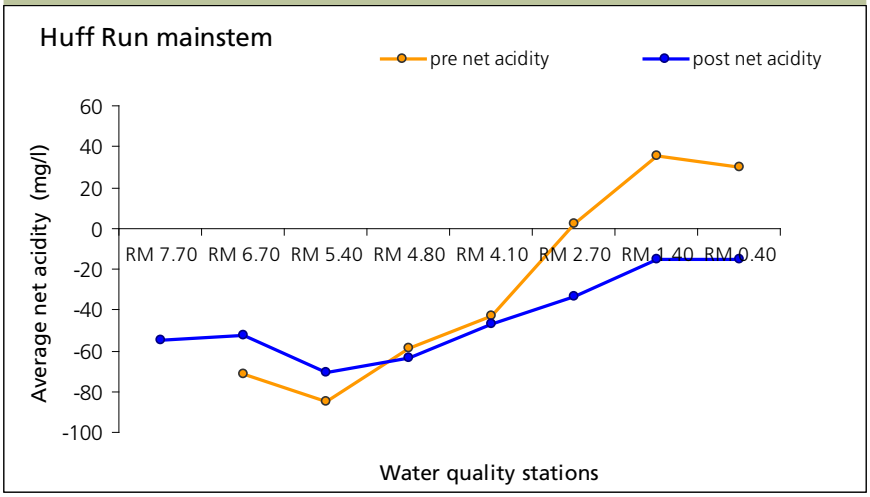
## Water quality report

Water quality data was collected along the mainstem at long-term monitoring stations during pre- and post- construction conditions. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of Huff Run. Changes between the pre- and post- conditions are attributed to the completed AMD reclamation projects. Graphs based on 2005 data.

### Figure 1. Pre and Post pH



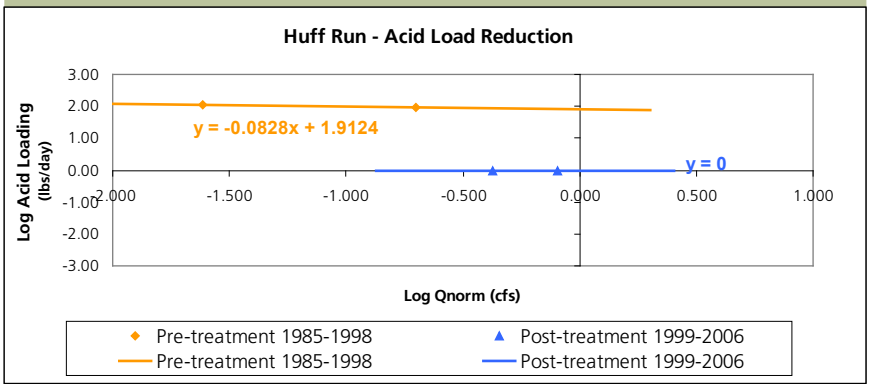

### Figure 2. Pre and Post Acidity



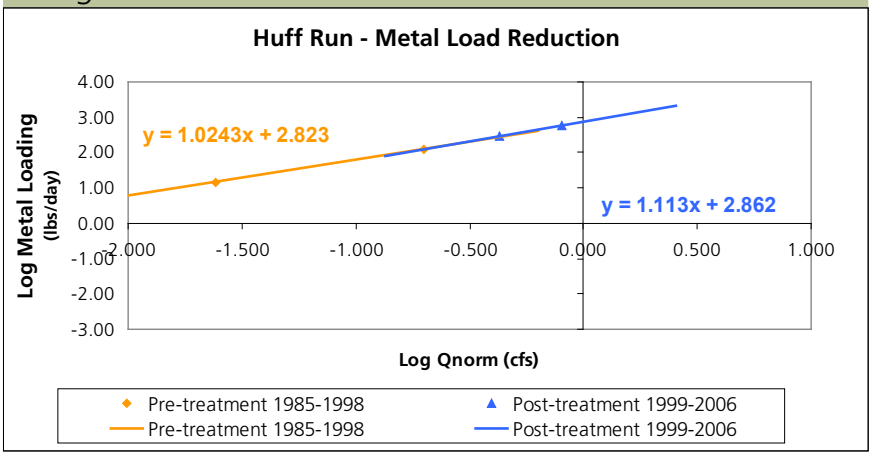

As a result of these projects completed in Huff Run Watershed, the pH and net acidity as improved downstream of the reclamation sites for 5 miles to the mouth. Pre-construction data shows pH in the range of 4.5 – 7.0 along the mainstem. However after the completion of seven major AMD reclamation projects, post-construction data shows pH in the range of 6.3 – 7.3. The net acidity concentrations decreased resulting in net alkaline conditions the entire length of Huff Run, 10 miles.

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum and discharge were measured pre- and post-construction at the project discharge from 1985 to 1998 for pre-construction and from 1999 – 2006 for post-construction. Graphs based on 2005 data.

## Figure 3. Acid Load Reduction




## Figure 4. Metal Load Reduction




*Stoertz, Mary W. and Douglas H. Green, 2004. Mean Annual Acidity Load: A Performance Measure to Evaluate Acid Mine Drainage Remediation. Ohio Department of Natural Resources Conservation and Restoration Innovations 2004 Applied Research Conference at Ohio University.*

## Pre-construction

The Huff Run AML Reclamation Project was the first major project in the watershed. It was completed in 1998 to reduce sedimentation and acid loading from a large, unreclaimed surface mine. The project involved the resoiling and revegetation of over 60 acres, 109,000 cubic yards of earthwork, 1600 linear feet of stream reconstruction and removal of an AMD impoundment. This project was in Mineral City, in the area of the American Legion Hall.

Project Status: Complete 2003 Project Number: TS-SN-06 and TS-SN-20

## Pre-construction

*Farr AMD discharge pre-construction*
*Photo by Huff Run Watershed*

## Post-construction

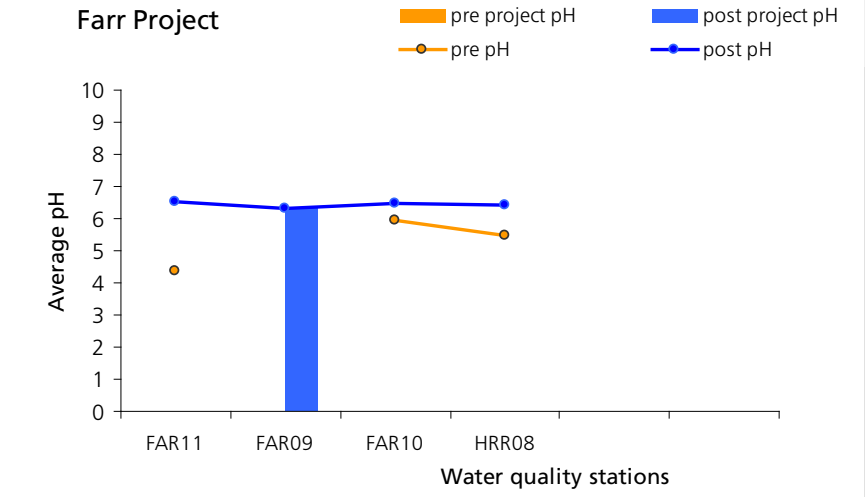
*View from finishing cells looking upstream*
*Photo by Douglas Leed*

Farr Project is located in Sandy Township in Tuscarawas County. The site is located at the open limestone channel before entering the Huff Run. The Acid Pit #1 discharges into Huff Run at river mile 1.0. The design was completed by Gannett Flemming for $30,976. The treatment approach was to passively treat deep mine discharge with a anoxic limestone system. The treatment consisted of installing 500 linear feet of limestone channels, a 10,000 cubic foot anoxic limestone drain, a 0.5 acre wetland and complete 1.2 acres of surface reclamation. The goal of the design was to reduce high metals from deep mine discharge to mainstem of Huff Run. Construction was complete may 2003 by Tucson Inc. for a cost of $150,000. Problems with the construction were unexpected high flows versus design flow of system, inadequate retention in system, continue high metal output, limited space for reconstruction or improvements. The funding sources for this project were for the design was ODNR-DMRM and for construction was OSM Clean Steams, ODNR/MRM and Ohio EPA.

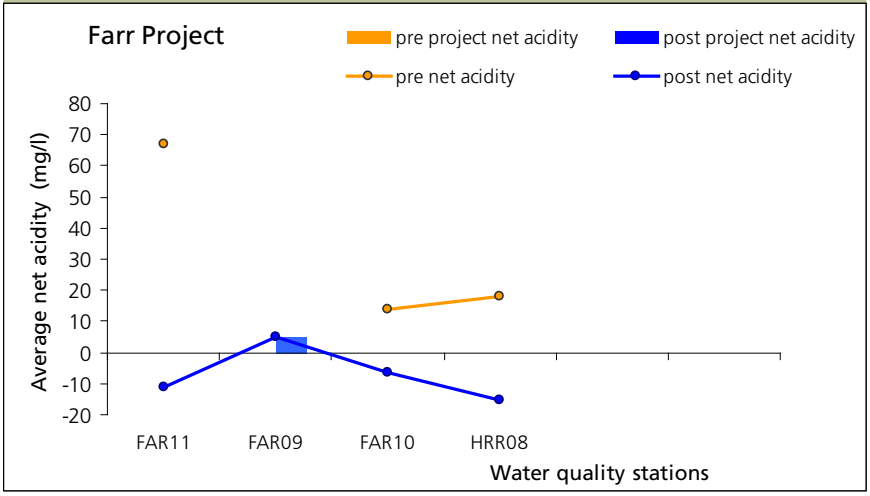
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity




As a result of the Farr Project, pH and net acidity have slightly improved downstream approximately 1.0 mile. Pre-construction data shows pH at 5.97 downstream the project discharge. After installation of the Farr Project, post-construction data shows pH 6.47 downstream the project discharge. The net acidity concentration decreased 100% downstream the project discharge at site FAR10 on Huff Run.

## Pre-construction

*Farr AMD discharge pre-construction*
*Photo by Huff Run Watershed*

## Post-construction

*Huff Run Awareness Day 2003*
*Photo by Huff Run Watershed*

Treatment Approach: Mine drainage passes sequentially through a flow control system, a wetland, to reduce metals concentrations and provide microbial nutrients, and finally through an inoculated Pyrolusite limestone treatment bed and/or attendant discharge structures and diversion ditches,before being discharged to the receiving stream.

Design: Allegheny Mineral Abatement Company

Cost:

Construction: Tucson, Inc.

Cost:$321,619

Funding Source:

Project Status: Complete 2004 Project Number: TS-SN-28

Pre-construction

Post-construction

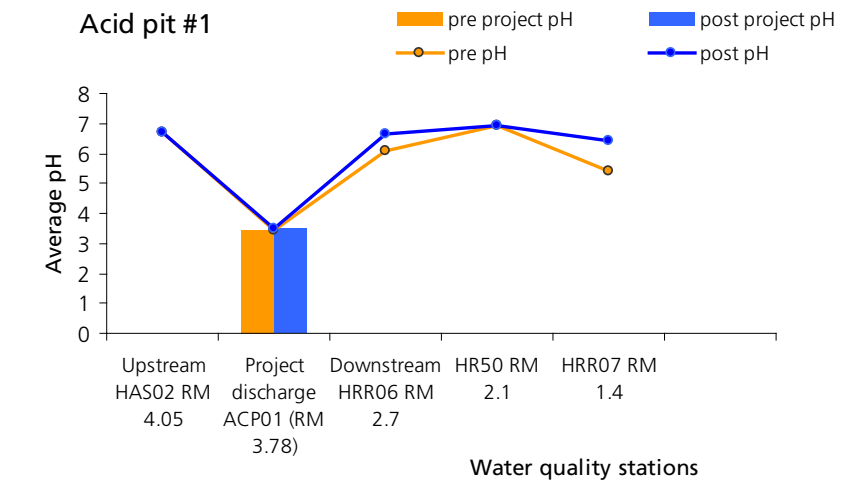
*Acid pit completed project*
*Photo by Jim Gue*

Acid Pit #1is located in Rose and Sandy Township in Tuscarawas County. The site is located at the effluent from Acid Pit #1. The Acid Pit #1 discharges into Huff Run at river mile 3.78. The design was completed by Ohio Department of Natural Resources – Division of Mineral Resources Management. The treatment approach was to eliminate the acid-filled impoundments, reclaims the mine spoil, eliminate the recharge through the spoil and provide positive drainage. The treatment consisted of installing 2000 linear feet of limestone channels and to reclaim 15 acres of gob pile. The goal of the design was eliminate collection and recharge of extremely acid water through spoil material and to main stem Huff Run. Construction was complete March 2004 by Tucson Inc. for a cost of $150,000. Problems with the construction were no solid base (underclay) to effectively place underdrains for subsurface collection of mine drainage flows. The funding sources for this project were for the design was ODNR-DMRM and for construction was OSM Clean Steams, ODNR/MRM.

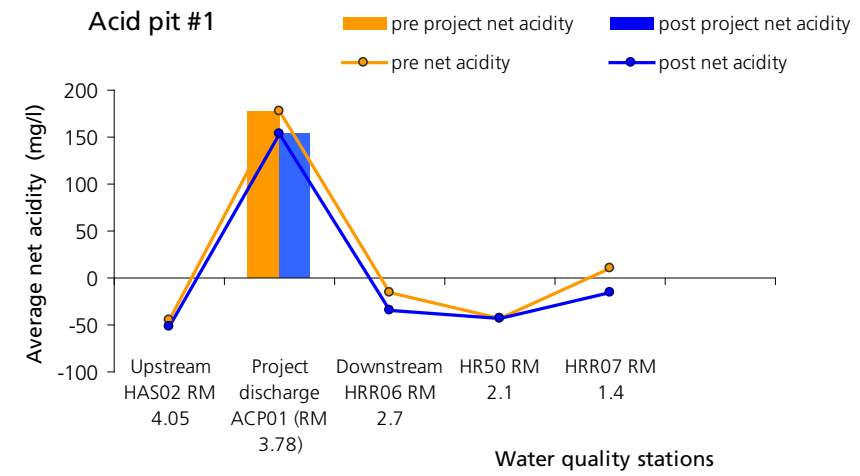
## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

### Figure 1. Pre and Post pH




### Figure 2. Pre and Post Acidity




As a result of the Acid pit #1 Project, pH and net acidity have slightly improved downstream approximately 2.4 miles. Pre-construction data shows pH in the range of 3.46 – 5.43 at the project discharge and downstream. After installation of the Acid Pit #1Project, post-construction data shows pH in the range of 3.5 – 6.4 at the discharge and downstream. The net acidity concentration decreased 13% at the project discharge. This project needs discharge measurements to show acid and metal load reductions.

Project Status: Complete 2005 Project Number:

## Pre-construction

*One of four acidic ponds on project site*
*Photo by Jim Gue*

## Post-construction

*Lindentree reclamation area*
*Photo by Maureen Wise*

Treatment Approach: The restoration project regraded and revegetated the area along with filling in acid pits and using mill slag and limestone channels to raise alkalinity. A wetland originally on the project site is still used for filtration of heavy metals. (www.huffrun.org)

Design: MRM in-house & OSM design

Cost: $60,239.50

Construction: Monarelli

Cost:$210,000

Funding Source: ODNR-DMRM and Ohio EPA 319

## Pre-construction

Access road facing west with new limestone channels
Photo by Maureen Wise

## Post-construction

Harsha North spoil and gob pile
Photo by Jim Gue

Treatment Approach: Eartwork started Summer 2006 to reclaim the project site. The site is primarily toxic coal refuse piles and highwalls along with areas affected by deep mine entries, deep mine drainage and unreclaimed contour surface mines.(www.huffrun.org)

Design: ATC Associates

Cost: $106,909.00

Construction: Tuscon

Cost: $686,186

Funding Source: ODNR-DMRM, Ohio EPA 319, and OSM Clean Streams

## Pre-construction

*Overview of gob on the project site*
*Photo by Brent Miller*

## Post-construction

*After construction major outlet*
*Photo by Jim Gue*

Lyons is located in Sandy Township in Tuscarawas County. The project site is 35 acres. Lyons discharges into Huff Run at river mile 1.90. The design was completed by ATC Associates for $53,335. The treatment approach was to reclaim eroding mine spoils, eliminate acid impoundment, install alkaline recharge with steel slag berms and open limestone channels. The treatment consisted of installing 3000 linear feet of limestone channels and 1500 linear feet of steel slag channel and reclaim a 15 acre of gob pile and 5 acres of surface reclamation. The goal of the design was to eliminate eroding acid spoils and impoundments, generate alkalinity to deep mine pools and decrease AMD discharges and neutralize acidic discharges prior to main stem. Construction was complete December 2005 Malcuit for a cost of $794,030. Problems with the construction were placement of underdrain tiles to effectively collect subsurface flows to constructed OLC/steel slag channels. The funding sources for this project were Ohio EPA and ODNR/MRM.

## Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre and post construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the mainstem of the receiving stream upstream and downstream of the project discharge as a result of the AMD reclamation project.

Figure 1. **Pre and Post pH**

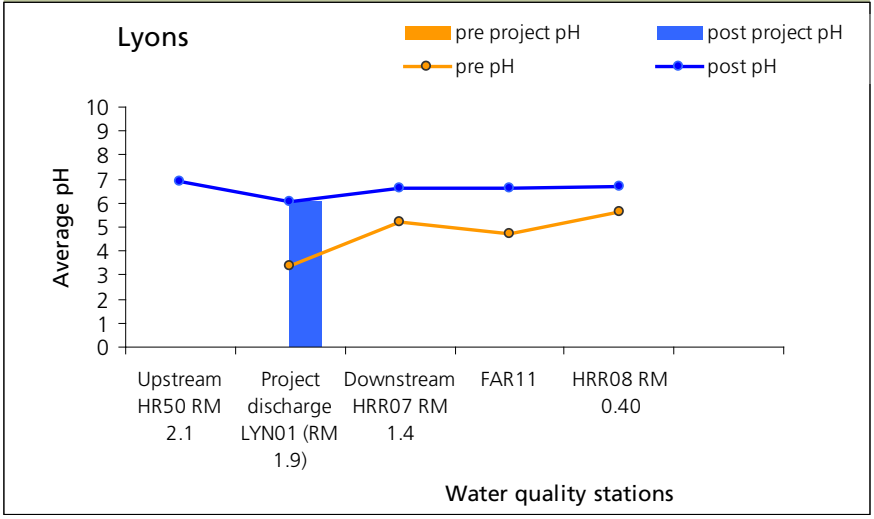
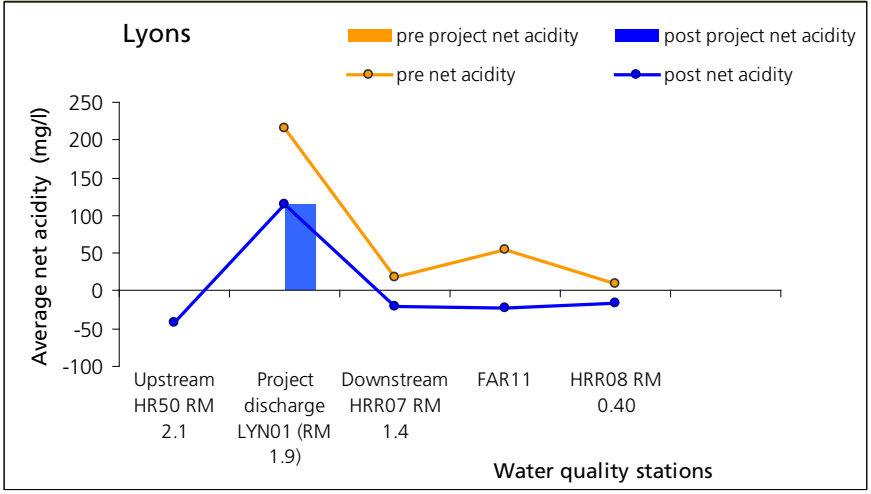



Figure 2. **Pre and Post Acidity**




As a result of the Lyons Project, pH and net acidity have improved downstream approximately 1.5 miles. Pre-construction data shows pH in the range of 3.39 – 5.63 at the project discharge and downstream. After installation of the Lyons Project, post-construction data shows pH in the range of 6.1 – 6.7 at the discharge and downstream. The net acidity concentration decreased 47% at the project discharge. This project needs discharge measurements to show acid and metal load reductions.

Project Status: - Funded

## Pre-construction

*AMD plume*
*Photo by Maureen Wise*

Treatment Approach: HR-42 consists of a few acid pits and a large AMD plume that sits directly beside Huff Run itself and dumps severe amounts of AMD directly into the stream.

Design: Baker Consulting and ODNR-DMRM

Costs:$

Funding Source: OSM Clean Stream and ODNR-DMRM

Project Status: Funded

## Pre-construction

*Gob pile with impounded acidic water*
*Photo by Huff Run Watershed*

Treatment Approach: The Army Corps of Engineers plan includes reclamation of mine spoil and related land as well as a passive treatment system to treat the remaining seeps with a successive alkaline producing system (verticle flow wetlands). (www.huffrun.org)

Design: ODNR-DMRM

Expected construction costs: $700,000

Funding Source: US EPA Targeted Watershed Grant and ODNR-DMRM

Project Status: Funded Project Number: CR-Rs-08

## Pre-construction

*Southern area with large beaver ponds*
*Photo by Maureen Wise*

Project number: CR-Rs-08
Treatment Approach: The site is composed of approximately twenty acres of surface mine water impoundments and toxic mine spoil. The impoundments are recharging a shallow deep mine, allowing for large contributions of metals and acidity to Huff Run. Plans for restoration include a limestone channel for drainage and erosion control plus regrading and revegetation of the spoils and pits. (www.huffrun.org)

Design: ODNR-DMRM

Costs:$275,000

Funding Source: Ohio EPA and ODNR-DMRM

Project Status: Funded Project Number:

The Mineral City Park/Mineral-Zoar Road will take place in the summer of 2006. The reclamation will include a wetland and limestone system that will not only fix AMD problems but also help with flooding in the direct vicinity. This project is located in Mineral City. An Office of Surface Mining grant will fund the construction.