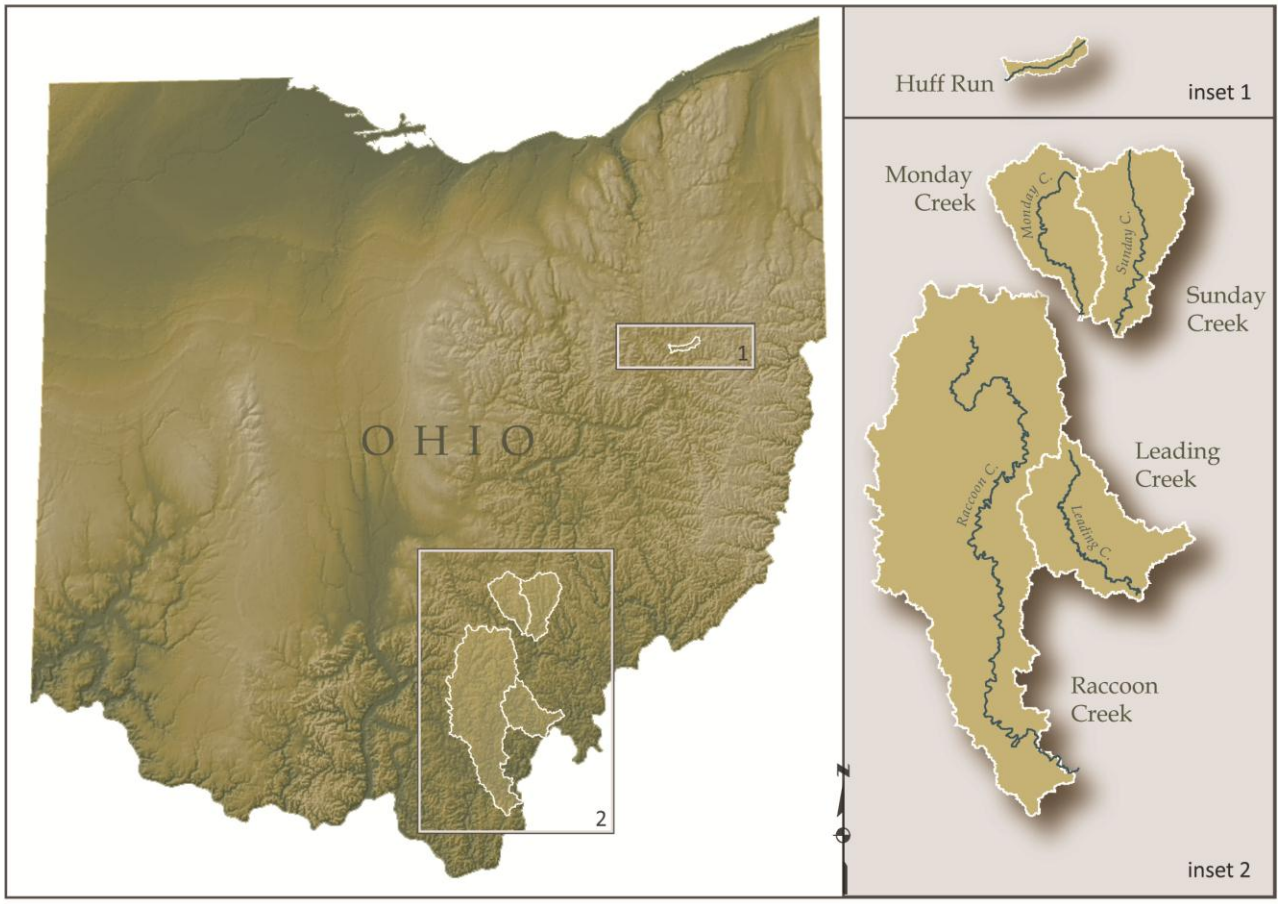
2011 Nonpoint Source (NPS) Monitoring Project
for
Acid Mine Drainage

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



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Jennifer Bowman
8-24-12

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Section IV – NPS entry form report 2011
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 under the 'Reports Tab'.

Acknowledgements

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

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Abstract

The Voinovich School of Leadership and Public Affairs at Ohio University created an evaluation system to track changes in chemical and biological data for the following watersheds: Monday Creek, Sunday Creek, Raccoon Creek, Huff Run and Leading Creek. The annual monitoring and reporting system was developed for the Ohio Department of Natural Resources Division of Mineral Resources Management (ODNR-DMRM) in 2005 to track progress towards the targets of the state's 2005 Non Point Source (NPS) management plan for acid mine drainage (AMD) on an annual basis. The state's Nonpoint Source Management plan is no longer active. However, the ODNR-DMRM is still interested in tracking chemical and biological changes in the watersheds where active AMD abatement and treatment reclamation is being planned and being implemented.

The NPS annual reporting website (www.watersheddata.com) integrates water quality and biology data from watershed groups' online ArcIMS database with project status details including: maps, graphs, charts, photos, and printable reports to address the progress with respect to AMD treatment and reclamation. Water-quality and biological 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 were evaluated during 1994-2001 and are considered the baseline conditions, 341 stream miles were impacted at that time. Each year the number of stream miles surveyed that suggest they are meeting Warmwater Habitat WWH) based on their fish and macroinvertebrate index scores are recorded. As of 2010, 47 stream miles of the 175 miles assessed suggest they meet full attainment of the Warmwater Habitat Status. In addition to tracking the number of stream miles meeting their fish and macroinvertebrate target levels, incremental water-quality changes are also tracked, pH values show 168 miles of stream improved from not meeting the pH 6.5 water quality standard during the baseline time period to meeting in 2011.

Acidity, pH, and macroinvertebrates were evaluated annually from 2006-2011. Incremental changes from year to year can be tracked using these indicators. Net acidity and pH values have improved from

2006 to 2011. Values of pH show 159 miles of stream met the pH 6.5 water quality target in 2006, 114 miles in 2007, 130 miles in 2008, 162 miles in 2009, 169 in 2010, and 168 in 2011 (Figure 1). The family-level biological indicator, Macroinvertebrate Aggregated Index for Streams (MAIS), were measured annually from 2006 to 2011, there have been slight fluctuations seen within each watershed. Over the past six years the most notable improvements are seen in Little Raccoon Creek and Monday Creek mainstem. There has been a steady improvement in the biological community that correlates to the improvements in water quality.

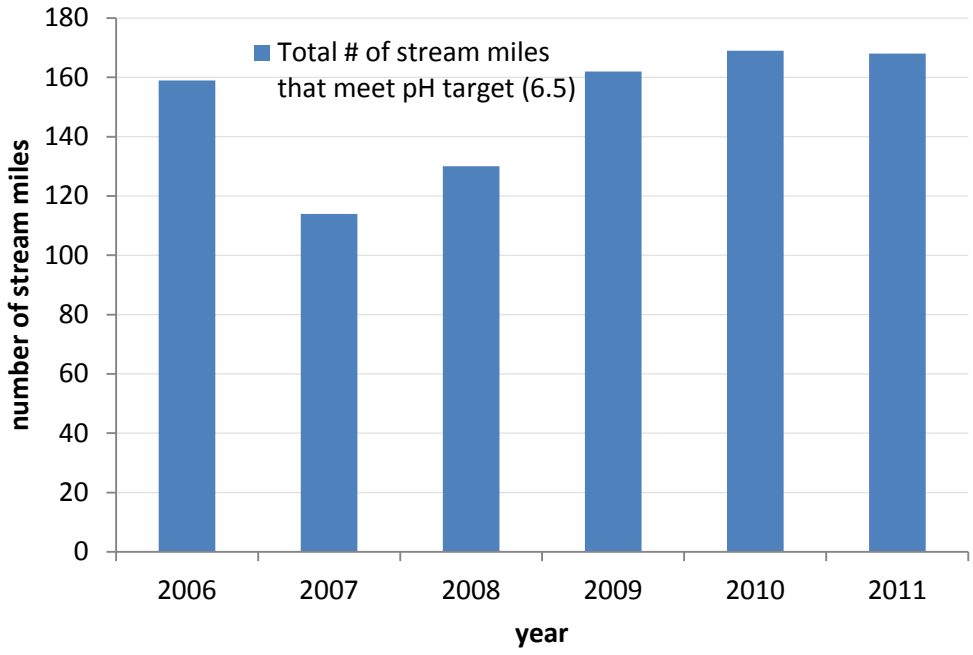


Figure 1. Total number of stream miles that meet the pH target of 6.5 in Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run through time (on average 203 stream miles monitored).

Introduction

The Nonpoint Source (NPS) Monitoring Project was created by the Voinovich School of Leadership and Public Affairs at Ohio University in 2005 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. This plan is no longer active, however the ODNR-DMRM, watershed partners, and university researchers continue monitor the effects of acid mine drainage and reclamation in the region. This report reflects the works of this partnership at the federal, state, and local level working together to improve water quality in the Appalachian coal region of Ohio.

As a result of the NPS Monitoring Project, an on-line reporting system, www.watersheddata.com, has been created to track environmental changes in five watersheds: Raccoon Creek, Monday Creek, Sunday Creek, Huff Run and Leading Creek. These five 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 monitor the changes in water quality as a result of AMD reclamation. The website provides a repository of information related to acid mine drainage reclamation and water quality including reports of: AMD reclamation projects and watersheds water quality trends. All water quality data can be viewed, entered, edited, mapped and downloaded for each watershed.

Reports

The NPS monitoring reporting system (www.watersheddata.com) provides four levels of reports: Section I, reports on progress toward the overall goals to improve the greatest number of miles of streams, Section II, provides a comprehensive watershed level report showing accumulative chemical and biological effects from abandoned mining reclamation, Section III, lists a summary report of each individual acid mine drainage reclamation project detailing project specifics (i.e. load reductions, costs, etc…), and Section IV, shows the AMD project form report showing the raw data collected from watershed groups from the ArcIMS database on the website using the NPS entry form report for 2011.

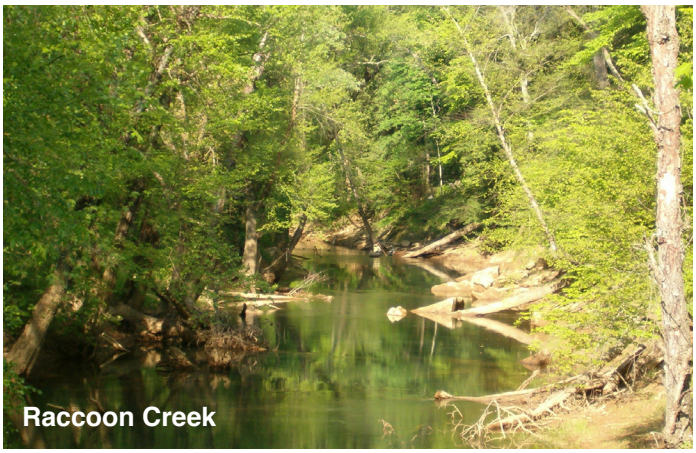
Section I – Overall progress of AMD reclamation

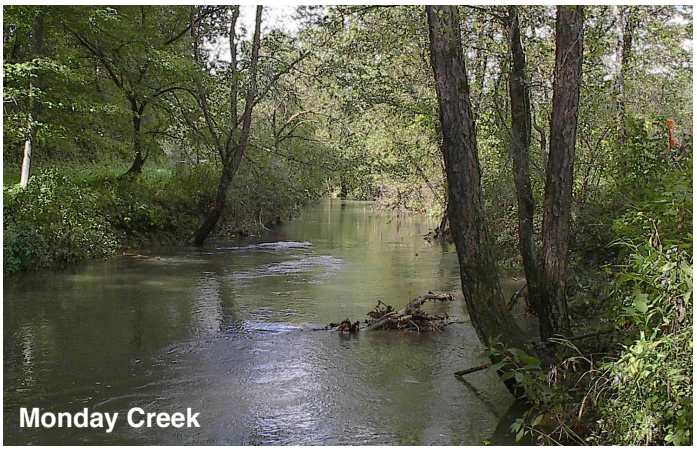
Section I contains an evaluation of four watersheds: Raccoon Creek, Monday Creek, Sunday Creek and Huff Run

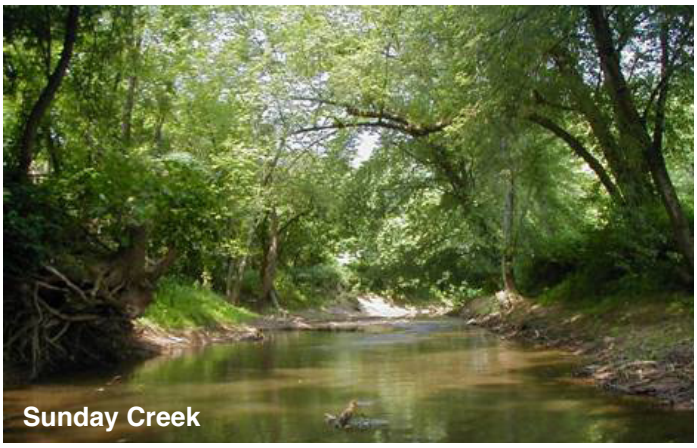
To track the overall progress of acid mine drainage reclamation efforts, the following activities were conducted. Baseline condition for water quality and biology were established for four watersheds where active reclamation projects are occurring; Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run. Leading Creek is planning its first reclamation project, scheduled to be complete in 2012. Data collected throughout the Leading Creek watershed will be integrated into this report as water quality changes are monitored and documented. 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 streams that are impacted by abandoned mining. Of the 763 named streams in these four watersheds, 569 miles were assessed during the baseline period (1994-2001) and was determined that 341 miles are impacted by abandoned mining practices.

Over the past seven years, pH along the mainstems and major tributaries of each watershed has been monitored quarterly to twice a year. The average pH values were compared through time to the state target for pH of greater than 6.5. In 2011, 168 of the 203 miles monitored met this target, which is approximately 83% of the total miles monitored.


Huff Run


Raccoon Creek


Monday Creek


Sunday Creek

To track the overall health of Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run, the watersheds where acid mine drainage reclamation is active, chemical data were collected annually since 2005. Biological data are collected annually for family–level macroinvertebates (MAIS) and every 3-5 years for fish (IBI). Baseline conditions were established during the time period of 1997-2001 with historic data. In 2005, 175 stream miles were evaluated and compared to the baseline data for IBI. Comparing the same stream segments from baseline to 2005, from a biologists' perspective, (these changes are not official use attainment status changes made by the Ohio EPA) 23.3 stream miles improved to suggest WWH use attainment. During 2010 fish and macroinvertebate data suggest a total of 47 miles of stream meet the use attainment for WWH, with 51 stream miles evaluated for both family-level macroinvertebrates (MAIS) and fish (IBI). Individually, over 158 miles were evaluated for MAIS and 54 miles for IBI. This data was collected to compare these indices to the biological health targets of 12 for MAIS and IBI scores of 44/40 for wadable/boatable streams. Stream miles that improved in biological health from baseline 2005 are shown in Figure 2. Figures 3 and 4 show 18.4 miles were improved in the Raccoon Creek watershed and 5.3 miles improved in West Branch of Sunday Creek from 2005 to 2010.

Other significant incremental water changes are also tracked and described in this report; for example, 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.

Another measure of success is to look at the fish community changes over time in a watershed (Figure 5 & 6). These statistical changes show improving fish communities in Raccoon and Little Raccoon Creeks.

Figure 2: Biological health improvements in Raccoon Creek from baseline (1997) to 2005.

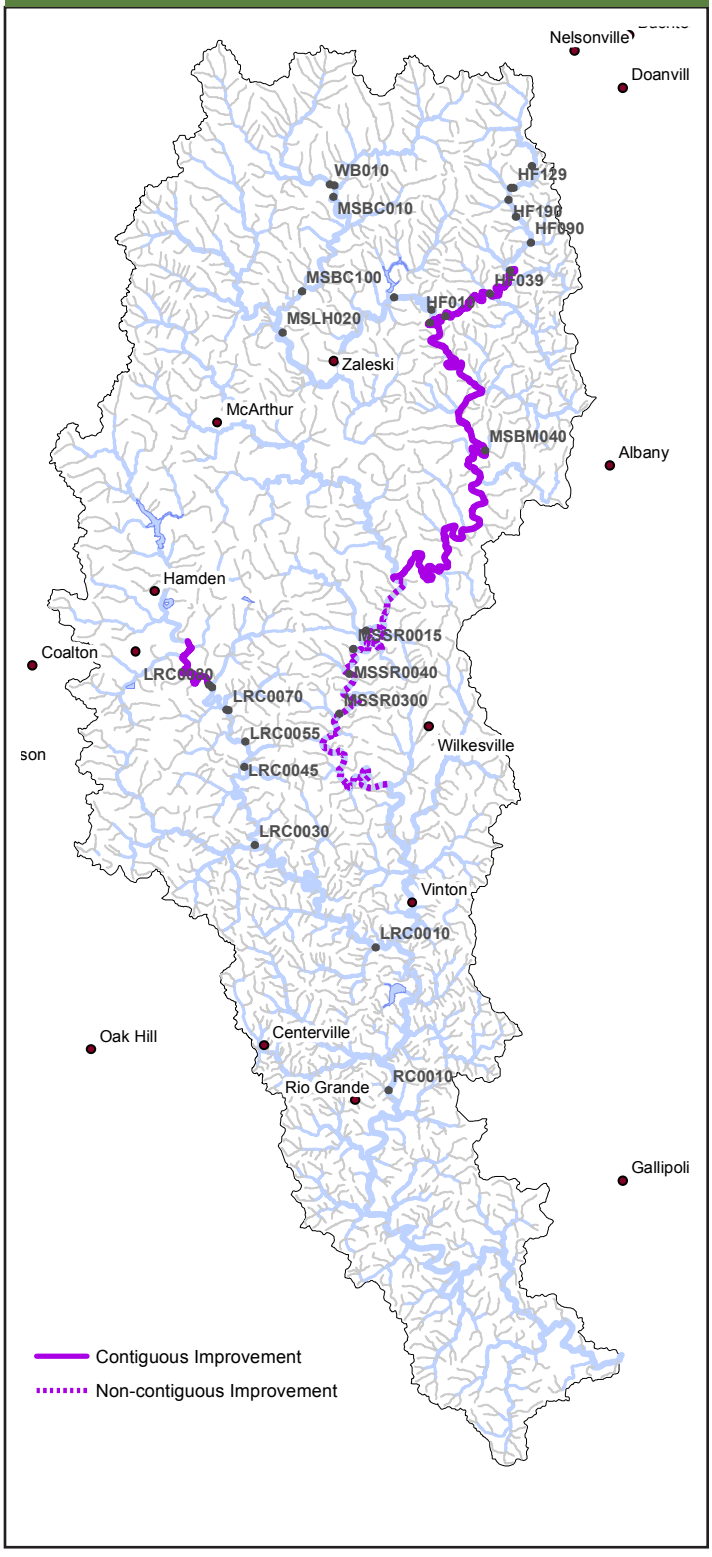


Figure 3: Biological health improvements in Raccoon Creek from 2005 to 2010.

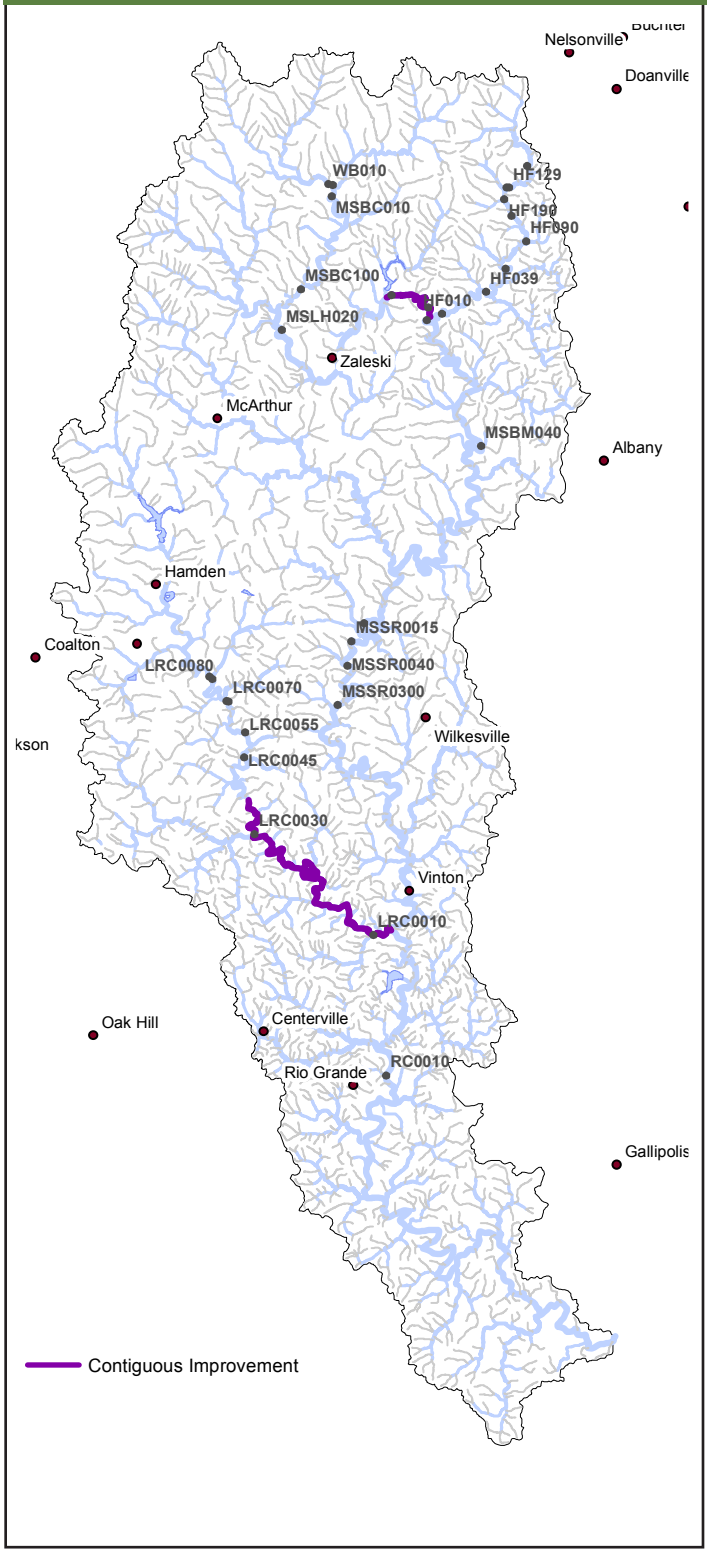
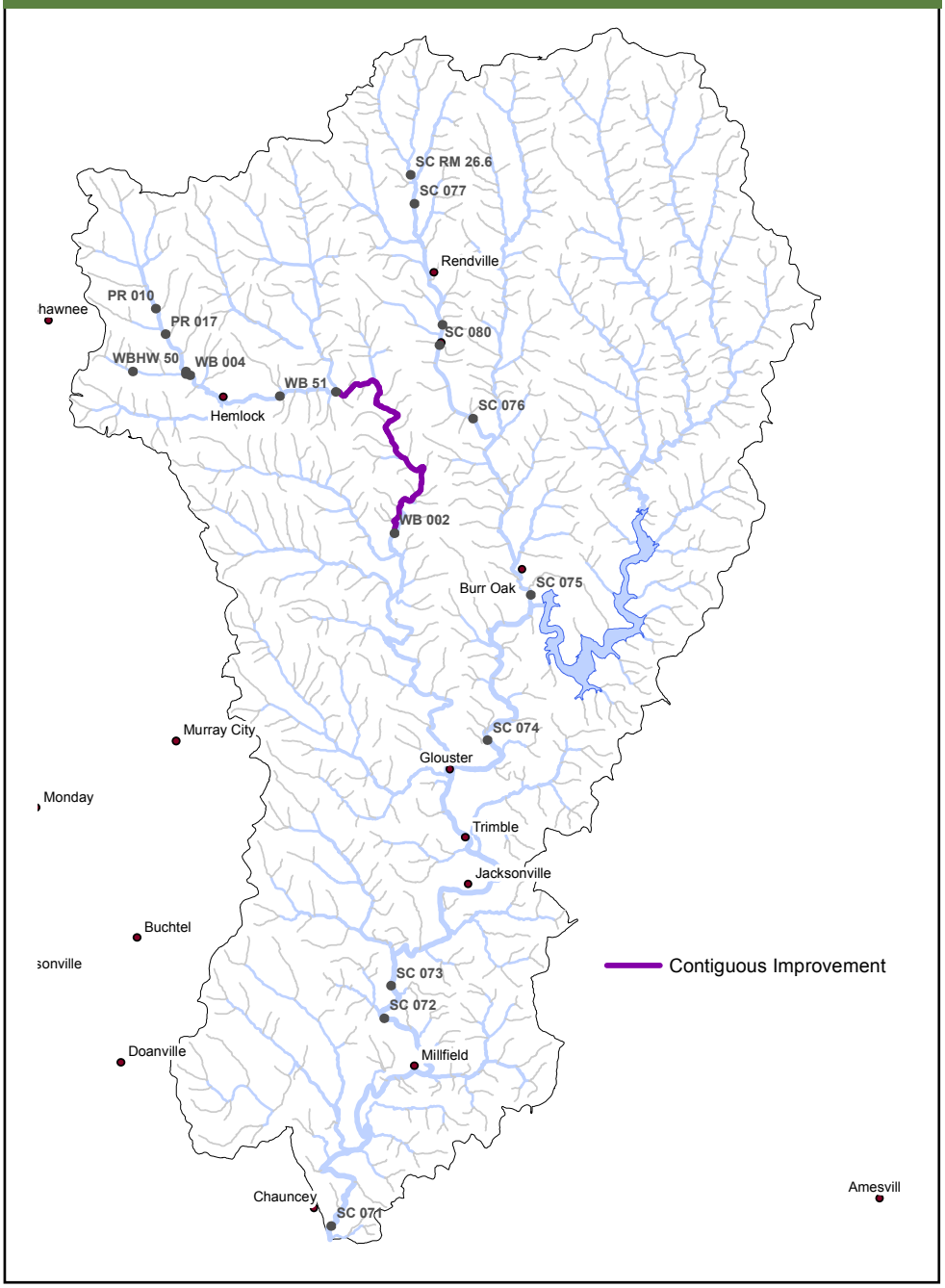


Figure 4: Biological health improvement in Sunday Creek West Branch from 2005 to 2010.



Upper Raccoon Creek (Figure 5):

- 1980's: no data collected
- 1990's: 25 species, 59% tolerant fish, 26% moderately sensitive fish, 2 darter species (2.5%), 1 bass species (5.4%), 82 fish average per sample.
- 2000's: 30 species, 28% tolerant fish, 30% moderately sensitive fish, 4 darter species (6.3%), 3 bass species, (7.5%), 208 fish average per sample.

Little Raccoon Creek (Mulga Run to the mouth) (Figure 6):

- 1980's: 13 species, 92% tolerant fish, 3% moderately sensitive fish, 0 darter species, 1 bass species (1.8%), 20 fish average per sample. Some samples had no fish present.
- 1990's: 26 species, 63% tolerant fish, 17% moderately sensitive fish, 3 darter species (4.7%), 3 bass species (7.1%), 111 fish average per sample.
- 2000's: 41 species, 43% tolerant fish, 30% moderately sensitive fish, 5 darter species (7.4%), 3 bass species, (10.7%), 96 fish average per sample. 1 intolerant species (Rosyface Shiner) was present.

In both figures 5 and 6, in the headwaters of Raccoon Creek and Little Raccoon Creek from the 1980s/1990s to the 2000s total number of species increased but specifically the moderately sensitive fish have increased while the percentage of tolerant fish decrease. Also the number of predatory species (i.e. bass and darters) increased. These data suggest the combined efforts of Ohio EPA, ODNR, Raccoon Creek Partnership (RCP) and other watershed partners have made a positive difference in this watershed.

Figure 5: Raccoon Creek Headwaters Fish Community Recovery 1990s to 2000s

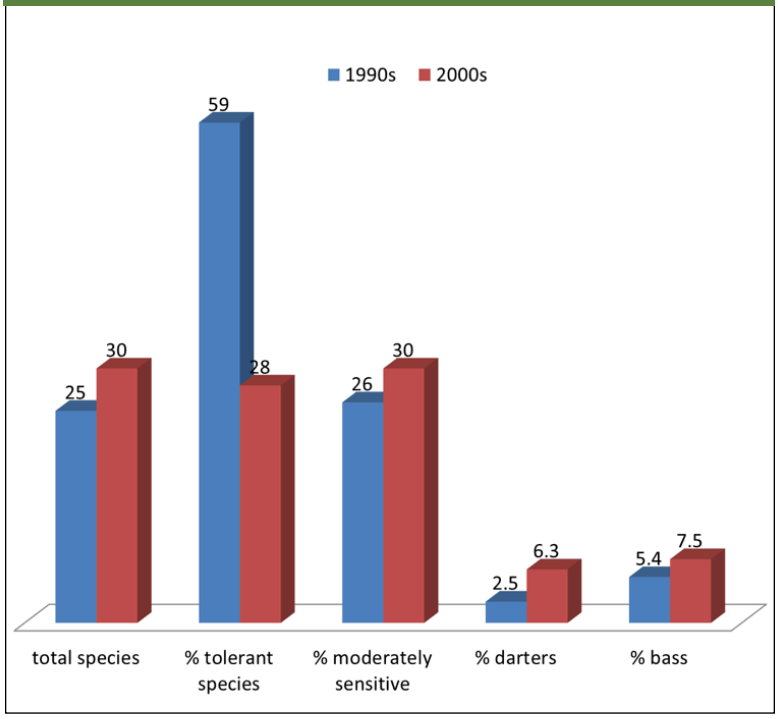


Figure 6: Little Raccoon Creek fish Community Recovery 1980s, 1990s, and 2000s.

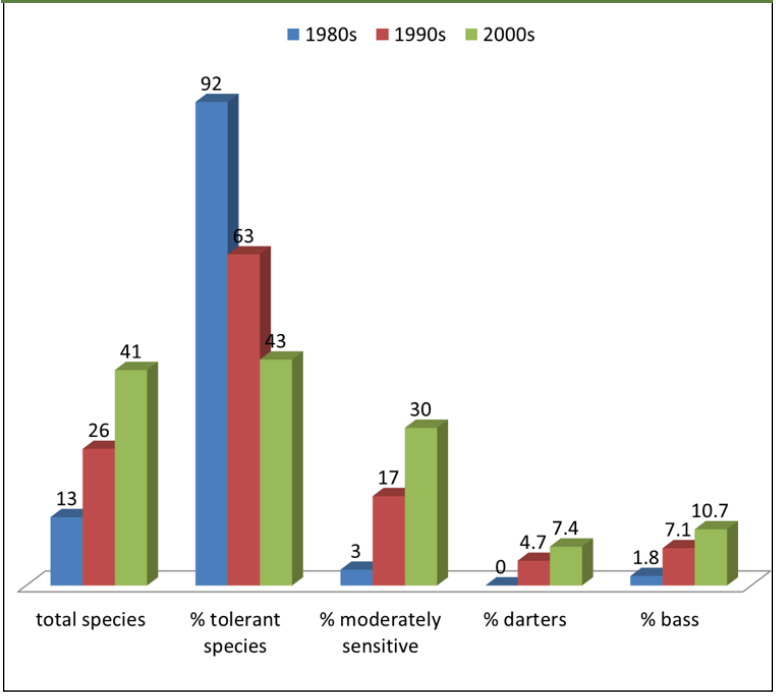


Table 1. Summary of the NPS targets for each of the four watersheds evaluated in 2005 to 2009: Raccoon Creek, Monday Creek, Sunday Creek, and Huff Run.

Watershed	Total number of completed projects	Total costs	Total acid load reduction lbs/day	Total stream miles improved in 2005/2010 to meet IBI & MAIS Biological stream health targets	Goal of number of stream miles to meet WWH Full attainment by 2010	Stream miles that met the pH target	Total stream miles monitored
Raccoon Creek	14	$9,710,495	5,414 *	23.3/18.42 (41.7)	57	103	117
Monday Creek	13 (plus 5 subsidence projects, costs are not included)	$5,871,172	3,877	0/0	25	21	38
Sunday Creek	8 (4 of 8 are subsidence projects)	$1,965,706	18	0/5.26 (5.26)	18	34	37
Huff Run	12	$4,678,279	965	0/0	3	10	10
Total	47	$22,225,651	10,274	23.3/23.7 (47.0)	103	168	202

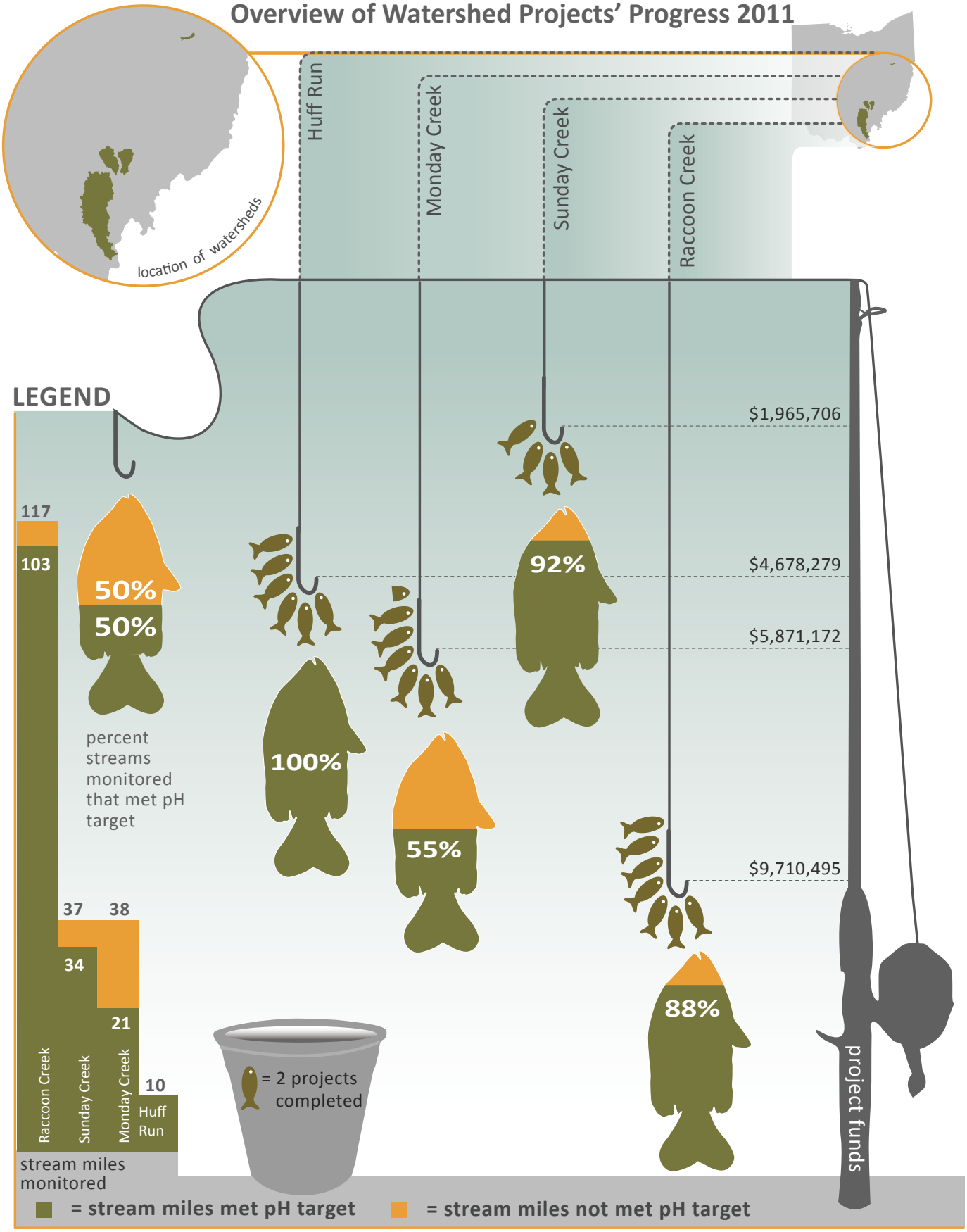
**Salem Rd/Middleton Project evaluated at the site MiR0021 only, as of 2010, no 2011 data were collected*

Reductions

Total acid load reductions = 10,274 lbs/day

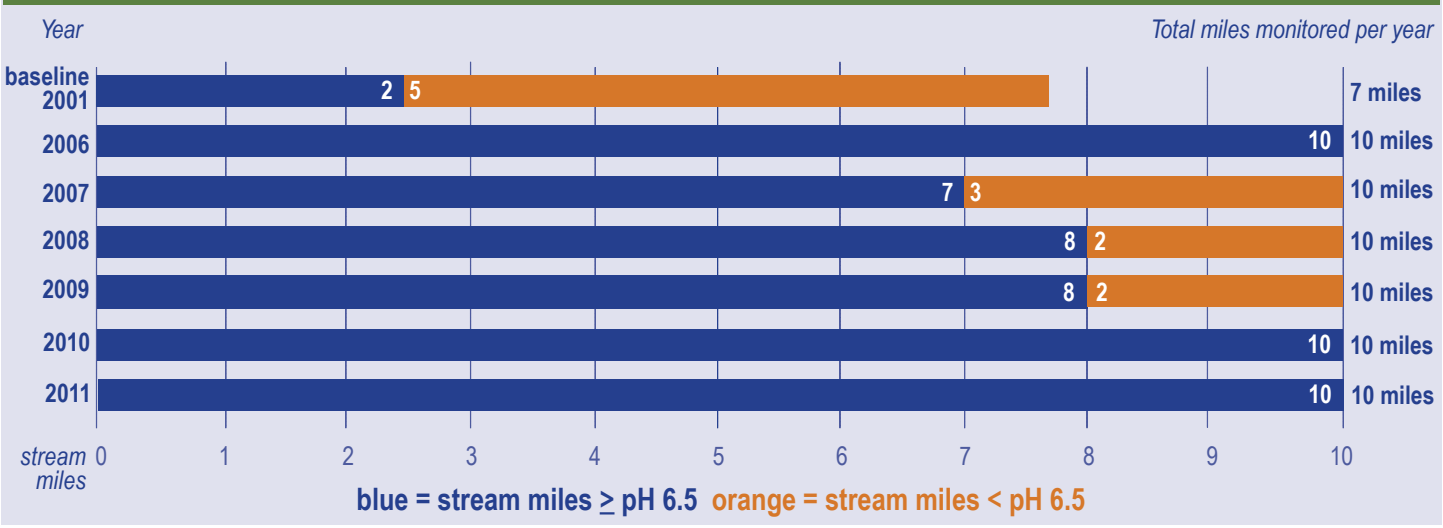
Costs

Total reclamation costs = $22,225,651

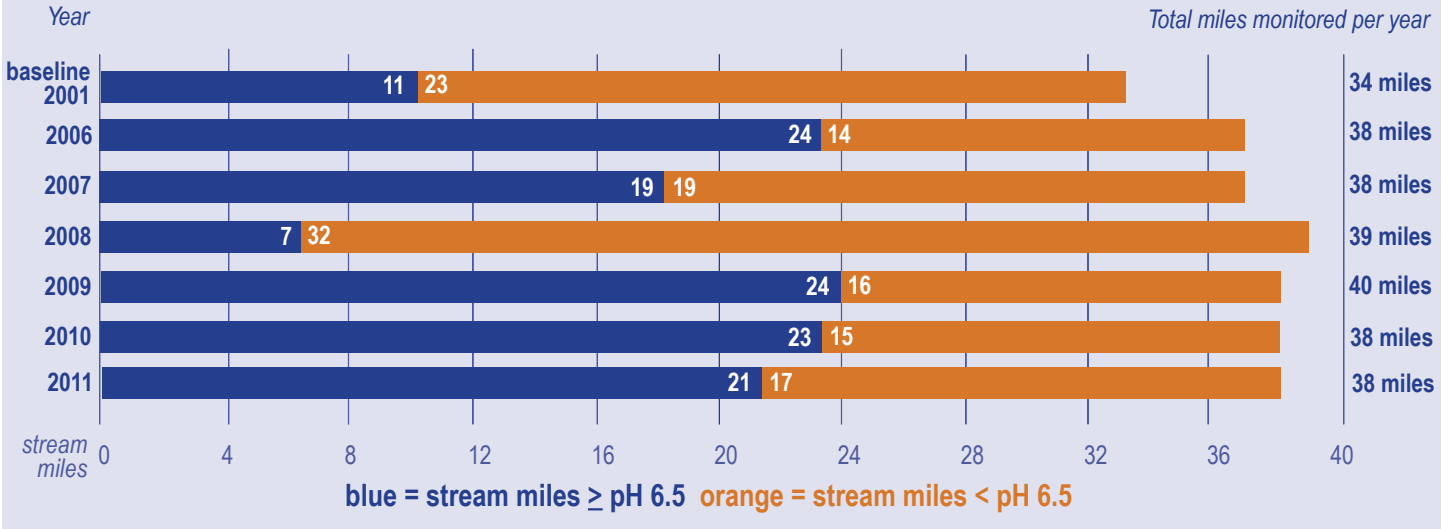

Overview of Watershed Projects' Progress 2011
location of watersheds
Huff Run
Monday Creek
Sunday Creek
Raccoon Creek
LEGEND
$1,965,706
$4,678,279
$5,871,172
$9,710,495
117
103
50%
50%
92%
100%
55%
88%
percent streams monitored that met pH target
37
38
34
21
10
Raccoon Creek
Sunday Creek
Monday Creek
Huff Run
stream miles monitored
= 2 projects completed
project funds
= stream miles met pH target
= stream miles not met pH target

Over the past four years pH has been monitored along the mainstem of each of the four watersheds. The following four figures show a total number of stream miles that meet the pH target of 6.5 and the total number of stream miles monitored each year. Collectively, pH values showed 159 miles of stream met the pH 6.5 water quality target in 2006, 114 miles in 2007, 130 miles in 2008, 162 miles in 2009, 169 miles in 2010, and 168 miles in 2011. These variations in pH can be attributed to the changes in the environment due to: reclamation efforts, seasonal changes, and hydrologic conditions.

Huff Run total stream miles monitored for pH through time



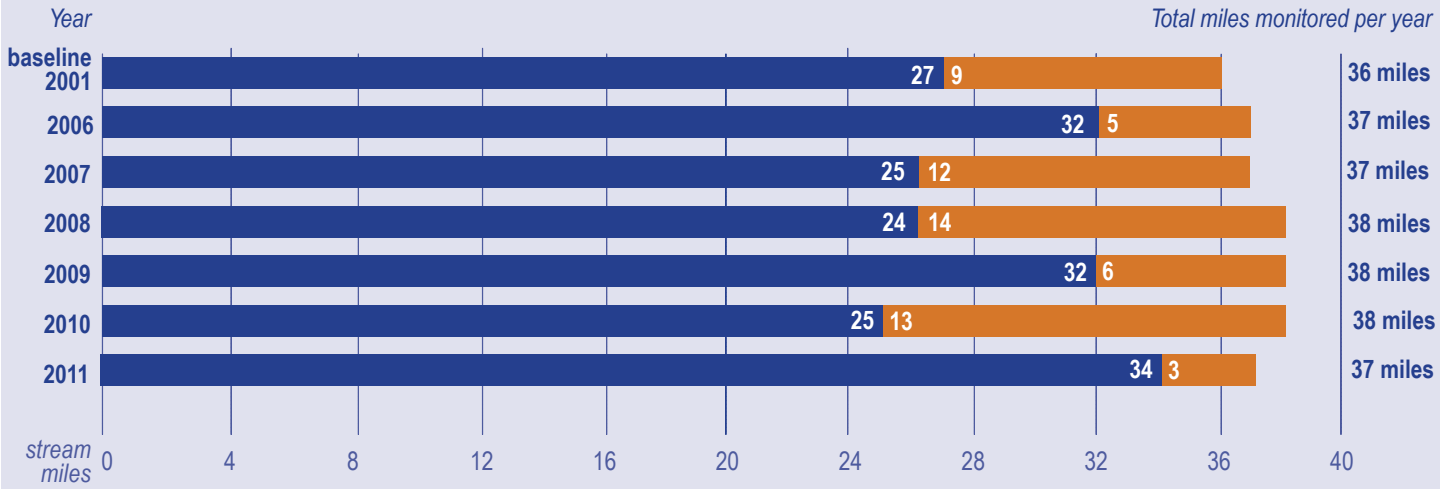
Monday Creek total stream miles monitored for pH through time



Raccoon Creek total stream miles monitored for pH through time

blue = stream miles ≥ pH 6.5 orange = stream miles < pH 6.5

Sunday Creek total stream miles monitored for pH through time



blue = stream miles ≥ pH 6.5 orange = stream miles < pH 6.5

Abandoned Mine Drainage Abatement and Treatment (AMDAT) Plans

The Ohio Department of Natural Resources Division of Mineral Resources Management (MRM) AMD program is evaluating the degree and impact of AMD on streams and rivers in the coal bearing region of Ohio. This region falls within the Western Allegheny Plateau (WAP) eco-region, which covers most of unglaciated Appalachian Ohio. The ultimate goal of this undertaking is to better understand the extent of the AMD problem in Ohio, develop restoration plans (AMDATs) where applicable, and to implement AMD remediation or treatment projects where streams or rivers can be expected to improve to meet state biological water quality standards. A committee of ODNR-DMRM staff has developed a four phase process to accomplish this task.

The first phase is to determine if AMD is present in watersheds that are potentially impaired by abandoned coal mines based on previous water quality data or MRM staff recommendations (Map 1 tan areas and Appendix 1). The second phase involves a more detailed investigation of those streams where AMD was documented in the first phase to determine the degree and extent of impact on water quality and on the aquatic biology (fish and macroinvertebrates). The third phase consists of developing a priority-ranking scheme and schedule for AMDAT development for watersheds impaired by AMD. This step involves determining which watersheds/streams are most likely to recover biologically if AMD abatement and treatment is initiated. The fourth and final phase is to develop AMDAT plans for priority watersheds determined in phase III. The AMDAT plan will identify and outline projects, develop a restoration strategy, and determine a cost estimate for implementation. Once an AMDAT is developed for a particular watershed, it will become eligible for AMD program funds to implement the plan. However, development of an AMDAT does not guarantee funding for implementation projects (Kinney et al. 2010).

- Twelve 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, Yellow Creek, and Upper Rush Creek.

Three new AMDAT watersheds currently under investigation include a tributary to the Muskingum River, Brush Creek in Muskingum County, a tributary to the Tuscarawas River, Mud Run in Tuscarawas County, and Fall Run, a tributary to Wheeling Creek in Belmont County. Updates to existing AMDAT plans are being conducted in Huff Run, Sunday Creek, and Little Raccoon Creek.

Watersheds With Active AMD Reclamation

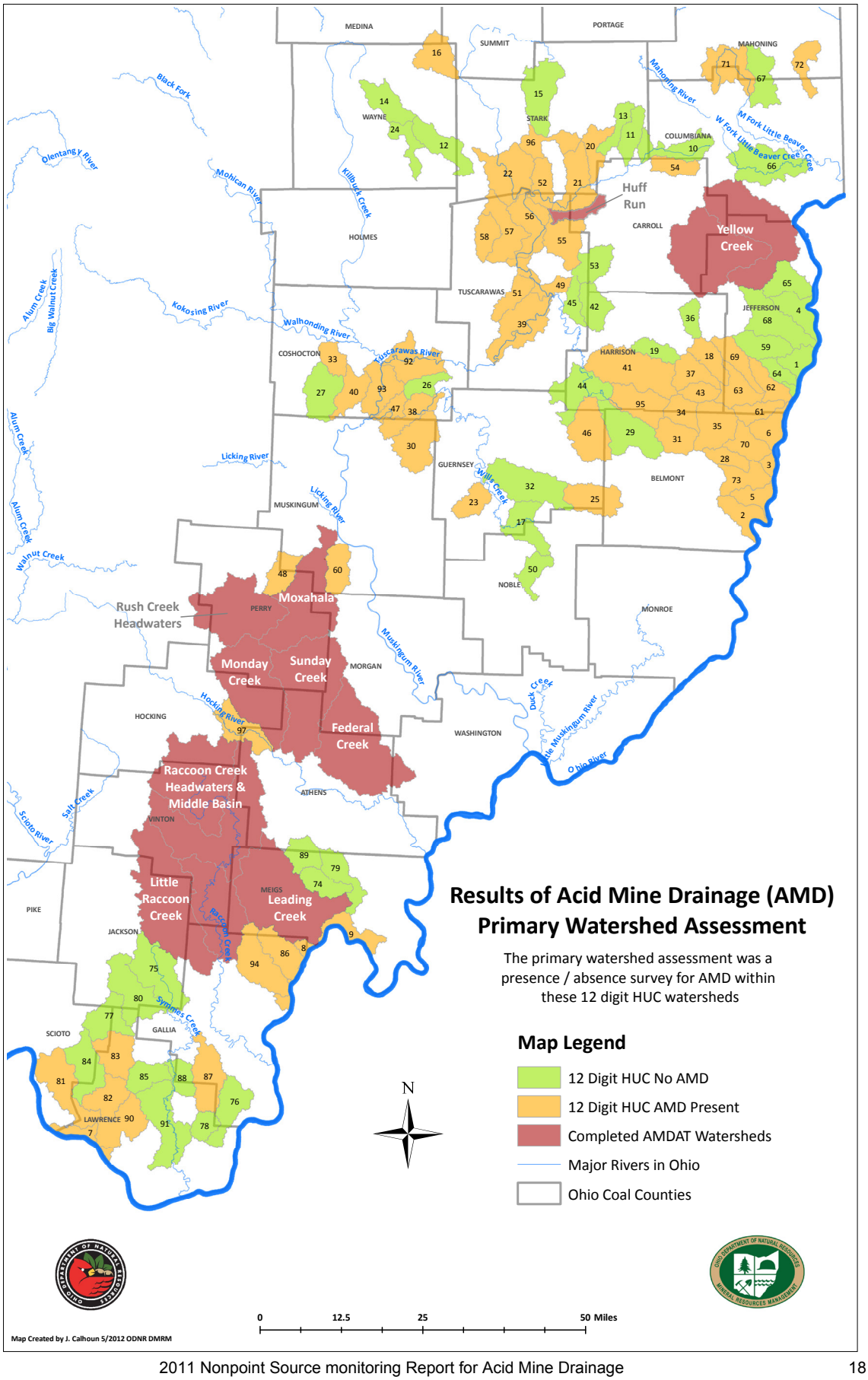
As of 2011, the following nine watersheds are implementing reclamation actions endorsed in their AMDAT plan: Little Raccoon Creek, Headwaters of Raccoon Creek, Middle Basin of Raccoon Creek, Monday Creek, Sunday Creek, Huff Run, Leading Creek, Moxahala and Yellow Creek.

This report and website (www.watersheddata.com) were created in 2005 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 abandoned mine reclamation. This report is available on the website under the reports tab and updated annually.

2011 Stream Health Report

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Map 1. Results of Acid Mine Drainage (AMD) Primary Watershed Assessment



Section II – Watershed reports

Section II contains four watershed level NPS reports detailing the chemical and biological data trends from baseline condition to 2011.

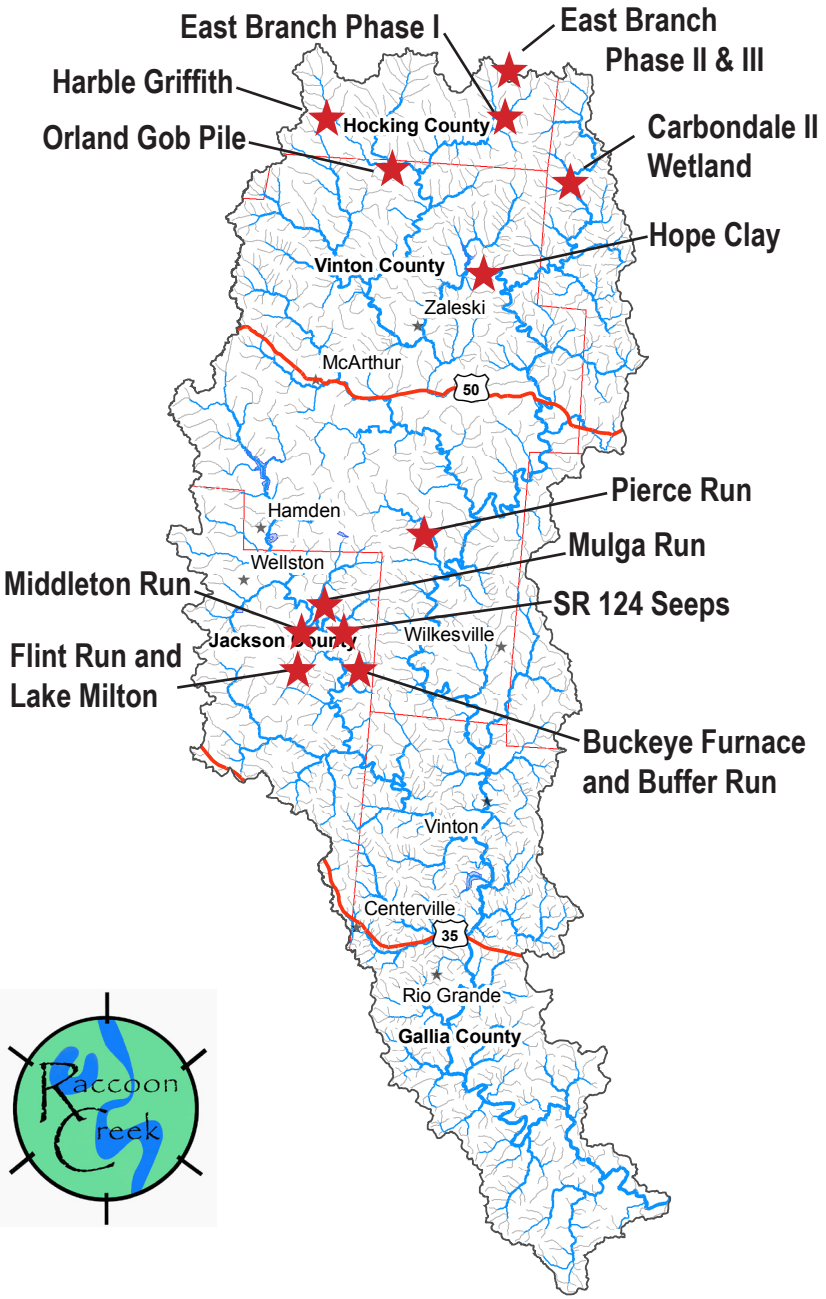
1. Raccoon Creek Watershed
2. Monday Creek Watershed
3. Sunday Creek Watershed
4. Huff Run Watershed

2011 NPS Report - Raccoon Creek Watershed

Generated by Non-Point Source Monitoring System
www.watersheddata.com

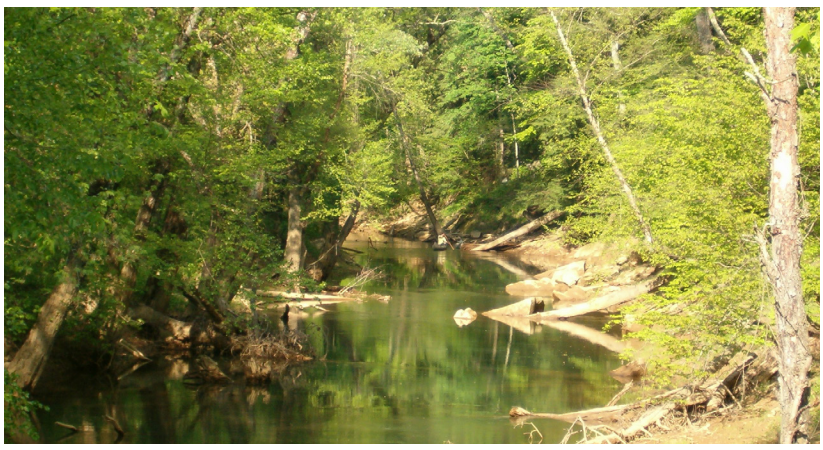
The Raccoon Creek Partnership is a local partnership working towards conservation, stewardship, and restoration of the watershed for a healthier stream and community. The partnership consists of multiple agencies and individuals working to restore and promote the waters of Raccoon Creek. Encompassing 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 Voinovich School of Leadership and Public Affairs at Ohio University, 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 and West Branch, where several impacted tributaries contribute to significant acid and metal loadings in Raccoon Creek. Brushy Creek and the Mainstem of Raccoon Creek above Brushy Creek are also priority AMD abatement sites.



Raccoon Creek near Moonville, Photo by Ben McCament

2011 NPS Report - Raccoon Creek Watershed

Generated by Non-Point Source Monitoring System
www.watersheddata.com

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. Project was completed in 2006. 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 are coordinated by the Raccoon Creek Partnership. Annual litter pick-ups, and canoe-floats all encourage residents to become stewards of our watershed. The Waterloo Aquatic Education Center is used for school programs for youths to help educate students about water quality, acid mine drainage, and the value of clean water. In addition, a community group, the Raccoon Creek Water Trail Association, 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

Biological Health Performance

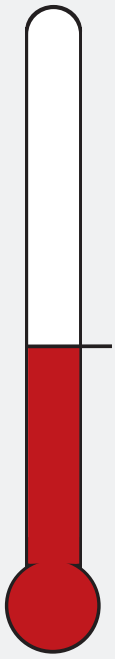
Total stream miles assessed/impacted by mine drainage = 190 miles

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

2010 progress=23.3+18.42=41.72 miles met both the IBI & MAIS targets

2006 progress = 23.3 miles meeting Full WWH attainment
(48 miles assessed in 2006)

Completion



Sub-target 2

Total projects proposed in three Raccoon Creek Watershed AMDATS = 25

Total projects complete = 14

Reductions

Total acid load reduction = 5,414 lbs/day
Total metal load reduction = 1,052 lbs/day

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

Cost

Design = $1,800,521
Construction = $7,909,974

Total Costs through 2011 = $9,710,495

TIMELINE OF THE RACCOON CREEK WATERSHED PROJECT MILESTONES & AMD PROJECTS

1980s	• Formation of Raccoon Creek Improvement Commitee (RCIC): Grassroots citizens group to address water quality issues in Raccoon Creek
Early **1990s**	• RCIC invited 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
2002	
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 to establish a water trail on Raccoon Creek • Flint Run and Lake Milton Projects completed • Watershed Coordinator three year extension funded
2007	• Raccoon Creek Partnership formed 501 (c) 3 • Waterloo Aquatic Education Center opened
2008	• East Branch Phase I AMD Project completed
2009	• Pierce Run AMD Project and East Branch Phase II Project began
2010	• East Branch Phase II completed • Watershed Coordinator 3 year extension funded
2011	• East Branch III Completed

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 Ohio University's Voinovich School, with funding from various state and federal grants but mostly from Ohio EPA's 319 program and ODNR-DMRM's AMD program.

2011 NPS Report - Raccoon Creek Watershed

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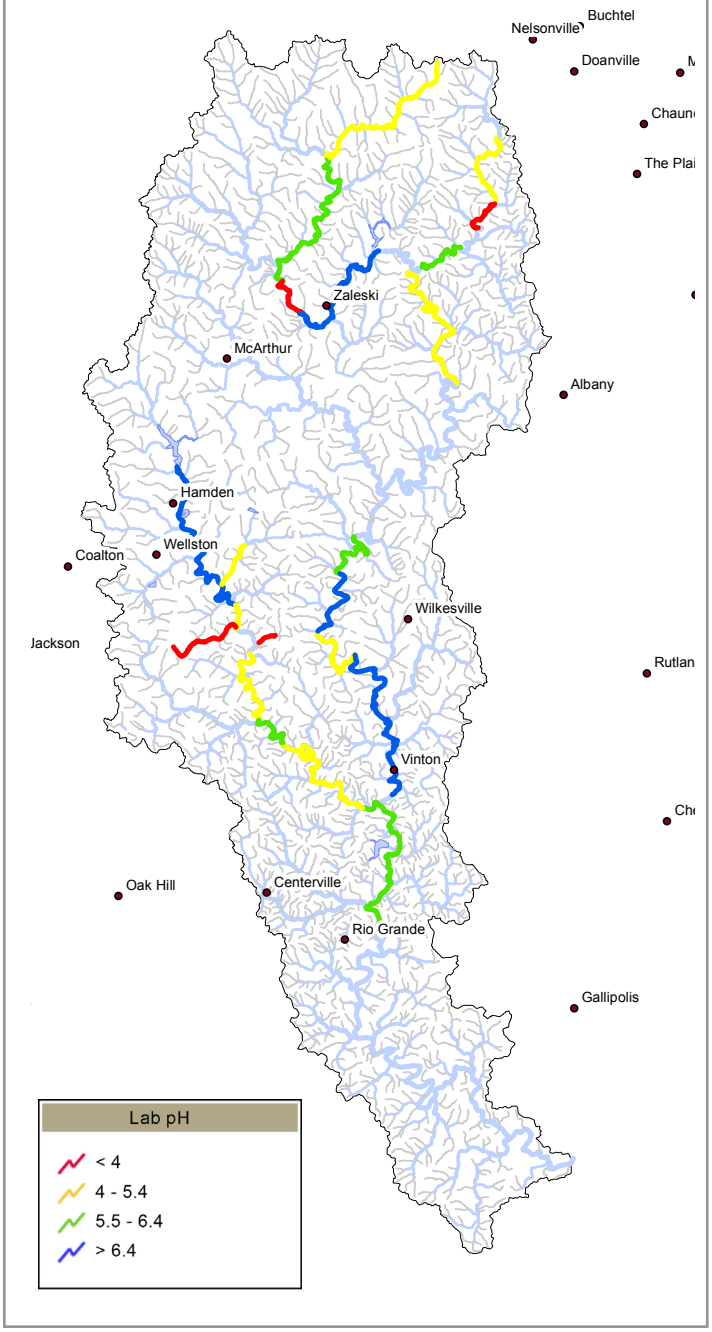
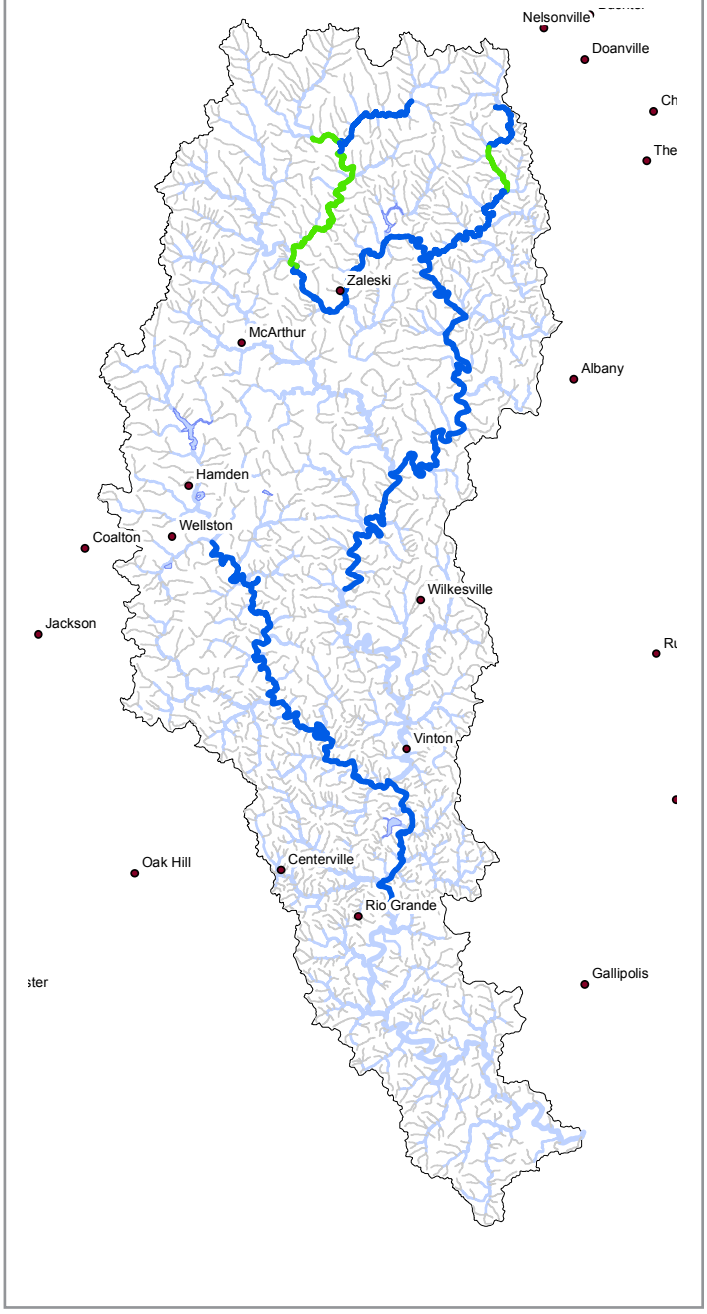
www.watersheddata.com

Chemical Water Quality

Raccoon Creek baseline pH



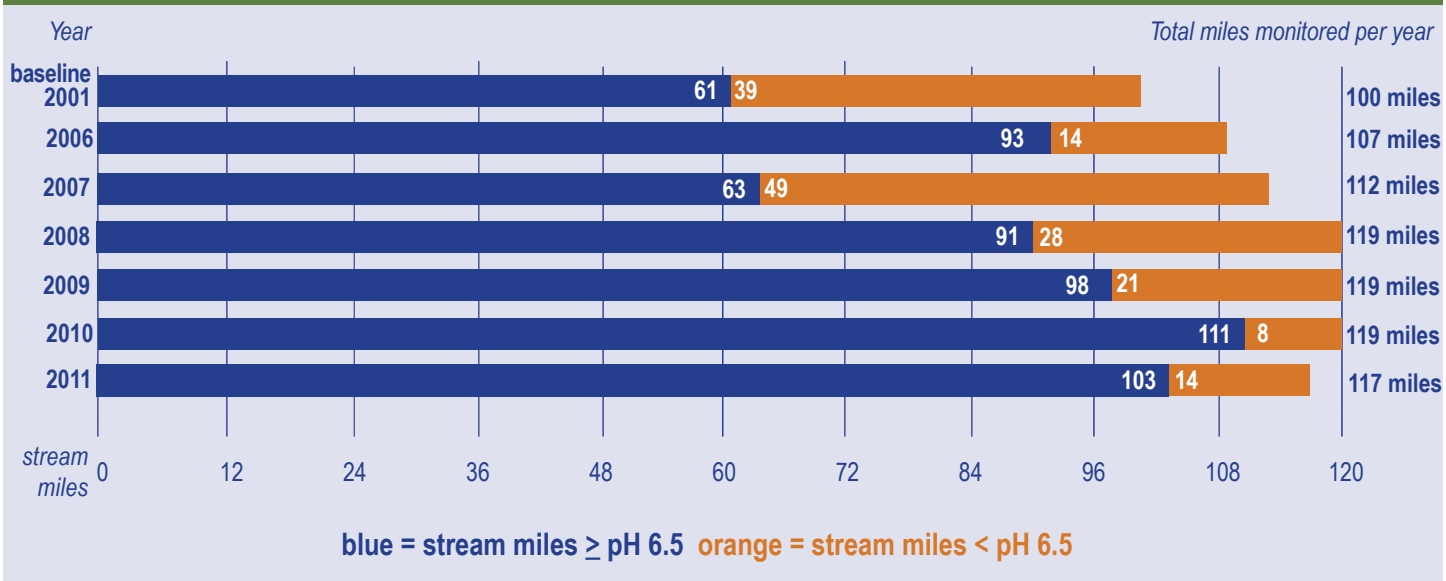
Raccoon Creek 2011 pH



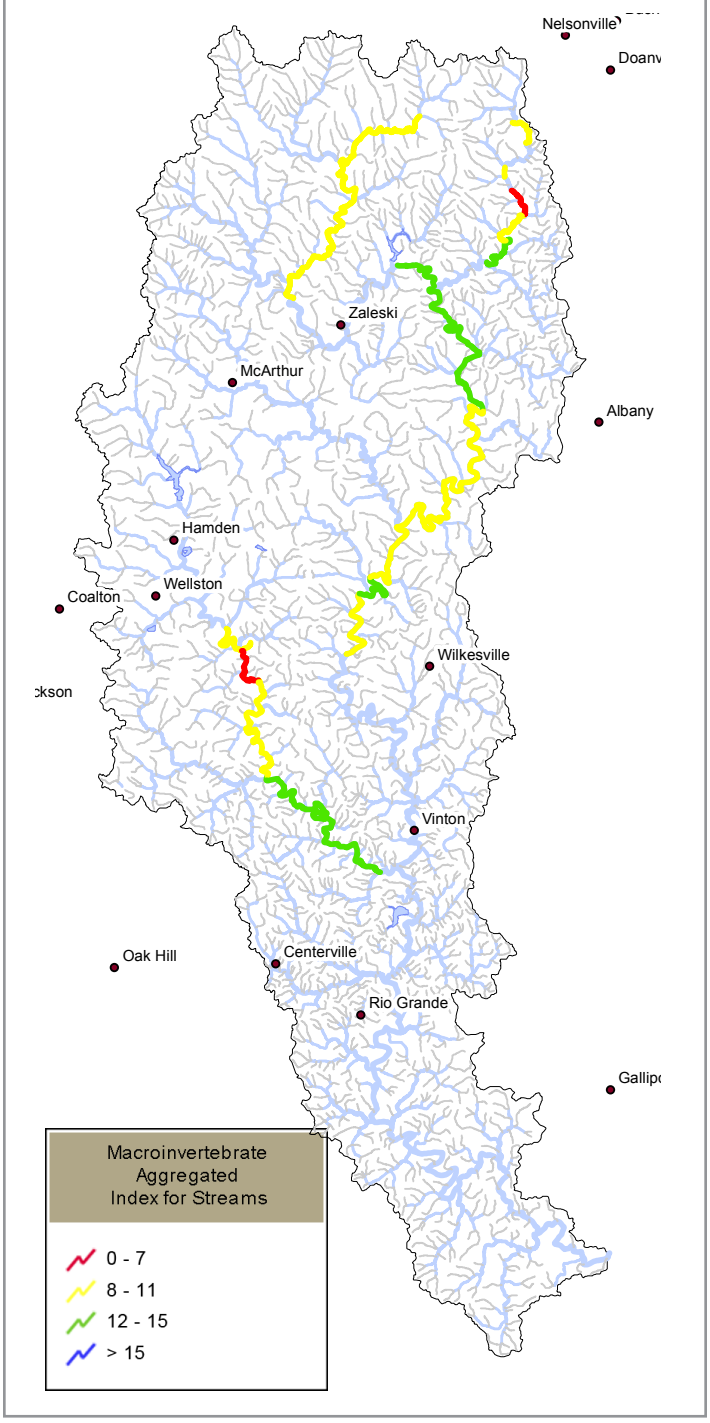
In Raccoon Creek pH values have improved throughout the watershed from baseline conditions (1994-2001) to 2010. Raccoon Creek mainstem, Hewett Fork and Little Raccoon Creek average pH values have increased from a range of 4.0-5.4 during baseline to 5.5-8.0 in 2010, 6.24-7.3 in 2011. In 2010, 10.7 river miles in Hewett Fork, 6 miles in East Branch, all 27 river miles in Little Raccoon Creek (LRC), and all 68 miles along the mainstem of Raccoon Creek met the pH standard (pH >6.5). In 2011, Hewett Fork gained 1.5 miles meeting the pH target, LRC and East Branch remained the same, and the headwaters of Raccoon Creek sites MSBC100 & MSLH020 average pH dropped just below the target with an average pH of 6.4.

There are approximately 119 stream miles monitored each year along the mainstem of Raccoon Creek (downstream to Rio Grande), Little Raccoon Creek, Hewett Fork, and East and West Branch. A pH target has been set to 6.5. Each year there is an increase in the number of miles that meet this target. In 2007 nearly 64 miles of the 113 monitored met this target. In 2008, there was a large increase (30%) with nearly 91 stream miles meeting the pH target of 6.5 of the 119 miles monitored. In 2009, 98 of the 119 miles monitored met the target, a 7% increase from 2008. Currently in 2011, 103 of the 117 miles of stream monitored met the pH target, a slight decrease from 2010 (Figure A).

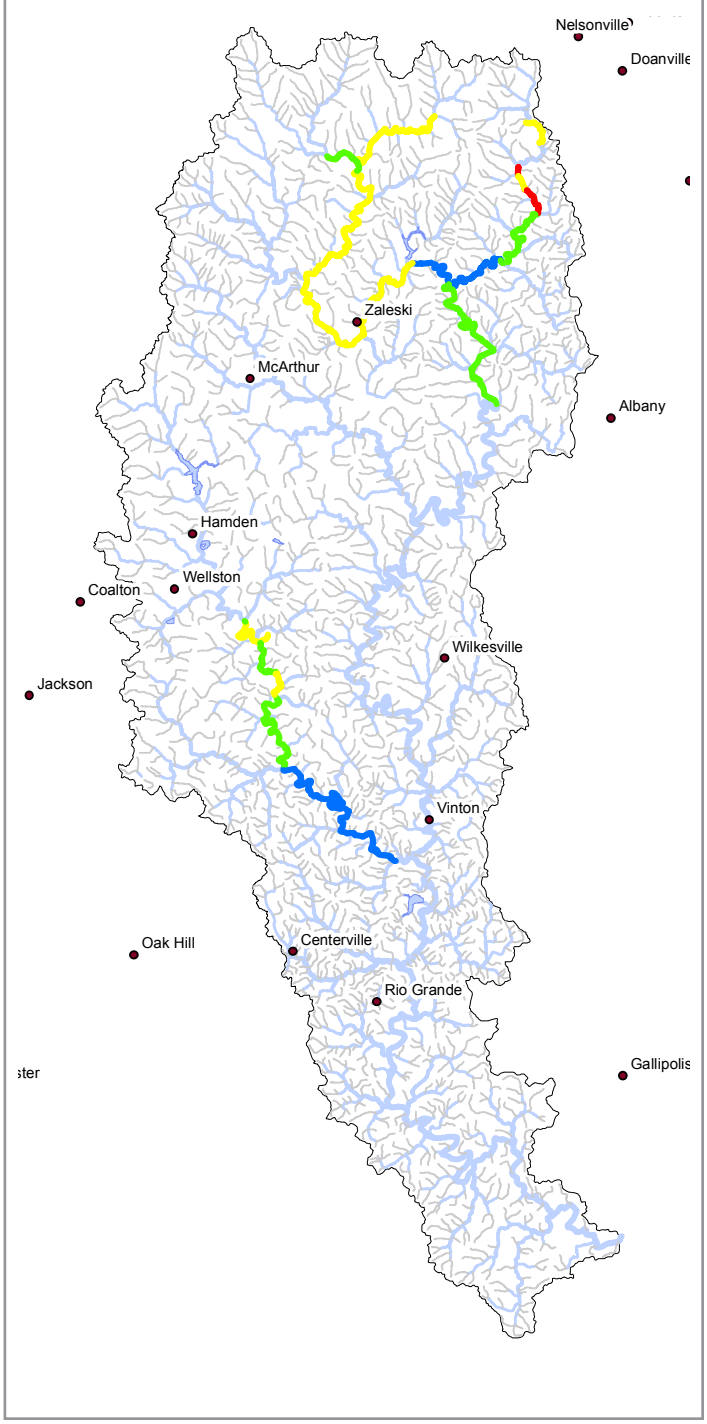
Figure A. Raccoon Creek total stream miles monitored for pH through time



Raccoon Creek baseline MAIS



Raccoon Creek 2011 MAIS

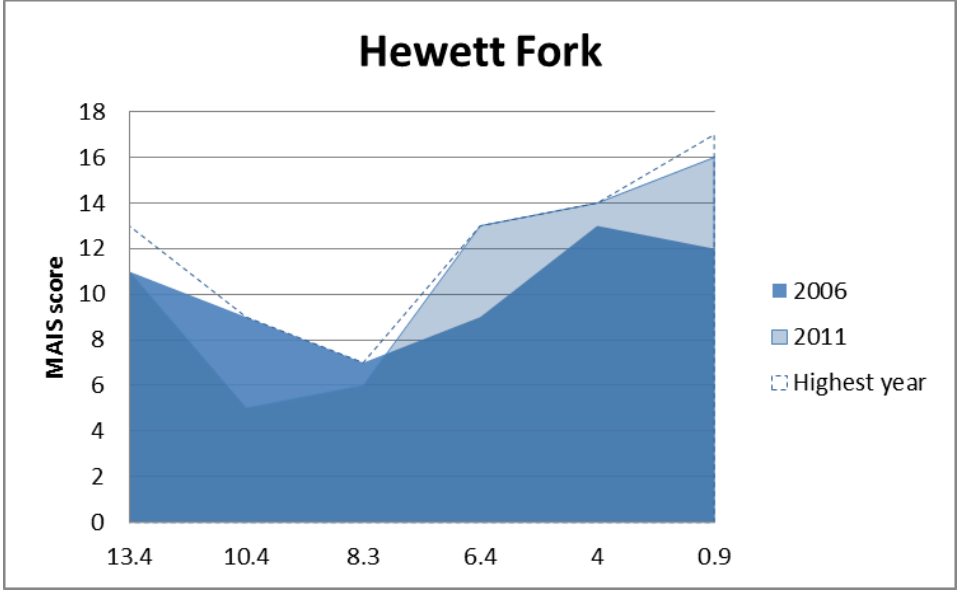


MAIS samples were collected throughout Raccoon Creek in 2011 (excluding Middle Basin sites). These stations have been established as annual monitoring stations for macroinvertebrates. The sites are used to track incremental changes each year (figures 1 and 2).

Raccoon Creek - Hewett Fork

In 2011, the overall biological quality of the eleven mile reach below the Carbondale doser was close to the highest it has been over the past six years (Figure B). All but two sites scored their highest scores in 2011. One of these sites, at RM 10.4, is immediately downstream of the doser in the 'impacted zone' where high quantities of metals have precipitated onto the substrate. Biological quality has declined at this site over the past six years, after the doser was installed in 2004. For several miles downstream, macroinvertebrate scores exhibit high annual variability that may be related to episodic pulses of acid mine drainage or re-suspension of sediment metals. In 2011, the lower four miles of Hewett Fork all scored above '12', the highest quality observed in this section to date.

Figure B. Area of degradation for MAIS scores in Hewett Fork from 2006 to 2011.



The blue dashed line identifies the highest MAIS score ever achieved at that site throughout the monitoring time period.

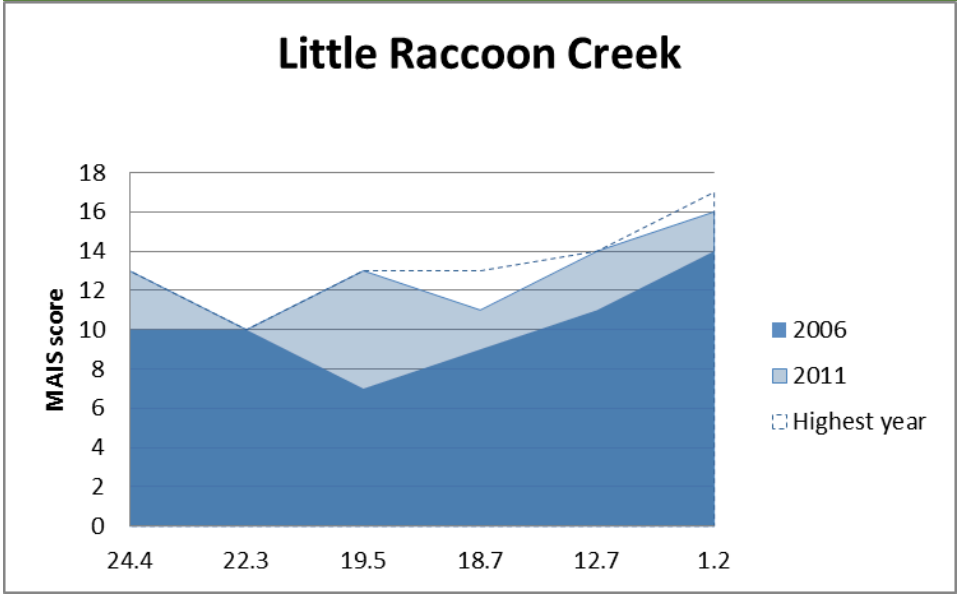
Hewett Fork MAIS Regressions

RM	*2001*	*2002*	*2003*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	Linear trends	P-value	Yrs
13.4					11	8	9	12	13	11	no change	0.294	6
10.4					9	3	7	6	6	5	some decline	0.087	6
9.8					4	3	6	3	3	8	no change	0.385	6
8.3	2	3	3	5	7	3	5	6	3	6	no change	0.106	10
6.4					9	9	8	10	10	13	**some improvement**	0.070	6
4					13	13	14	13	13	14	no change	0.414	6
0.9					12	12	15	17	13	16	no change	0.184273	6

Raccoon Creek - Little Raccoon Creek

Little Raccoon Creek continues to show solid trends of improved biological quality since 2006 (Figure C). Much of the improvements followed the completion of the six major reclamation projects upstream of RM 19.5 (Mulga Run, Salem Road/Middleton Run, State Rte. 124 seeps, Flint Run East, Lake Milton, and Buckeye Furnace). In 2011, four out of six sites achieved target macroinvertebrate scores of '12'.

Figure C. Area of degradation for MAIS scores in Little Raccoon Creek from 2006 to 2011.



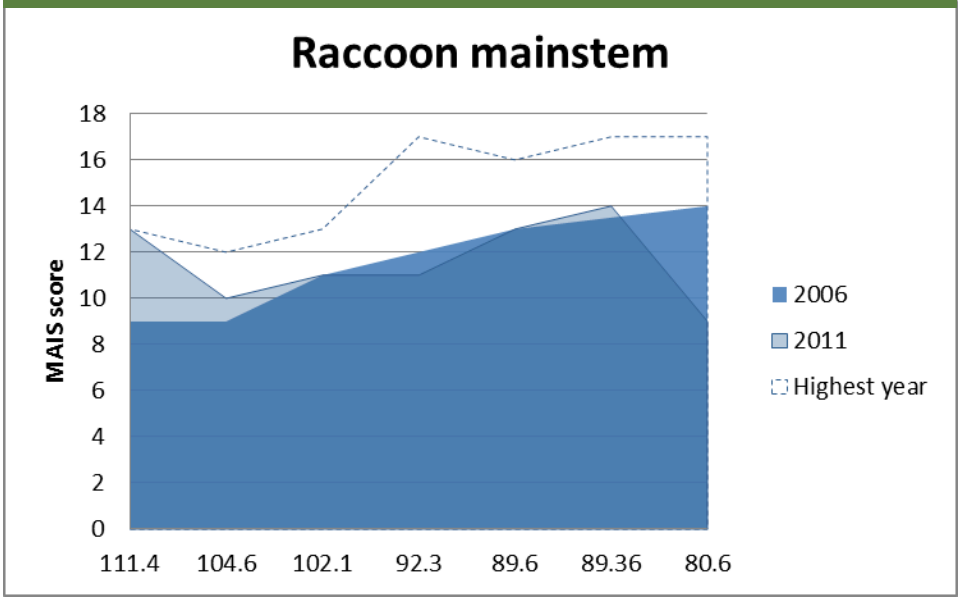
Little Raccoon Creek MAIS Regressions

RM	2005	2006	2007	2008	2009	2010	2011	Linear trends	P-value	No. of years
24.4	8	10	11	11	9	9	13	no change	0.246	7
22.3	8	10	10	9	10	10	10	no change	0.165	7
19.5		7		9	11	12	13	improved	5.65E-05	6
18.7	14	9	12	9	13	11	11	no change	0.726	7
12.7	3	11	13	13	14	14	14	improved	0.041	7
1.2	14	14	13	15	17	16	16	improved	0.046	7

Raccoon Creek Mainstem

The thirty or more miles of the Raccoon Creek Mainstem have shown transient years of improved quality, some achieving MAIS scores of 17 ('very good' quality rating) in the 2008 and 2010. However, trends are modest and thus far only the uppermost headwaters sites have achieved statistical significance (Figure D).

Figure D. Area of degradation for MAIS scores in Raccoon Creek Mainstem from 2006 to 2011.



The blue dashed line identifies the highest MAIS score ever achieved at that site throughout the monitoring time period.

Raccoon Creek Mainstem MAIS Regressions

RM	2005	2006	2007	2008	2009	2010	2011	Linear trends	P-value	No. of years
111	8	9	12	9	10	12	13	improved	0.043	7
105		9	11	12	9	11	10	no change	0.868	6
102		11	11	10	13	10	11	no change	1.00	6
92.3				10	10	17	11			
89.6		13	14	11	16	12	16	no change	0.863	6
89.4			12	16	14	17	13	no change	0.711	5
80.6		14	14	17	16	12	14	no change	0.686	6

2011 NPS Report - Monday Creek Watershed

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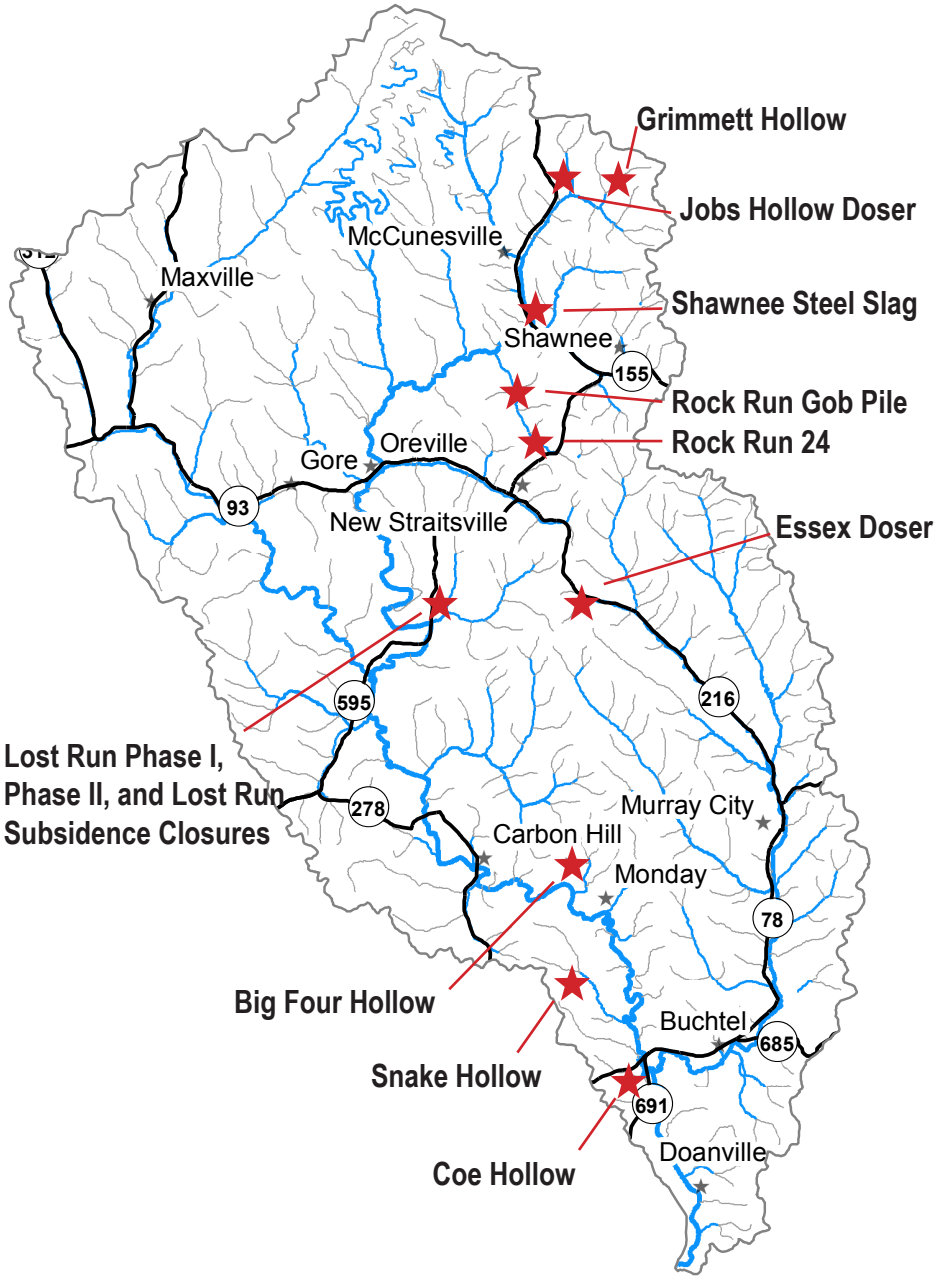
- Monday Creek, located in the Appalachian Region of southeastern Ohio, is a 27-mile long tributary of the Hocking River, the latter which flows directly into the Ohio River. The Monday Creek Watershed drains a 116 square-mile area, with streams winding through portions of Athens, Hocking, and Perry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

- Monday Creek Restoration Project is a program of Rural Action, Inc., a non-profit group working to revitalize Appalachian Ohio. 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 by 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.

- 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



363,425,000 gallons of stream water per year eliminated from entering into the deep mines as the result of conducting seven stream capture closure projects in Monday creek

Monday Creek Restoration Project

Reductions

Total acid load reduction = 3,877 lbs/day

Total metal load reduction = 597 lbs/day

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

Costs

Design $359,519 *(excluding Snake Hollow)*

Construction $5,511,654

Total costs through 2011 = $5,871,172

Monday Creek Stream Capture Projects

Project status: Six subsidence closures projects were completed from 1995-2010

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
Lost Run	2007	100	USFS	35,000,000
Coe Hollow	2010	80	USFS	29,490,000

Seven stream captures located in the Monday Creek Watershed were closed and completed from 1995 to 2010. A total of 991 acres surface drainage area drained year round into the deep mines and as a result of closing these subsidences holes. Using the equation for annual average discharge where 1 sq. mile = 1 cfs (USGS 2001), approximately 363,425,000 gallons per year were diverted from entering into the deep mine thus abating the generating of acid mine drainage.

TIMELINE OF THE MONDAY CREEK WATERSHED PROJECT MILESTONES & AMD PROJECTS

1994
- Formation of Monday Creek Restoration Project (MCRP)

1995
- First stream water quality study on Monday Creek (USFS, CURSML, and USGS)
- OSM awarded MCRP with an Appalachian Clean Stream Initiative (ACSI) grant for Rock Run

1996
- Ohio EPA awarded MCRP with a 319 grant for Rock Run

1997
- "Monday Creek Watershed Acid Mine Drainage Abatement and Treatment Plan I" published
- Ohio EPA awarded Ohio University with a 319 grant to treat mine drainage at Rock Run, Brush Fork and seal a subsidence on Goose Run and at Majestic Mine site
- Monday Creek video "Silent Waters: The Story of Monday Creek" produced

1998
- Grant from CURSML for capping Jobs 13 gob pile
- Streambank stabilization and riparian tree planting at Carbon Hill, Brush Fork, and Goose Run
- MCRP logo designed

1999
- First Management Plan, "A Comprehensive Plan for the Monday Creek Watershed," published
- MCRP Office opened in New Straitsville
- OSM awarded MCRP with an ACSI grant for Jobs Hollow doser, Snake Hollow, and Salem Hollow
- ODOT awarded MCRP with mitigation funds for reclamation in Big Four Hollow
- "Monday Creek Watershed Acid Mine Drainage Abatement and Treatment Plan II" published
- OSM awarded MCRP a Cooperative Agreement for treatment at Rock Run 24
- Greenway Feasibility Study published

2000
- Ohio EPA awarded MCRP with a 319 grant for work at Jobs Hollow (Grimmett Site) and Monkey Hollow
- MCRP received first Watershed Coordinator Grant, for 6 years

2001
- Wayne National Forest closed subsidences at Orbiston North, Long Hollow, and Essex Mine

2002
- U.S. Forest Service funding received for reclamation at Snake Hollow
- U.S. Forest Service closed a small subsidence in Sycamore Hollow near New Straitsville

continued on next page

TIMELINE OF THE MONDAY CREEK WATERSHED PROJECT MILESTONES & AMD PROJECTS

2003
- Jobs 13 gob pile capping completed
- Video about Monday Creek entitled "Cool Waters" released

2004
- Volunteers planted nearly 7,000 Pine on Sunday Creek Coal Company land
- Jobs active alkaline doser installed
- U.S. Forest Service constructed a series of limestone leach beds and channels in Snake Hollow
- Ohio EPA awarded MCRP with a 319 grant for work at Lost Run

2005
- U.S. Army Corps of Engineers Civil Works Review Board approved the Monday Creek Feasibility Study for a favorable Chief of Engineers' Report and inclusion in Water Resources Development Act of 2005 (WRDA '05)

2006
- Acid Mine Drainage Abatement and Treatment (AMDAT) Plan III approved
- Essex Doser (319 grant) operational
- U.S. Forest Service constructed open limestone channels, closed subsidence and established positive drainage at New Straitsville North area, Monkey Hollow, Goose Run, and Elm Rock area
- MCRP Watershed Management Plan fully endorsed by the Ohio DNR and Ohio EPA
- Lost Run Phase I reclamation and OEPA 319 grant completed

2007
- Ohio EPA awarded MCRP a 319 grant for construction of a steel slag leach bed at Shawnee
- U.S. Forest Service completed restoration near State Route 216 and Snake Hollow
- Water Resources Development Act of 2007 approved, Congress authorized $21 million for ecological restoration of Monday Creek

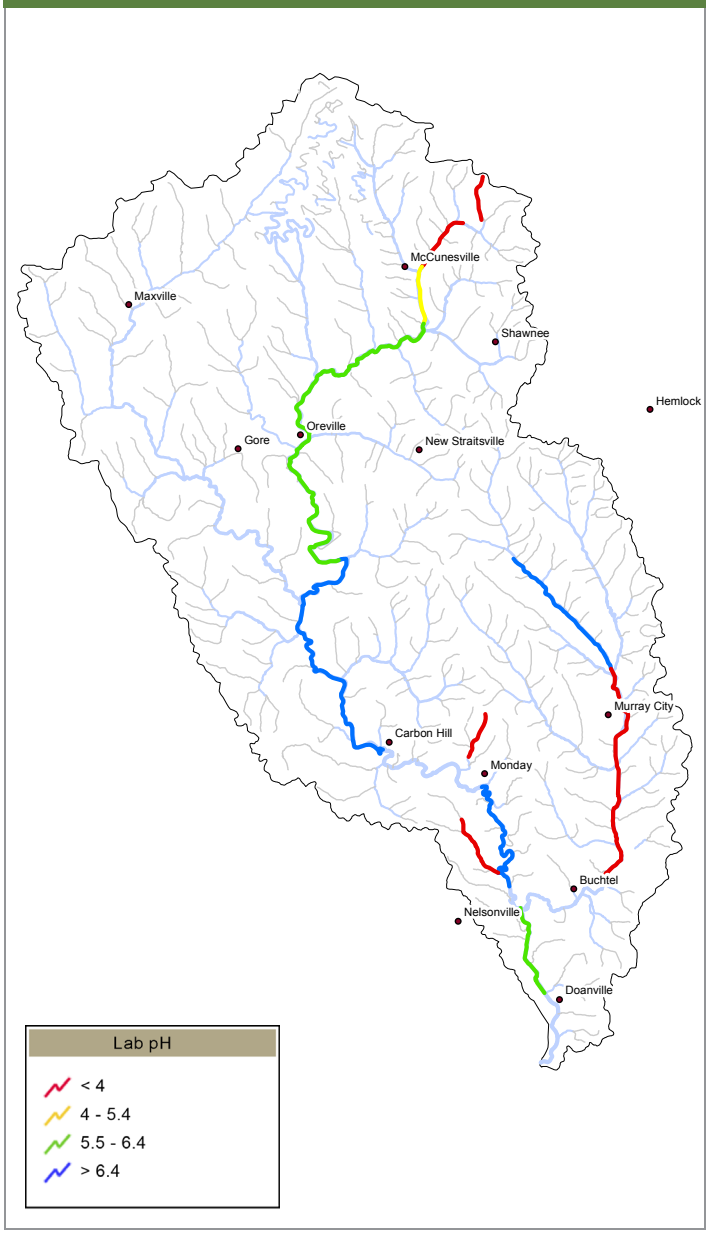
2008
- U.S. Forest Service completed reclamation in Valley Junk area at Coal Dale, and near State Route 216
- ODOT mitigation funds of $200,000 secured for work at Lost Run Phase II

2009
- ODOT mitigation funds in place for work in Big Four Hollow and at Rock Run
- U.S. Forest Service completed reclamation work along State Route 278, New Straitsville South area, Lost Run headwaters, Brush Fork, and Coe Hollow.
- Ohio DNR completed phase II of Shawnee steel slag bed

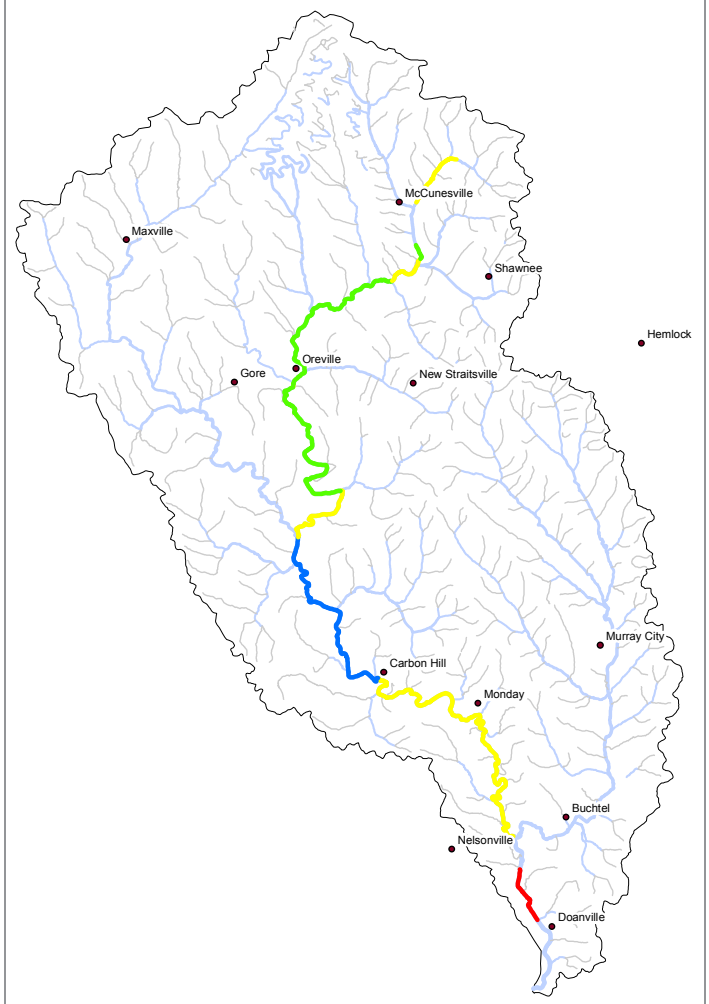
2010
- U.S. Forest Service closed subsidences along Snow Fork, Rock Run, and New Straitsville South
- Portable doser and subsidence channels installed at Brush Fork (MCRP and USFS)
- Two vernal pools established at the Trimble Township Land Lab through an OEEF grant
- Bacteria sampling throughout Monday Creek watershed

2011
- U.S. Forest Service closed subsidences in the Cawthorn area
- Ohio DNR conducted reclamation and needed maintenance at Rock Run
- U.S. Forest Service and ODNR completed reclamation in Sand Run
- Ohio DNR completed construction to minimize sediment transport at Big Four Hollow

Monday Creek baseline pH

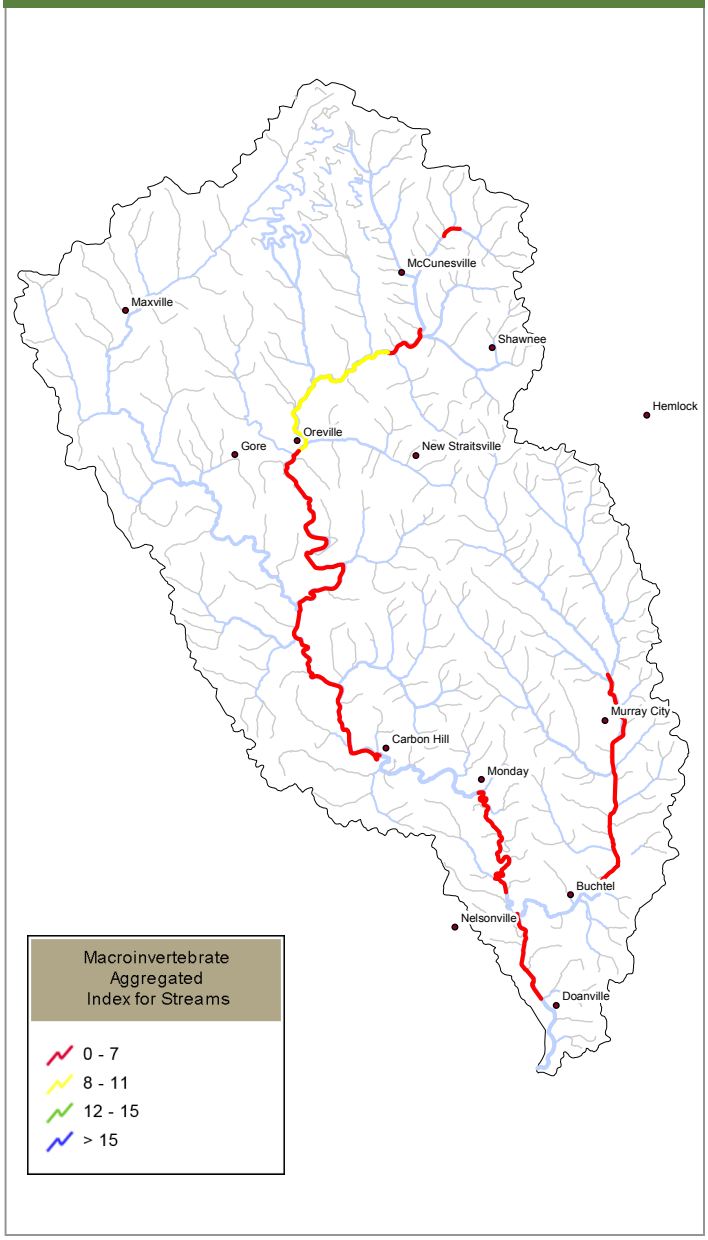


Monday Creek 2011 pH

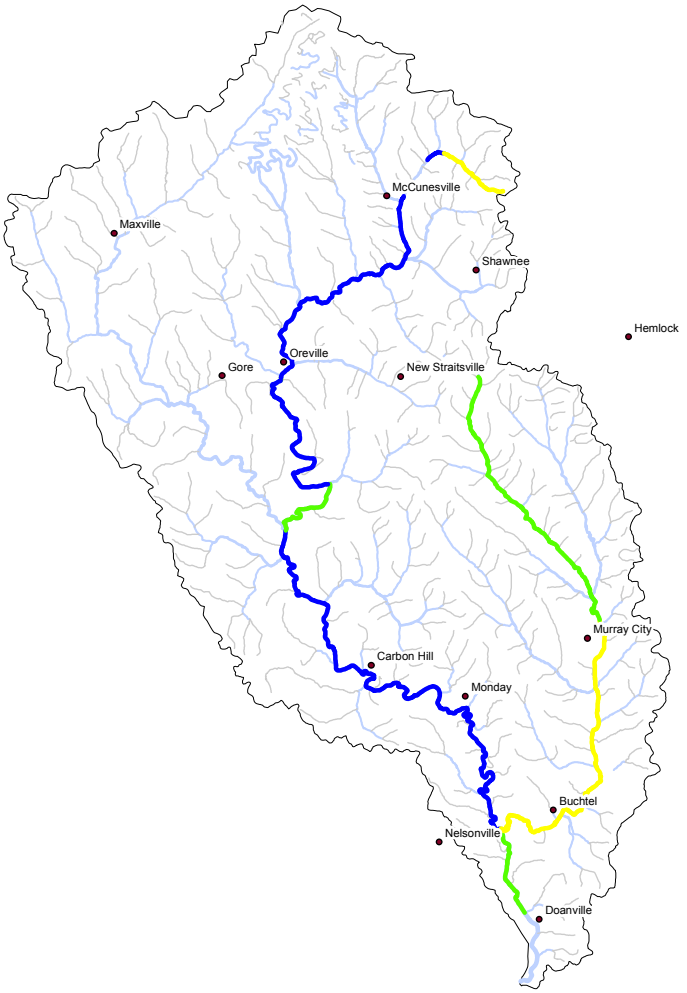


In Monday Creek pH values have improved throughout the watershed from baseline conditions (2001) to 2011. From 2006 (32%) to 2011(60%) there has been a 28% increase in the number of stream miles that meet the pH target of 6.5.

Monday Creek baseline MAIS



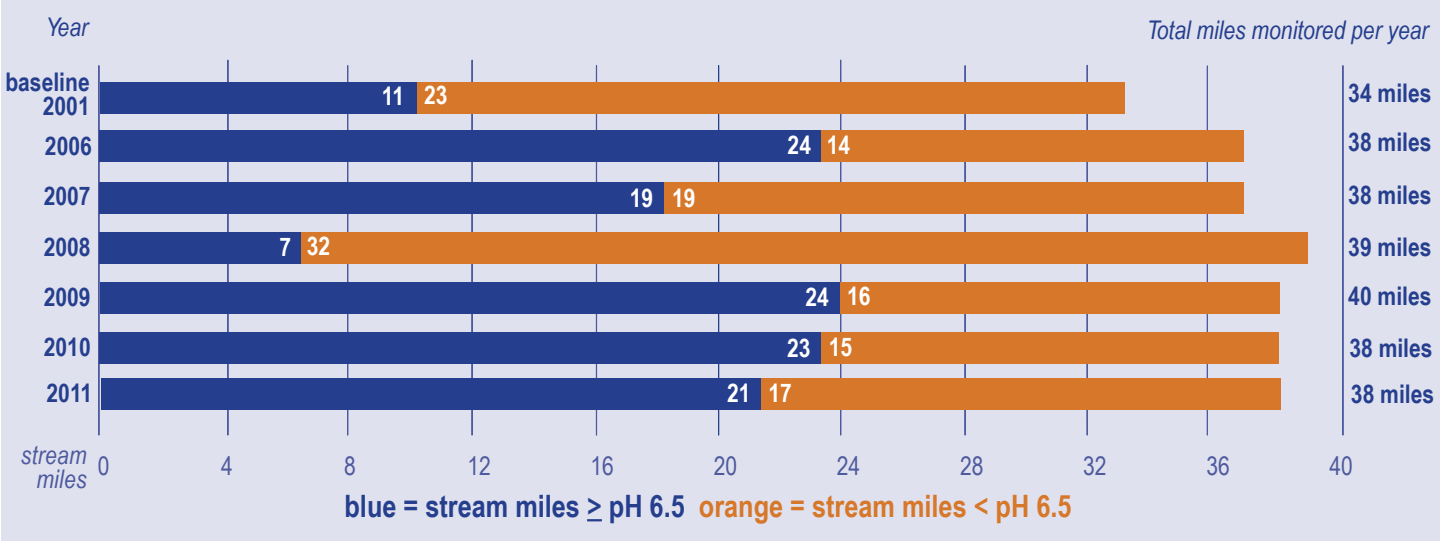
Monday Creek 2011 MAIS



MAIS samples were collected throughout Monday Creek at established annual monitoring stations from 2001 through 2011.

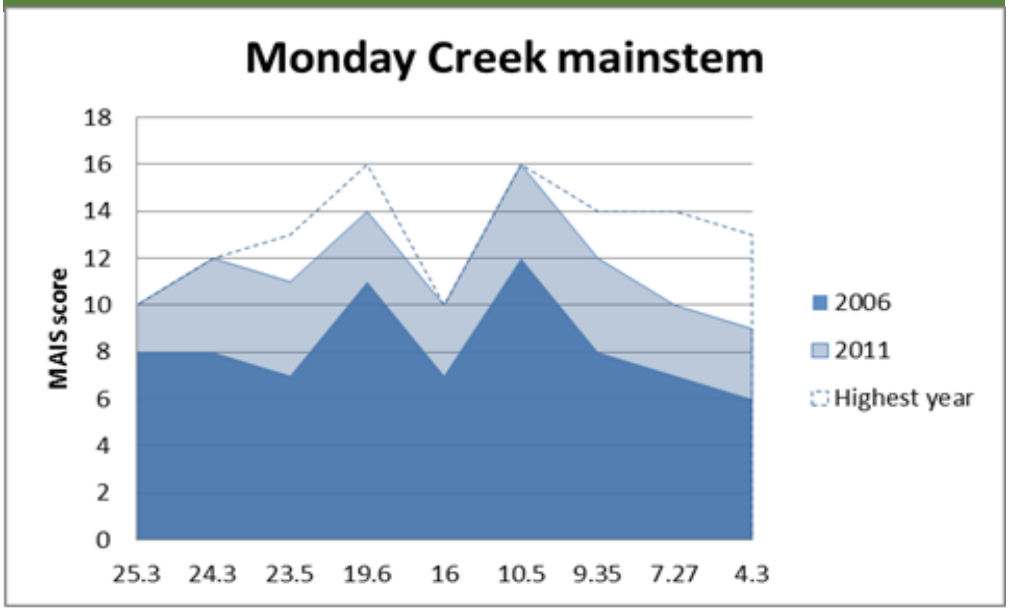
There are approximately 38 stream miles monitored each year along the mainstem of Monday Creek and major tributary Snow Fork. A restoration target for pH is 6.5. Since 2007 there have been increases and decreases in the number of stream miles that meet this target. In 2007, 19 stream miles of the 38 monitored met the pH target of 6.5. However in 2008 only 7 miles of the 39 miles monitored met this target. In 2009 and 2010 data shows an increase again with approximately 24 of the 39 miles monitored meeting the pH target. In 2011, the site near Lost Run MC00500 dropped below the pH target with an average pH value of 6.24 (figure A).

Figure A. Monday Creek pH



The majority of the long-term monitoring sites along the Monday Creek mainstem have shown steady improvements in biological quality over the last ten years (Figure B). By 2010, nine of thirteen sites had shown statistically significant ($P < 0.05$) or somewhat significant ($P < 0.10$) improvement over the previous seven to ten years. Although most sites did not achieve the high scores attained in 2010, the overall trends of improvement were sustained in 2011. Site JH00500 monitored for ten years showed modest but significant improvement for the first time. The site which has declined in quality since 2005 JH00902 is located immediately downstream the Jobs Hollow doser and is not expected to support high quality biological life, as it is located in the designated 'impacted zone' or 'mixing zone'. Two sections, between RM 24.3 and 19.6, and from 10.5 downstream, show potential for continued improvement, based on the highest year scores.

Figure B. Area of Degradation



The blue dashed line identifies the highest MAIS score ever achieved at that site throughout the monitoring time period.

Figure C. Monday Creek MAIS Regressions

RM	2001	2002	2003	2005	2006	2007	2008	2009	2010	2011	Linear trends	P-value	Yrs.
JH00902				8	6	6	4	4	4	4	declined	0.009	7
JH00500	4	6	4	7	6	5	4	7	8	9	**improved**	0.037	10
25.3				7	8	7	4	9	6	10	no change	0.553	7
24.3				6	8	12	12	11	11	12	**improved**	0.051	7
23.5	5	3	1	11	7	9	12	7	13	11	**improved**	0.011	10
19.6	8	9	10	13	11	12	12	13	16	14	**improved**	0.0004	10
16	2	6	6		12	11	10	10	10		**improved**	0.047	5
10.5	5	10	13	13	12	14		12	16	16	**improved**	0.005	10
9.4					8	9	10	9	14	12	**improved**	0.052	6
7.3				8	7	7	8	10	14	10	**some improvement**	0.070	7
4.3	2	6	2	8	6	9	7	4	13	9	**improved**	0.032	10
SY00080				9	4	13	6	7	8		no change	0.880	7
SYRM0.1				6	3	5	8	10	10		**improved**	0.008	7

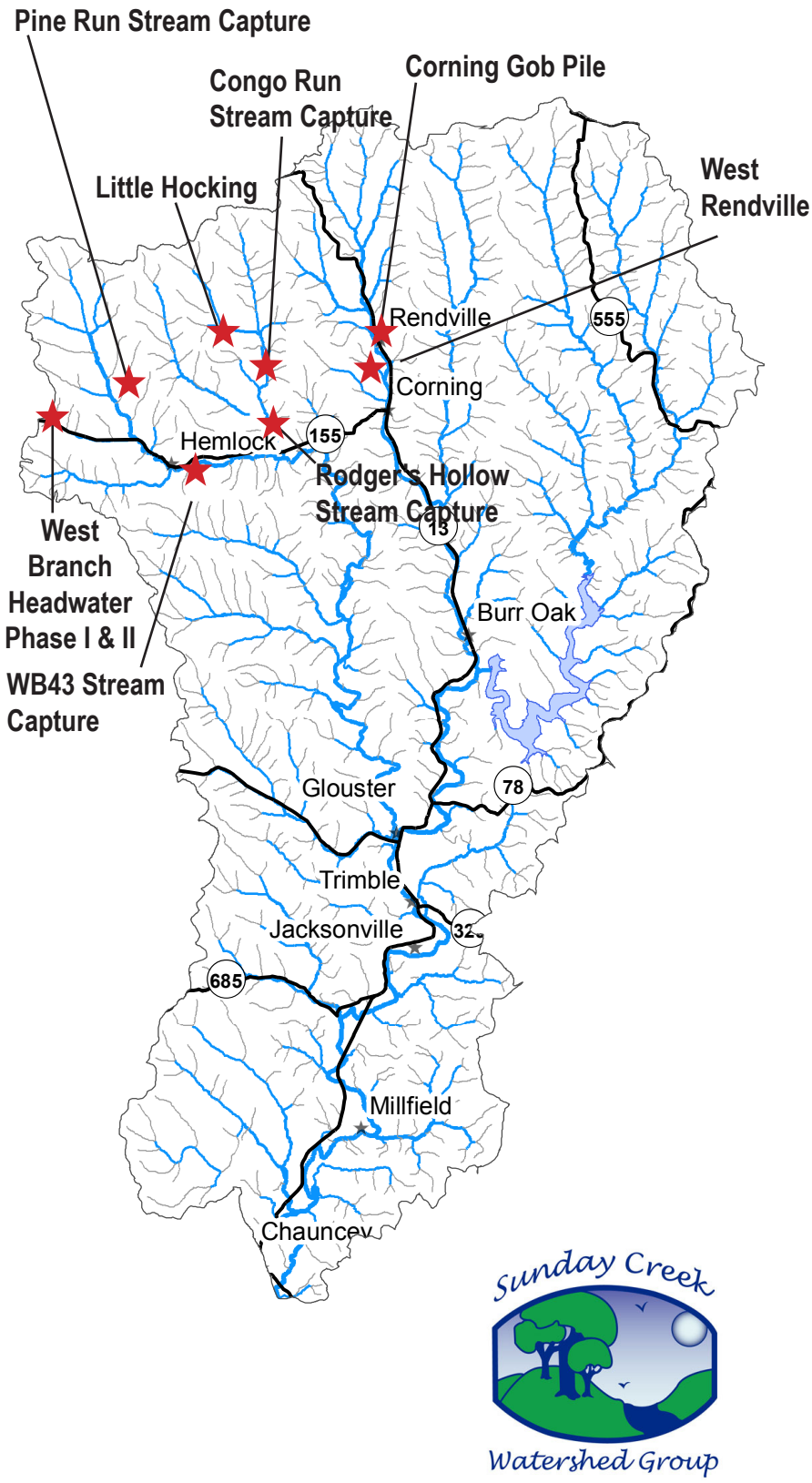
2011 NPS Report - Sunday Creek Watershed

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Sunday Creek Watershed Group (SCWG) is a nonprofit citizens group 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. Sunday Creek Watershed is a program of Rural Action, Inc., a non-profit group working to revitalize Appalachian Ohio. Sunday Creek Watershed covers 139 square miles (88,775 acres) and encompasses part of Perry, Athens, and Morgan Counties. Sunday Creek measures 27 miles long and starts flowing north of Corning and flows south through Chauncey where it enters into the Hocking River. Sunday Creek Watershed is primarily wooded (78%), 38% of the watershed has been deep mined for coal, and 15% of the land is public, owned by the Wayne National Forest. Major water quality impacts on Sunday Creek include acid mine drainage, improperly treated wastewater, illegal dumping, and sedimentation. The watershed group focuses restoration activities around these issues.

Since the group was founded in 1999, they have completed seven acid mine drainage reclamation projects within the Sunday Creek Watershed and are currently working on two new projects for next year. These projects have been funded by EPA Section 319 Grants and OSM Appalachian Clean Stream Initiative Grants with matching funds from the ODNR-DMRM. Over the last ten years, SCWG has also completed 17 upgrades of septic systems, planted thousands of trees, cleaned up over 200 tons of garbage, and educated thousands of children. The group is able to complete projects to improve water quality due to the strong partnerships of agency officials, residents, and other non-profits in the region. Sunday Creek Watershed Group completed their AMDAT plan in 2003 and is currently working on updating this plan. The watershed group has also completed an updated watershed action plan that is now officially endorsed by the State of Ohio.

To learn more about the Sunday Creek Watershed Group, visit our website at www.sundaycreek.org or call 740.767.2225.



2011 NPS Report - Sunday Creek Watershed

Generated by Non-Point Source Monitoring System
www.watersheddata.com

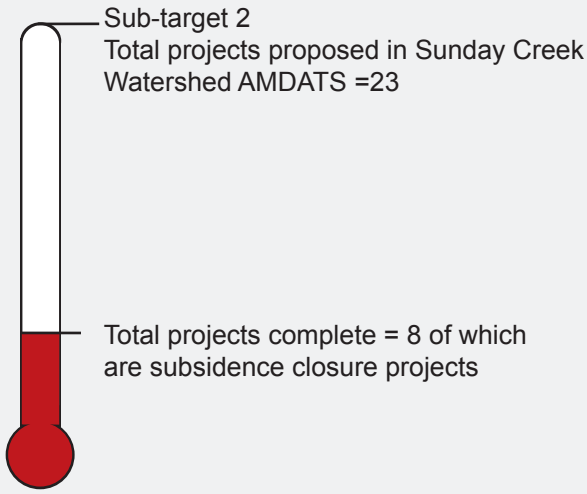
Reductions

Project Name	Year Completed	Acres Captured	Agencies funding	Estimated water diverted from entering the deep mine
Congo Run CR-15	2004	72	ODNR-DMRM, OSM	24,000,000 gallons/yr
Pine Run	2007	138	ODNR-DMRM, OEPA	50,867,000 gallons/yr
Rodgers Hollow	2007	1,600	ODNR-DMRM, OEPA	589,290,000 gallons/y
Little Hocking	2009	286	ODNR-DMRM, OSM	105,400,000 gallons/yr
West Branch WB43	2010	65	ODNR-DMRM	26,000,000 gallons/yr
West Rendville	2011	240	ODNR-DMRM, OSM	88,464,000 gallons/yr

Six stream captures located in the Sunday Creek Watershed were closed and completed from 2004-2011. A total of 2401 acres surface drainage area drained year round into the deep mines and as a result of closing these subsidence holes 884,021,000 gallons per year were diverted from entering into the deep mine thus abating the generating of acid mine drainage. Expected additional alkaline loading from these closures returning clean water to the recieving streams is 986 lbs/day. As result of the Rodgers Hollow Subsidence closure, the deep mine discharge in Drakes has seen a reduction in acidity loads by 18 lbs/day.

Biological Health Performance

Completion

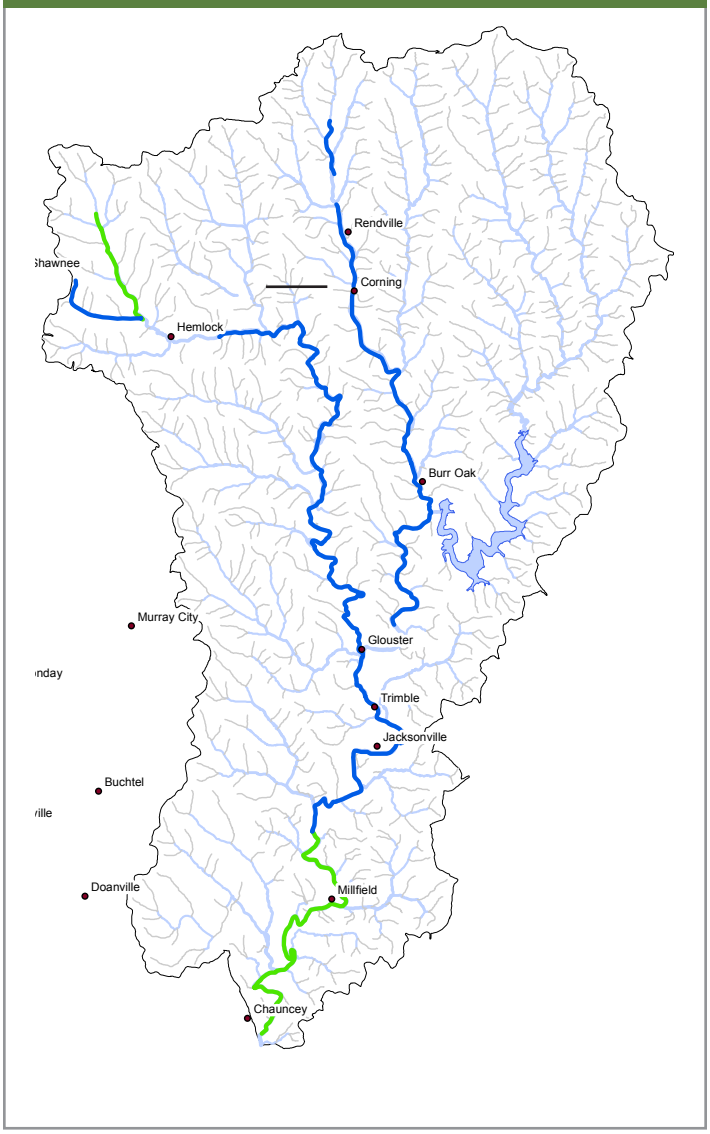


Costs

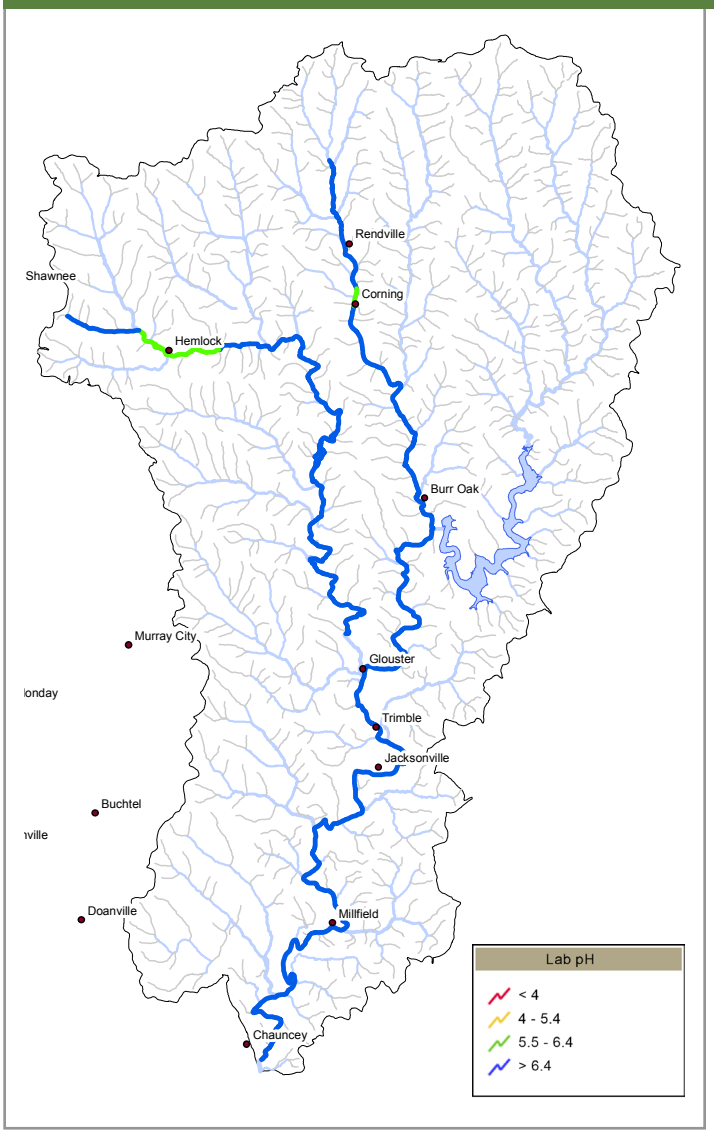
Design = $289,544
Construction = $1,676,162

Total costs through 2011 = $1,965,706
(excluding Congo Run CR-15 & WB 43 design)

Sunday Creek baseline pH

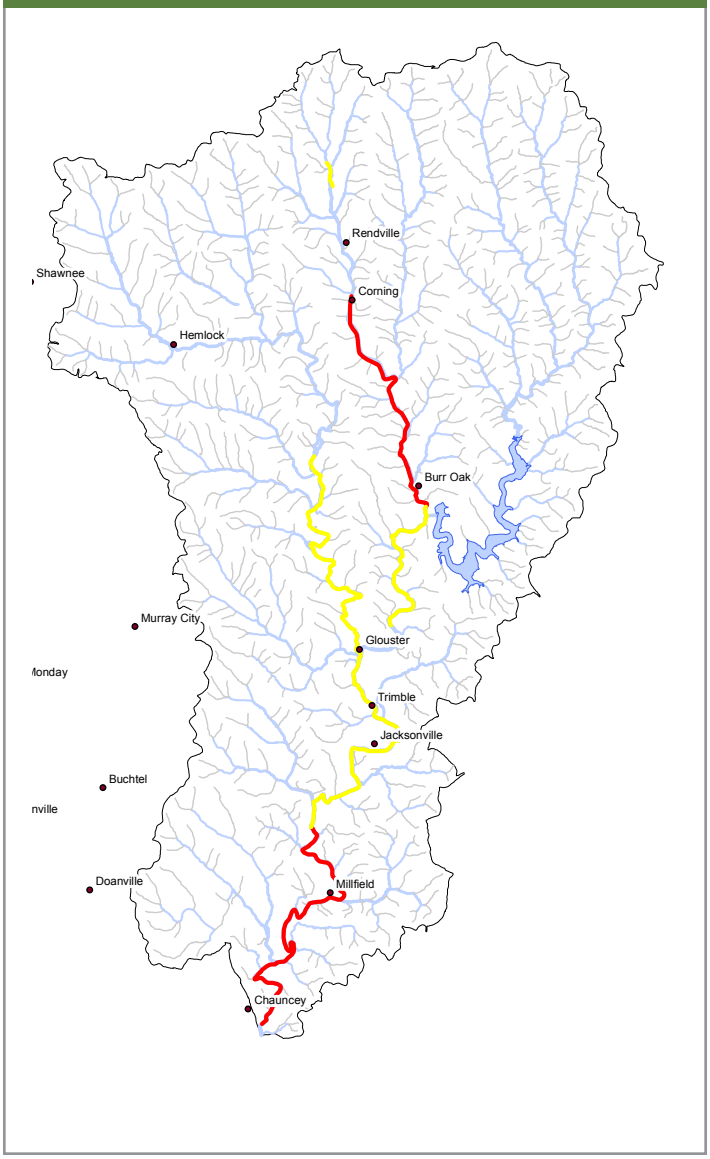


Sunday Creek 2011 pH

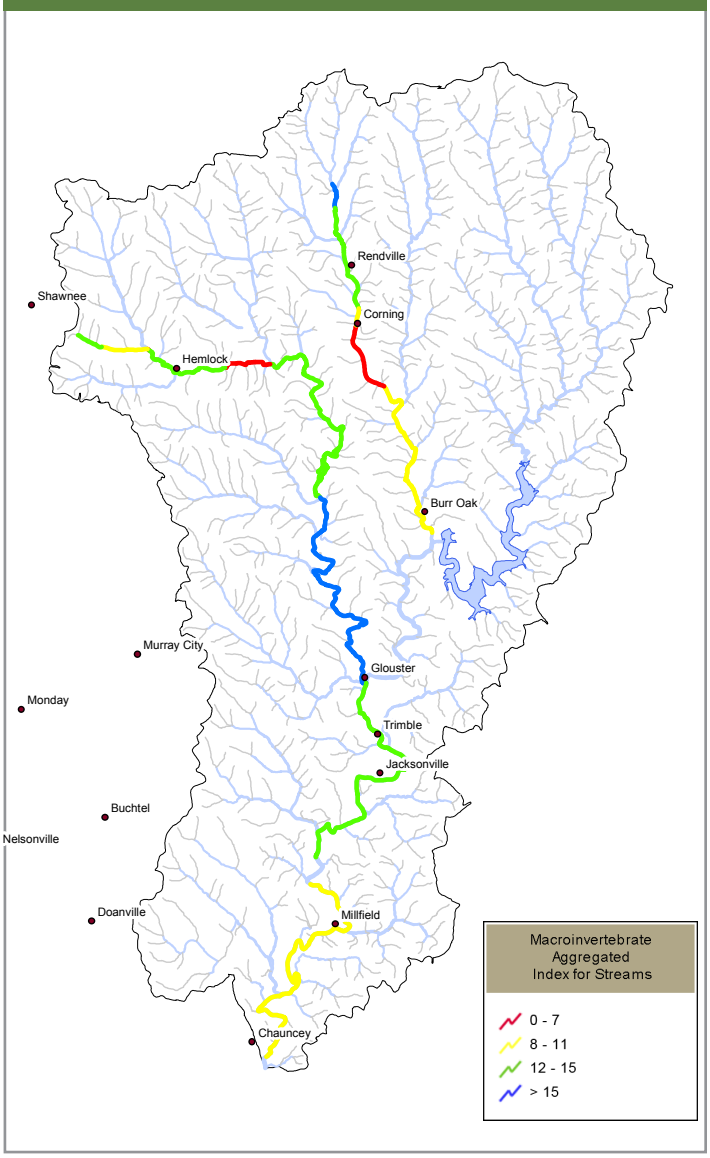


Water quality along the West Branch of Sunday Creek was degrading from baseline conditions in 2001 to 2007. Values of average pH dropped from >6.4 to 4.0-5.4 range in 2005 to 2006 and remained constant in 2007. When the subsidence features increased in Rodger's Hollow, funneling more water into the mine that generated AMD and discharged it into West Branch of Sunday Creek, the water quality decreased. However, since the subsidence closure in Rodger's Hollow in late 2007, the 2008 data for the first time shows an increase in pH along this stream segment. The average pH in 2007 at site WB 003 was 4.83, in 2008 5.97, in 2009 6.08, in 2010 6.25, and 6.51 in 2011.

Sunday Creek baseline MAIS



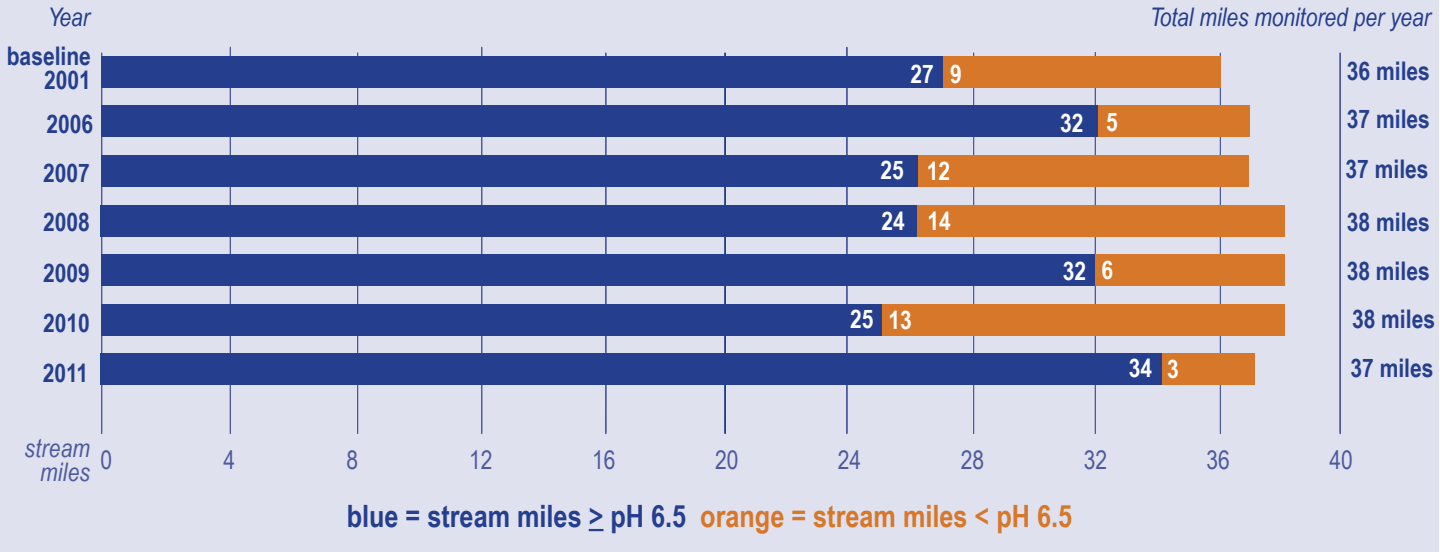
Sunday Creek 2011 MAIS



MAIS samples were collected throughout Sunday Creek at established annual monitoring stations from 2001 through 2011.

There are approximately 38 stream miles monitored each year along the mainstem of Sunday Creek and major tributary West Branch. A restoration target for pH has been set to 6.5. Since 2007 there have been increases and decreases in the number of stream miles that meet this target. In 2007 nearly 25 miles of the 35 monitored met this target. In 2008, this number remained constant. In 2009 a 25% increase was recorded with 32 stream miles of the 38 monitored met the pH target of 6.5. While in 2010, only 25 of the 38 miles met the target. In 2011, the number of stream miles meeting the pH target were as high as they have ever been with 34 of the 37 miles monitored meeting the pH target of 6.5 (Figure A).

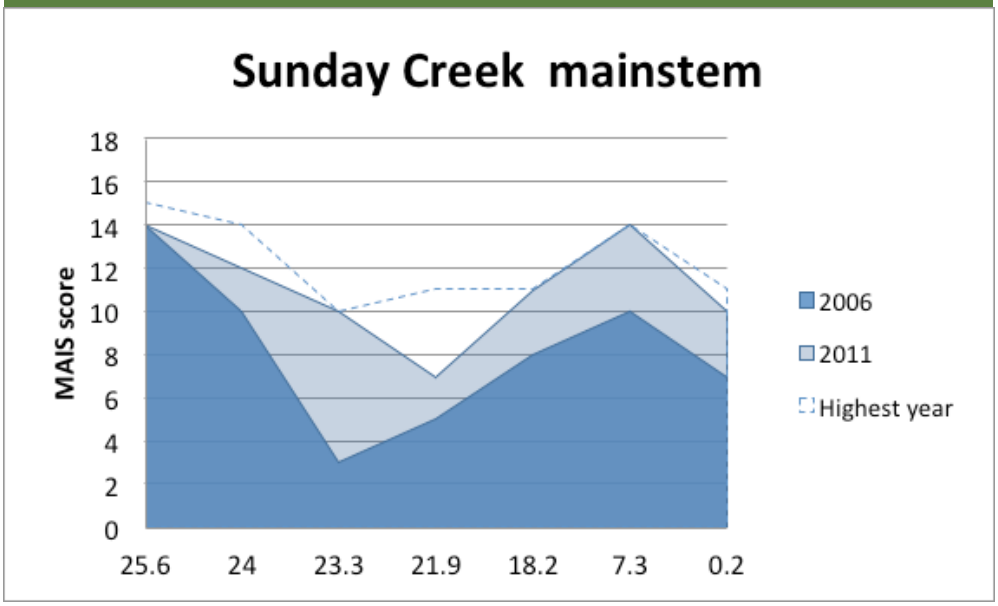
Figure A. Sunday Creek pH

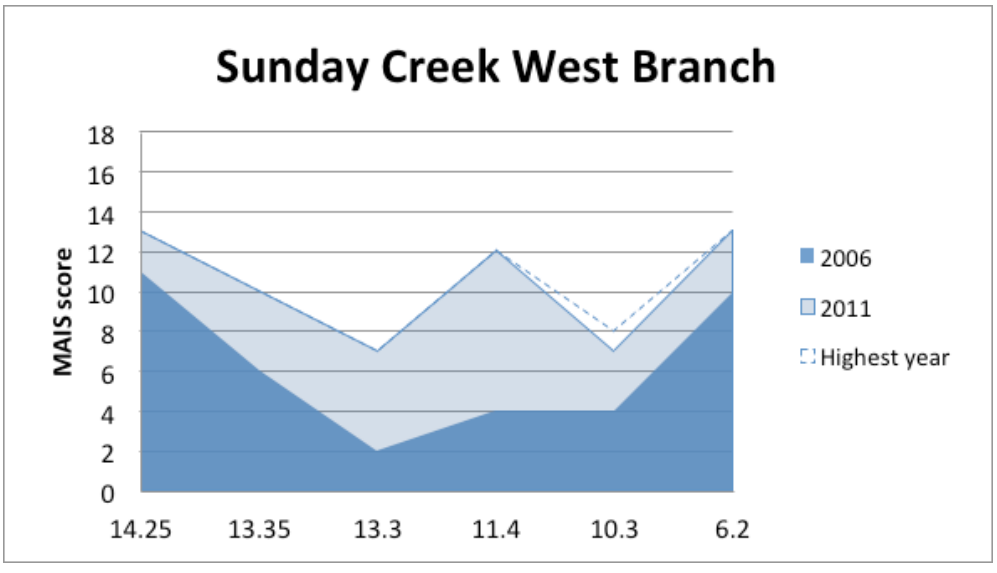


The biological quality along the Sunday Creek mainstem reflects the longitudinal pattern in water chemistry, with a sharp decline immediately below the Corning discharge (RM 24), followed by gradual improvement to RM 7.3, just upstream of the Truetown discharge (Figure B). While the biological quality for the first mile immediately downstream of the Corning discharge is consistently poor (since 2006), most of the sites between RM 21.9 and 7.3 have shown good potential for recovery, in that they have achieved notably higher scores in some years (highest year, dashed line). However, for most sites these gains were transient and lost in subsequent years.

However, the lowermost site near the mouth (RM 0.2) shows a solid and statistically significant trend of improvement over the past ten years, a good reflection of the cumulative effects of restoration activities in the watershed. More improvements in biological quality are seen in the West Branch compared to the mainstem, with four of the six monitoring sites reporting the highest biological scores since 2006 (Figure C). Three sites in the West Branch now show significant long-term improvement in macroinvertebrate scores: the site at RM 13.3, which supported almost no macroinvertebrates in 2005 (MAIS score of "1"), the mouth (RM 6.2), which has attained a score of "13" for two consecutive years, and the headwaters site (WBHW 03) (Figure D).

Figure C. Area of Degradation 2006-2011





The blue dashed line identifies the highest MAIS score ever achieved at that site throughout the monitoring time period.

Figure D. Sunday Creek MAIS Regressions

RM	2001	2002	2003	2005	2006	2007	2008	2009	2010	2011	Linear trends	P-value	yrs
Mainstem													
24				12	10	10	14	12	13	12	no change	0.346	7
23.3				5	3	2	7	12	5	10	no change	0.142	7
21.9	2	1	2	11	5	5	9	2	3	7	no change	0.332	10
18.2	5	9	8	10	8	10	5	7	8	11	no change	0.904	10
7.3	10	11	11	11	10	10	10	12	11	14	no change	0.123	10
0.2	4	2	3	8	7	3	6	11	8	10	improved	0.012	10
West Branch													
WBHW 50					11	10	11	8	12	13	no change	0.679	6
WBHW 03				5	6	4	8	6	8	10	improved	0.036	7
13.3				1	2	2	5	5	7	7	improved	0.0004	7
11.4				8	4	2	7	9	5	12	no change	0.272	7
10.3				8	4	3	4	8	4	7	no change	0.878	7
6.2				7	10	8	10	10	13	13	improved	0.008	7

TIMELINE OF THE SUNDAY CREEK WATERSHED PROJECT MILESTONES & AMD PROJECTS

1999
- Sunday Creek Watershed Group founded

2000
- Rural Action added VISTA volunteer to SCWG staff

2001
- SCWG hired first Watershed Coordinator, funded for six years

2002

2003
- Sunday Creek Watershed AMDAT completed
- SCWG Watershed Action Plan conditionally endorsed by the State of Ohio

2004
- Congo Subsidence/ Stream Capture Project completed

2005
- Sunday Creek Watershed TMDL Study completed

2006
- SCWG Coordinator funded for three more years

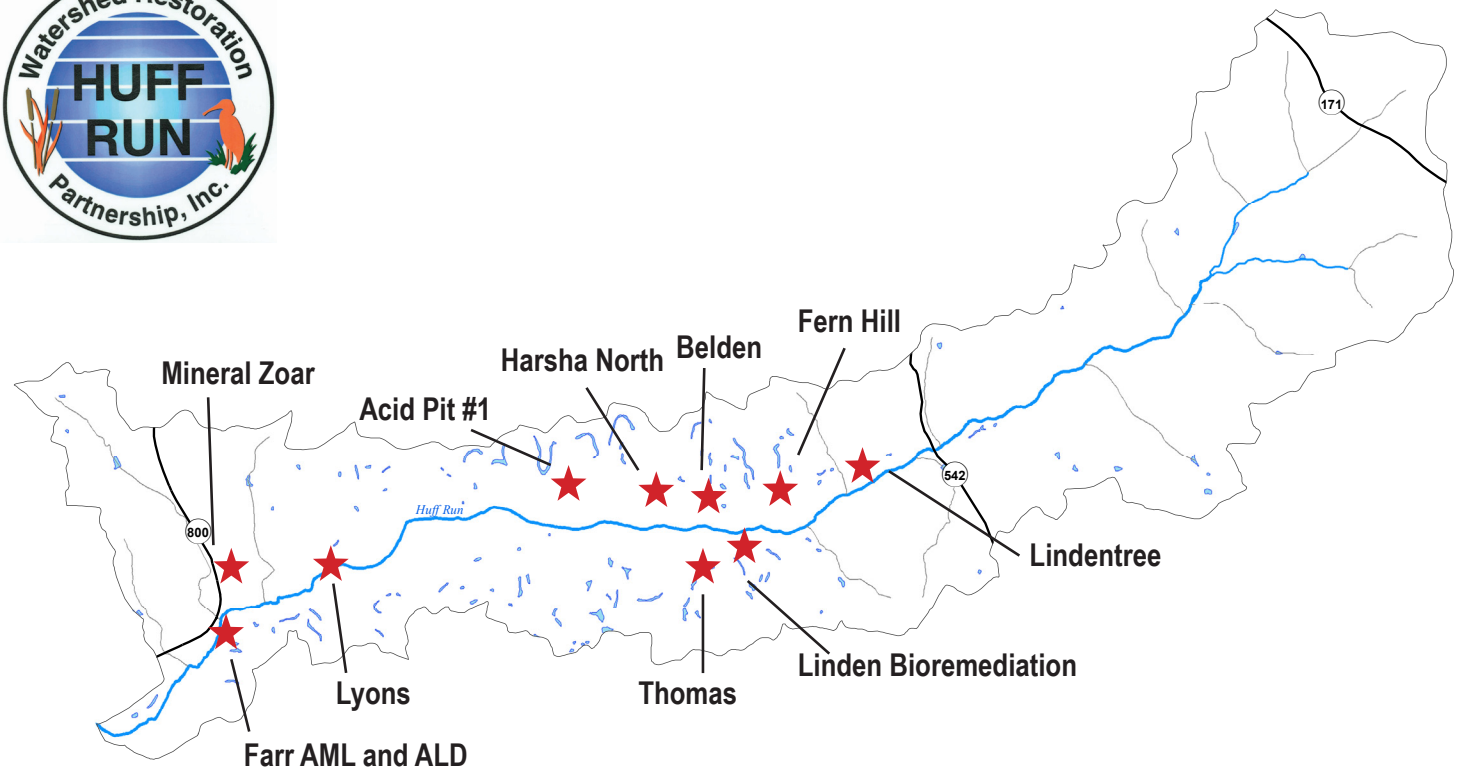
2007
- Pine Run Stream Capture Project completed
- Rodger's Hollow Stream Capture Project completed
- Corning Gob Pile Reclamation Project completed

2008

2009
- Congo Run (CR-11/ Little Hocking) Stream Capture Project completed
- SCWG Coordinator funded for three more years
- Rural Action added AmeriCorps volunteer to SCWG staff

2010
- West Branch Headwaters Phase I Project completed
- West Branch 43 Stream Capture Project completed

2011
- SCWG Watershed Action Plan officially endorsed by the State of Ohio
- West Branch Headwaters Phase II Project completed
- West Rendville Stream Capture Project completed



- 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. The 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 has 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.

2011 NPS Report - Huff Run Watershed

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Reductions

Total acid load reduction = 81 lbs/day at site HRR08

Total acid load reduction at all project sites = 965 lbs/day

excluding Mineral Zoar and Farr

Costs

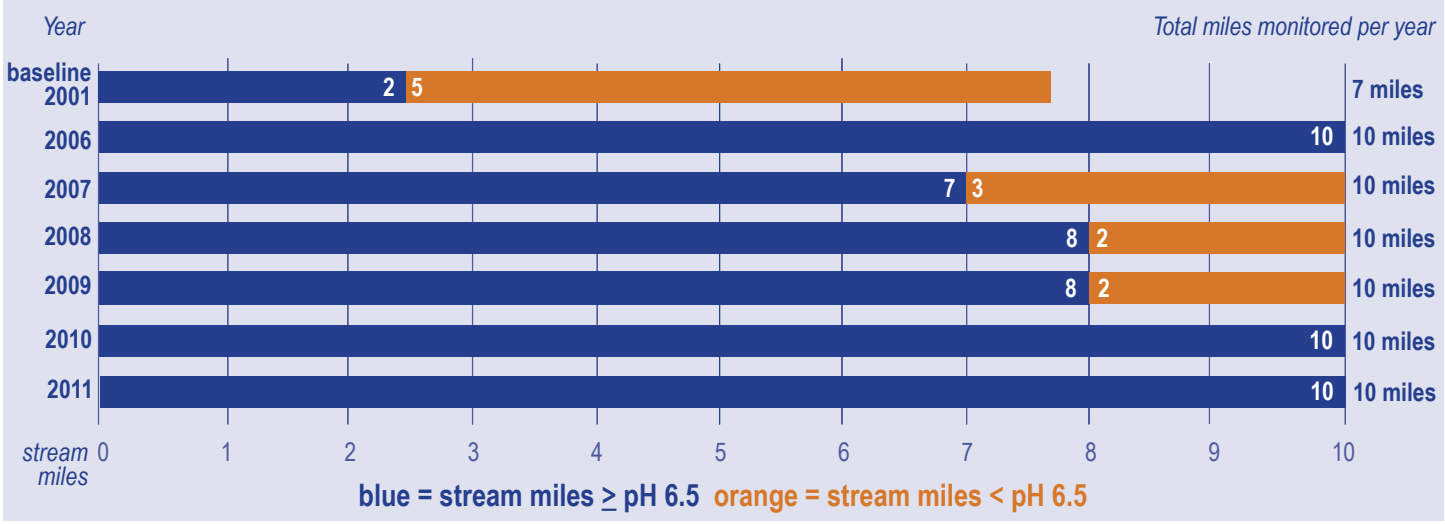
Design $649,563 (excluding Fern Hill, pond A & Belden Gob)

Construction $4,028,716

Total cost through 2011=$4,678,279

The mainstem of Huff Run is approximately 10 miles in length with monitoring occurring year round. In 2009, 8 miles met the pH target of 6.5 while the two downstream stream reaches (HRR08 and HRR07) fell slightly below the target with an average pH of 6.4. In 2010 and 2011, all 10 miles met the pH target (Figure A).

Figure A. Huff Run pH



2011 NPS Report - Huff Run Watershed

Generated by Non-Point Source Monitoring System
www.watersheddata.com

TIMELINE OF THE HUFF RUN WATERSHED PROJECT MILESTONES & AMD PROJECTS

1985
- Study funded by ODNR/DR conducted by Benatec Associates to identify acid problems in Huff Run Watershed

1988
- First abandoned mine land project, Jobes, completed in the watershed

1996
- Huff Run Watershed Restoration Partnership founded

2000
- Huff Run AMDAT completed
- Huff Run Watershed Coordinator funded for six years
- First acid mine drainage restoration project, Farr, completed in watershed

2001
- First draft of Huff Run Watershed Plan completed

2002
- Linden Bioremediation Project constructed

2003
- Acid Pit Restoration Project completed

2004
- Lindentree Restoration Project completed

2005
- Rural Action and Huff Run awarded US EPA Targeted Watershed Grant
- Rural Action added VISTA volunteer to Huff Run staff
- Second draft of Huff Run Watershed Plan authored, endorsed by the State of Ohio
- Lyons Restoration Project constructed

2006
- Harsha North Restoration project completed

2007

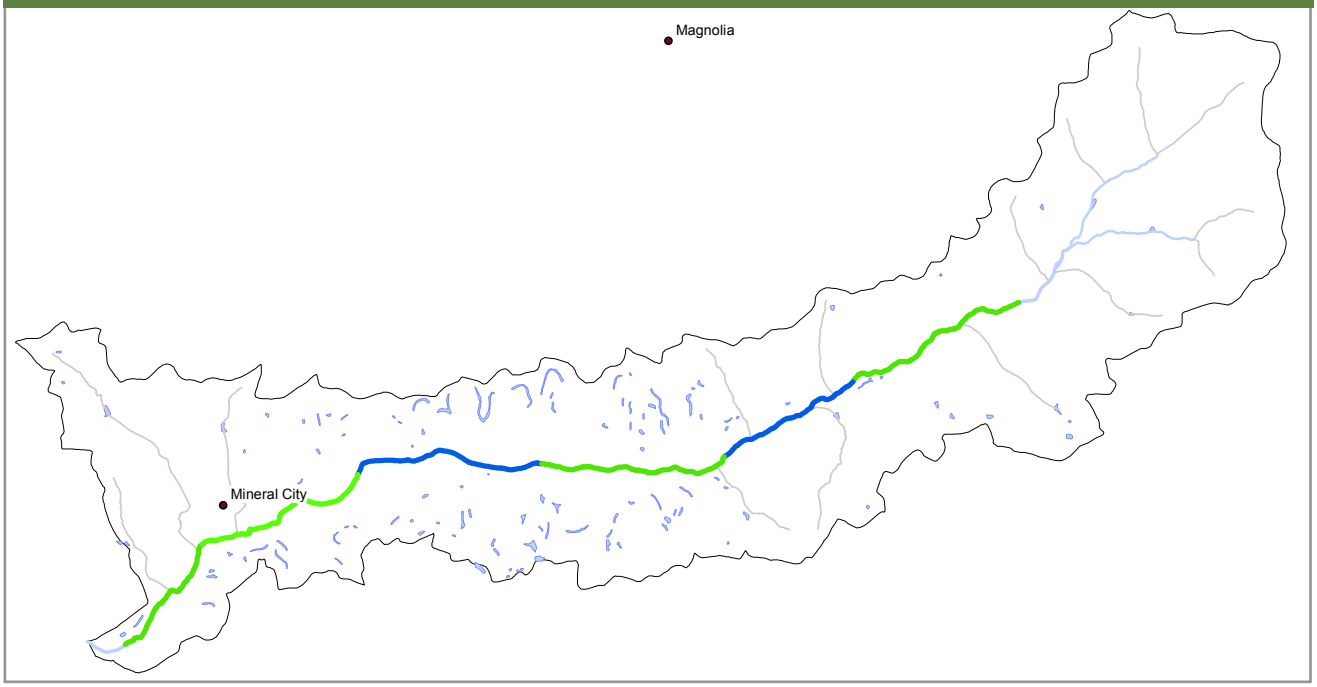
2008
- Belden Restoration Project constructed
- Fern Hill (HR-42) Phase II Project constructed

2009
- Huff Run Watershed Coordinator funded for three years
- Mineral Zoar Project completed
- Rural Action added AmeriCorps volunteer to Huff Run staff

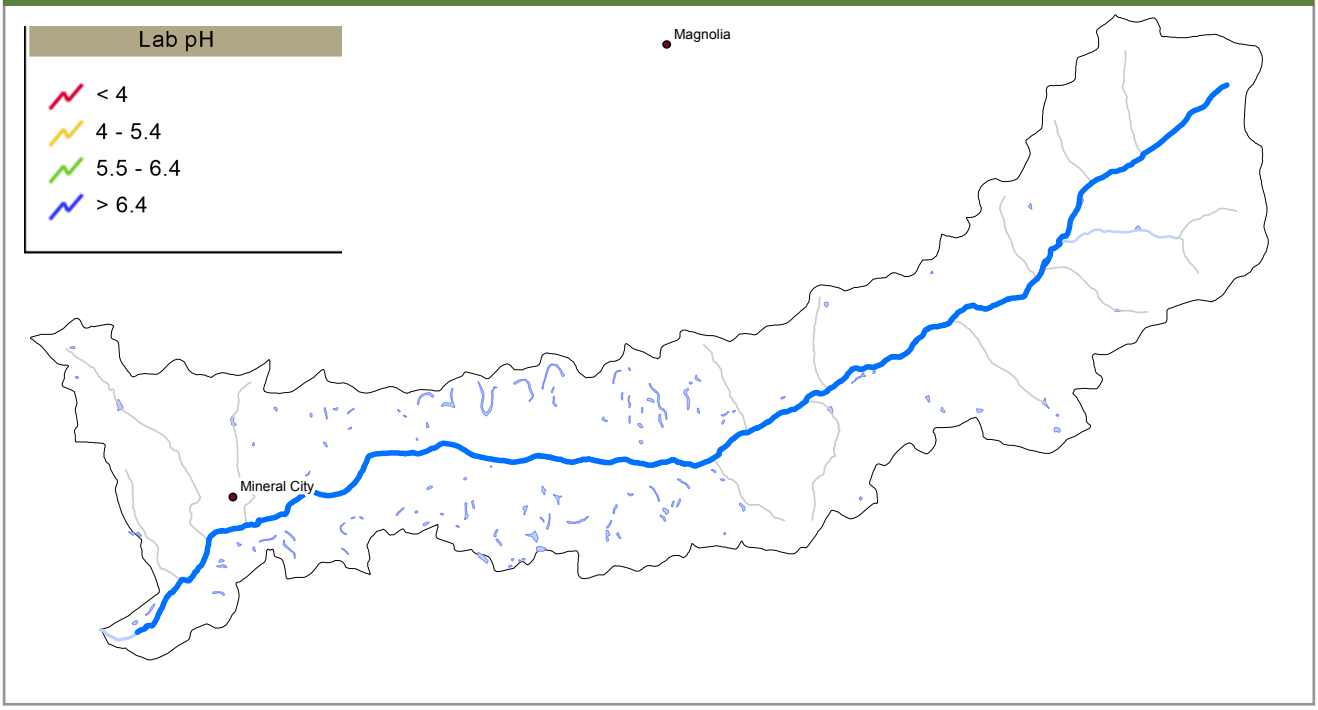
2010
- Thomas Project, Fern Hill Pond A & Belden Gob pile constructed

2011
- Lyons II constructed

Huff Run baseline pH

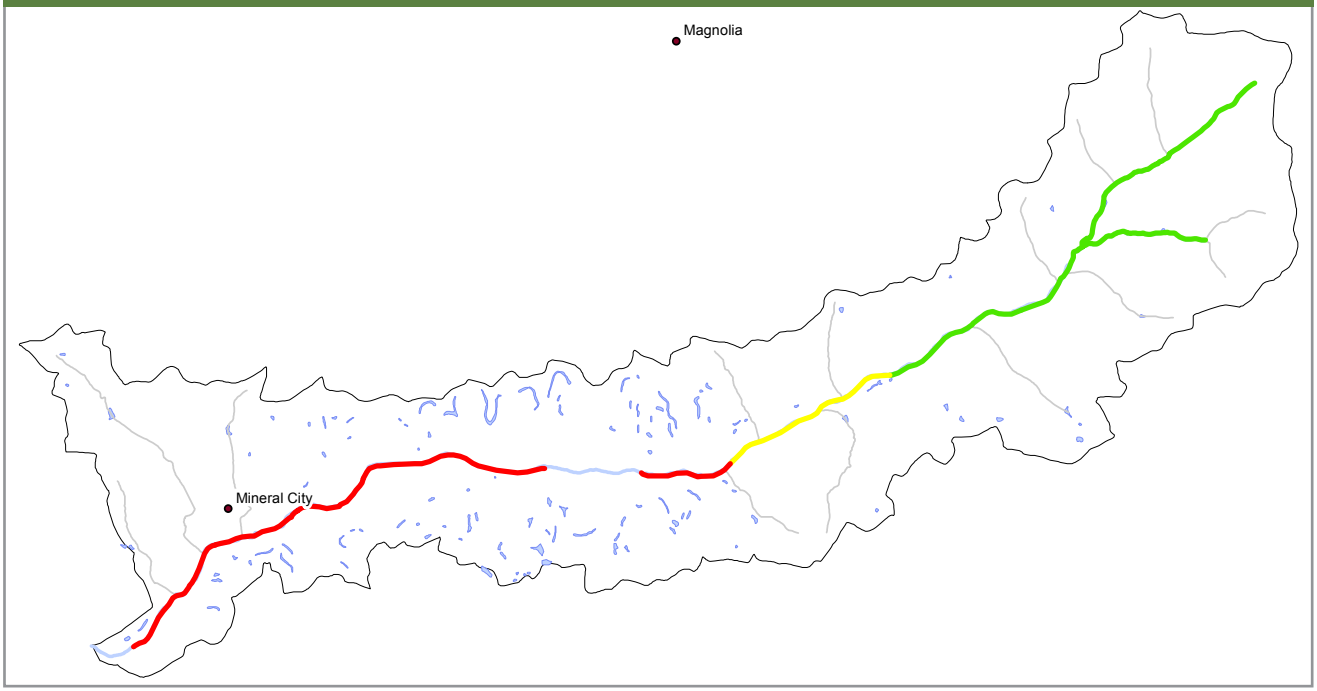


Huff Run 2011 pH

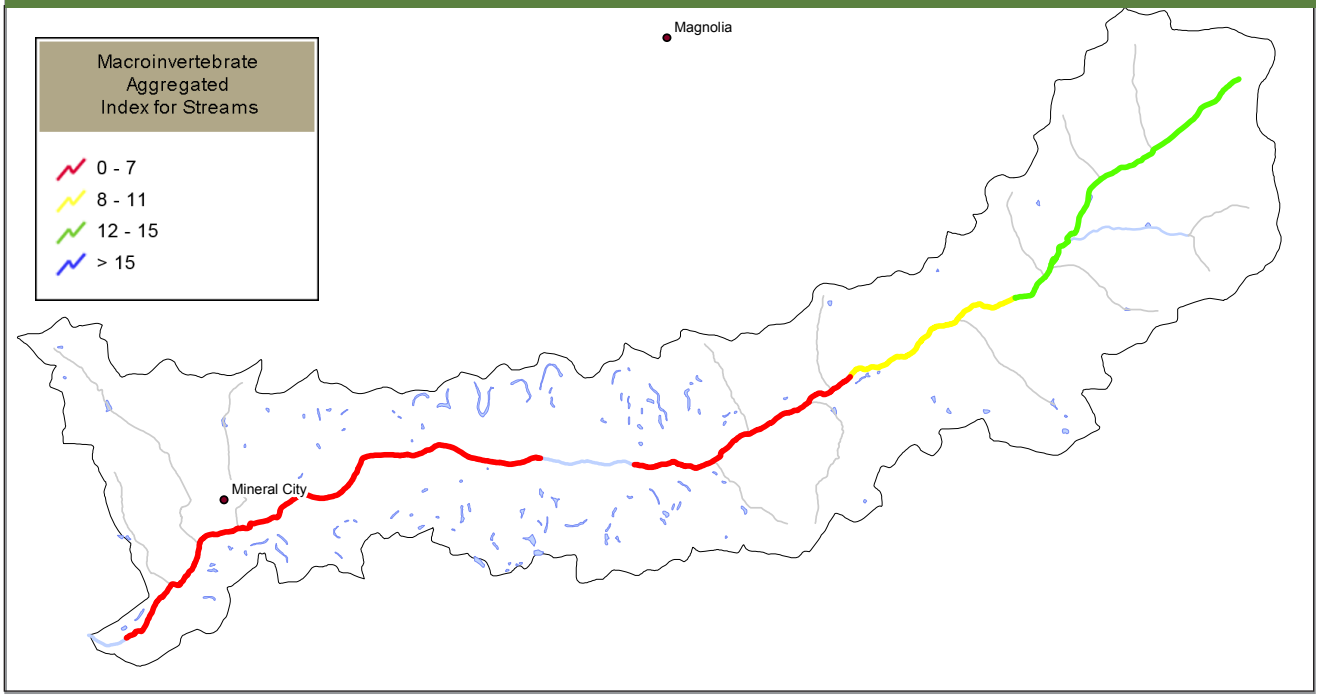


Huff Run pH values have improved from baseline conditions (1985-1998) to 2011. The entire length of Huff Run has met the pH target (6.5) for the last two years.

Huff Run baseline MAIS



Huff Run 2011 MAIS

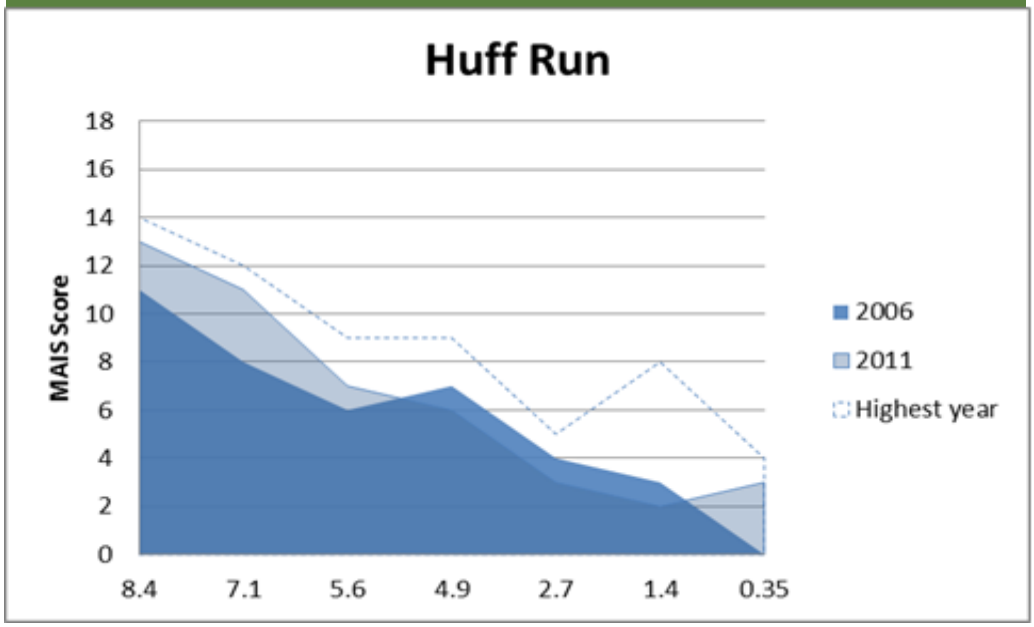


Biological quality in Huff Run decreases from headwaters to the mouth.

Biological Water Quality

Biological quality in Huff Run (based on macroinvertebrate data) showed significant improvements at five stations between 2006 and 2009 (Figure B), but in 2010 scores dropped at the headwaters (RM and 8.4) and the two lowermost sites (RM 1.4 and 0.35), reducing the strength of the trend such that only two river miles (RM 7.1 to 4.9) exhibit more stable improvements in biological quality (Figure C).

Figure B. Huff Run Area of Degradation 2006-2011



The blue dashed line identifies the highest MAIS score ever achieved at that site throughout the monitoring time period.

Figure C. Huff Run MAIS Regressions

RM	2005	2006	2007	2008	2009	2010	2011	Linear trends	P-value	No. of years
8.4	14	11	12	12	13	9	13	no change	0.537861	7
7.1	12	8	8	8	9	11	11	no change	0.699987	7
5.6	8	6	7	6	8	9	7	no change	0.547054	7
4.9	6	7	9	8	9	9	6	no change	0.629812	7
2.7	5	4	5	3	4	5	3	no change	0.337149	7
1.4	2	3	3	2	8	2	2	no change	0.821827	7
0.35	3	0	4	3	4	3	3	no change	0.449765	7

Section III – AMD project reports

Raccoon Creek Watershed comprehensive acid mine drainage projects progress report for 2011.

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 in the 2011 NPS monitoring report:

1. Carbondale II Doser
2. Mulga Run
3. Salem Road/Middleton Run
4. State Route 124 Seeps
5. Flint Run East
6. Lake Milton
7. Buckeye Furnace/Buffer Run
8. East Branch Phase I
9. Pierce Run
10. East Branch Phase II & III
11. Harble Griffith
12. Orland Gob Pile

Archive

13. Hope Clay – Status Completed archived in 2008 report*

* "Status Completed" projects are no longer being monitored

2011 NPS Report - Raccoon Creek Watershed - Carbondale II Doser

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete: 2004 ODNR Project Number: AT-WI-05

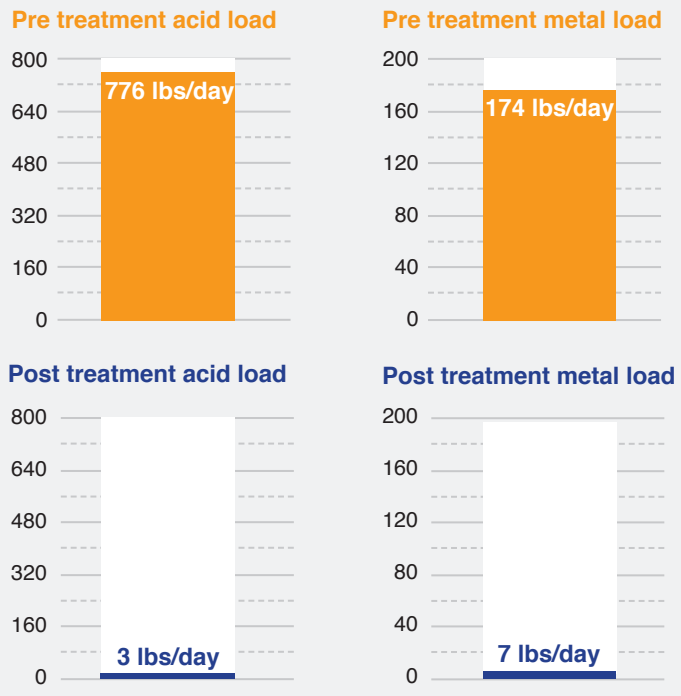
Pre-construction

Carbondale East Seep, Photo by Brett Laverty

Post-construction

Carbondale II Project Doser, Photo by JT Kneen

Site: HF131



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 majority of AMD in Hewett Fork originates from abandoned underground coal mines near Carbondale. ODNR-DMRM installed a passive wetland treatment system to reduce the acid and metal load from two mine portals in this area in the mid 1990's. This wetland was effective at reducing metal and acid loads but was not efficient enough to produce improvements in Hewett Fork. The Carbondale Doser was implemented as Phase II at the site to remediate the entire acid load from the mine discharge in 2004. 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. 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 one with 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 773 lbs/day of acid were reduced from entering into Hewett Fork as a result of this AMD reclamation project. In addition to the acid load reduction there is an addition of approximately 50 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 167 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.

As a result of the Carbondale II 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 Doser, post-construction data shows pH in the range of 6.1– 9.0 downstream of the project discharge. The net acidity concentrations decreased, showing net alkaline conditions continuing for 11 miles downstream to station HF010.

Figure 1. Pre and Post pH

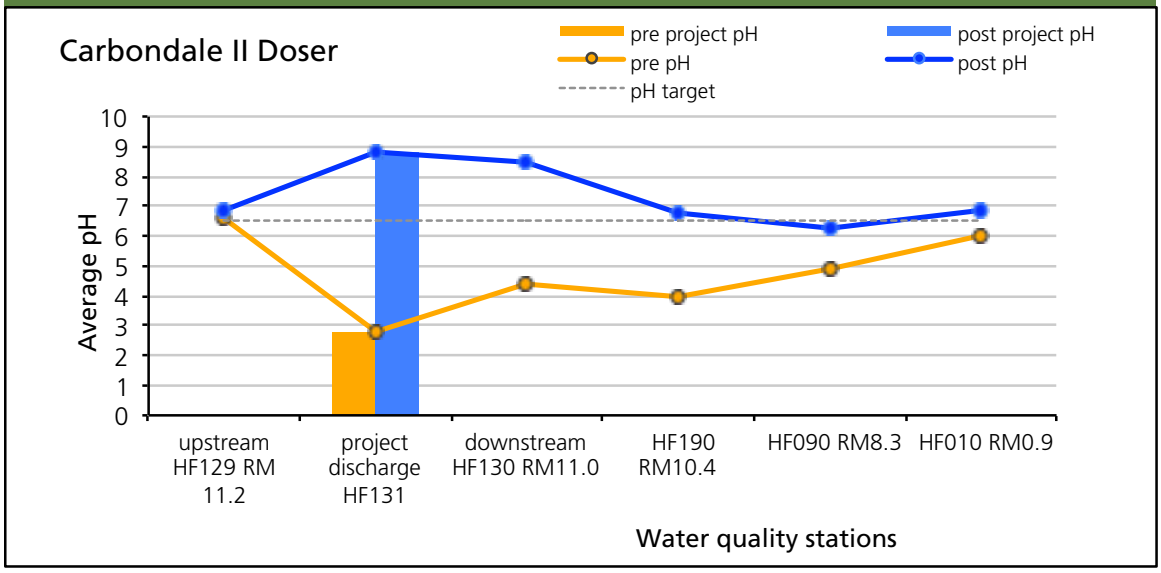
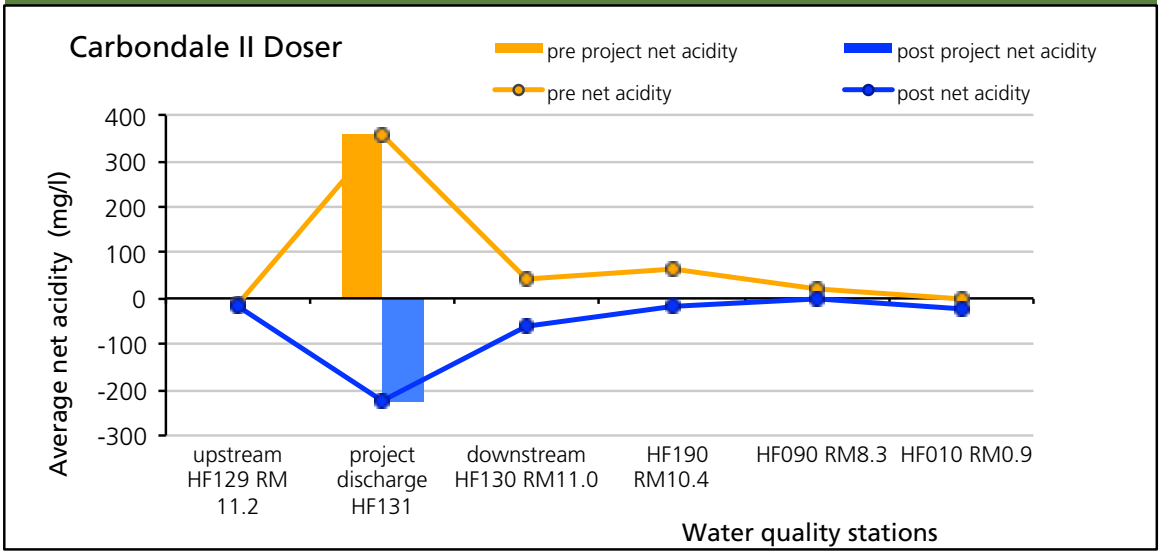


Figure 2. Pre and Post Acidity



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 6/21/1996 to 5/1/2003 for pre-construction and from 6/1/2004 to 12/31/2011 for post-construction.

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 Doser site is controlled primarily by deep mine drainage and not surface drainage.

Figure 3. Acid Load Reduction

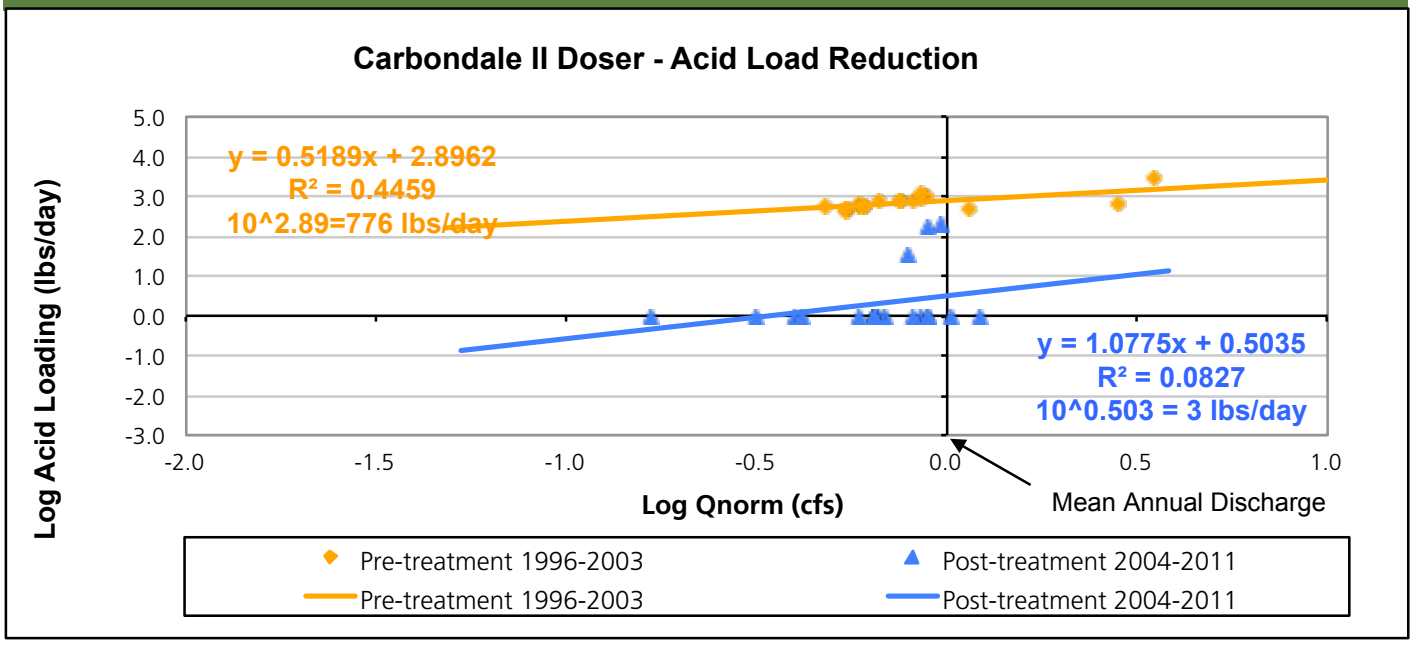
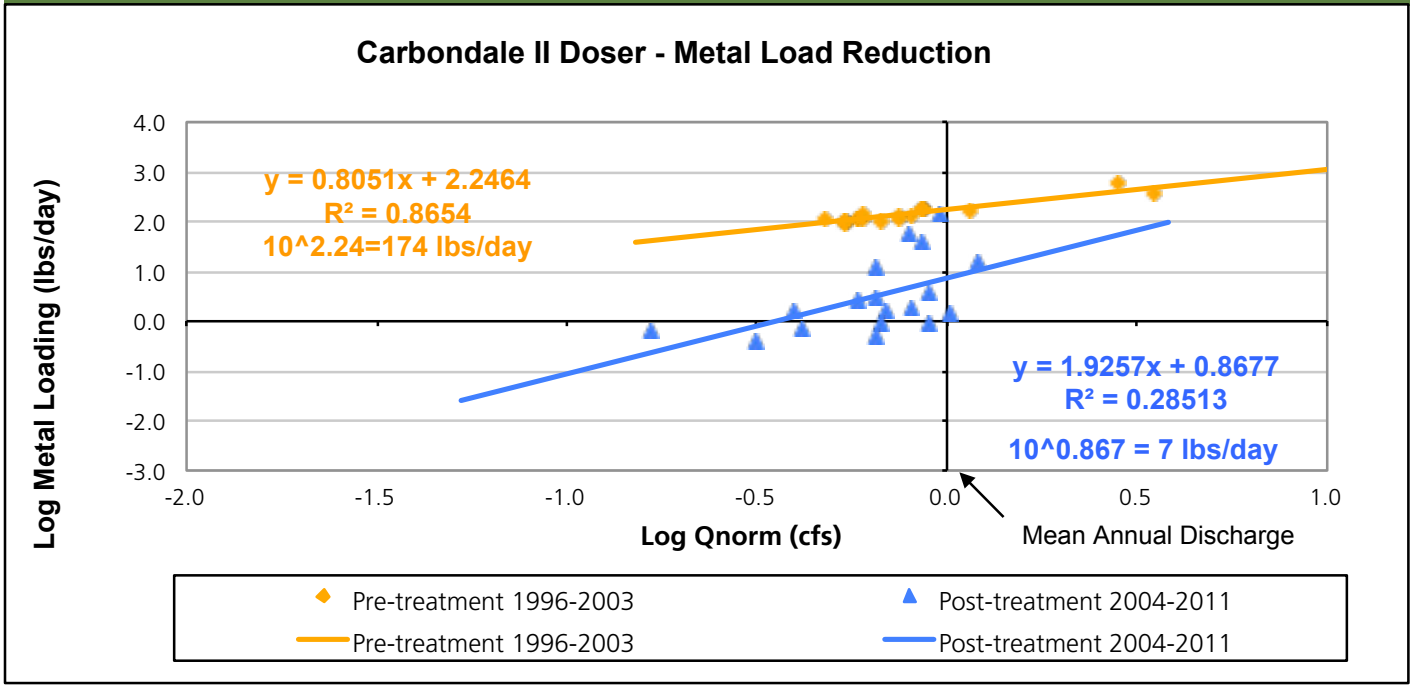


Figure 4. Metal Load Reduction



Similar to other environmental best management practices (BMPs), performance of passive acid mine drainage reclamation projects are also expected to decline with time. Active treatment systems are not expected to decline with time but sometimes need to undergo maintence. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6. The decline seen in 2011 was a resut of varieation in dosing rates.

Figure 5. Yearly Acid Load Reduction

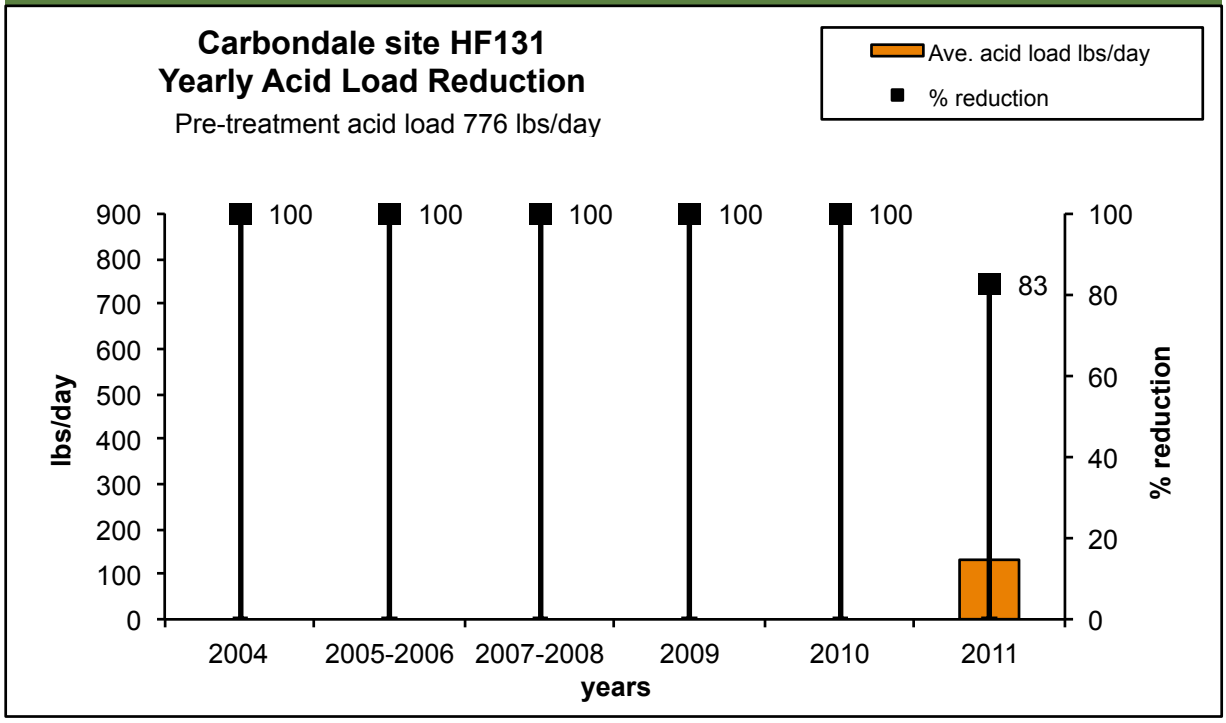
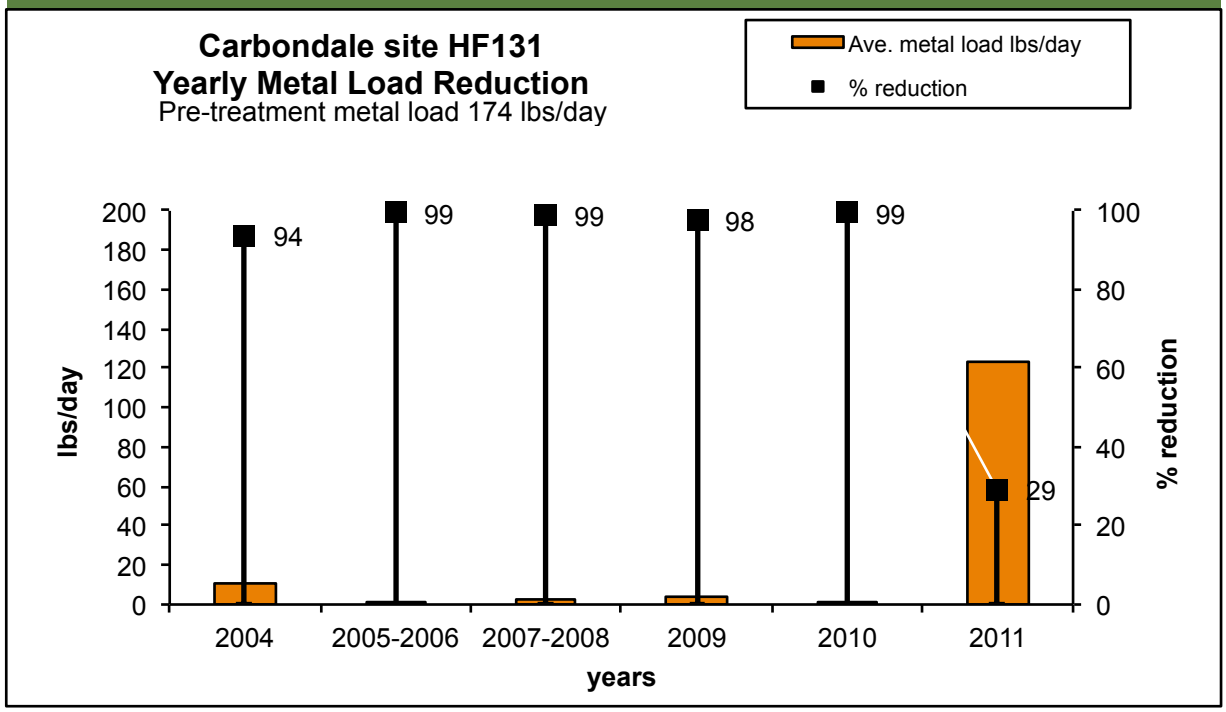


Figure 6. Yearly Metal Load Reduction



2011 NPS Report - Raccoon Creek Watershed - Mulga Run

Generated by Non-Point Source Monitoring System
www.watersheddata.com

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

Pre-construction

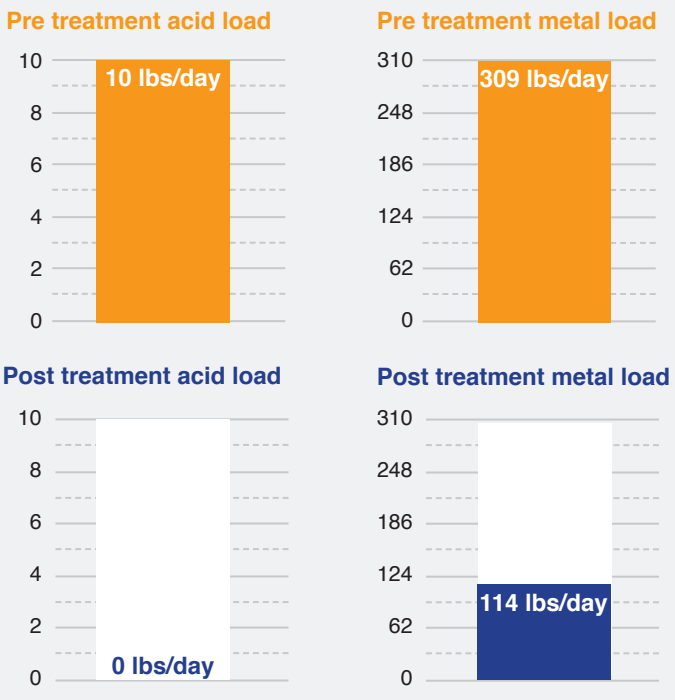
Underground mine entrance, Photo by Brett Laverty

Post-construction

Jaymar Steel Slag Leach Bed, Photo by Brett Laverty

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. Mulga Run is considered the third largest contributor of acid mine drainage to this subwatershed according to the AMDAT in 2001. Due to drainage from abandoned deep mines and un-reclaimed coal refuse piles throughout, a basin wide treatment approach was used to reduce acid and metal loads to Little Raccoon Creek. 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 percent. 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 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. On average approximately 10 lbs/day of acid and 195 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

Site: MR0010



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

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 1 and 2 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 1 and 2.

Figure 1. Yearly Acid Load Reduction

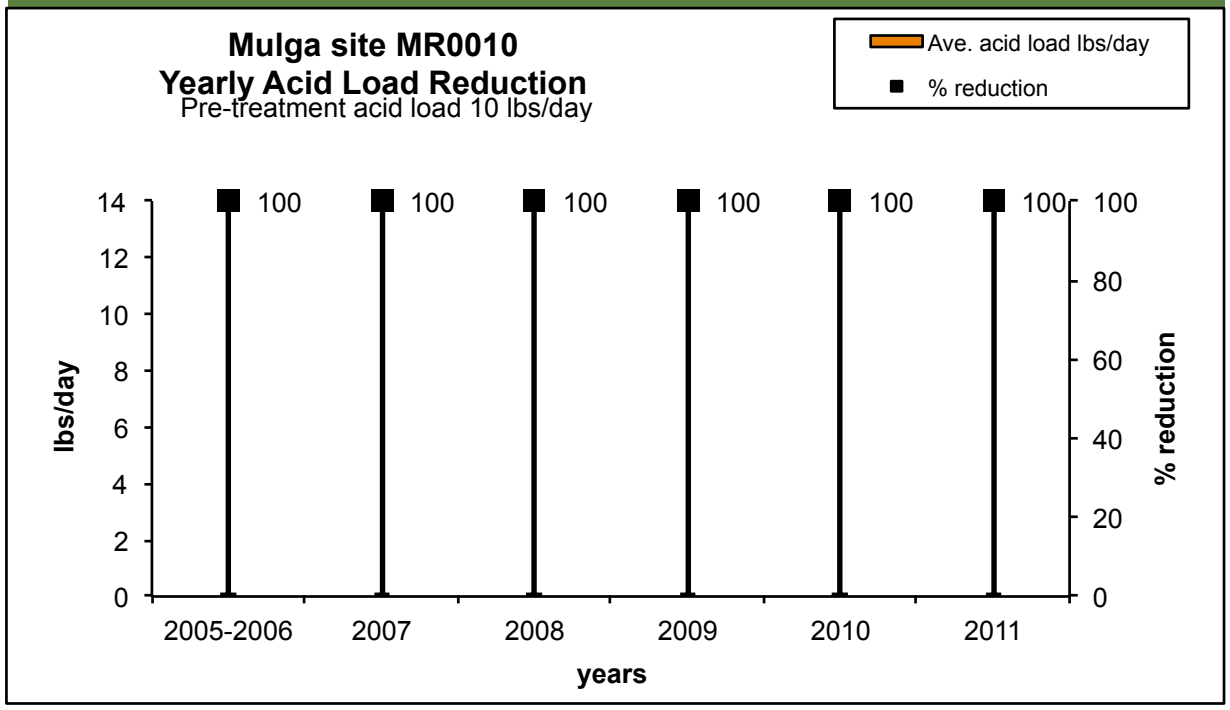
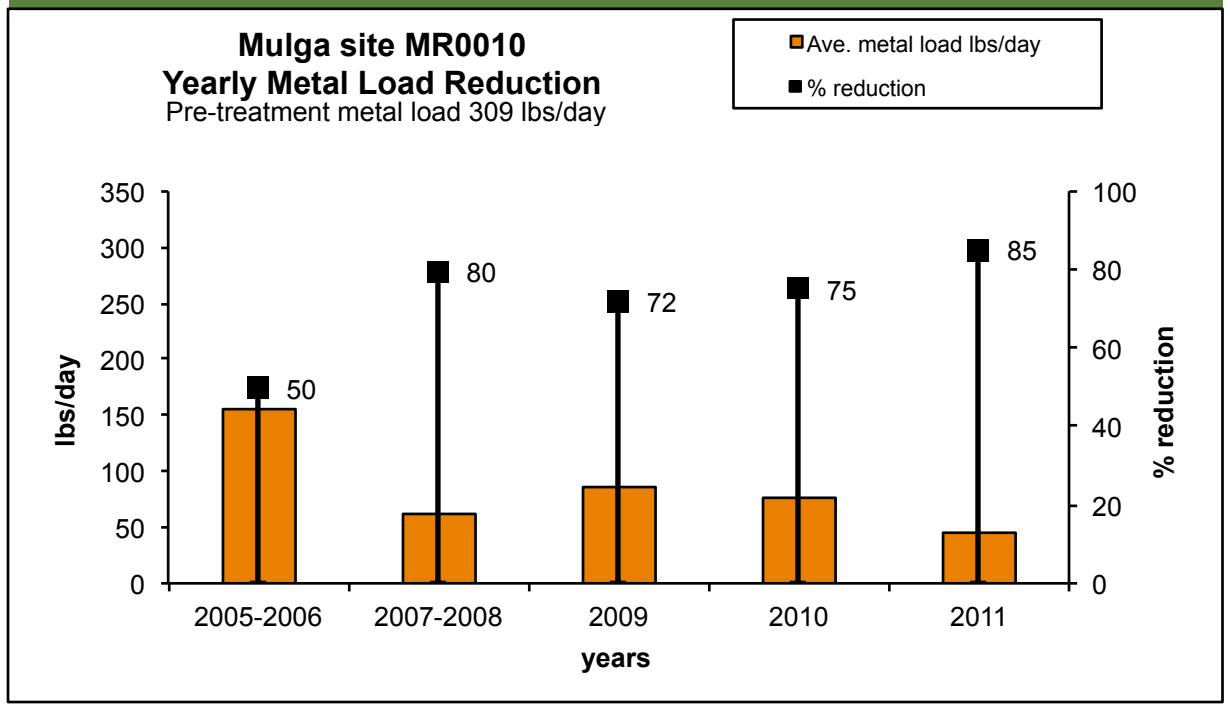


Figure 2. Yearly Metal Load Reduction



2011 NPS Report - Raccoon Creek Watershed - Salem Road/Middleton Run

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete: 2005 ODNR Project Number: JK-MI-51

Pre-construction

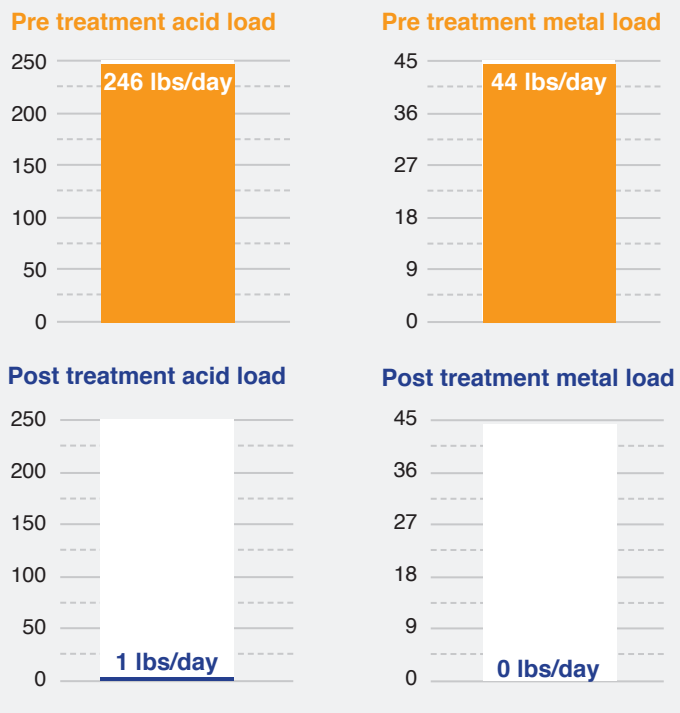
Exposed mine pit floor, Photo by Brett Laverty

Post-construction

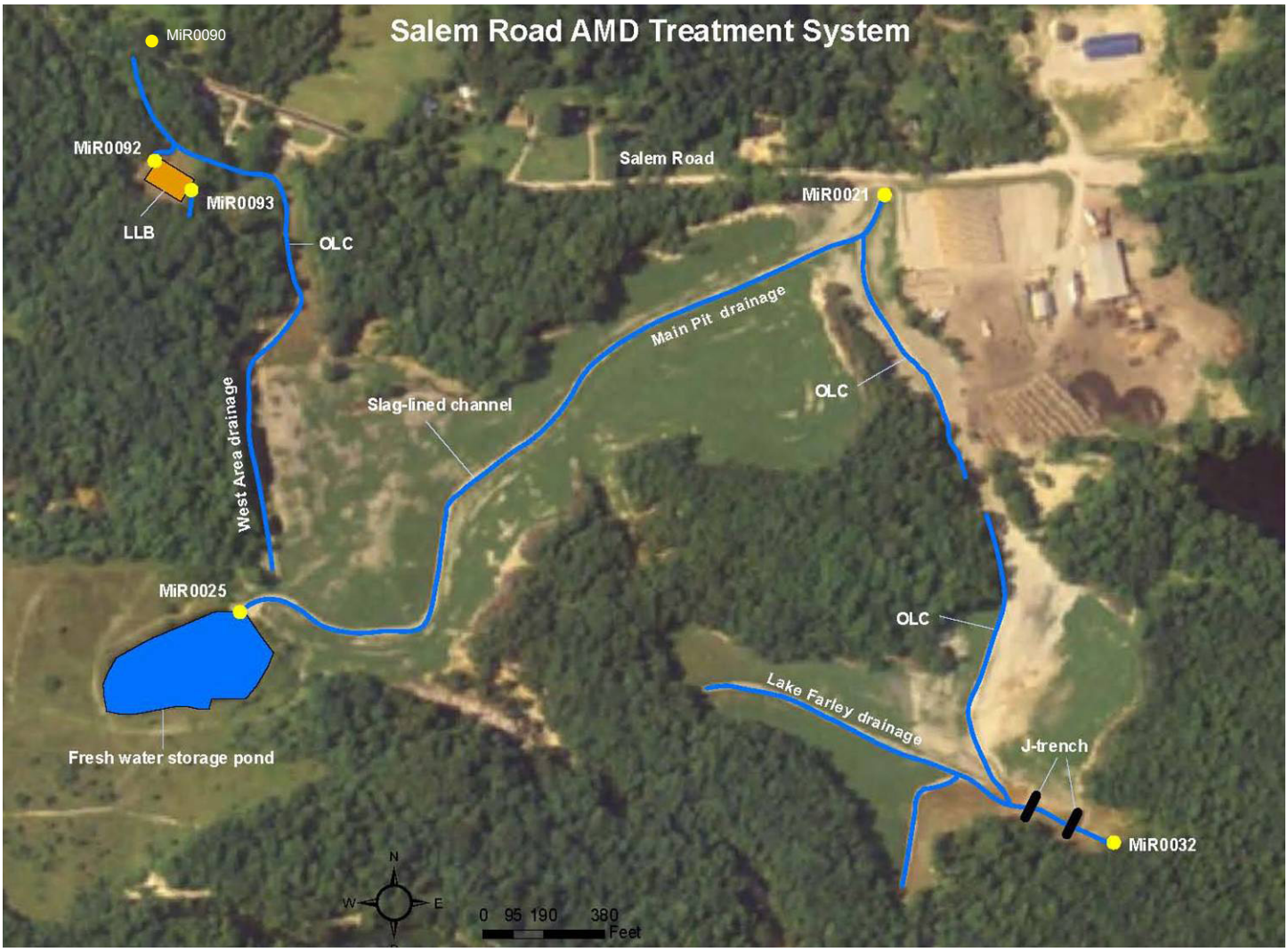
Middleton Run limestone channels, Photo by Ian Hughes

Salem Road/Middleton Run Project is located in Section 15 of Milton Township in Jackson County and lies within the 14-digit HUC unit #05090101050030. The site totals 60 acres and is located in the Little Raccoon Creek subwatershed. This large area has been affected by deep mines, strip mine lands, and un-reclaimed mine spoil that was part of the Broken Aro mine. Abandoned surface mines affect about 63% of this watershed while abandoned subsurface mines affect about 5%. The main valley on the sites was exposed pit floor with high amounts of clay and acidic spoil. Additionally, acidic lakes were present as well as a discharging underground mine. This project has three different drainages, all tributaries to Middleton Run. The design was completed by GAI Consultants Inc. and Bergmann Associates for $193,283. The treatment approach for this site was to install 3 separate treatment components consiting of: open limestone channels, steel slag channels, reclamation, J-trenches, and a limestone leach bed (see diagram on page 3 of this report). 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. Data monitored at the mouth of Middleton Run (MiR0010) for 2006-2008 have shown that 554 lbs/day of acid and 50 lbs/day of metal loads have been reduced from entering Little Raccoon Creek. 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. On average approximately 245 lbs/day of acid and 44 lbs/day of metals were reduced from entering into Middleton Run Creek as a result of site MiR0021 reclamation project. Each of the three treatment components, MiR0021, MiR0032, MiR0090 were evaluated in 2008 and 2009 but this analysis was discontinued in 2010 because monitoring in 2008 to 2009 showed site MiR0021 as the only treatment functioning and providing alkalinity for Middleton Run. The other two treatment sites (MiR0032 and MiR0090) have failed due to clogging. No data collected in 2011. Salem Road/Middleton Run remains an active site and will be evaluated in 2012.

SITE: MiR0021



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



An analysis of the acid and metal load reductions of the three separate treatment components are shown below.

Sample site ID	Description of the sampling station
MiR0090	Tributary draining limestone leach bed treatment, site is at crossing with Salem Road
MiR0032	Sample site located directly below the dam at MiR0031. Two limestone J-trenches with steel slag cores (experimental). Reclamation of mine spoil and removal of acicidic strip pit.
MiR0021	The site represents discharge across the former mine pit floor that was reclaimed. Sample site is at the Salem Road culvert (Fresh water pond draining into a limestone and steel slag channel.)

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 1 and 2 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 1 and 2.

Figure 1. Yearly Acid Load Reduction

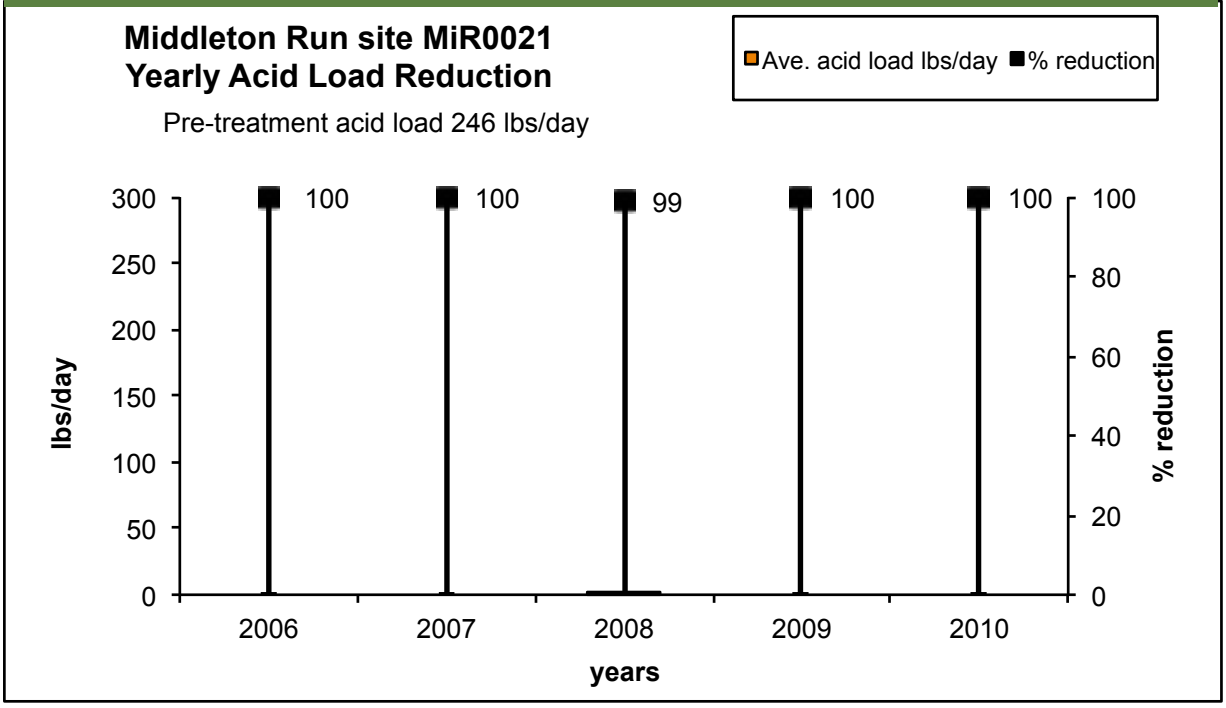
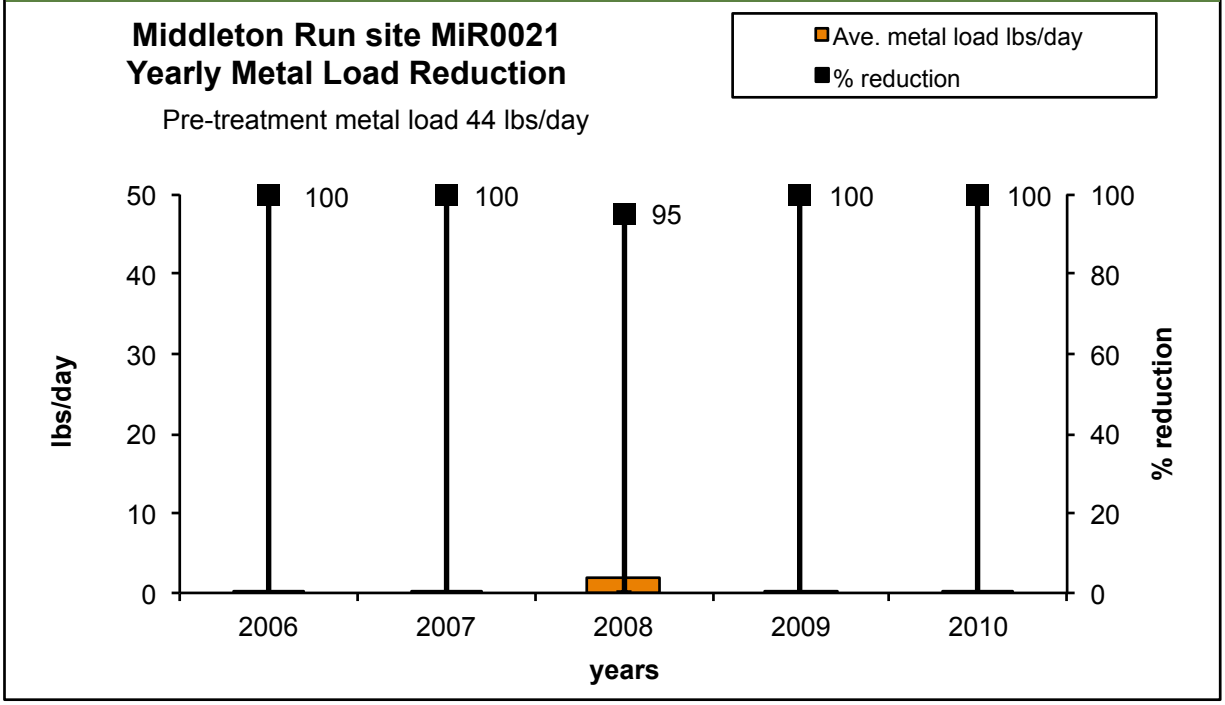


Figure 2. Yearly Metal Load Reduction



2011 NPS Report - Raccoon Creek Watershed - State Route 124 Seeps

Generated by Non-Point Source Monitoring System
www.watersheddata.com

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

Pre-construction

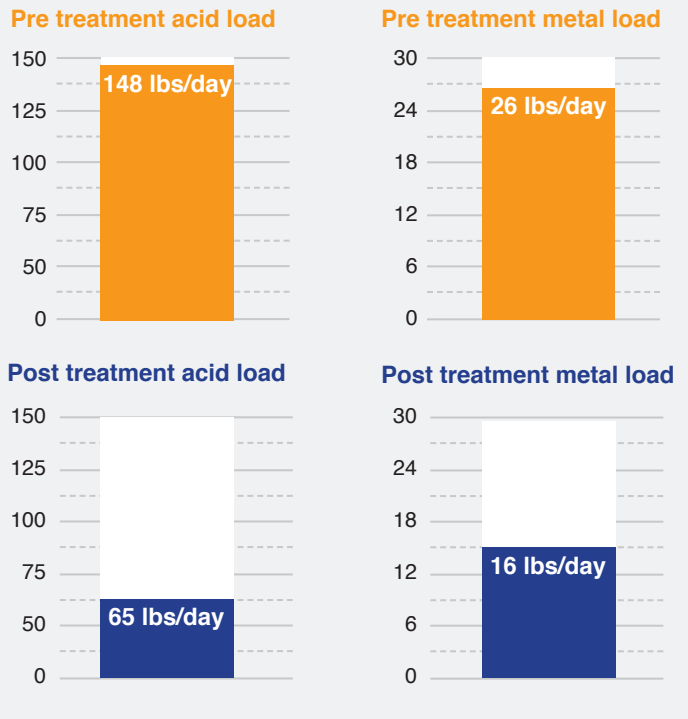
Between pond and seep, Photo by Brent Miller

Post-construction

Sr 124 hillside limestone channel, Photo by Chip Rice

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. This area consisted of an abandoned surface coal mine with an acidic surface pit. This un-reclaimed mine, resulted in seeps which drained directly into Little Raccoon Creek adjacent to SR 124. The site was reclaimed, pit was drained and regraded, and an open limestone channel was installed to collect drainage before discharging off site. 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 by 100 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. On average approximately 83 lbs/day of acid and 10 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

SITE: OTF0010



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

Water Quality – load reductions

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 1 and 2 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 1 and 2.

Figure 1. Yearly Acid Load Reduction

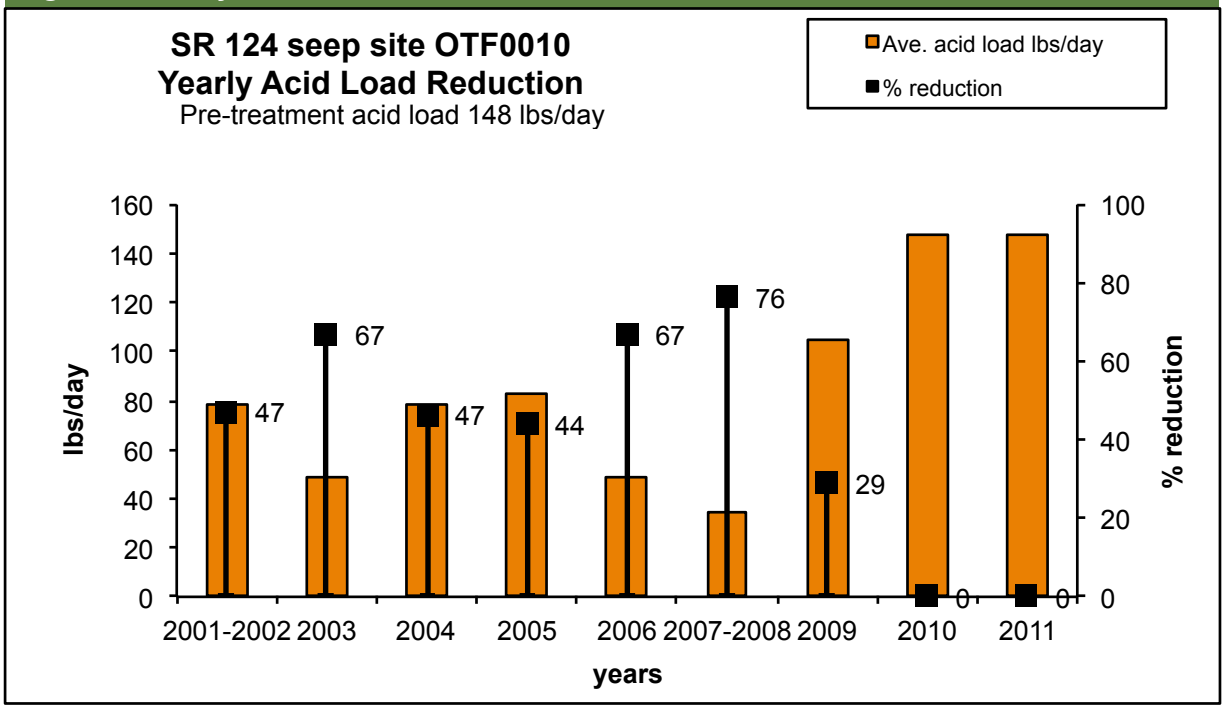
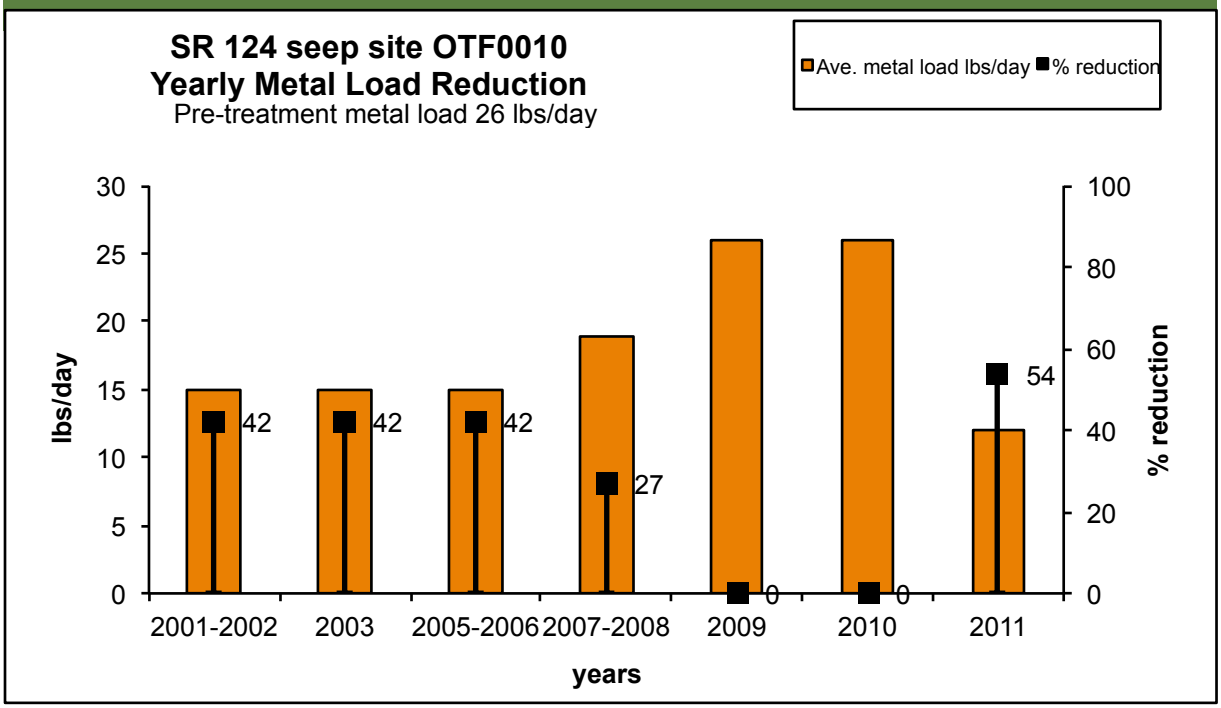


Figure 2. Yearly Metal Load Reduction



2011 NPS Report - Raccoon Creek Watershed - Flint Run East

Generated by Non-Point Source Monitoring System
www.watersheddata.com

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

Pre-construction

Flint Run East site discharge, Photo by Ben McCament

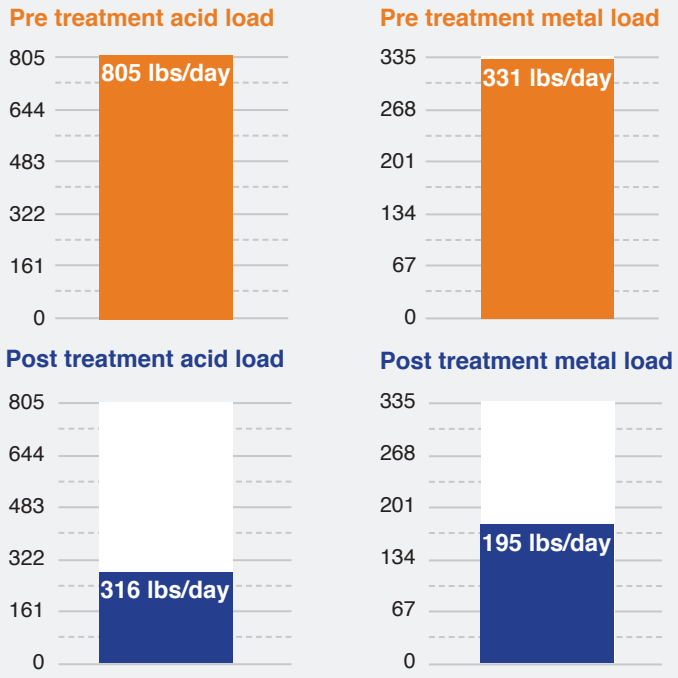
Post-construction

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

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 Flint Run sub watershed is affected by abandoned strip mine drainage and associated unreclaimed coal refuse piles mostly from the Broken Aro mine which is in the headwaters of Flint Run. This area was the coal washing and loading facility for the Broken Aro mine. The site is very complex hydrologically, the site consists of large buried slurry impoundments and surface mining pits around the rim of the main valley. Mead-Westvaco reclaimed the main slurry pond area with paper mill sludge in the mid 1980's. AMD seeps originate in many locations associated with the slurry impoundments and the surface mine pits. The design was completed by RD Zande for a cost of $241,702. The treatment approach for this site

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

SITE: FR0126



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

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. Construction was completed Aug. 1, 2006, by Berridge Reclamation for a cost of $1,456,106. The funding sources for this project were ODNR-DMRM for the design and ODNR-DMRM, EPA-319 and OSM ACSI for construction. On average, approximately 489 lbs/day of acid and 136 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project. Maintenance of SLB scheduled for 2012.

Water Quality – load reductions

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 1 and 2 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 1 and 2.

Figure 1. Yearly Acid Load Reduction

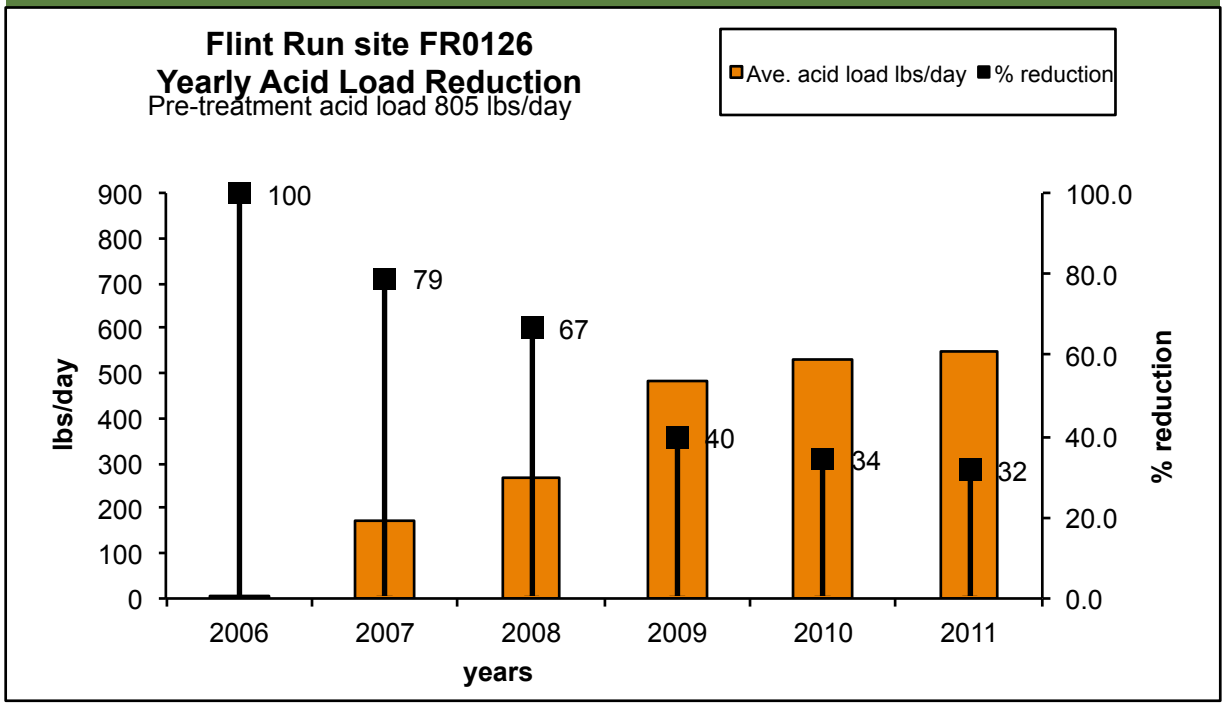
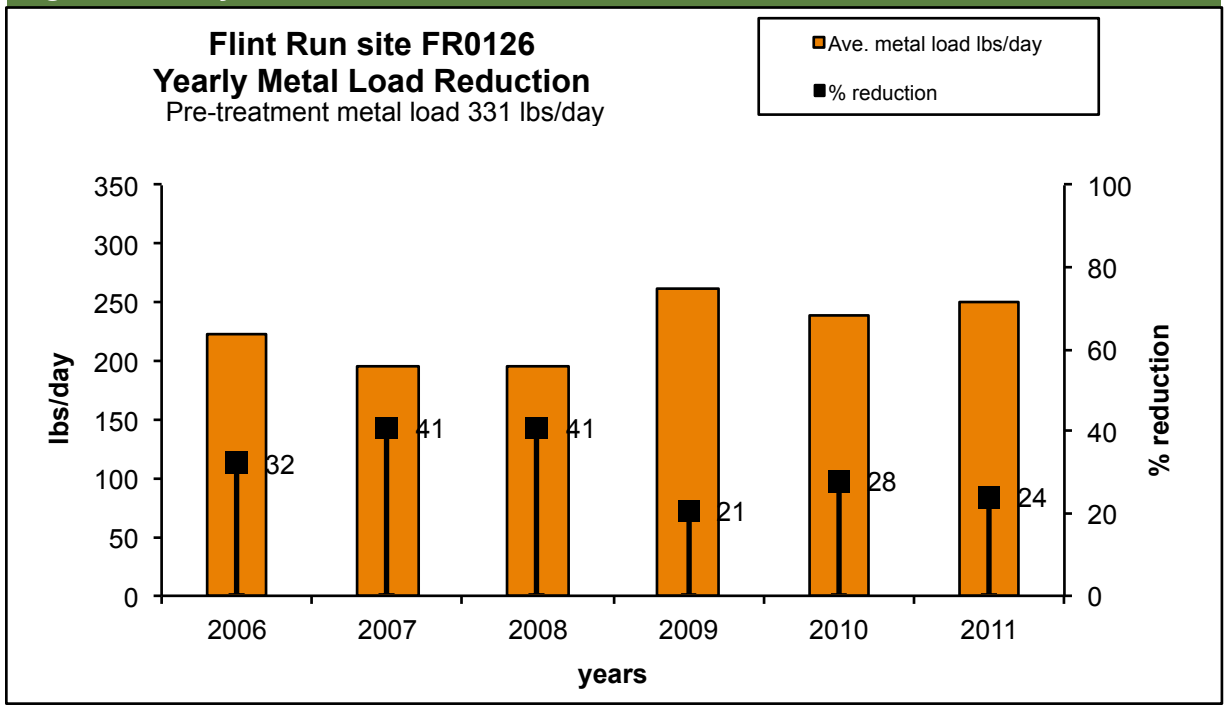
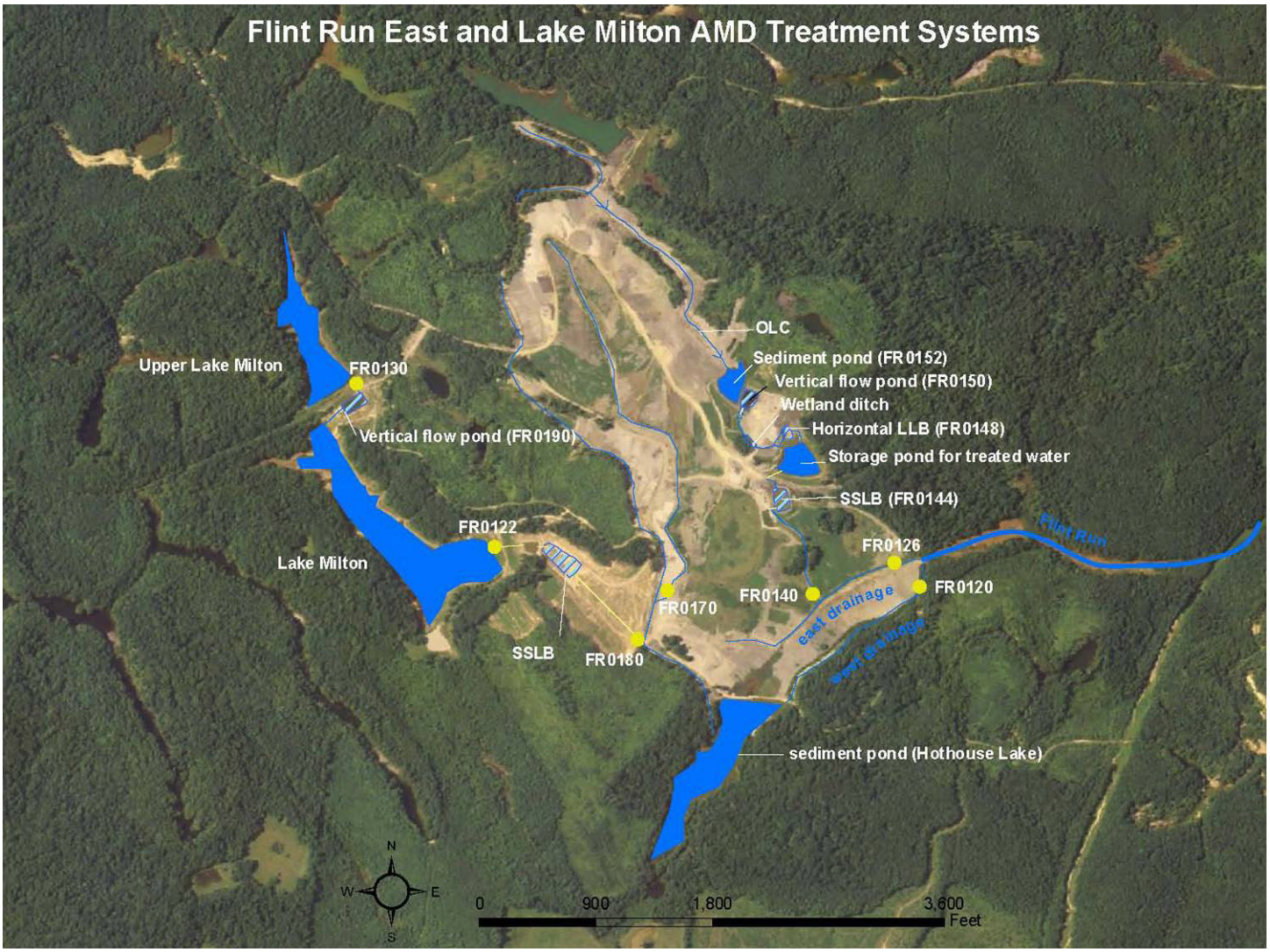


Figure 2. Yearly Metal Load Reduction



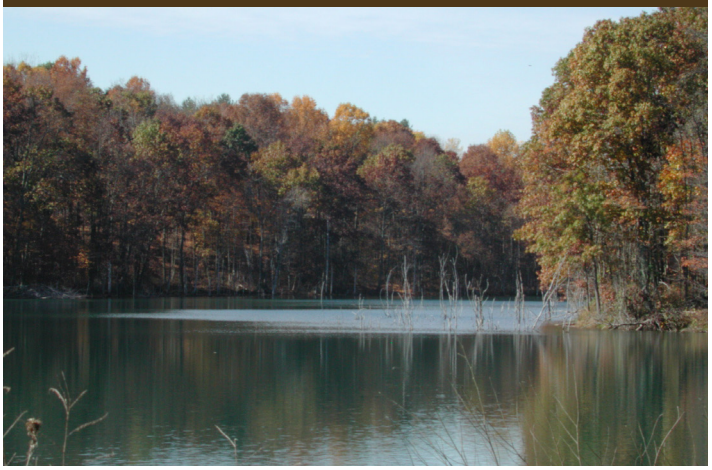

Flint Run East and Lake Milton AMD Treatment Systems
Upper Lake Milton
FR0130
Vertical flow pond (FR0190)
OLC
Sediment pond (FR0152)
Vertical flow pond (FR0150)
Wetland ditch
Horizontal LLB (FR0148)
Storage pond for treated water
SSLB (FR0144)
FR0122
Lake Milton
FR0126
Flint Run
FR0140
FR0120
east drainage
FR0170
SSLB
FR0180
west drainage
sediment pond (Hothouse Lake)
N
W
E
S
0
900
1,800
3,600
Feet

2011 NPS Report - Raccoon Creek Watershed - Lake Milton

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete: 9/5/2006 ODNR Project Number: Jk-MI-113

Pre-construction



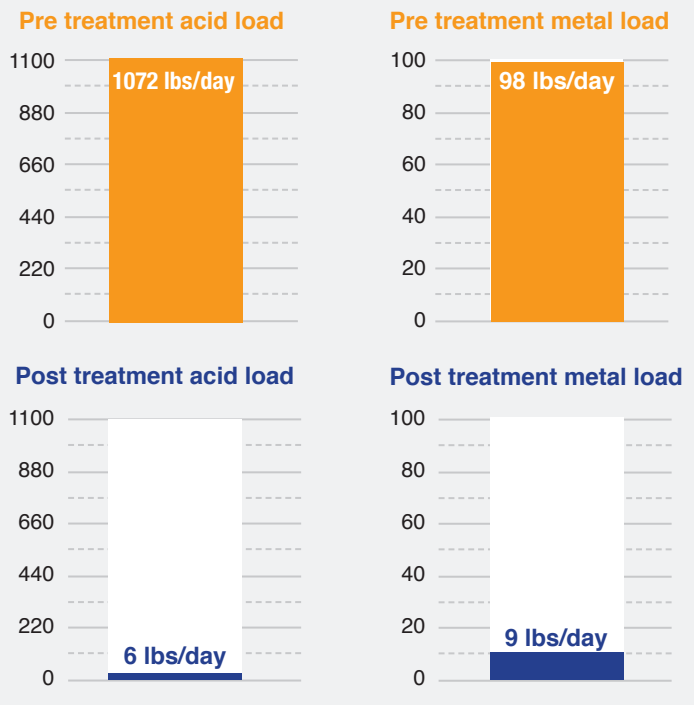
Lake Milton - 25 acre acidic lake, Photo by Ben McCament

Post-construction

Steel slag bed downstream Lake Milton, Photo by Ian Hughes

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. The project discharge was measured at the outlet from Hothouse Lake. Lake Milton is part of a manmade drainage system that was used during mining operations for coal washing by the Broken Aro mine. Lake Milton is adjacent to the Flint Run East site and is a 15 acre lake with a small watershed area. AMD originates in spoil areas near Upper Lake Milton (separated by railroad embankment) before flowing into Lake Milton. Additional AMD is generated after Lake Milton discharges into coal slurry waste in the valley downstream of the lake dam. Lake Milton drains into Hothouse Lake before entering into Flint Run. 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 funding sources for this project were ODNR-MRM, EPA-319 and OSM ACSI for both the design and construction. On average, approximately 1066 lbs/day of acid and 89 lbs/day of metals were reduced from entering into Little Raccoon Creek.

SITE: FR0120



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

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 1 and 2 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 1 and 2.

Figure 1. Yearly Acid Load Reduction

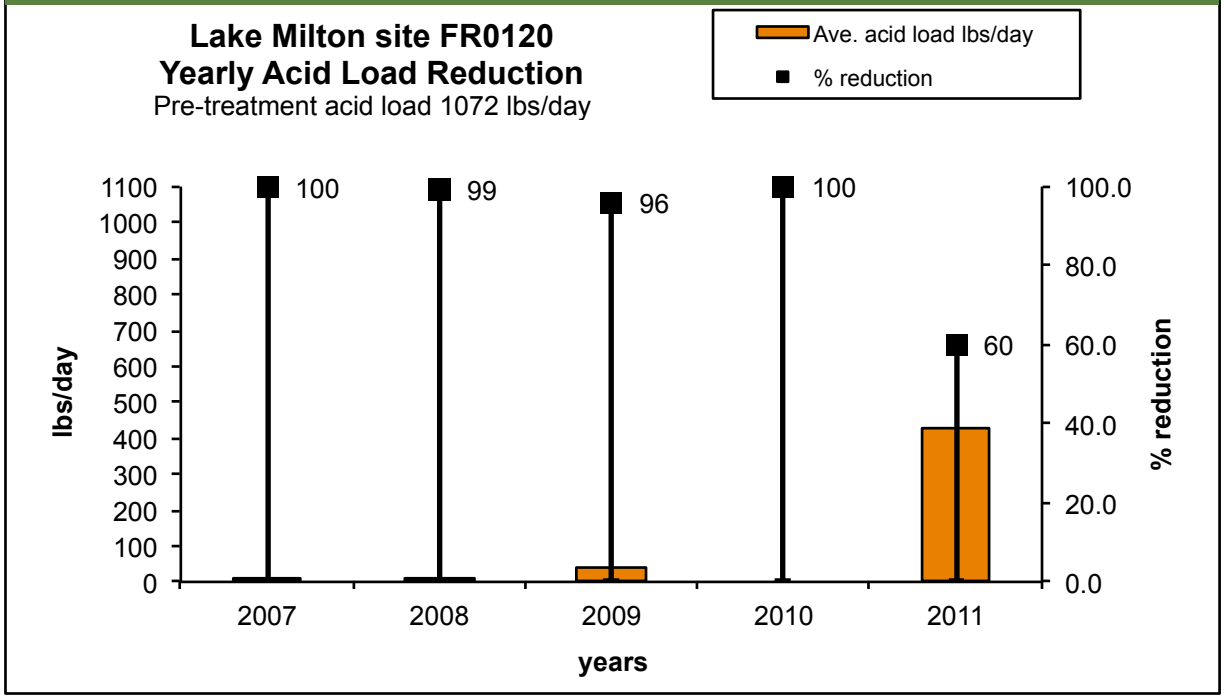
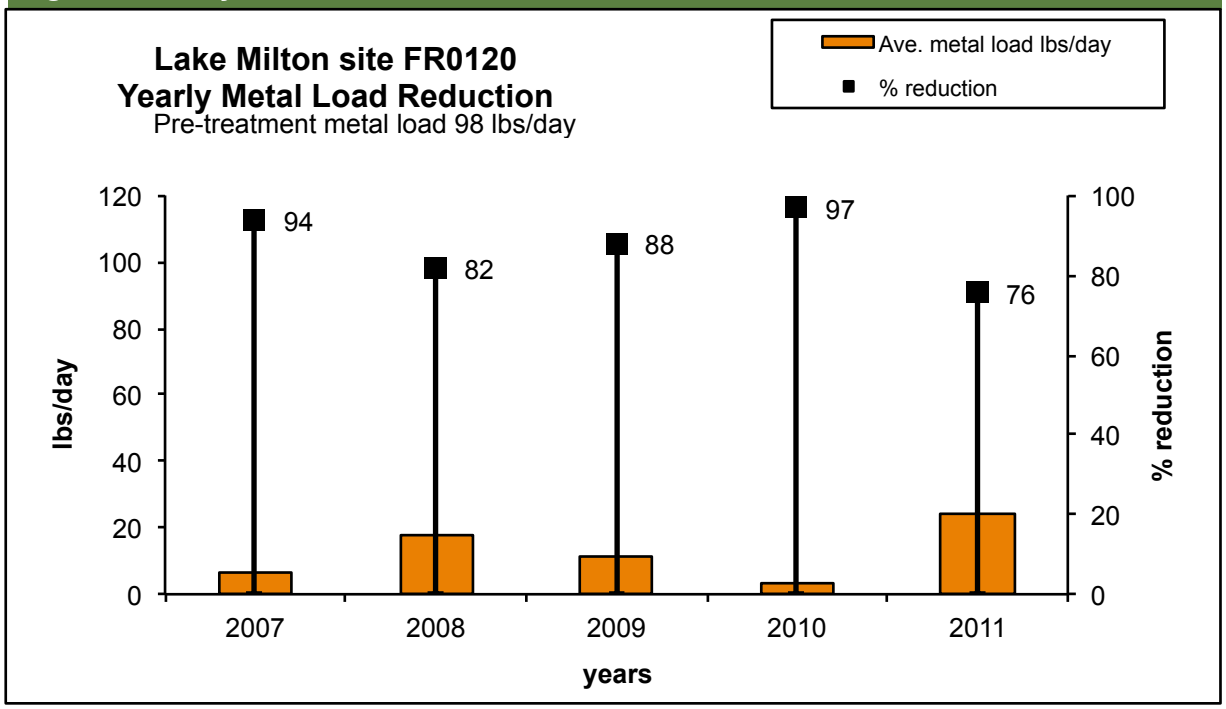


Figure 2. Yearly Metal Load Reduction



2011 NPS Report - Raccoon Creek Watershed - Buckeye Furnance

Generated by Non-Point Source Monitoring System
www.watersheddata.com

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

Pre-construction

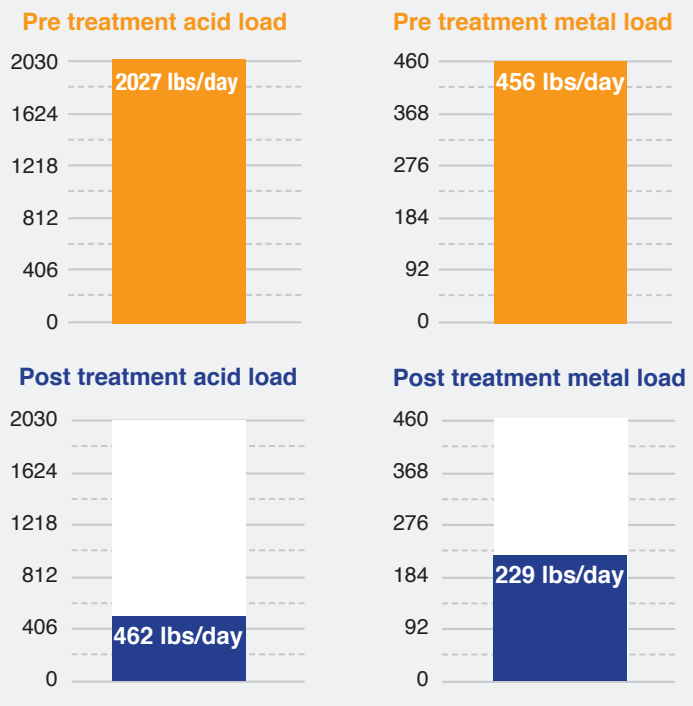
Mine waste in valley, Photo by Raccoon Creek Partnership

Post-construction

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

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. Deep mining of the area resulted in continuous AMD discharge from underground mines to Buffer Run, a tributary to Little Raccoon Creek. This area was also strip mined and used for a wash plant facility for a deep mine operation, resulting is several unreclaimed coal refuse areas and slurry ponds draining to Buffer Run. 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 load has been reduced by 78 percent. Construction was complete June 20, 1998, by Earth Tech Inc. for a cost of $1,090,530. The funding source for the project design was ODNR-DMRM, and for construction the sources were ODNR-DMRM, OEPA and OSM. On average, approximately 1565 lbs/day of acid and 277 lbs/day of metals were reduced from entering into Little Raccoon Creek as a result of this AMD reclamation project.

SITE: BR0010



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

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 1 and 2 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 1 and 2.

Figure 1. Yearly Acid Load Reduction

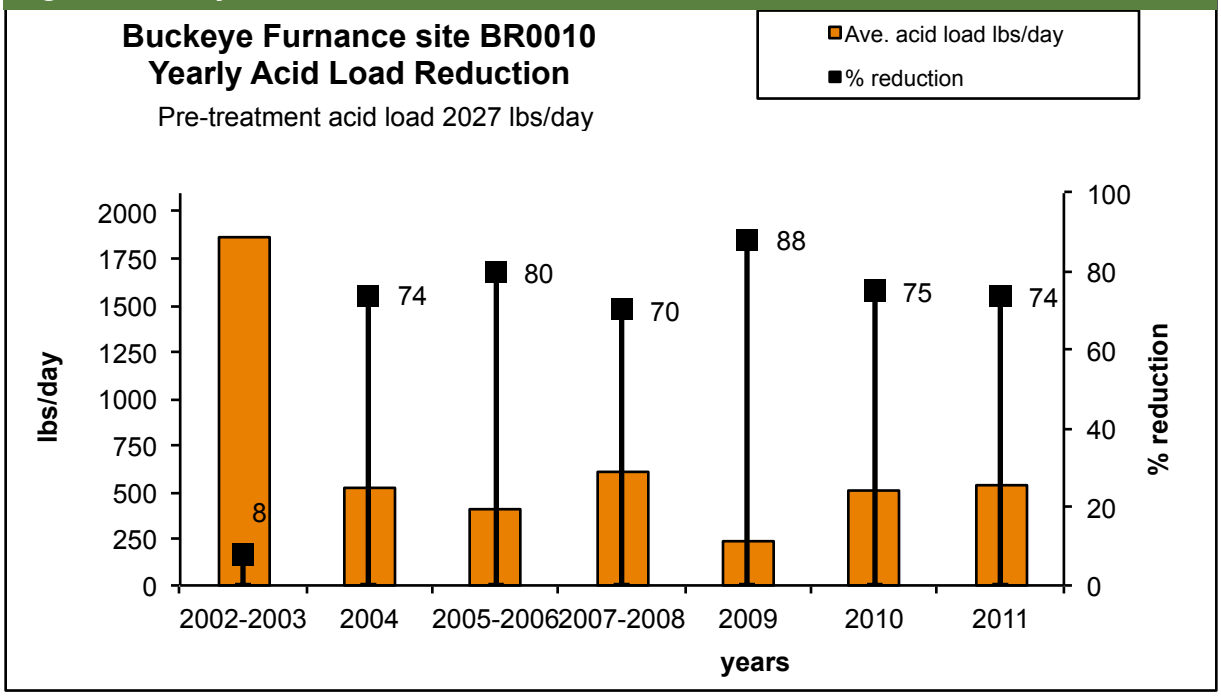
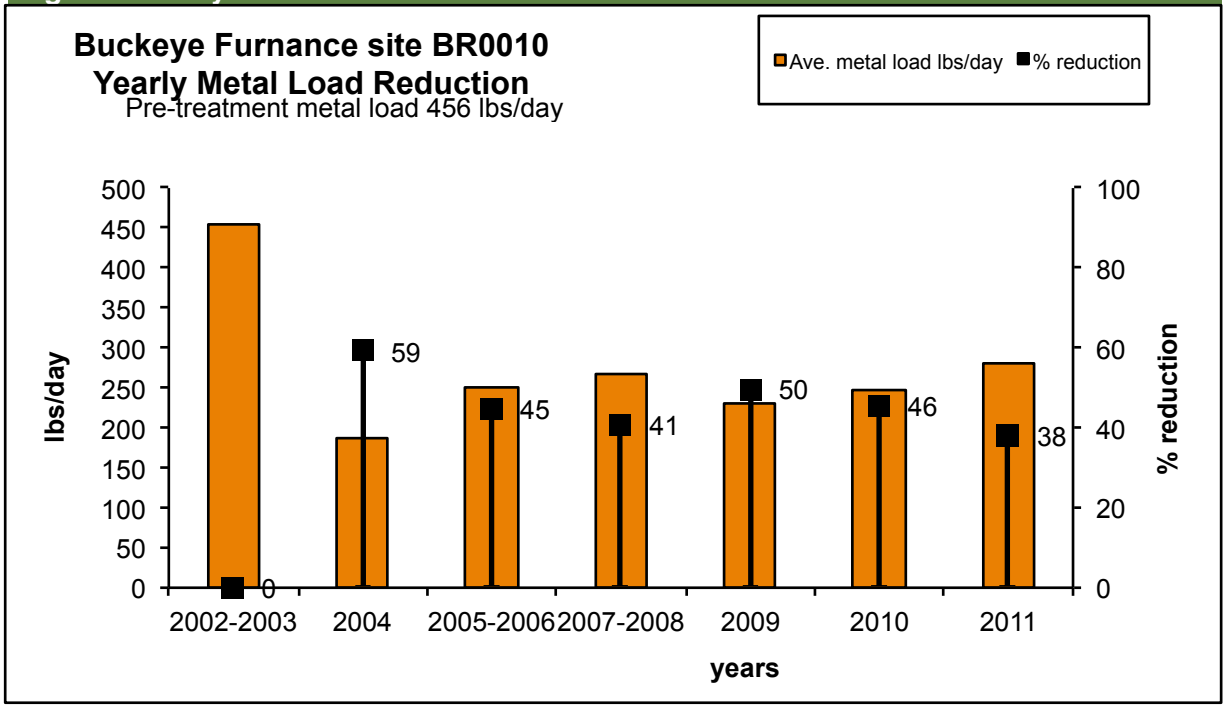


Figure2. Yearly Metal Load Reduction



2011 NPS Report - Raccoon Creek Watershed - East Branch Phase I

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete: 12/31/2007 ODNR Project Number: HC-ST-13

Pre-construction

East Branch EB200 Nov. 2003, Photo by Brett Laverty

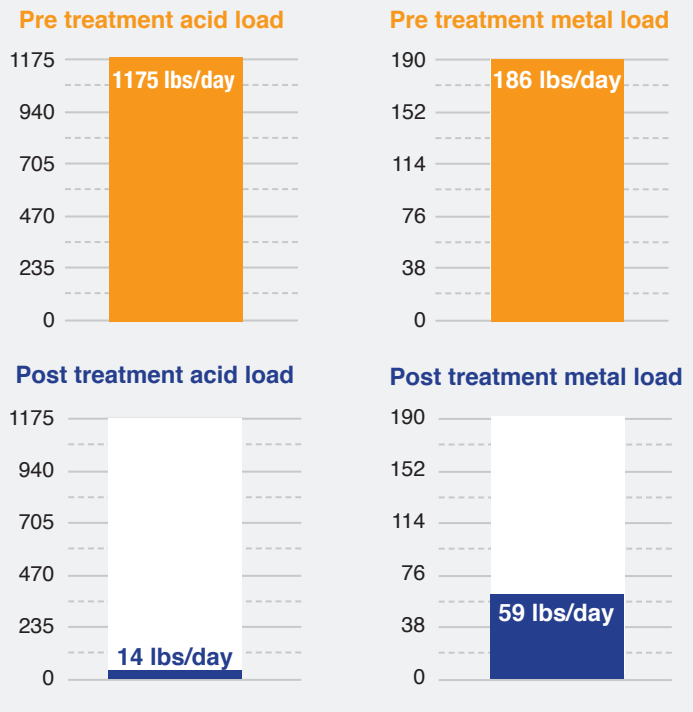
Post-construction

Site #3 steel slag leech bed full of water 2-7-08, Photo by Amy Mackey

East Branch Phase I Reclamation Project is located in Section 14 and 15 of Starr Township in Hocking County and lies within the 14 digit HUC unit #05090101020010. There are six separate sites spread out over three headwater drainages of the East Branch of Raccoon Creek, project footprint of the six sites is approximately 27 acres. East Branch is the largest contributor of acid mine drainage to the headwaters of Raccoon Creek. Large areas of strip mined land, some has been reclaimed under the 1972 Act, coupled with few deep mine discharges resulting in seeps, contribute to the AMD which affects East Branch and its tributaries. The AMD is diffuse throughout the area due to the extensiveness of surface mining and has required a basin wide approach that focuses on reducing acid and metal load to Raccoon Creek. The design was completed by ATC Associates Inc. for $65,438. The treatment approach for this site was to install six steel slag leach beds (16,251 sq. ft), 1,100 linear feet of open limestone channels, reclaim 4.8 acres of gob piles, and install two passive settling ponds with limestone berms (42,000 square feet). The goal of the design was to reduce acid at the mouth of the East Branch (EB010). Construction was complete December 31, 2008 by Tucson Inc. for a cost of $918,401. The funding source for the project design was Ohio EPA 319 grant and for construction the sources were ODNR-DMRM and Ohio EPA 319. Figure 3 and 4 (shown on page 3 of this report) estimate approximately 1161 lbs/day of acid and 127 lbs/day of metals were reduced from entering into East Branch and Raccoon Creek as a result of this AMD reclamation project.

Note: EB210 site does not take into account 1 SLB site #8 (EB160)

SITE: EB210



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

Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre-construction 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. East Branch Phase I Reclamation project pre-construction monitoring show pH and net acidity at East Branch river mile 6.33, downstream to the mouth of East Branch, and along the mainstem of Raccoon Creek, shown below. Pre-construction data shows pH in the range of 4.5–6.2 at river mile 6.33 of East Branch and downstream of the project on Raccoon Creek. Post-construction data at EB210 downstream to Raccoon Creek show pH in the range of 5.7-6.6.The acidity concentrations decreased by 82 percent, showing net alkaline conditions downstream in Raccoon Creek mainstream (7.3 miles).

Figure 1. Pre and Post pH

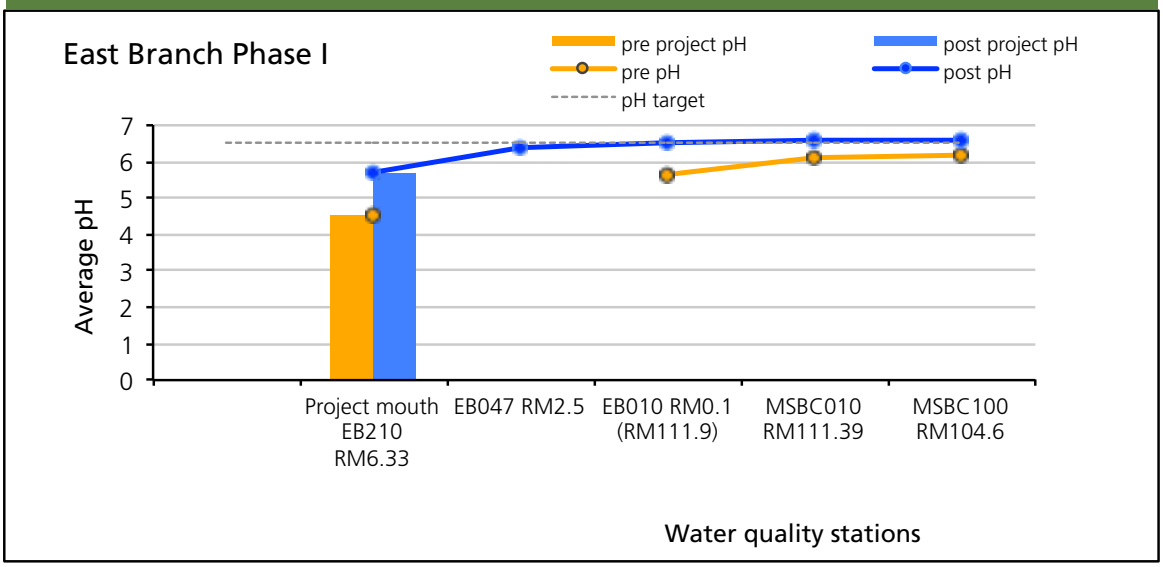
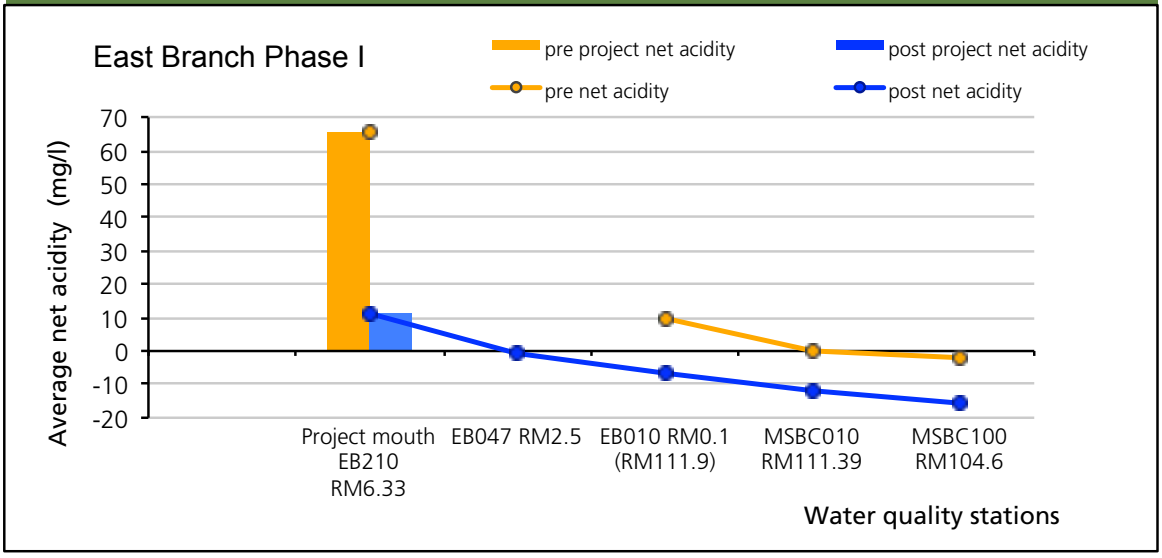


Figure 2. Pre and Post Acidity



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 11/1/2004 for pre-construction and from 2/18/2008 to 12/31/2011 for post-construction.

Figure 3. Acid Load Reduction

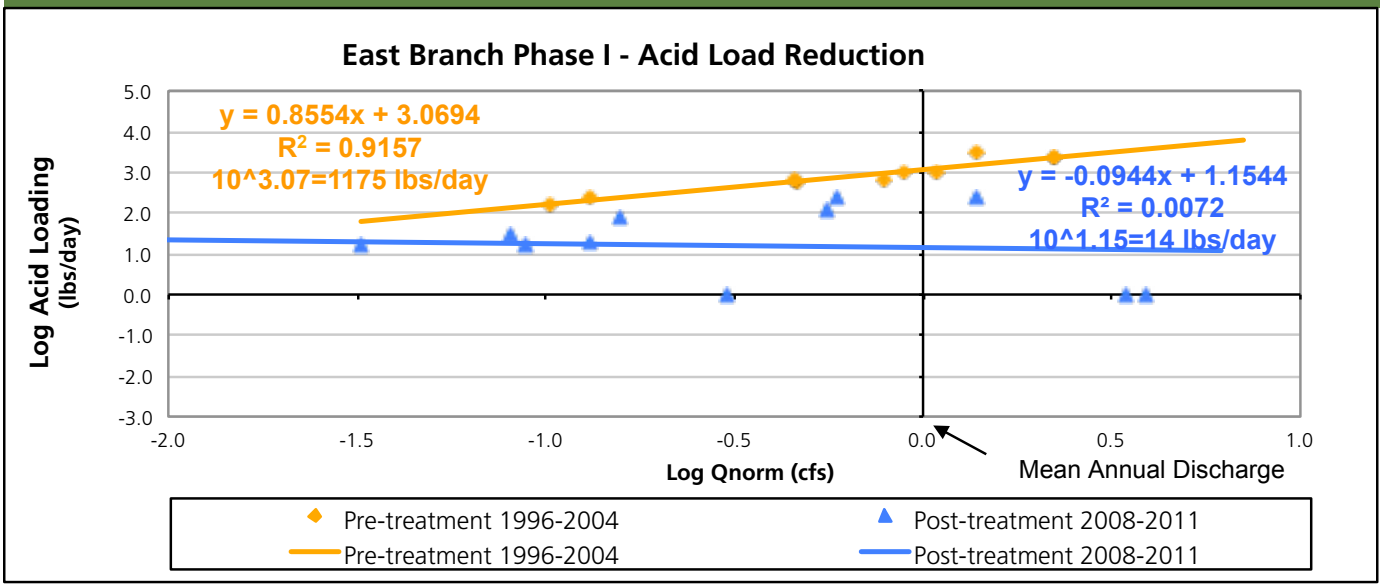
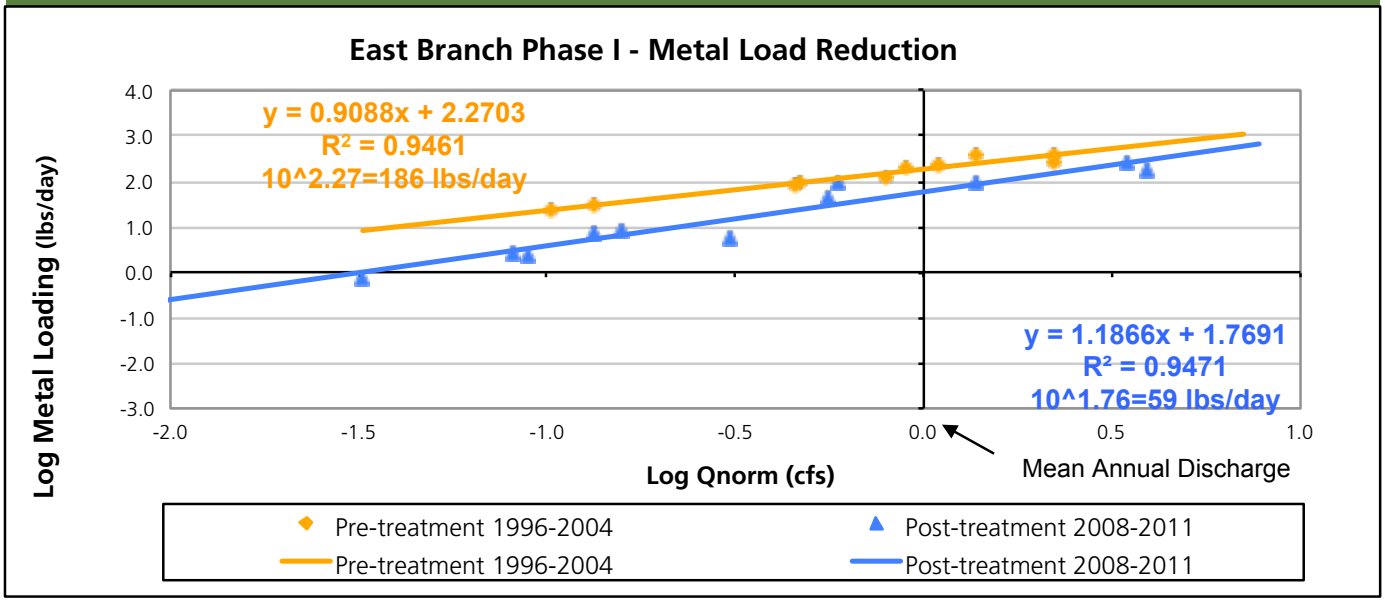


Figure 4. Dissolved Metal Load Reduction



Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

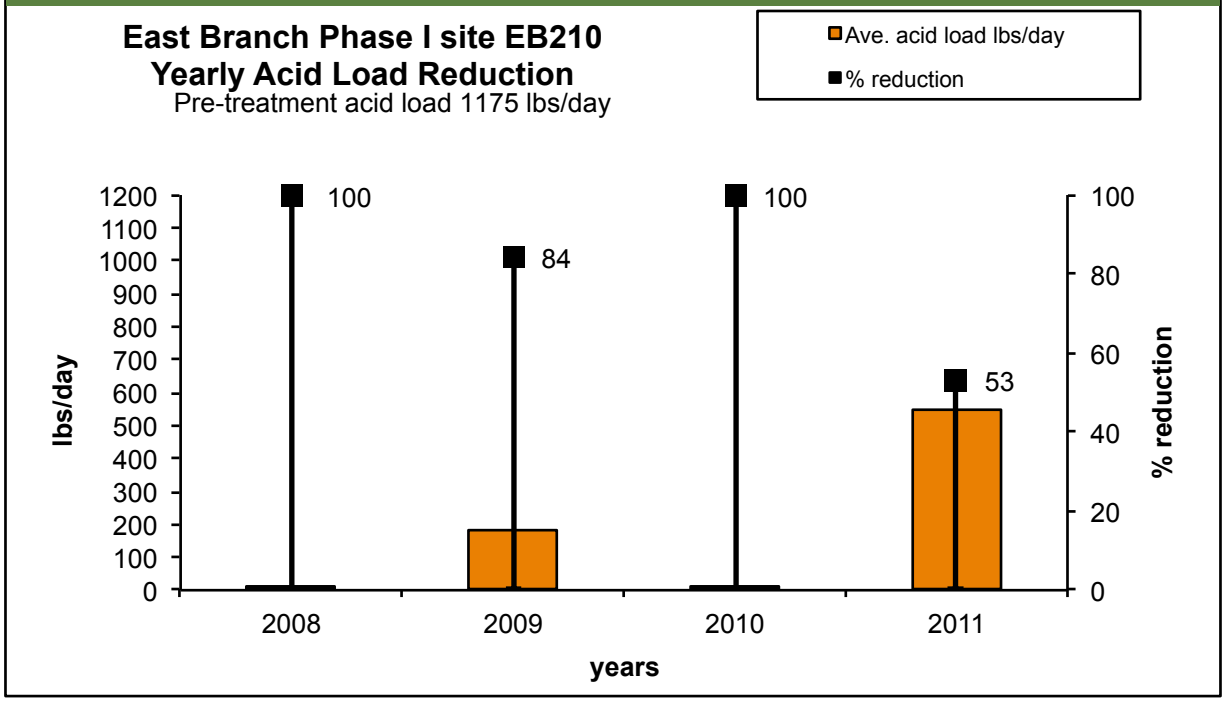
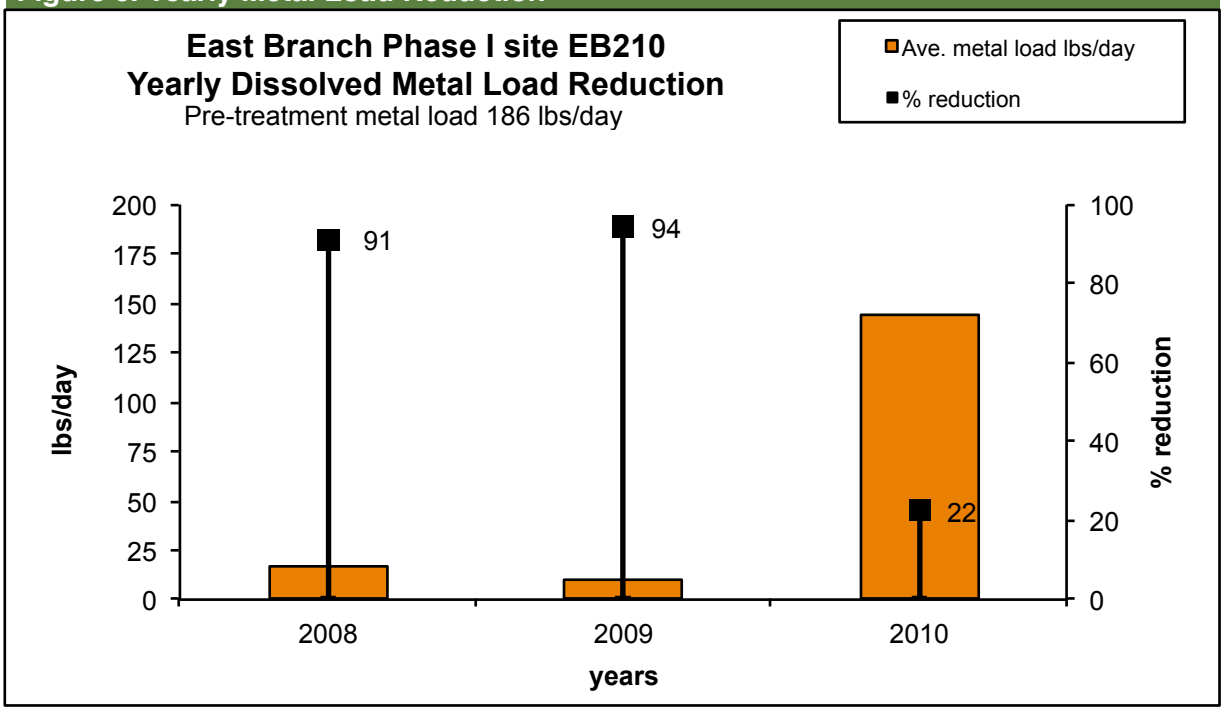
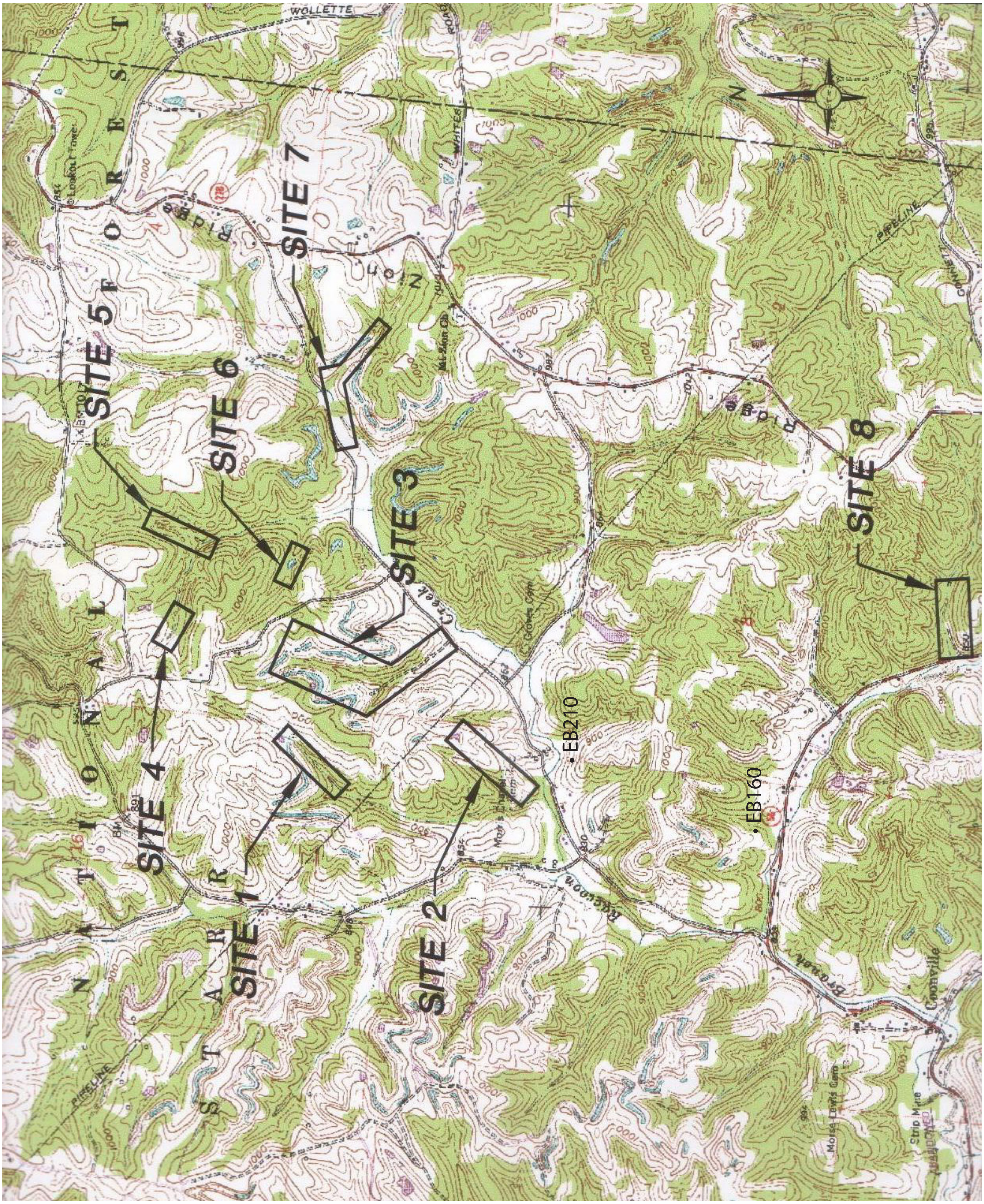


Figure 6. Yearly Metal Load Reduction




SITE 1
SITE 2
SITE 3
SITE 4
SITE 5
SITE 6
SITE 7
SITE 8
EB210
EB160
N

2011 NPS Report - Raccoon Creek Watershed - Pierce Run

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: final completion expected fall 2012 ODNR Project Number: VN-Vn-06

Pre-construction

Oreton Seep, the major acid mine drainage discharge
Photo by Ben McCament

Post-construction

Freshwater pond overflow at Pierce Run
Photo by Raccoon Creek Partnership

Pierce Run Reclamation Project is located in Section 19 of Vinton Township in Vinton County and lies within the 14 digit HUC unit #05090101040020. The Oreton Seep is located in the former town of Oreton along SR 160 in Vinton County and is the most consistent and largest acid loader within the Pierce Run watershed. The source of the seep is a 116 acre underground coal mine (Clarion 4a seam) which was abandoned by the Oreton Mining Company in October of 1924. The seep appears to originate from a collapsed abandoned entry in an upper valley of a small unnamed tributary. The design was completed by ATC Associates Inc. and ODNR-DMRM. The treatment approach for this site is to install one large steel slag leach bed. The goal of the design is to reduce acid at the mouth of the Pierce Run (PR0010) before entering into Raccoon Creek. The project goal will be evaluated in 2012 annual report. Initial construction was complete Fall 2010 by Seals Construction for a cost of $587,754. Funding source for the project design was Ohio EPA 319 grant and for construction the sources were ODNR-DMRM, Ohio EPA 319, and OSM. However, modifications to the dam and pipes are needed. In 2011, ODNR completed the design for the slurry wall that will prevent water from seeping around and under the dam. This design also included improvements to the primary outlet (standpipes) that failed after initial construction in Fall 2010. This project will be bid out in early 2012.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre-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. Post construction monitoring will begin winter 2012, results will be reported in 2012 annual report.

Data analysis

Pierce Run Reclamation project pre-construction monitoring show pH and net acidity at the mouth of Pierce Run and along the mainstem of Raccoon Creek, shown above. Pre-construction data shows pH in the range of 5.5 – 6.9 at the mouth of Pierce Run and downstream along the mainstem of Raccoon Creek. Post-construction data will be reported in 2012 annual report.

Figure 1. Pre and Post pH

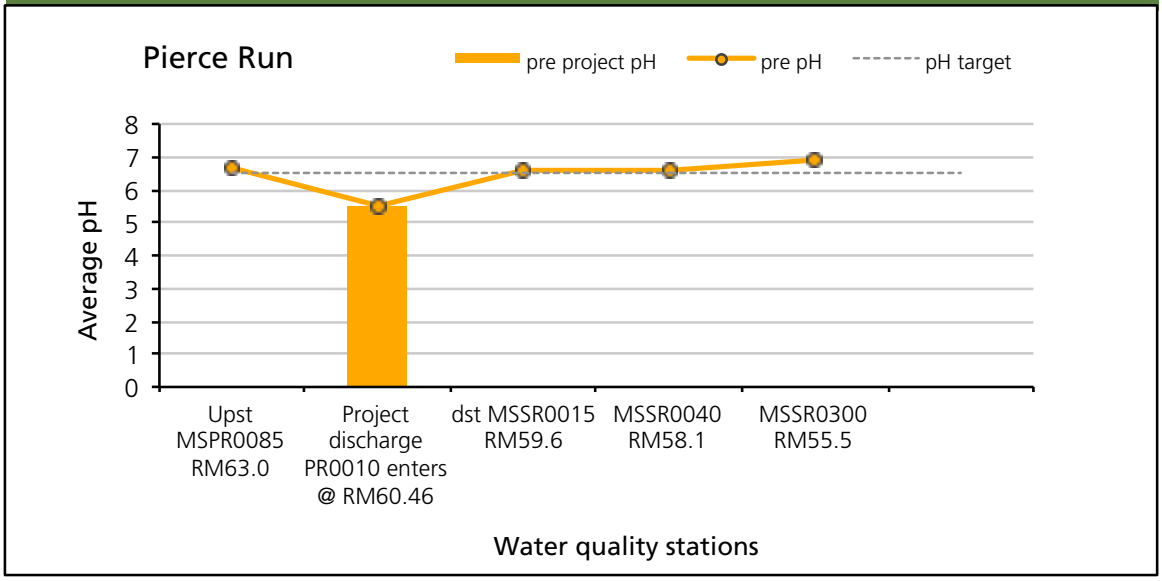
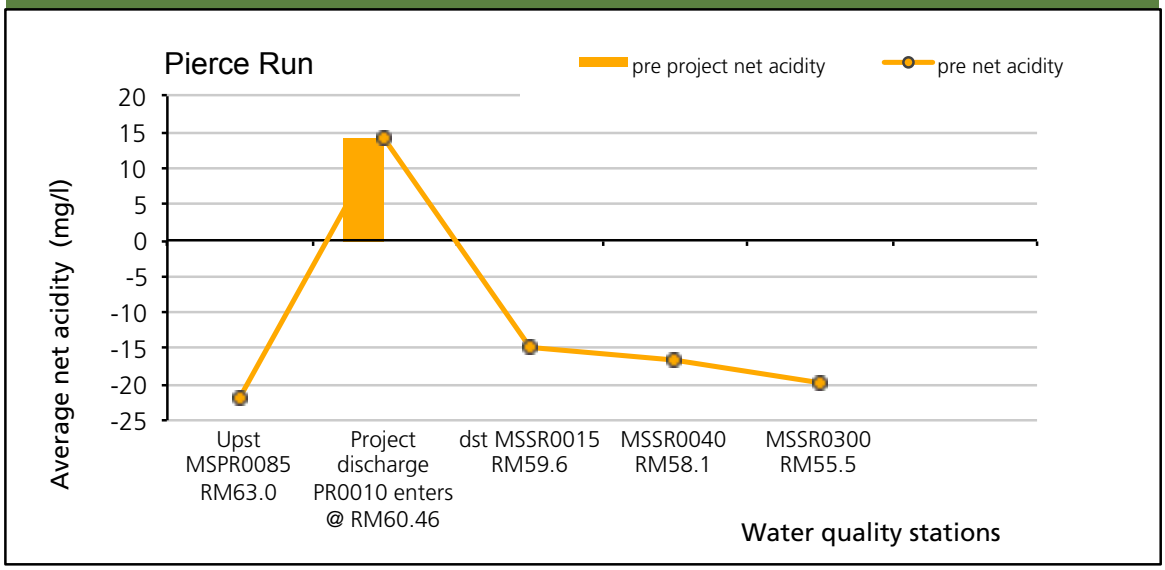


Figure 2. Pre and Post Acidity



2011 NPS Report - Raccoon Creek Watershed - East Branch Phase II and III

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: 2010-2011 ODNR Project Number: HC-St-14 HC-St-18

Pre-construction EB II

Kern Hollow SLB site, Photo by Amy Mackey

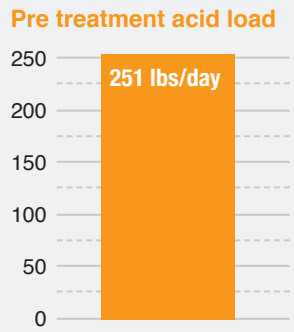
Post-construction EB II

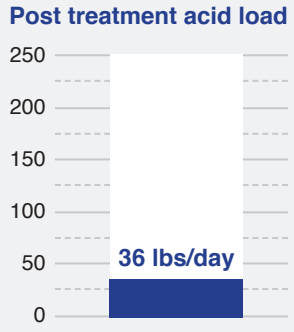
Steel slag bed at Kern Hollow, Photo by Amy Mackey

Post-construction EB III

EB III Winifred SLB Photo by Amy Mackey

SITE: EB190





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

East Branch Phase II and III (EB II and III) are located in Section 14 of Starr Township in Hocking County and lies within the 14 digit HUC unit #05090101020010 just south-east of Union Furnace. EB II and III project discharge, site EB190, is located just upstream of Laurel Run Road bridge. East Branch Phase II (EB II) project, completed in Dec. 2010, consists of constructing three steel slag beds in the project area: Kern Hollow, Northwood, and Forrest. East Branch Phase III (EB III) constructed in spring 2011, consists of one 7,800 square foot steel lag bed, minimal surface reclamation (2 acres), and a 520 ft open limestone channel. All of these projects lie on Wayne National Forest property. The designs were completed by ODNR-DMRM in-house. The treatment approach for this site is to install four steel slag leach beds (SLB) to add alkalinity to East Branch. At EB III in spring 2012, sediment washed in from heavy rainfall, sediment was scraped off to unclog the SLB. The goal of the design is to reduce acid at the site EB190. During high flow, precipitated metals are evident at EB190 with high levels of aluminum. Therefore, metal load reductions are not occurring at site EB190. Construction was completed fall 2010 at EB II by Stimmel Construction for a cost of $671,788. EB III was completed in spring 2011 by Tuscon Inc. for $323,036. Funding source for the project design and construction is ODNR-DMRM and OSM.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre-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.

Data analysis

East Branch Phase II pre-construction monitoring show pH and net acidity at the site EB190, Figure 1. Pre-construction data shows pH in the range of 4.79 – 6.5 at site EB190 and downstream along the mainstem of Headwaters to Raccoon Creek. Post-construction data collection began late fall 2010. Data results for post construction at site EB190 to downstream headwaters of Raccoon Creek show pH in the range of 6.4 -7.0. The net acidity concentration decreased by 100 percent with net alkaline concentrations for 13 miles downstream.

Figure 1. Pre and Post pH

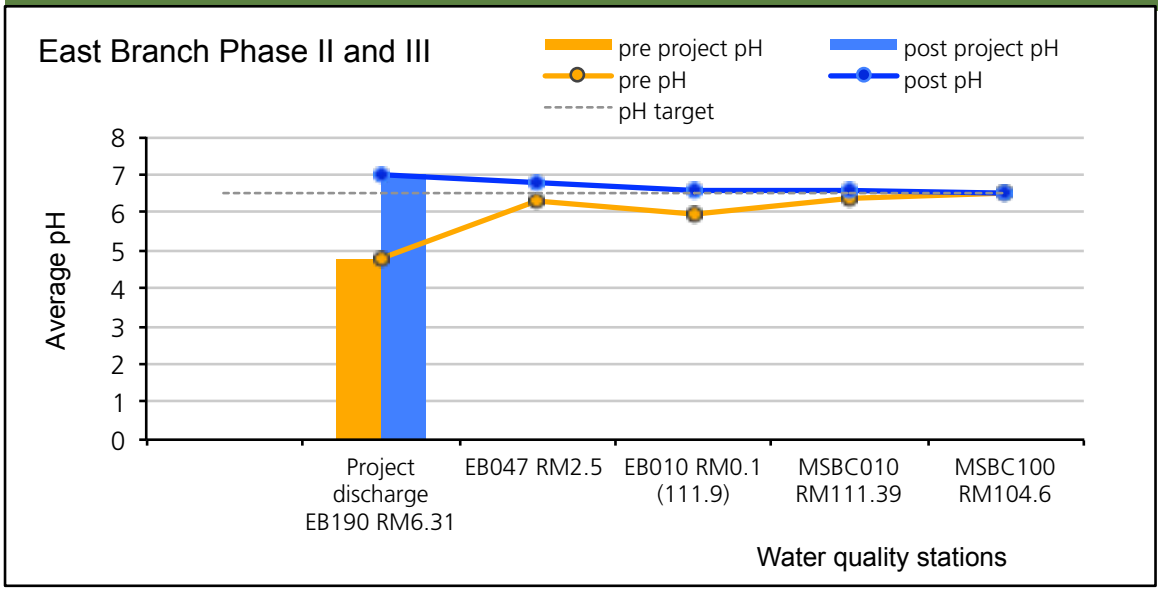
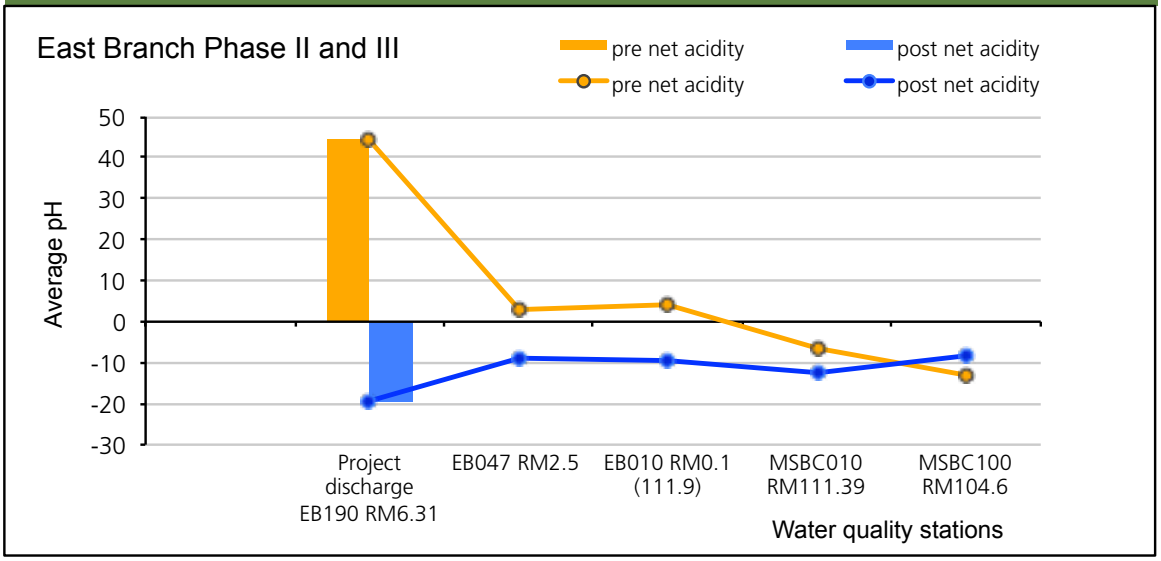


Figure 2. Pre and Post Acidity



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 3/2/2004 to 11/2/2010 for pre-construction and from 12/8/2010 to 12/31/2011 for post-construction.

Figure 3. Acid Load Reduction

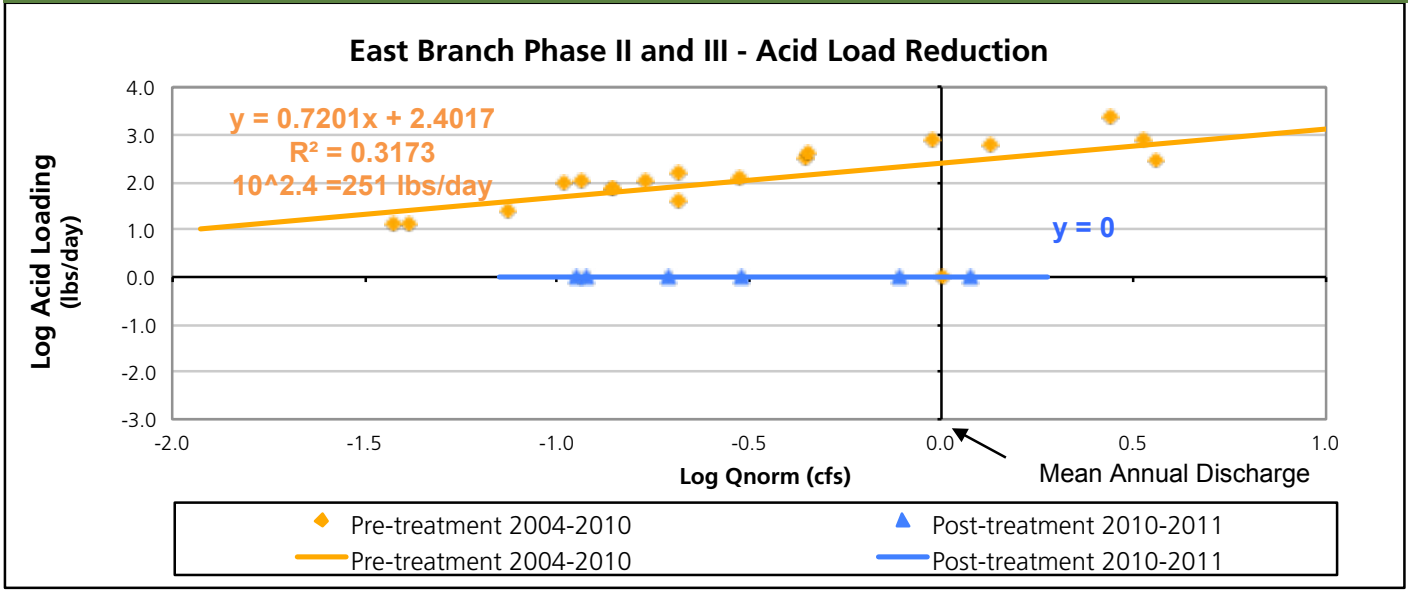
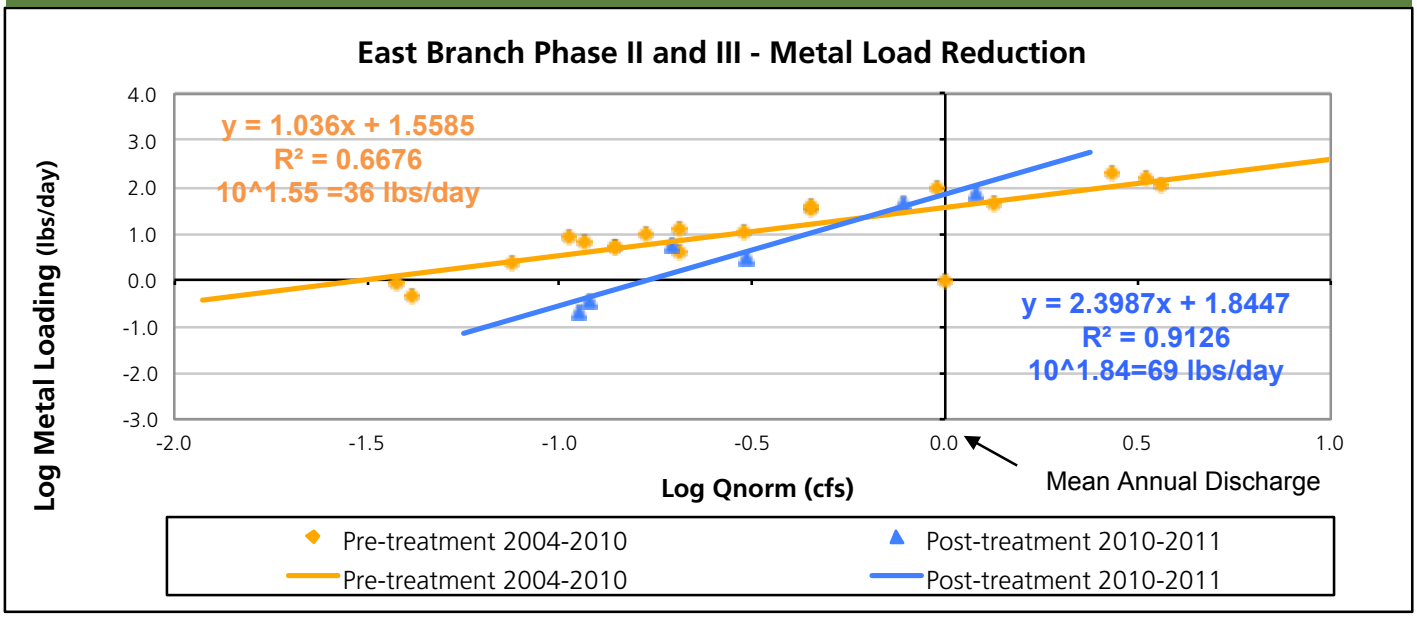


Figure 4. Metal Load Reduction



2011 NPS Report - Raccoon Creek Watershed - Harble Griffith

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Expected completion spring 2012 ODNR Project Number: HC-Ws-17

Pre-construction

Gob and spoil pile with standing water,
Photo by Amy Mackey

Post-construction

Recontoured and seeded hillside after removal or gob and spoil piles
Photo by Amy Mackey

Harble Griffith project is located in Section 33 of Washington Township in Hocking County and lies within the 14 digit HUC unit #05090101020020 just north of Mt. Pleasant. The Harble Griffith project discharge, site WB086, is located on an unnamed tributary that drains to the West Branch of Raccoon Creek. The project consists of approximately 29 acres of abandoned (pre-SMCRA) coal mine spoil located east of Harble Griffith Road. There are three large surface water pits that hold approximately 2 million gallons of AMD water and 16 acres of spoil. Due to poor surface water drainage throughout the project site most precipitation is directed inward to remnant ponds left by surface mining. These pits increase contact time with water and spoil and increase AMD generation. The treatment approach for this site consists of standard reclamation, re-grading, and re-vegetation of the 29 acre site. The pits will be drained and re-graded. Limestone channels (650 linear ft.) will be installed to treat residual drainage from the site along with a 10 acre passive wetland for metal retention. The goal of the design is to reduce approximately 300 lbs/day of acid loads and 50 lbs/day of aluminum loads from entering the West Branch of Raccoon Creek. The design was completed by ODNR-DMRM in-house, $42,145. Construction is expected to be complete spring 2012 by Redd Malcuit. Funding source for the project design and construction is ODNR-DMRM OSM, and OEPA 319. The project goal will be evaluated in 2012 annual report after post-construction monitoring is complete.

Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre-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 prior to construction. Post construction monitoring will begin spring 2012, results will be reported in 2012 annual report.

Data analysis

Harble Griffith pre-construction monitoring show pH and net acidity at the site WB086, Figure 1. Pre-construction data shows pH in the range of 4.33 – 6.6 at site WB086 and downstream along the mainstem of West Branch of Raccoon Creek and the headwaters of Raccoon Creek. Post-construction data will be reported in 2012 annual report.

Figure 1. Pre pH

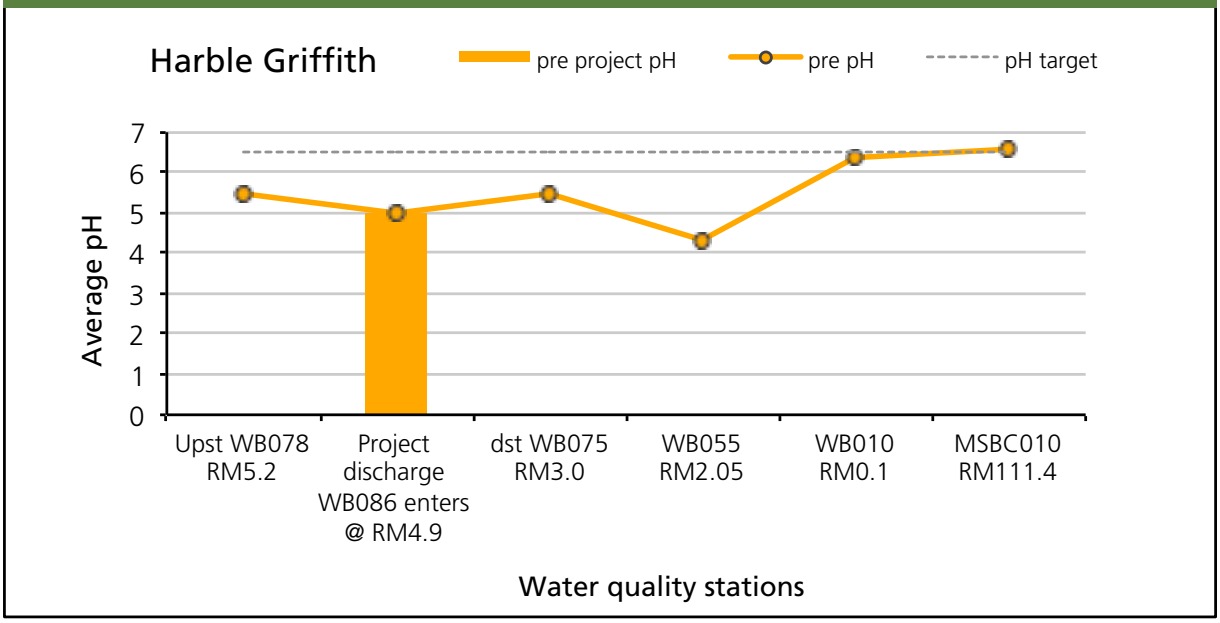
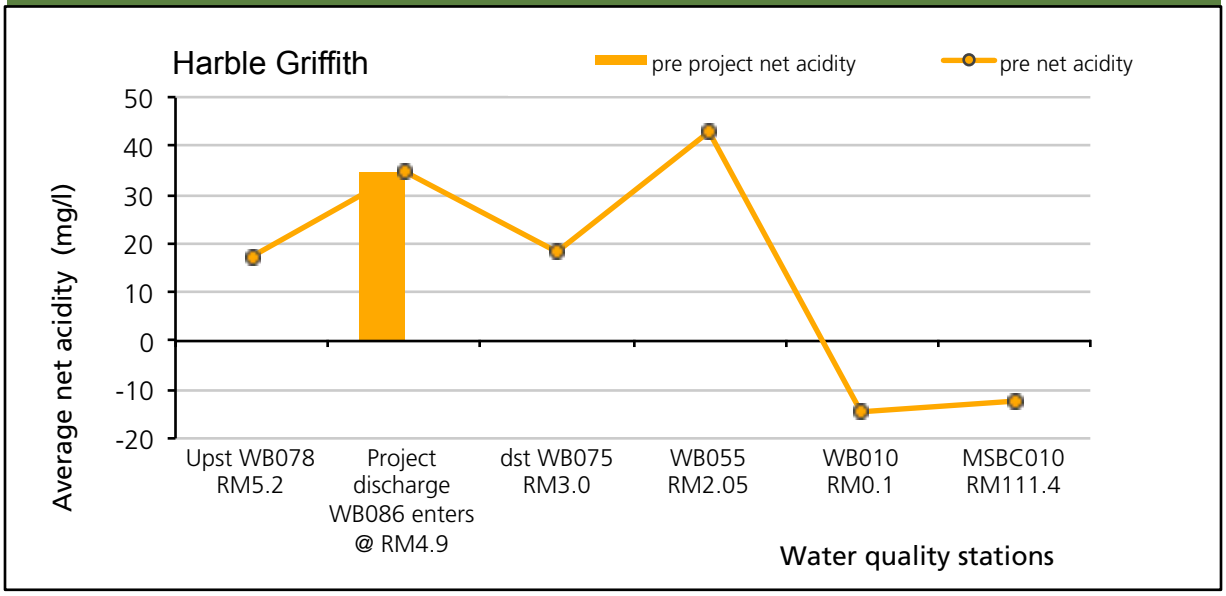


Figure 2. Pre Acidity



West Branch Raccoon Creek - Harble Griffith Road Project Map

New Plymouth USGS 7.5 Minute Quadrangle - OEPA River Mile Map Series - 1961

2011 NPS Report - Raccoon Creek Watershed - Orland Gob Pile

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Expected completion spring 2012 ODNR Project Number: VN-Sw-02

Pre-construction

Gob Pile with erosional gullies
Photo by Amy Mackey

Post-construction

Re-graded and re-vegetated hillside where Orland Gob Pile previously stood. Photo by Amy Mackey

Orland Gob Pile project is located in Section 2 of Swan Township in Vinton County and lies within the 14 digit HUC unit #05090101020020. The Orland Gob Pile project discharge, site WB050, is located on an unnamed tributary that drains to the West Branch of Raccoon Creek at river mile 2.0. The project consists of approximately a six acre refuse (gob) pile. The exposed gob pile generates acid mine drainage and erodes coal fines into the West Branch of Raccoon Creek. The treatment approach for this site consists of incorporating lime into the gob and re-soil material, grading the gob pile to obtain positive drainage, covering the gob with suitable re-soil material, installing a limestone diversion channels (975 linear feet) around the site and establishing vegetation. The goal of the design is to reduce approximately 60 lbs/day of acid loads and 14 lbs/day of metal loads from entering the West Branch of Raccoon Creek. The design was completed by ODNR-DMRM in-house, $34,940. Construction is expected to be complete spring 2012 by Seifert Construction. Funding source for the project design and construction is ODNR-DMRM and OSM. The project goal will be evaluated in 2012 annual report after post-construction monitoring is complete.

Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre-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 prior to construction. Post construction monitoring will begin Spring 2012, results will be reported in 2012 annual report.

Data analysis

Orland Gob Pile pre-construction monitoring show pH and net acidity at the site WB050, Figure 1. Pre-construction data shows pH in the range of 4.13 – 6.63 at site WB050 and downstream along the mainstem of West Branch of Raccoon Creek and headwaters of Raccoon Creek. Post-construction data will be reported in 2012 annual report.

Figure 1. Pre pH

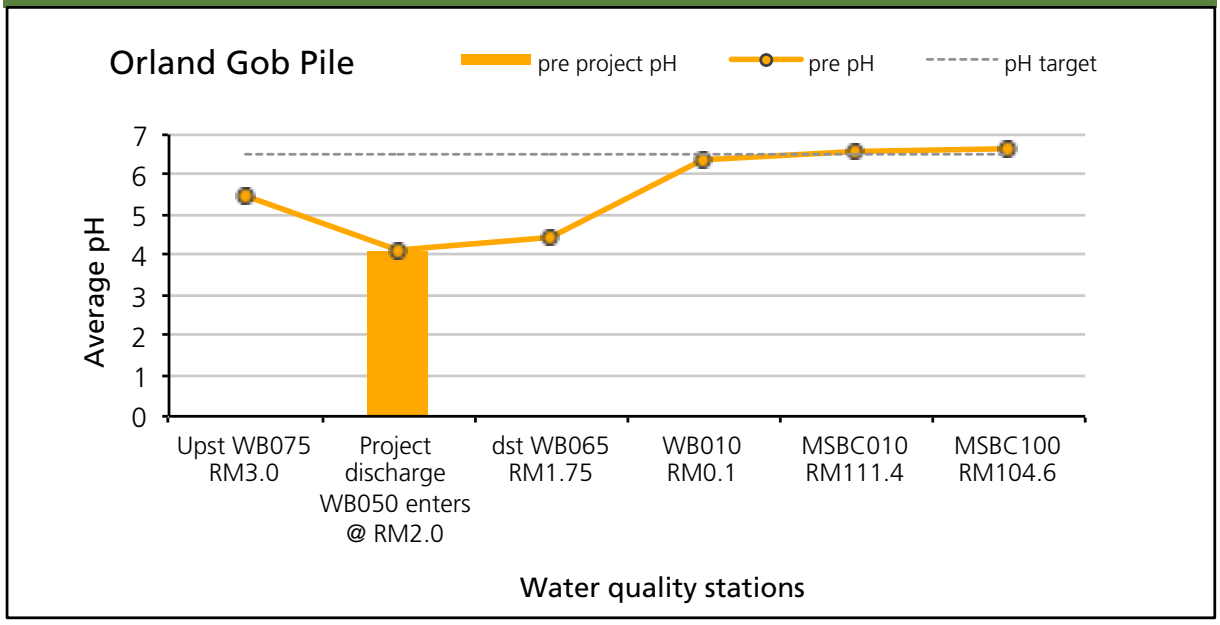
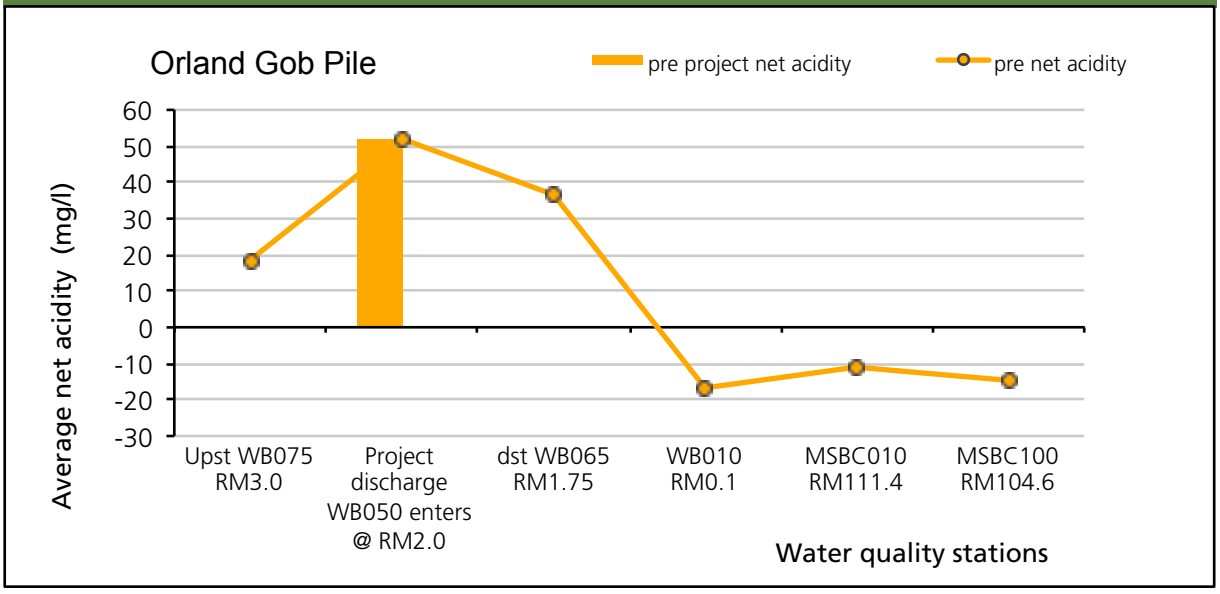
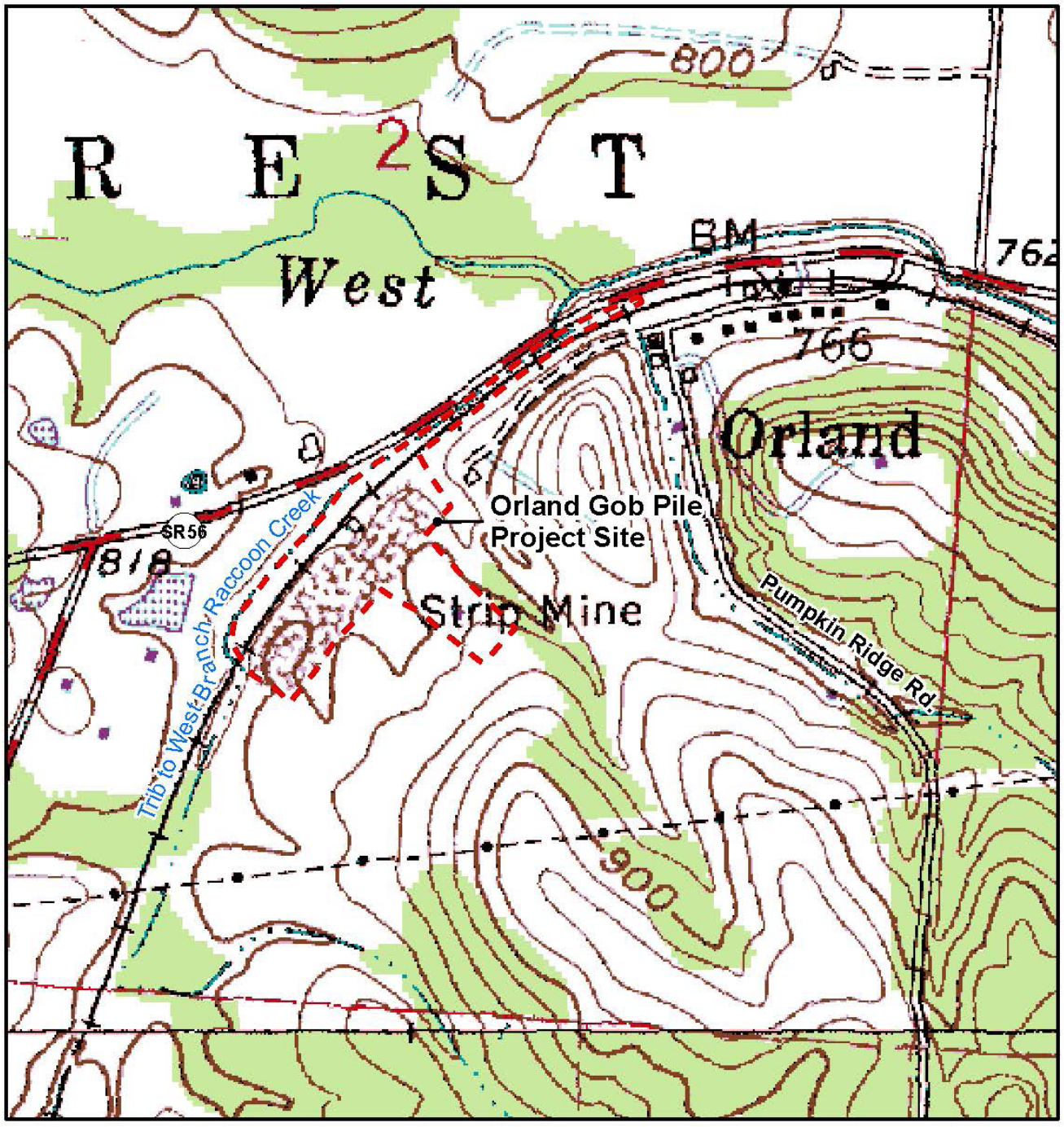


Figure 2. Pre Acidity



Orland Gob Pile Project Site
Vinton County, Swan Township, Section 2



Map prepared by Kaabe Shaw, ODNR-DMRM 10-14-10

Section III – AMD project reports

Monday Creek Watershed comprehensive acid mine drainage projects progress report for 2011.

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 2011 NPS monitoring report:

1. Grimmett Hollow
2. Jobs Hollow Doser
3. Lost Run Phase I
4. Lost Run Phase II
5. Shawnee Steel Slag
6. Coe Hollow
7. Rock Run Gob Pile revamped 2011

Archived

8. Big Four Hollow archived in 2011
9. Snake Hollow archived in 2011
10. Lost Run Subsidence Closures archived in 2009
11. Essex Doser archived in 2008
12. Rock Run 24 archived in 2007

2011 NPS Report - Monday Creek Watershed - Grimmett Hollow

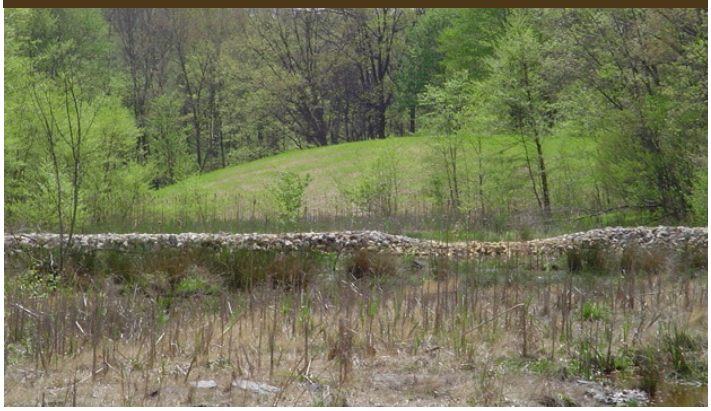
Generated by Non-Point Source Monitoring System
www.watersheddata.com

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

Pre-construction

Grimmett Hollow, Photo by Monday Creek Restoration Project

Post-construction



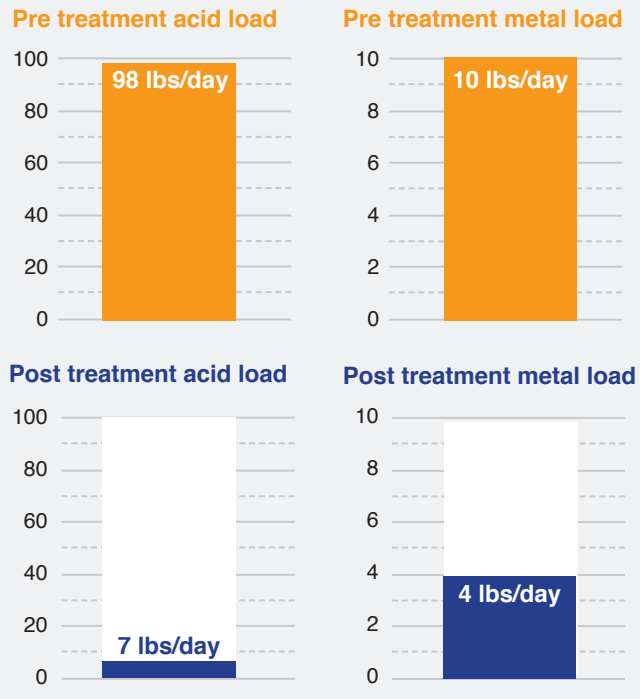
Grimmett Hollow, Photo by Monday Creek Restoration Project

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. This area was affected by abandoned strip mining, deep mining, and a remnant gob pile. The valley contained a wetland that received water from both strip pits and deep mines in the area. The gob pile was situated in the stream channel downstream of the wetland.

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 from above drainage underground mines, 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 funding sources for this project were ODNR-MRM and EPA-319 for both design and construction. On average approximately 91 lbs/day of acid and 6 lbs/day of metals were prevented from entering into Jobs Hollow and Monday Creek as a result of this AMD reclamation project.

Site: JH09020



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

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 1 and 2 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 1 and 2.

Figure 1. Yearly Acid Load Reduction

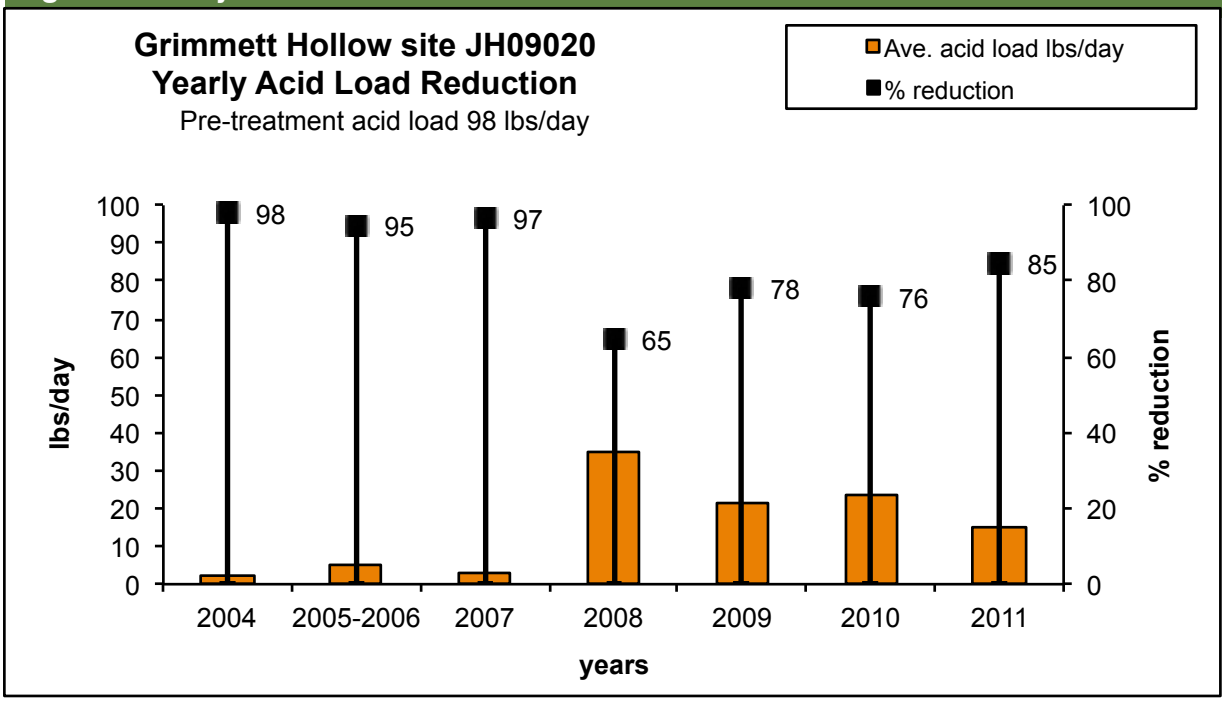
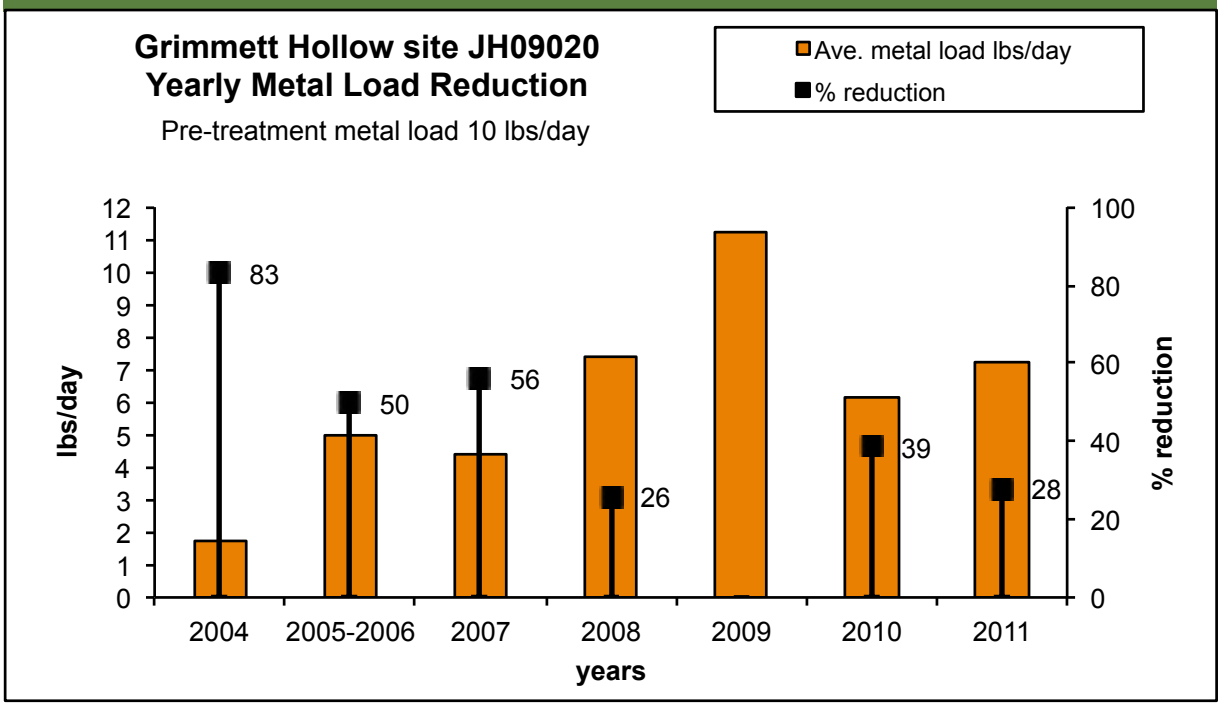


Figure 2. Yearly Metal Load Reduction



2011 NPS Report - Monday Creek Watershed - Jobs Hollow Doser

Generated by Non-Point Source Monitoring System
www.watersheddata.com

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

Pre-construction

Jobs Hollow, Photo by Monday Creek Restoration Project

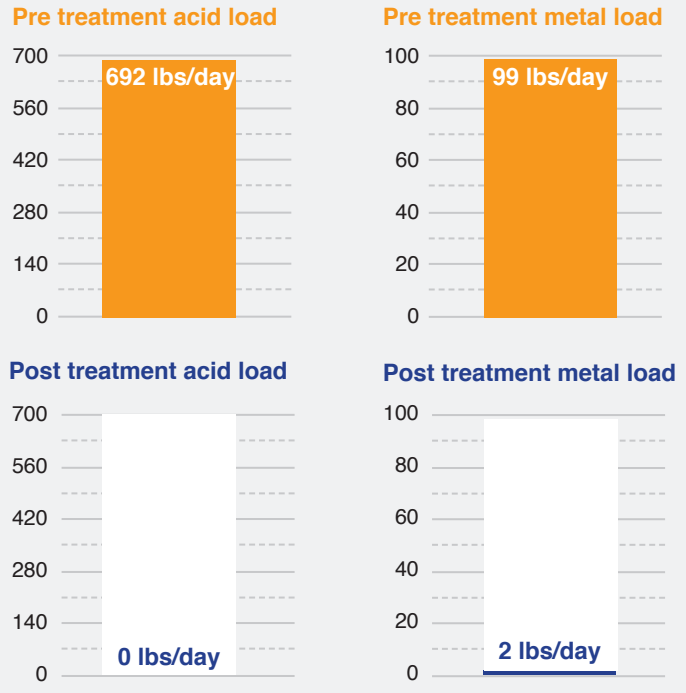
Post-construction

Jobs Hollow Doser, Photo by Monday Creek Restoration Project

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). This basin contains approximately 13 small tributaries, most of which are affected by acid mine drainage. The major contributors of acidity are from diffuse deep mine seeps and numerous gob piles. Due to the diffuse and abundant AMD sources and their inaccessibility, a doser was the most practical and efficient method for treatment.

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. 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, estimate approximately 692 lbs/day of acid was reduced from entering into Monday Creek as a result of this AMD reclamation project (shown on page 3). 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.

Site: JH00500



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

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.

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 6.5 – 8.2 downstream of the project discharge. The net acidity concentrations decreased100 percent showing net alkaline conditions continuing for 10 miles downstream.

Figure 1. Pre and Post pH

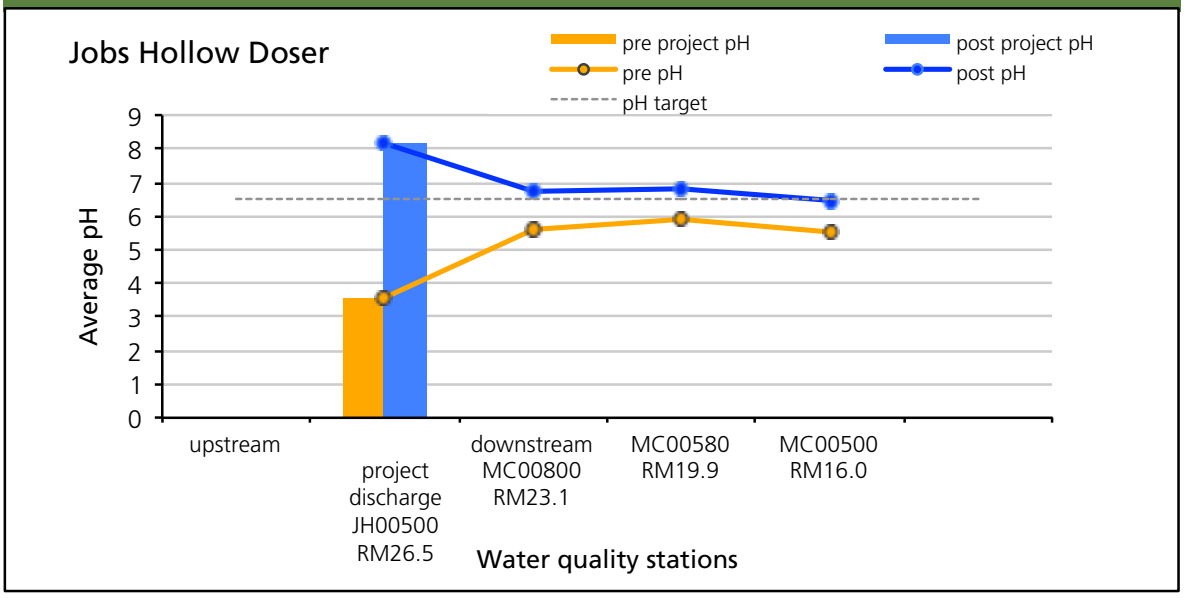
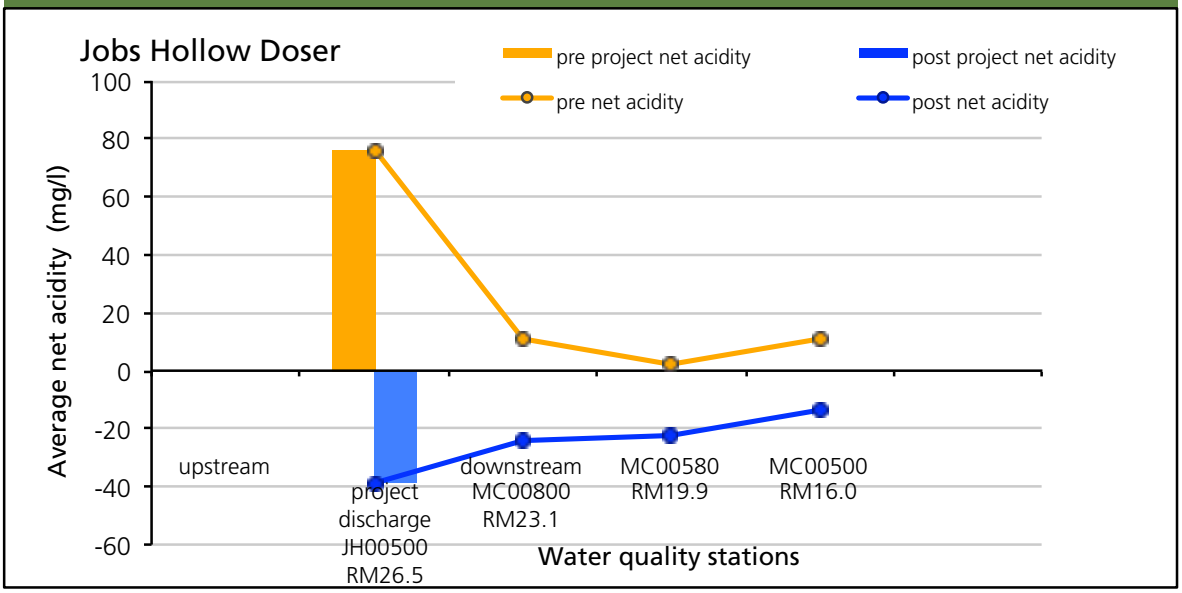


Figure 2. Pre and Post Acidity



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 12/31/2011 for post-construction.

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.

Figure 3. Acid Load Reduction

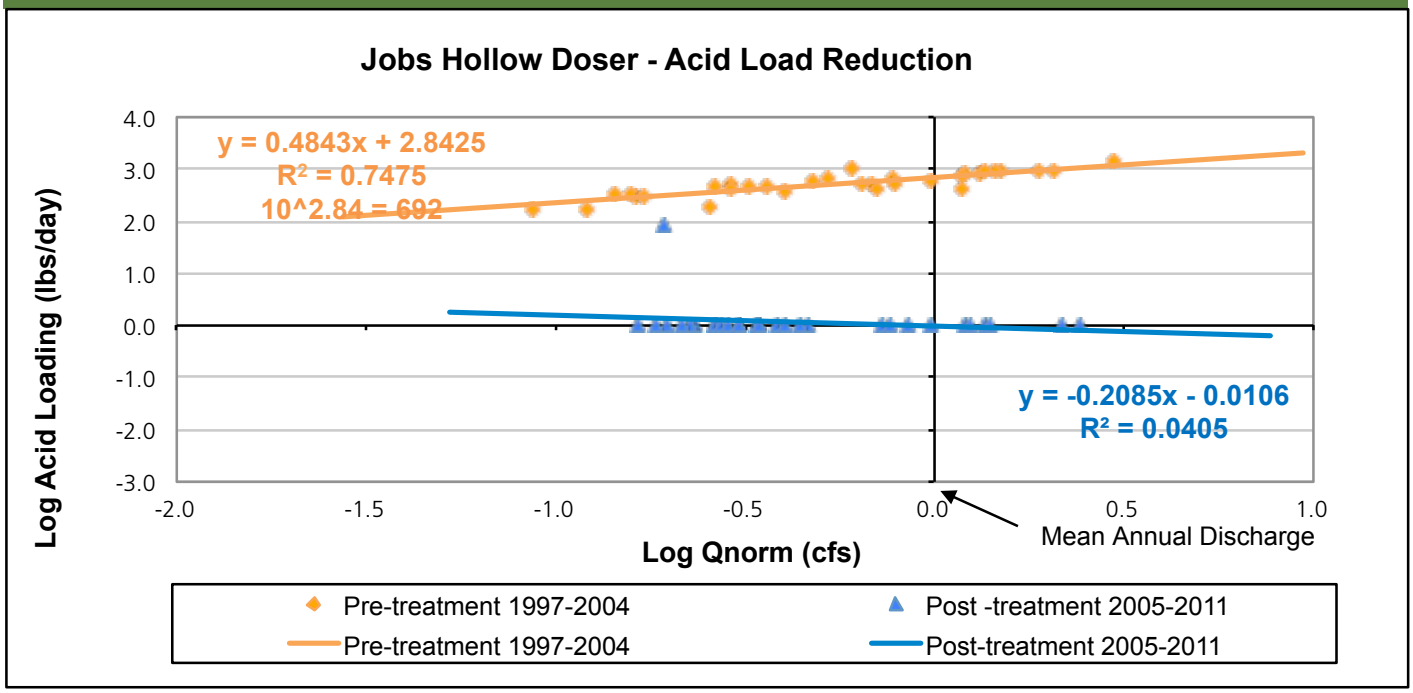
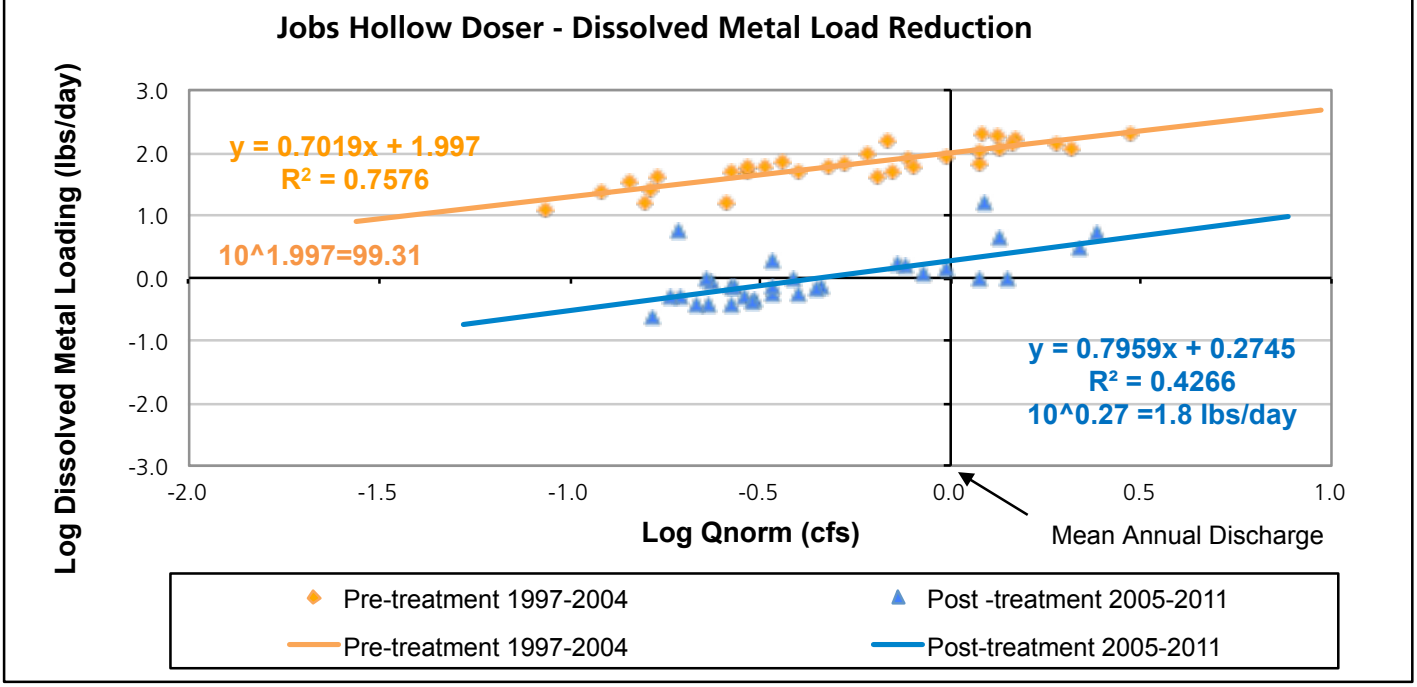


Figure 4. Metal Load Reduction



Similar to other environmental best management practices (BMPs), performance of passive acid mine drainage reclamation projects are also expected to decline with time. Active treatment systems are not expected to decline with time but sometimes need to go under go maintenance. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

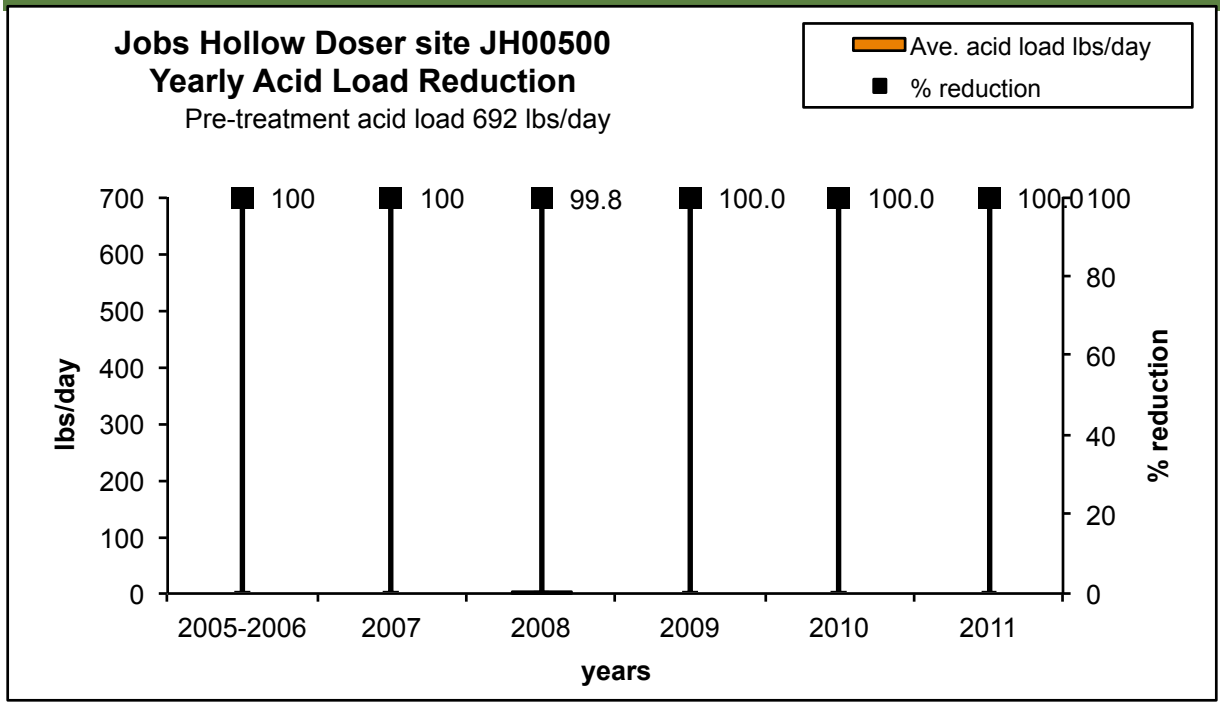
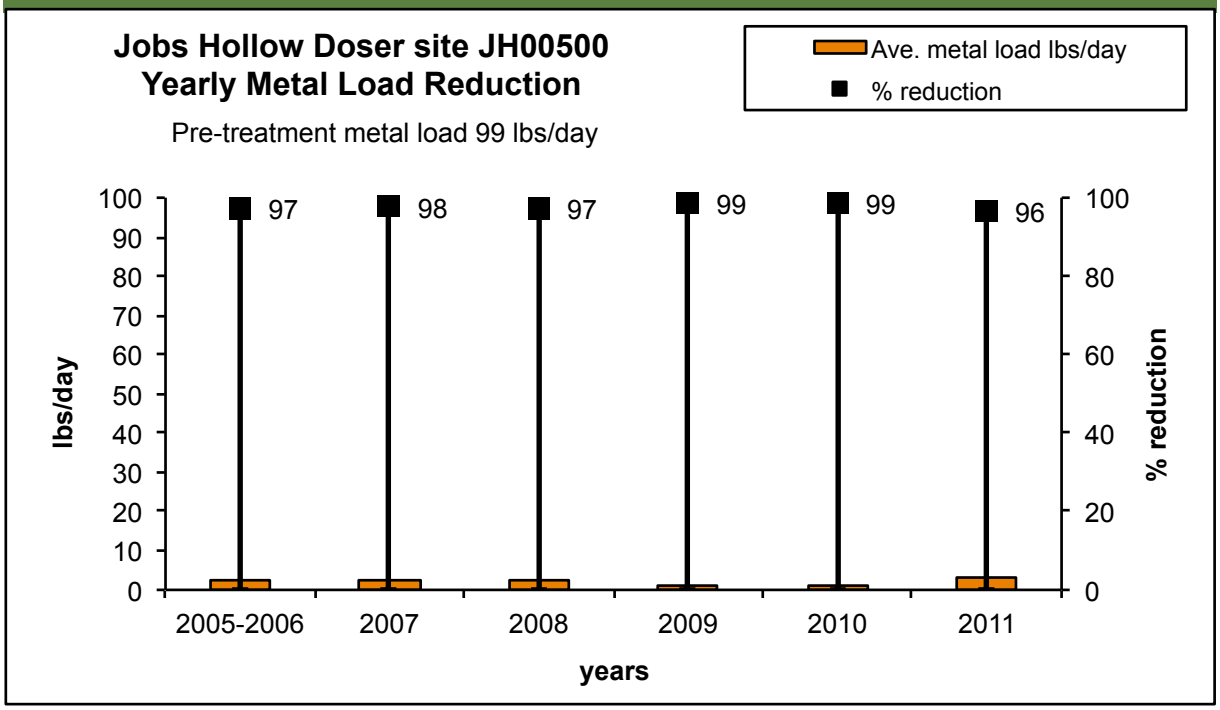


Figure 6. Yearly Metal Load Reduction



2011 NPS Report - Monday Creek Watershed - Lost Run Phase I

Generated by Non-Point Source Monitoring System
www.watersheddata.com

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

Pre-construction

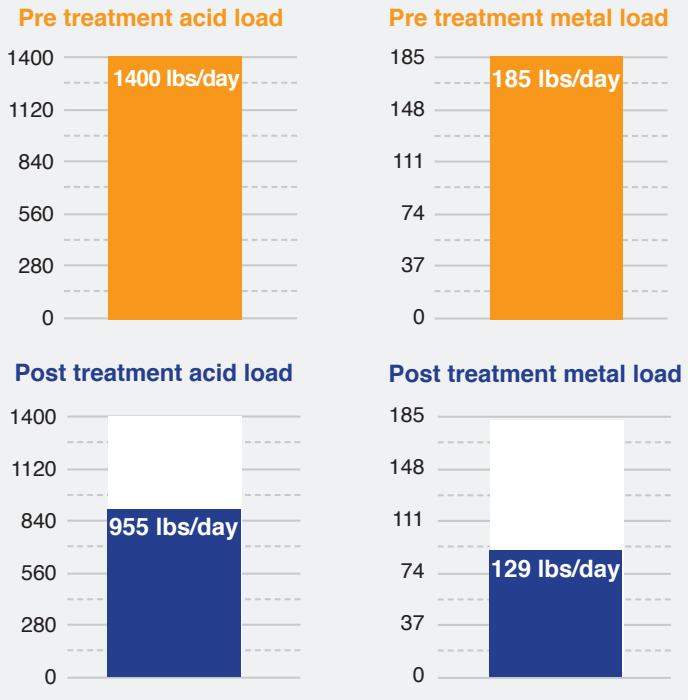
Lost Run Seep (1W2 Seep) Photo by Monday Creek Restoration Project

Post-construction

Lost Run Seep (1W5 Seep) 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 Lost Run area was providing recharge to underground mine complexes. The majority of AMD discharging in the lower portion of Lost Run occurred beneath the abandoned high walls, or near the perimeter of surface mine reclamation areas at the coal crop line. Seeps also occur in areas where overburden was deposited. 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 completed 10/31/2006 by Tucson Inc. for a cost of $456,087. Problems with the limestone leach bed were encountered summer of 2007. The system was modified and repaired August 2007. Figure 3 and 4 (shown on page 3 of this report) estimate that 445 lbs/day of acid and 56 lbs/day of metals were prevented from entering Monday Creek as a result of Phase I AMD reclamation project in Lost Run. The funding sources for this project were ODNR-DMRM for the design and for construction was MCRP, ODNR-DMRM and Ohio EPA 319.

Site: LR01020



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

Water Quality Report

Water samples were 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.

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, post-construction data shows pH in the range of 4.1 – 6.9 at the discharge and downstream. The net acidity concentration decreased 54% at the project discharge.

Figure 1. Pre and Post pH

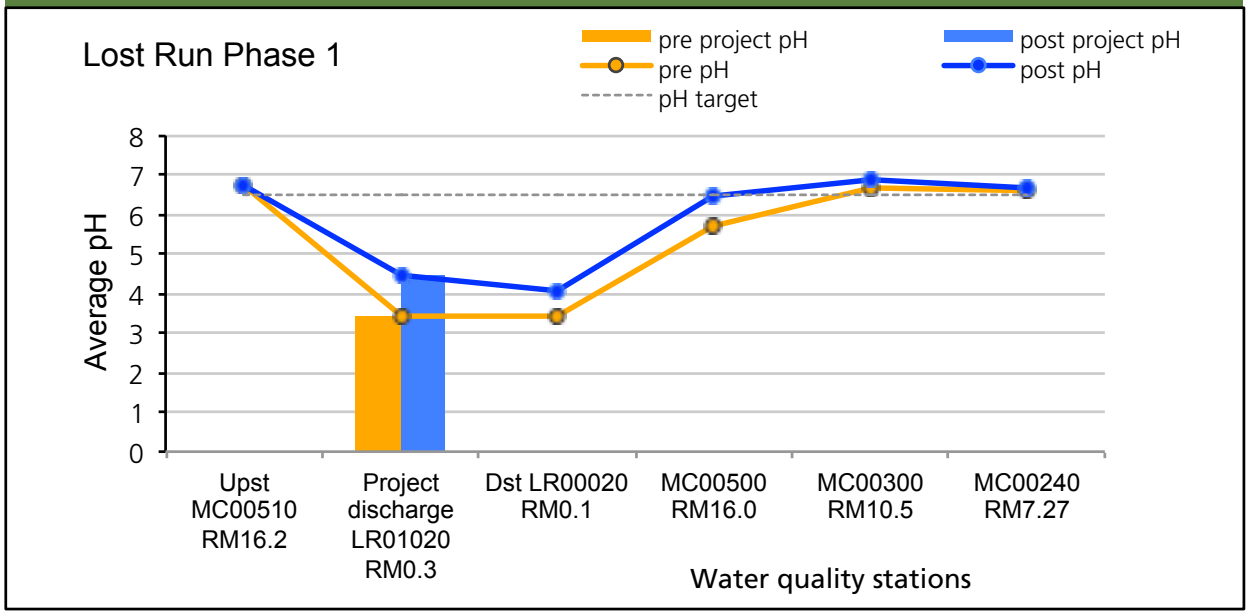
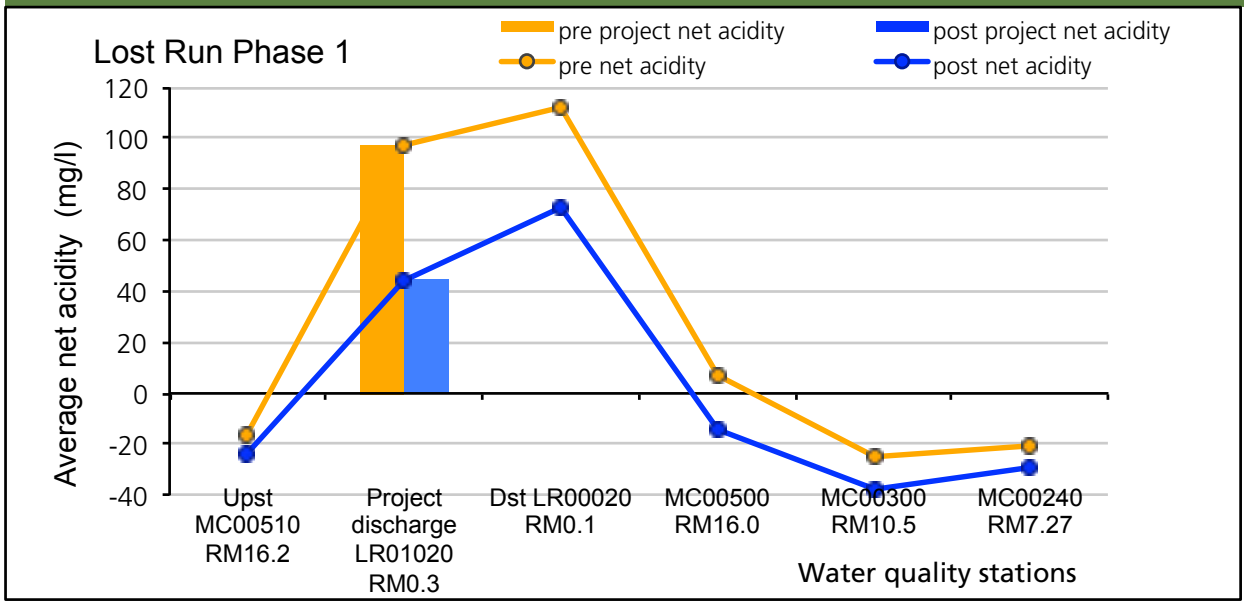


Figure 2. Pre and Post Acidity



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 5/9/2001 to 6/19/2006 for pre-construction and from 3/6/2007 to 12/31/2011 for post-construction.

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.

Figure 3. Acid Load Reduction

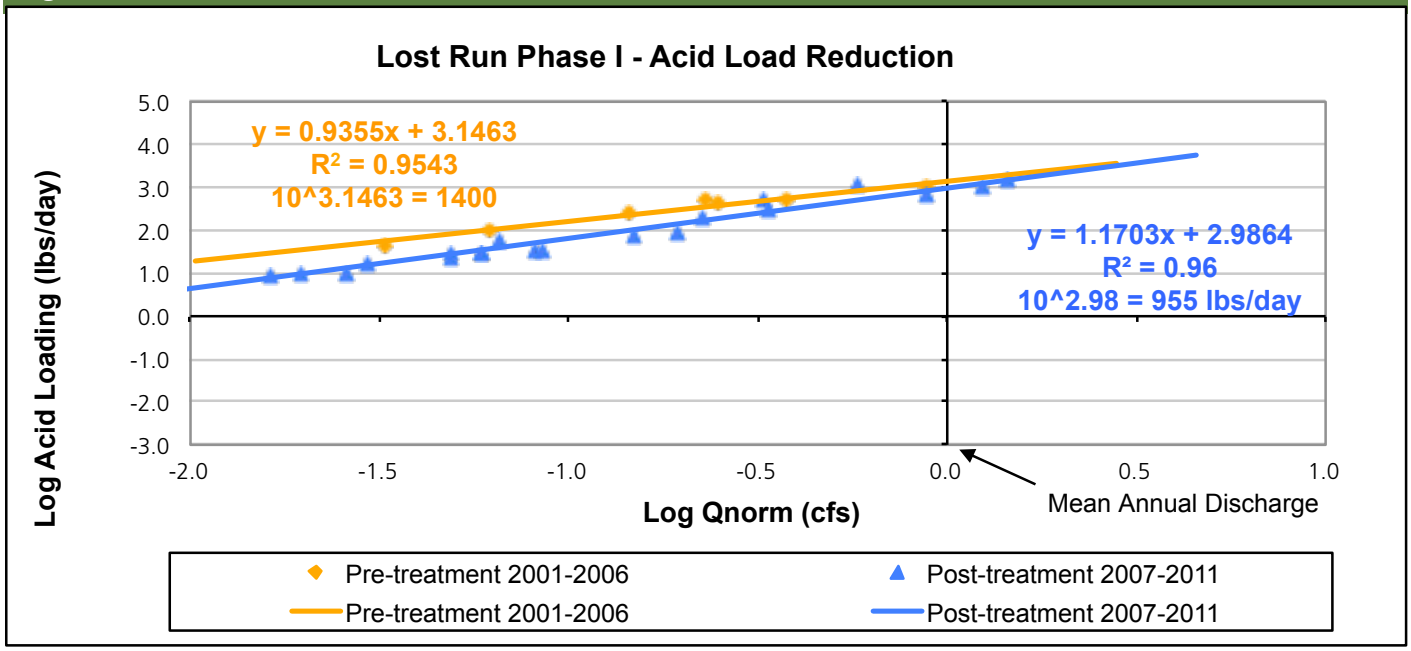
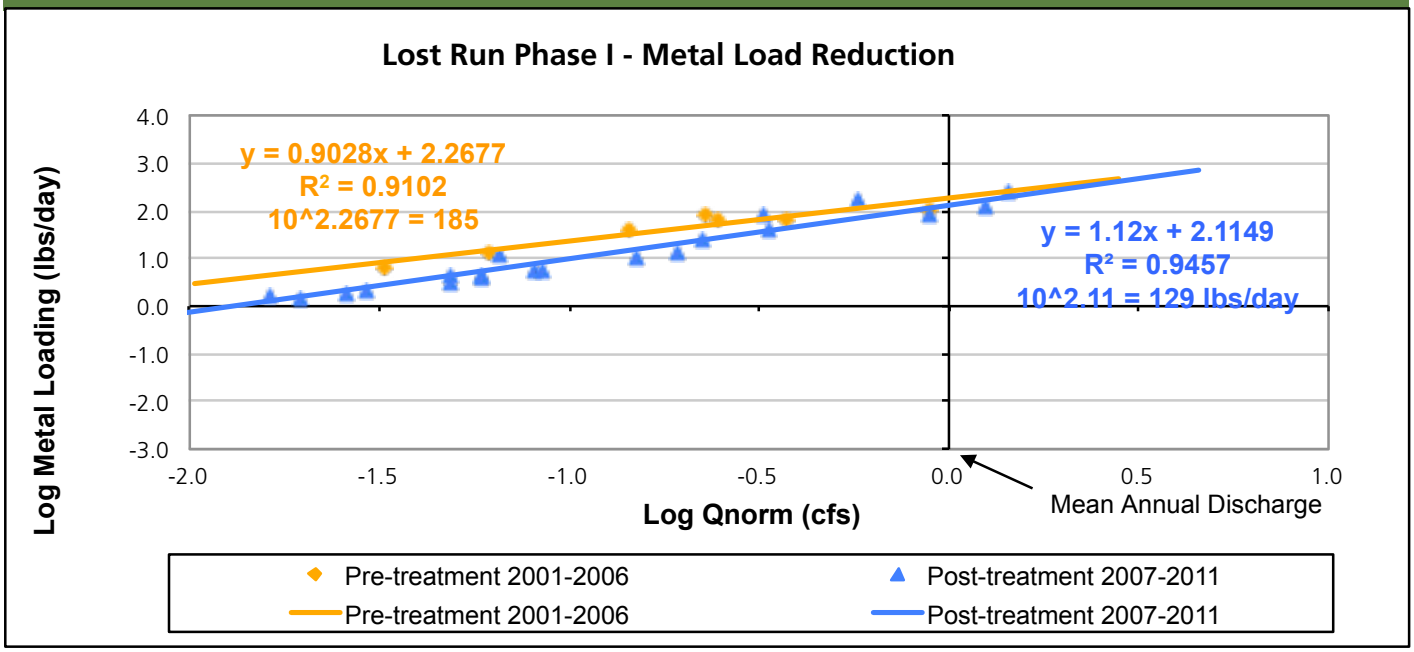


Figure 4. Metal Load Reduction



Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction

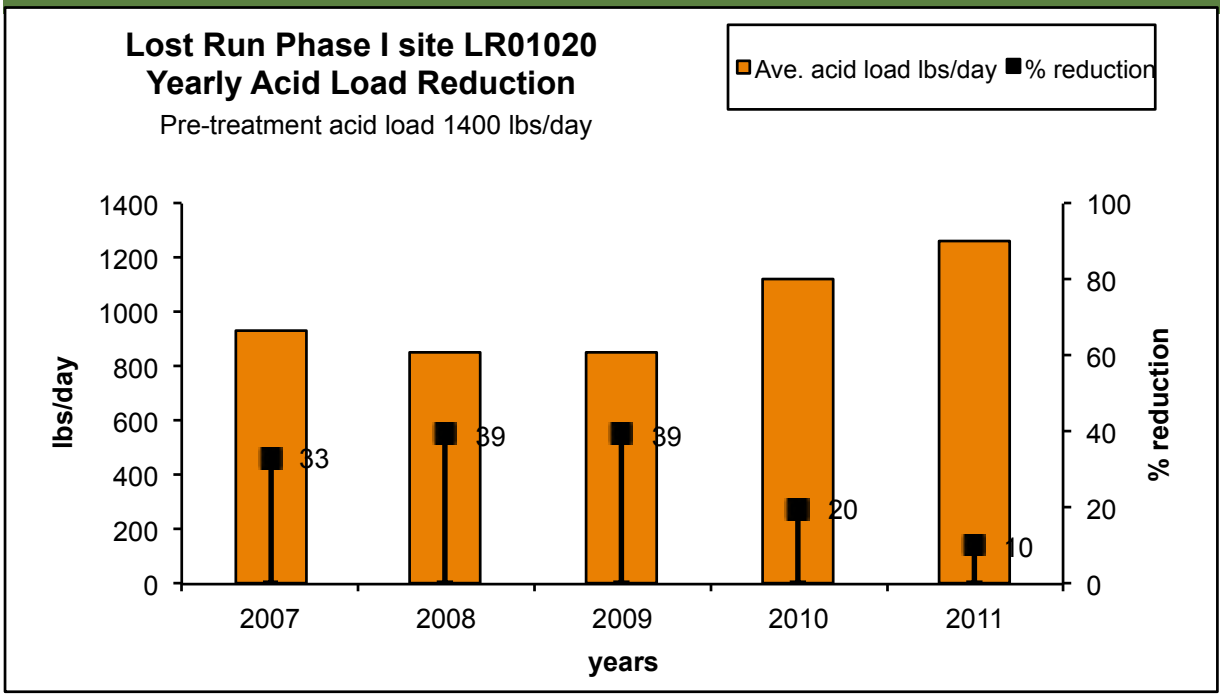
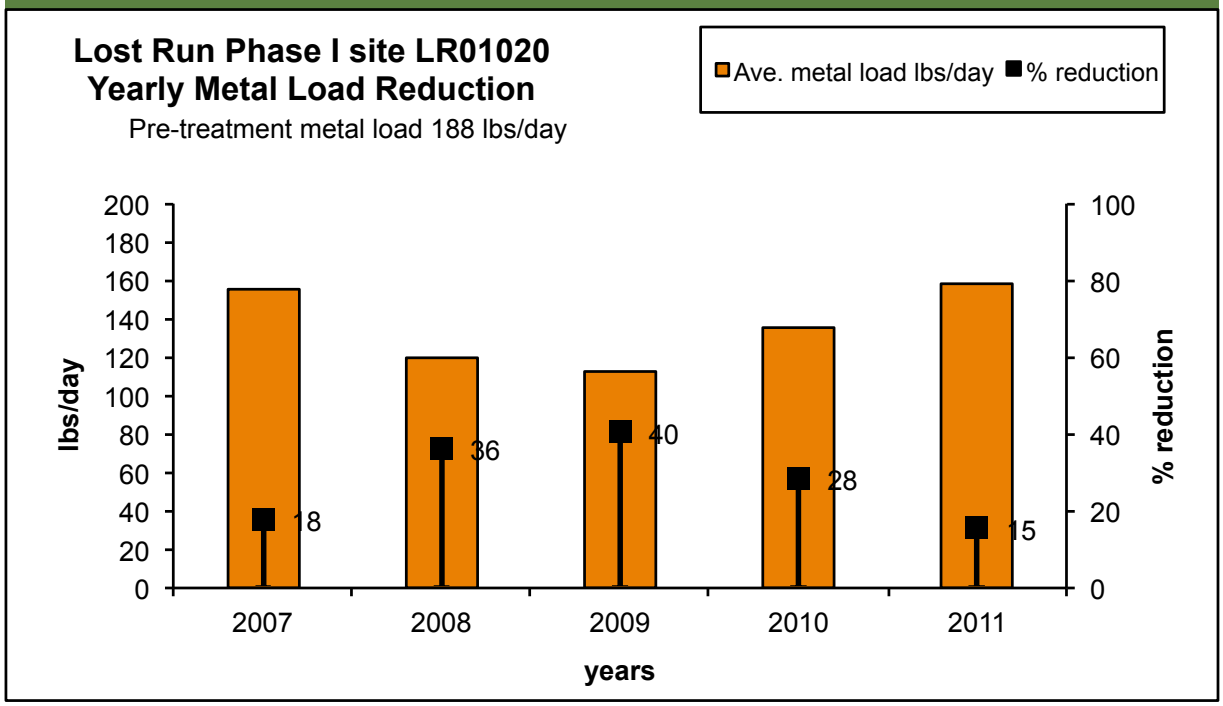


Figure 6. Yearly Metal Load Reduction



2011 NPS Report - Monday Creek Watershed - Lost Run Phase II

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete: 7/1/2007 ODNR Project Number: HC-Wr-34

Pre-construction

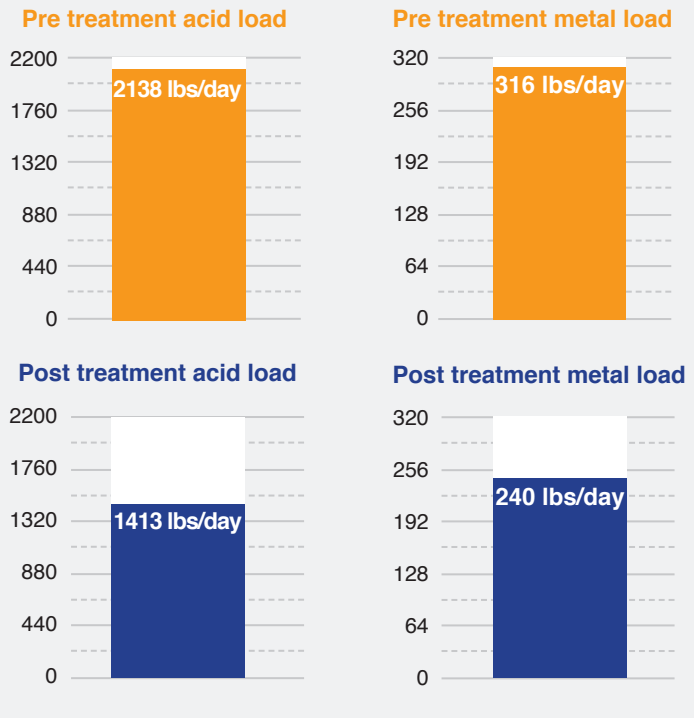
Lost Run Seeps, Photo by Nate Schlater

Post-construction

Lost Run limestone leach bed site (4W) Photo by Monday Creek Restoration Project

Lost Run Phase II is located in Section 30 of Ward Township in Hocking County and lies within the 14 digit HUC unit #05030204060010. Upstream AMD is generated from subsidence features, spoil blocks in side drainages of intermittent streams, fractured high walls, and slumped drift mine entries. Phase II of the Lost Run reclamation project consists of numerous alkaline addition systems spread throughout the headwaters of the Lost Run basin to buffer numerous AMD sources throughout the basin. Post construction monitoring is being collected at site LR00040. However, no pre-construction data was collected at this site. Therefore, reclamation results for this report are evaluated at the mouth of Lost Run (site LR00020). This site also represents water quality from Lost Run Phase I. For this report, both Phase I and II of Lost Run are evaluated at the mouth of Lost Run at site LR00020. The design was completed by ODNR – DMRM ($63,979). The treatment consisted of constructing a 7,650 square foot limestone leach bed, installing 1,300 linear feet of limestone channels, 140 linear feet of Limestone J-trenches, 14,250 square ft. of steel slag leach bed, and 197 linear feet of a steel slag berm to add alkalinity to buffer acidity generated in Lost Run. The goal of the design was to reduce acid and metal concentrations discharging into Monday Creek. Construction was complete 6/20/2007 by Stimmel Construction for a cost of $430,468. One of the planned steel slag berms could not be constructed due to private landowner denying permission. The funding sources for this project were for the design was ODNR-DMRM and for construction was MCRP, ODNR-DMRM and Ohio EPA 319. Figures 3 and 4 (shown on page 3 of this report) estimate approximately 725 lbs/day of acid and 76 lbs/day of metals were prevented from entering into Monday Creek as a result of Phase I and II of the Lost Run AMD reclamation project.

Site: LR00020



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

Water Quality Report

Water samples were 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.

As a result of the Lost Run Phase I and II Project, pH and net acidity have improved at the mouth of Lost Run. Pre-construction data shows pH at 3.4 at the mouth of Lost Run. After installation of the Lost Run Phase I and II Project, post-construction data shows pH at 4.12 at the mouth of Lost Run. The net acidity concentration decreased 36% at the mouth of Lost Run.

Figure 1. Pre and Post pH

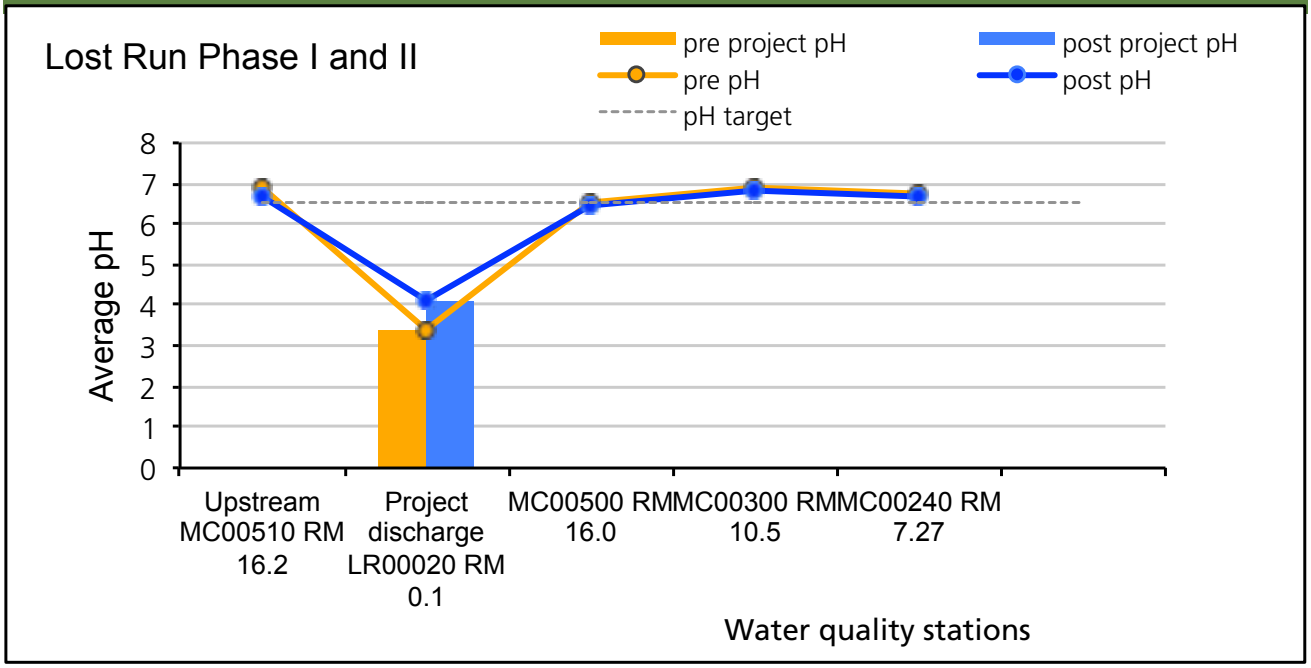
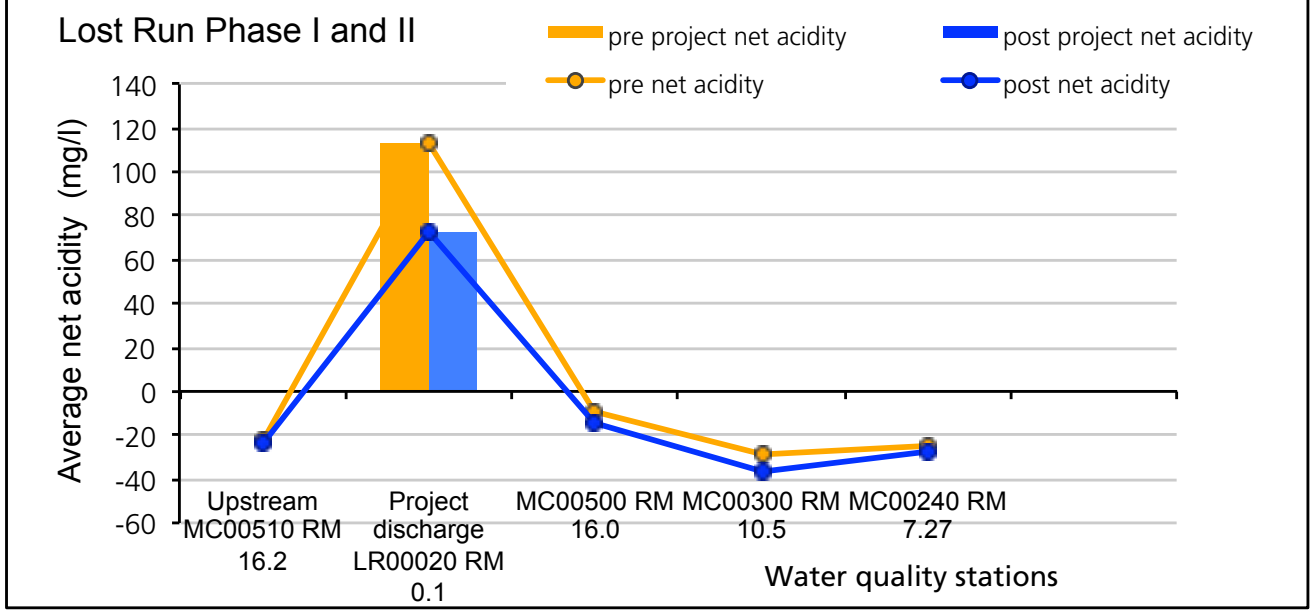


Figure 2. Pre and Post Acidity



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 3/21/2005 to 6/20/2007 for pre-construction and from 1/1/2008 to 12/31/2010 for post-construction.

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.

Figure 3. Acid Load Reduction

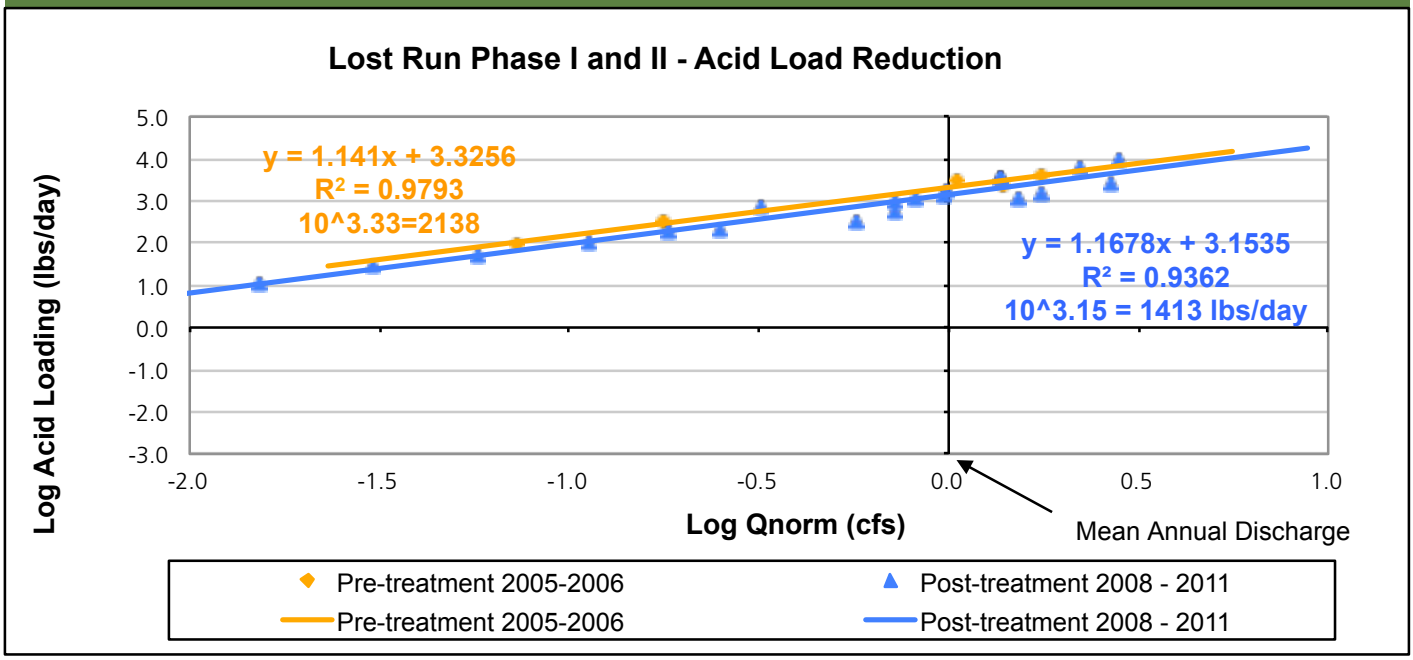
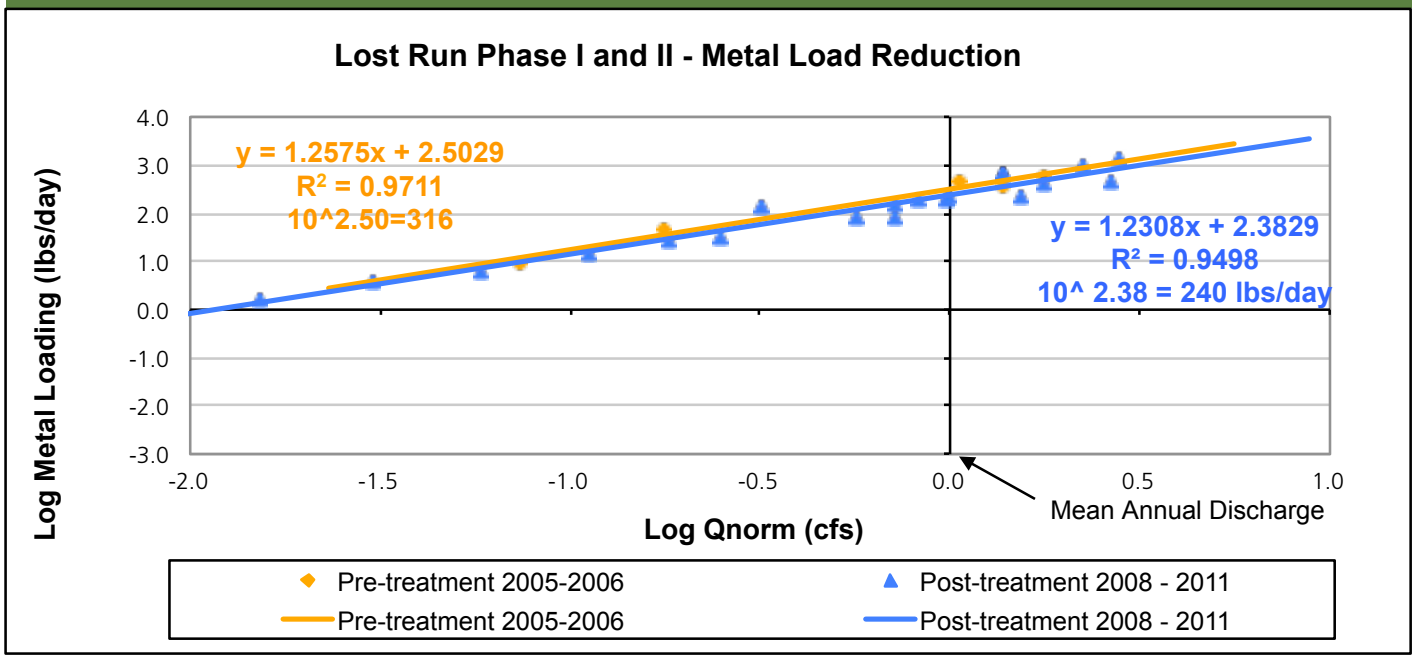


Figure 4. Metal Load Reduction



Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figures 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figures 5 and 6.

Figure 5. Yearly Acid Load Reduction

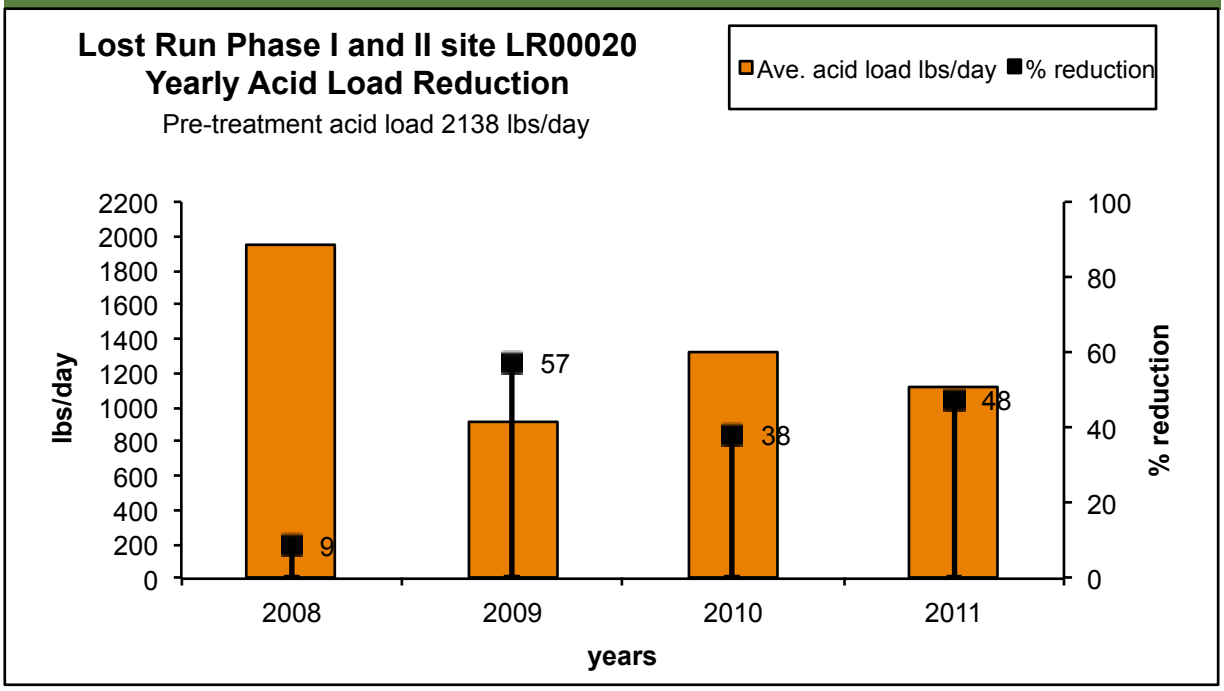
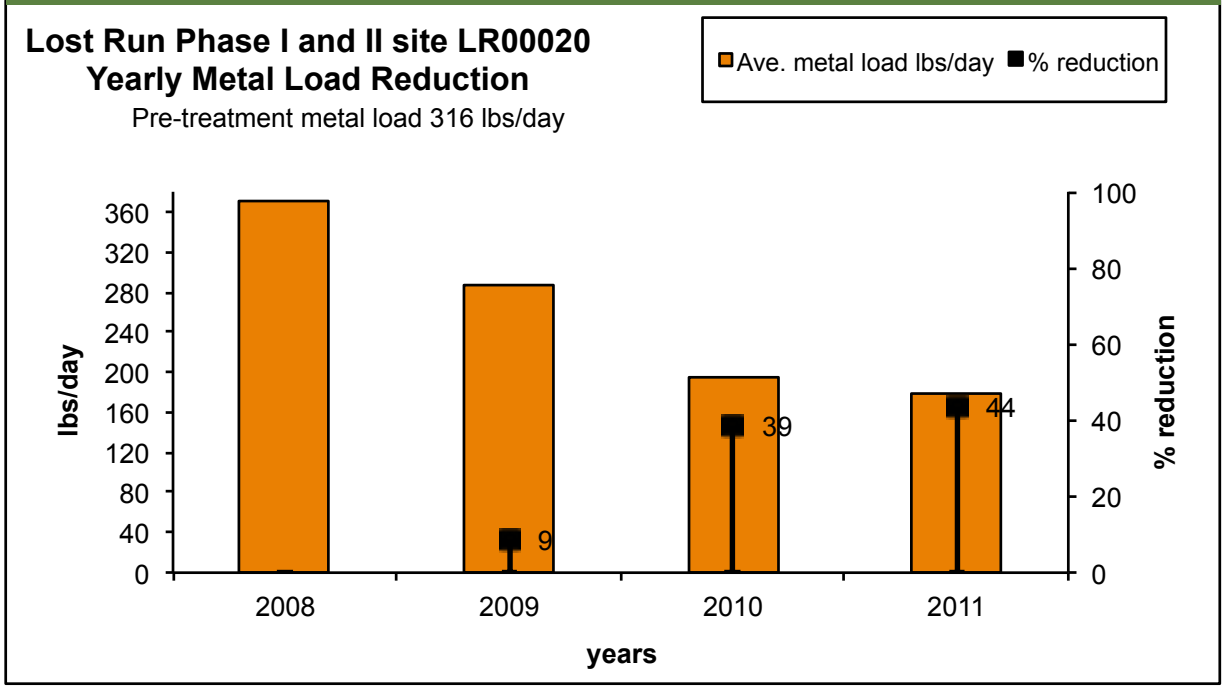


Figure 6. Yearly Metal Load Reduction



2011 NPS Report - Monday Creek Watershed - Shawnee Steel Slag Bed

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Completed 9/23/2008 ODNR Project Number: PR-SL-19

Pre-construction

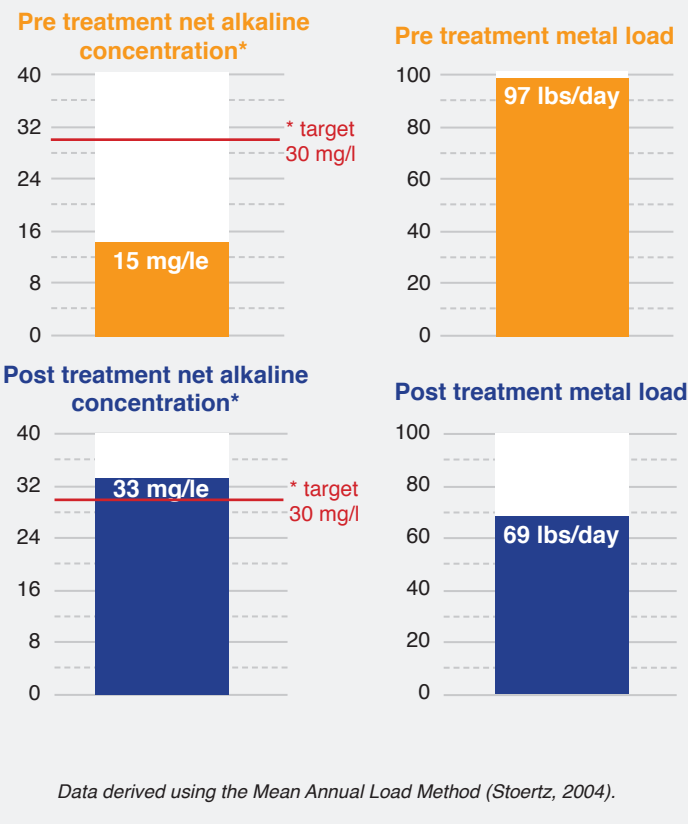
Shawnee Waste Water Plant, Photo by Monday Creek Restoration Project

Post-construction

Shawnee Waste Water Plant Post construction Photo by Monday Creek Restoration Project

Shawnee Steel Slag Bed is located in Section 17 of Salt Lick Township in Perry County and lies within the 14 digit HUC unit #05030204060020. Shawnee Steel Slag Bed reclamation project consists of constructing a steel slag leach bed at the effluent from the Shawnee waste water treatment plant to add alkalinity to Monday Creek. The design was completed by Ohio Department of Natural Resources Division of Mineral Resources Management ($20,000). The treatment consists of one 22,800 square foot steel slag bed, 190 linear feet of open limestone channel, and a sand filter to collect suspended solids and algae before entering the steel slag bed. The goal of the design is to boost net alkalinity on the mainstem to meet an alkalinity target of 30 mg/l and maintain a pH in the 6-9 range for approximately four miles downstream (Figures 1 and 2). Although the goal of this project is to add alkalinity to Monday Creek, reductions in metal loadings were observed (21 lbs/day) (Figure 3). Construction was complete 9/23/2008 by Tucson, Inc, for a cost of $231,498, but shut down to address an algae and suspended solids problems after approximately one month of being online. To solve the problems, a sand filter and algae removal system were installed October 2009. The systems began discharging treated water into Monday Creek November 2009. The SSLB was shut down during the fall of 2010 to allow for a maintenance project to help repair clogging issues that have occurred in the bed. The maintenance project was completed March 2011. The funding sources for the project was ODNR-DMRM for the design and Ohio EPA 319, ODNR-DMRM, and MCRP for construction. Maintenance projects were funded by DMRM.

Site: MC00900



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

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre-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.

Data from the Shawnee Steel Slag Bed Reclamation project pre-construction monitoring show pH and net acidity at project discharge and along the mainstem of Monday Creek, shown above. Pre-construction data shows pH in the range of 6.5 to 6.7 and net alkaline conditions in the range of 14 to 19 mg/l at the effluent and downstream of the project on Monday Creek. Post-construction data shows pH in the range of 6.9 to 8.4 and net alkaline conditions continue to rise in the range of -27 to -33 mg/l at the effluent and downstream of the Shawnee SLB project, thus meeting the project goal with pH values between 6 and 9 and alkalinity concentrations of 30 mg/l.

Figure 1. Pre and Post pH

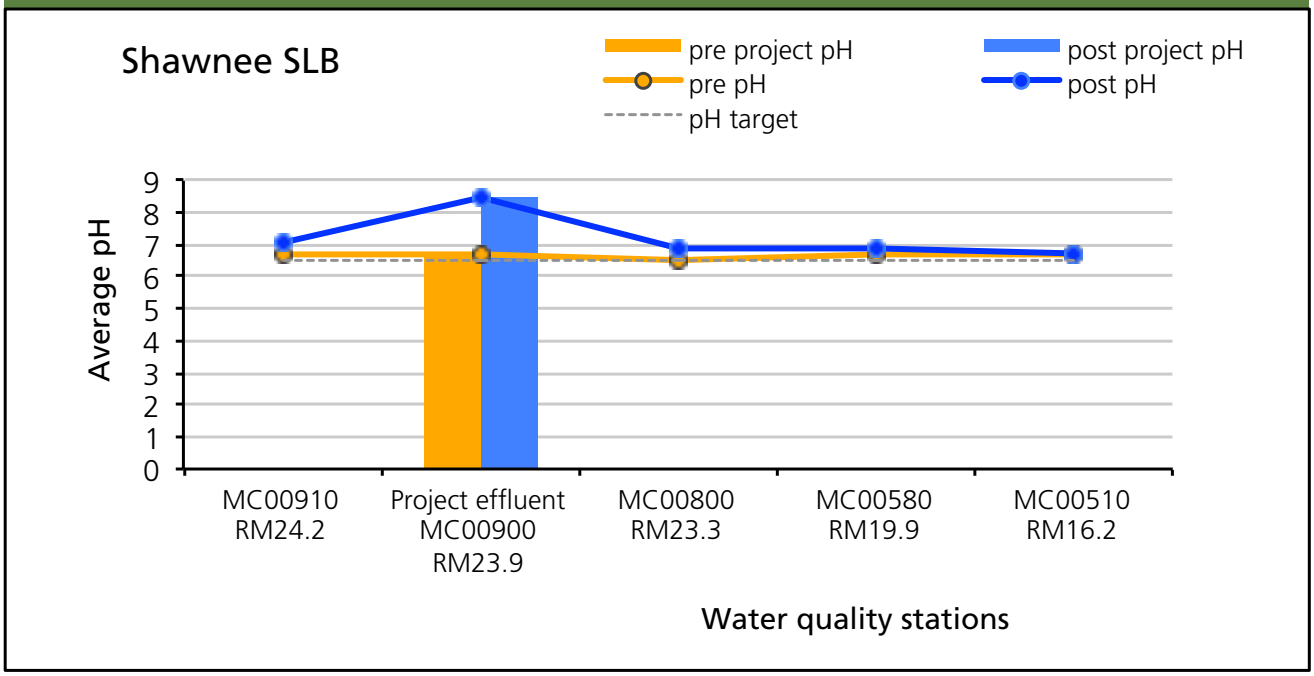
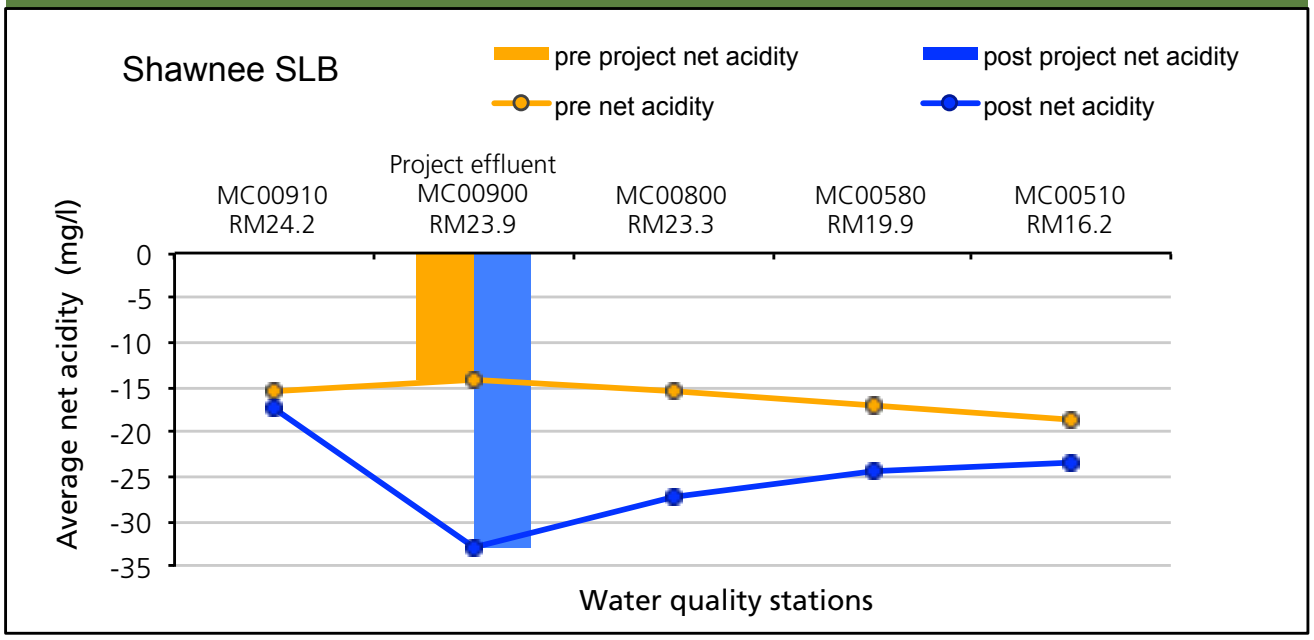


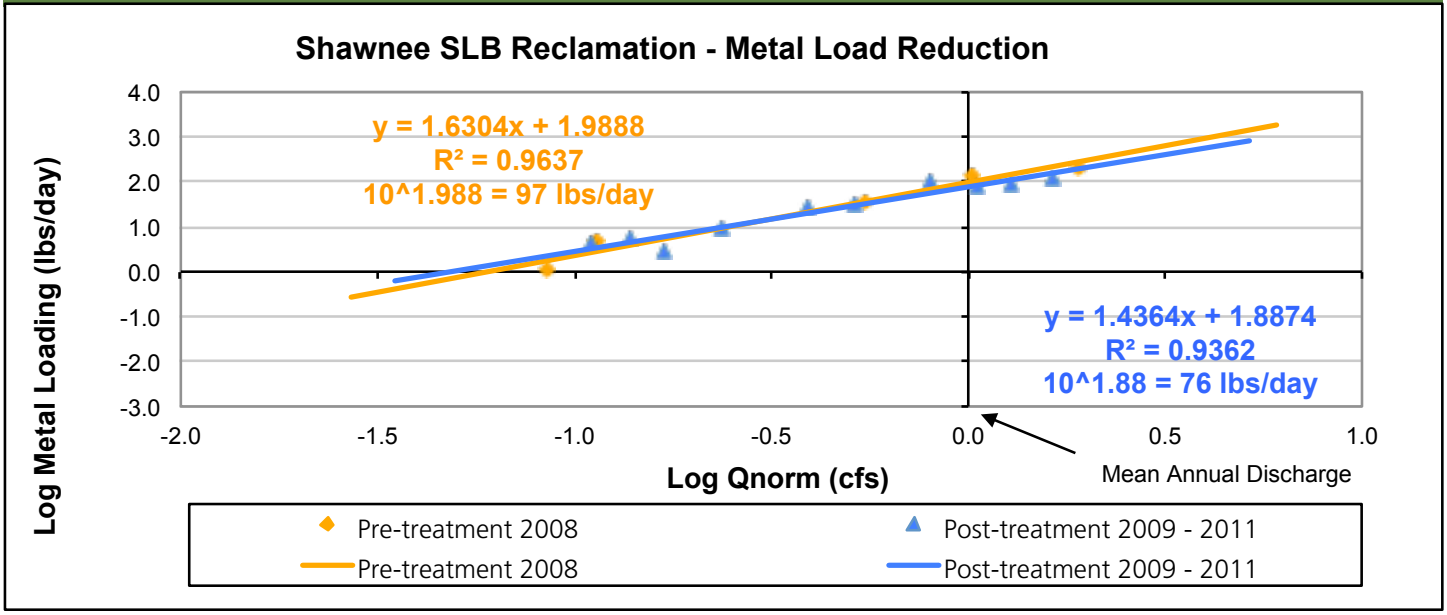
Figure 2. Pre and Post Acidity



Water Quality – load reductions

Using the Mean Annual Load Method (Stoertz, 2004) metal load reduction occurring at this project was plotted and shown in Figure 3. Iron, aluminum, and discharge were measured pre-construction at the project effluent from 2/04/2008 to 9/23/2008 for pre-construction and from 11/16/2009 to 12/31/2010 for post-construction.

Figure 3. Metal Load Reduction



2010 NPS Report - Monday Creek Watershed - Coe Hollow

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete: 9/6/2010 **ODNR Project Number: NA**

Pre-construction

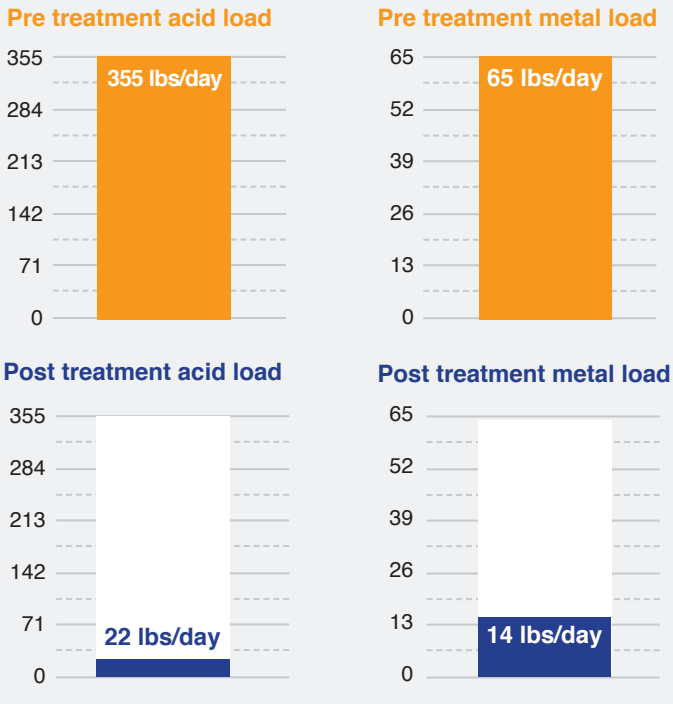
Coe Hollow pre-construction Photo by Mike Nicklow (USFS)

Post-construction

Coe Hollow Limestone Leach Berms (USFS)
Photo by Monday Creek Restoration Project

Coe Hollow is located in Section 11 of York Township in Athens County and lies within the 14 digit HUC unit #05030204060030. Coe Hollow reclamation project was a collaboration between the US Forest Service, Ohio Department of Transportation (ODOT), and the Monday Creek Restoration Project. Coe Hollow is located in the southern part of the Monday Creek Watershed between the city of Nelsonville and the village of Buchtel. While the sub-basin is small (131 acres), approximately 58% of Coe Hollow contains underground-mined areas. Accordingly to the AMDAT report (2005), field reconnaissance performed in 2001 documented numerous slumps on hillsides, dissipating or losing streams, one subsidence hole in the main-stem and north tributary, slumped mine entries, a small gob pile located in and adjacent to the stream channel, as well as several seeps discharging AMD at stream level. The treatment goal for this project was to reduce acid and metal loadings to Monday Creek by at least 80%. The design was completed by Redwing, Wayne National Forest, ODOT, and RJM ($41,000). The treatment consists of a series of limestone leach ponds (54,320 sq. ft.) between limestone berms (276 linear ft.) with approximately 6 inches of limestone on the bottom, to add alkalinity. Of the 9.2 acres of wetlands constructed, 1.5 acres were constructed downstream from the USFS project to capture precipitate metals, the other 7.7 acres were constructed on the other side of the road and are clean water. Of the 7.7 acres, 3.4 acres are used to supply the 13,608 sq. ft. steel slag leach bed. Two subsidence stream captures were sealed, reconnecting 80 acres of surface drainage back to the receiving stream. Construction was complete 9/6/2010 by DJ Group, Wayne National Forest ($409,000), and ODOT ($1,298,466) for a total cost of $1,707,446. The funding sources for this project were ODOT and USFS.

Site: CH00100



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

Water quality report

Water quality data was collected at the project discharge as well as multiple stations pre-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.
Coe Hollow pre-construction monitoring show pH and net acidity at the site CH00100, Figure 1. Pre-construction data shows pH in the range of 2.94 – 5.7 at site CH00100 and one mile downstream along Monday Creek mainstem. Post-construction data collection began late fall 2010. Data results for post construction at site CH00100 to one mile downstream along Monday Creek show pH in the range of 5.49 - 5.88. The net acidity concentration decreased by 81 percent.

Figure 1. Pre and Post pH

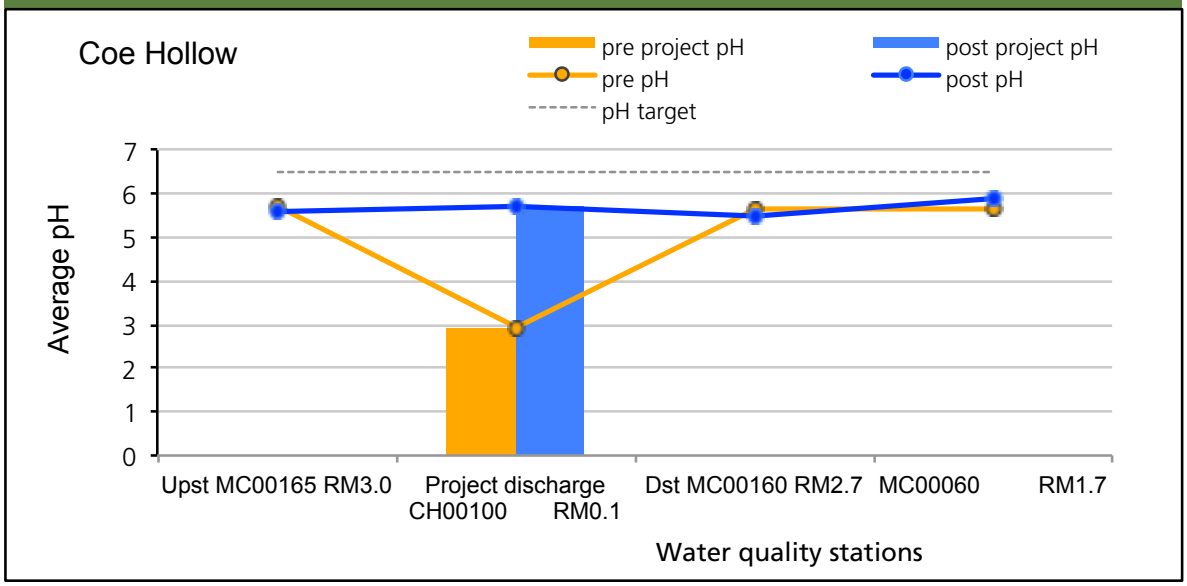
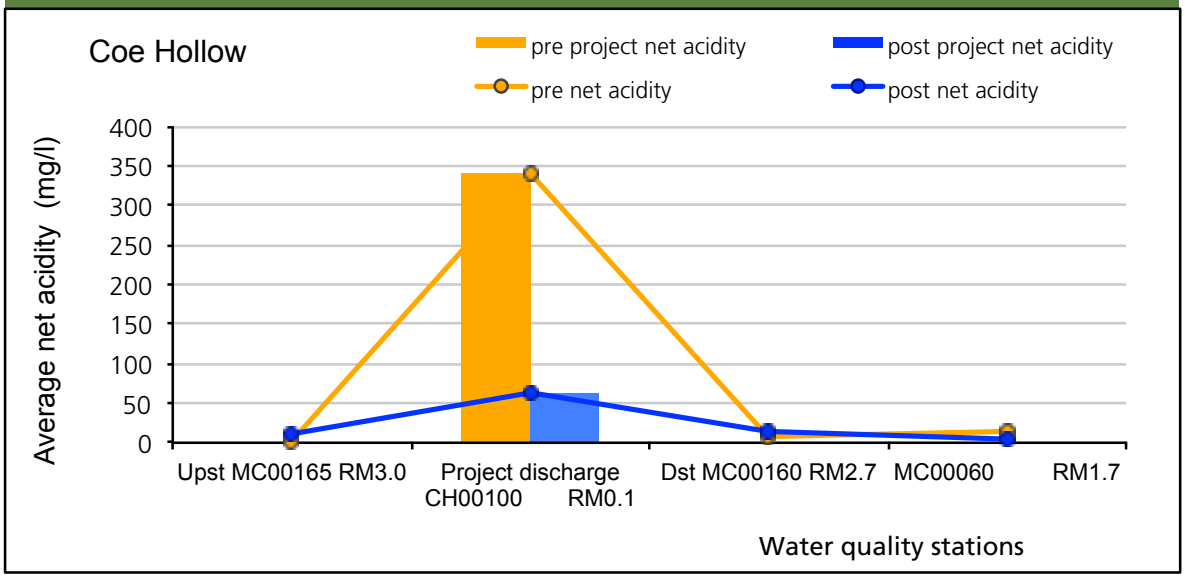


Figure 2. Pre and Post Acidity



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 12/31/2011 for post-construction.

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.

Figure 3. Acid Load Reduction

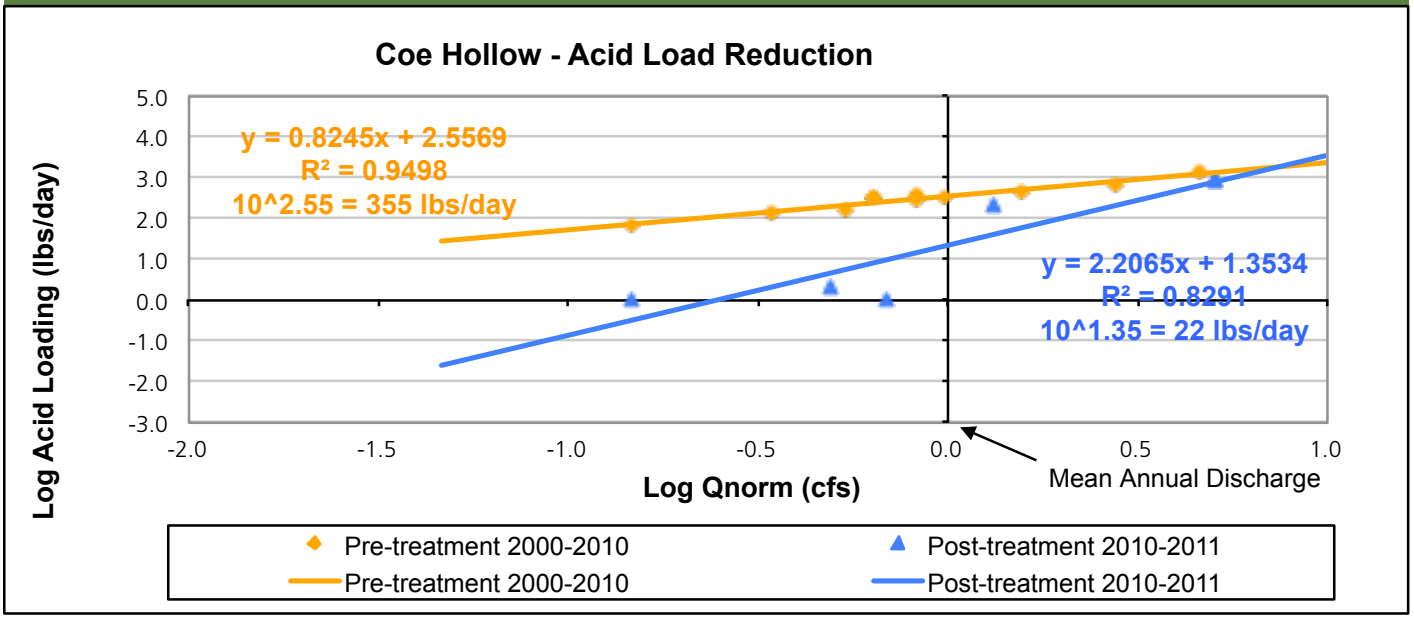
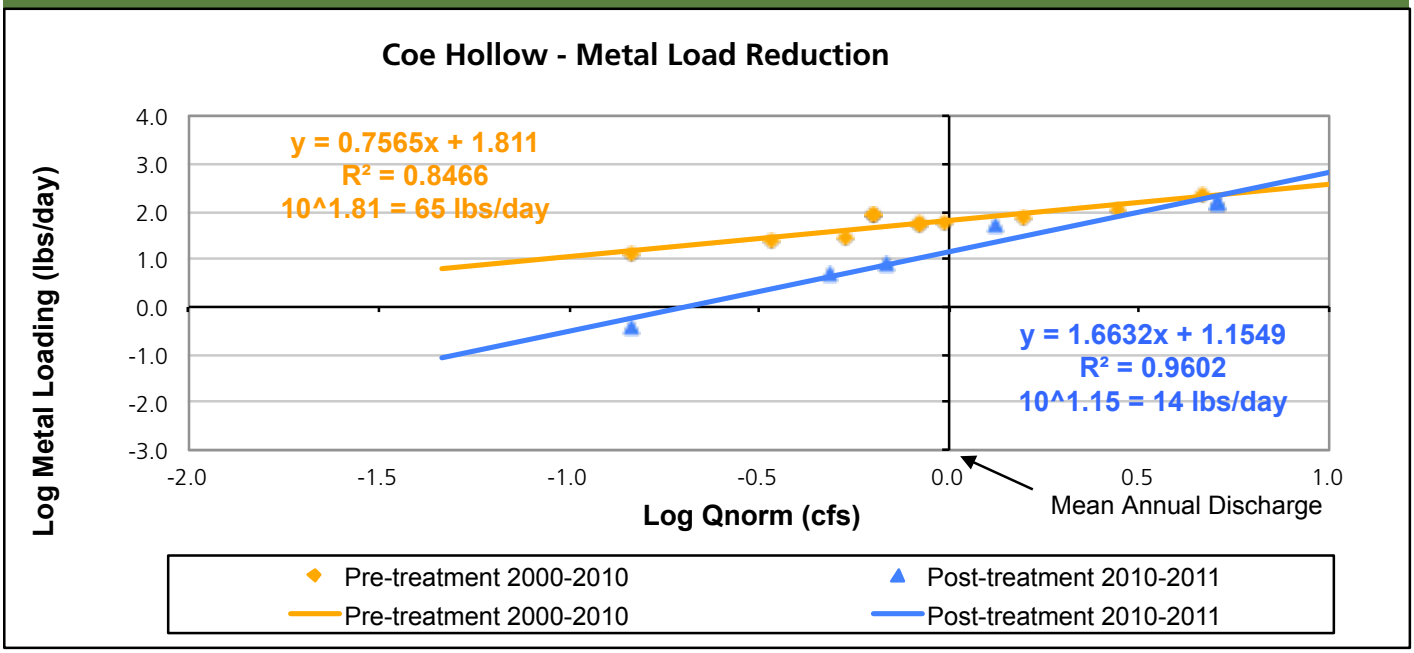


Figure 4. Metal Load Reduction



2011 NPS Report - Monday Creek Watershed - Rock Run Gob Pile

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete: 9/1/1999, Archived: 2010, Revamp: 2011 **ODNR Project Number: PR-Co-19**

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 which was actually a slurry impoundment 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 flue gas desulfurization, and installing a 3,200 Sq. ft. Successive Alkalinity Producing System (SAPS) was used 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. A major considerations encountered during the design process was that 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 funding sources for this project were for both the design and construction: ODNR-DMRM, EPA-319, and OSM-ACSI. Load reductions are not calculated due to lack of pre-construction data, see figure 3 & 4.

The Rock Run Gob Pile project was revamped during 2011 and completed on 8/30/2011. The successive alkaline producing system (SAPS), initially installed in 1999, became clogged with metals and debris. Untreated water was bypassing the system through the emergency spillway. Therefore maintenance was needed. The old compost and limestone was removed and replaced in the SAPS. In addition new piping was installed in the SAPS. A third settling pond was installed to improve settling and a by-pass channel was installed to route overflow storm water around the SAPS. Construction was completed by Tuscon Inc. for $192,005 and design was conducted in-house by ODNR-DMRM.

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.

As a result of the Rock Run Gob Pile Project and the revamp project in 2011, 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 3.1 – 5.2 at the project discharge and downstream. However after reclamation of the initial Rock Run Gob Pile Project completed in 1999-2009, post-construction data shows pH in the range of 3.7– 6.3. After the revamp project pH ranged from 3.5 to 7.6 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.

Figure 1. Pre and Post pH

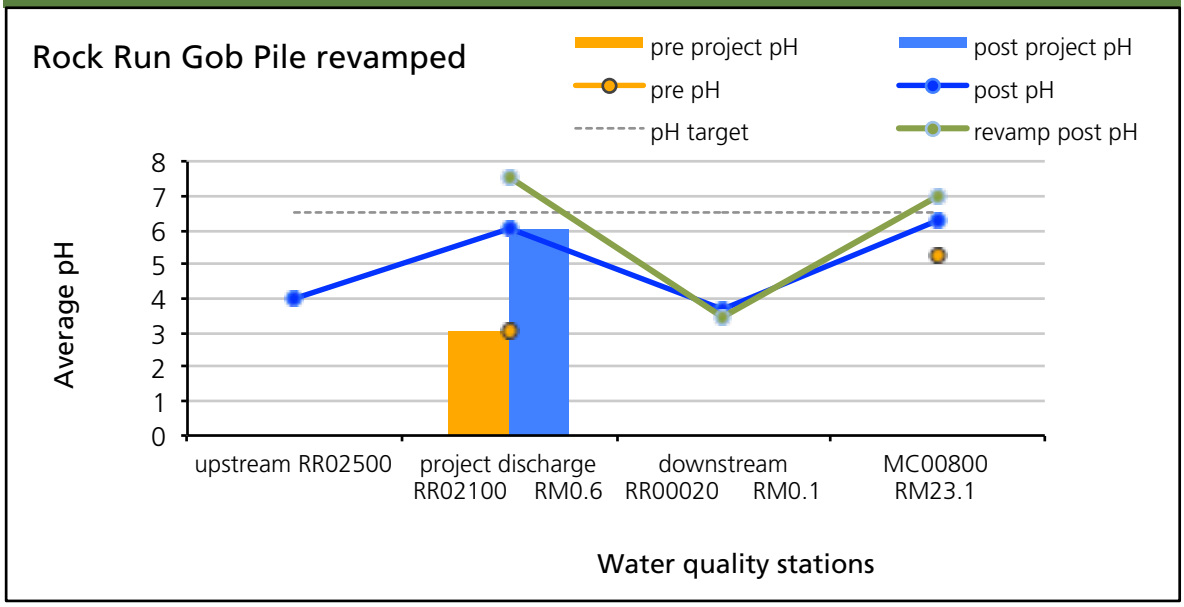
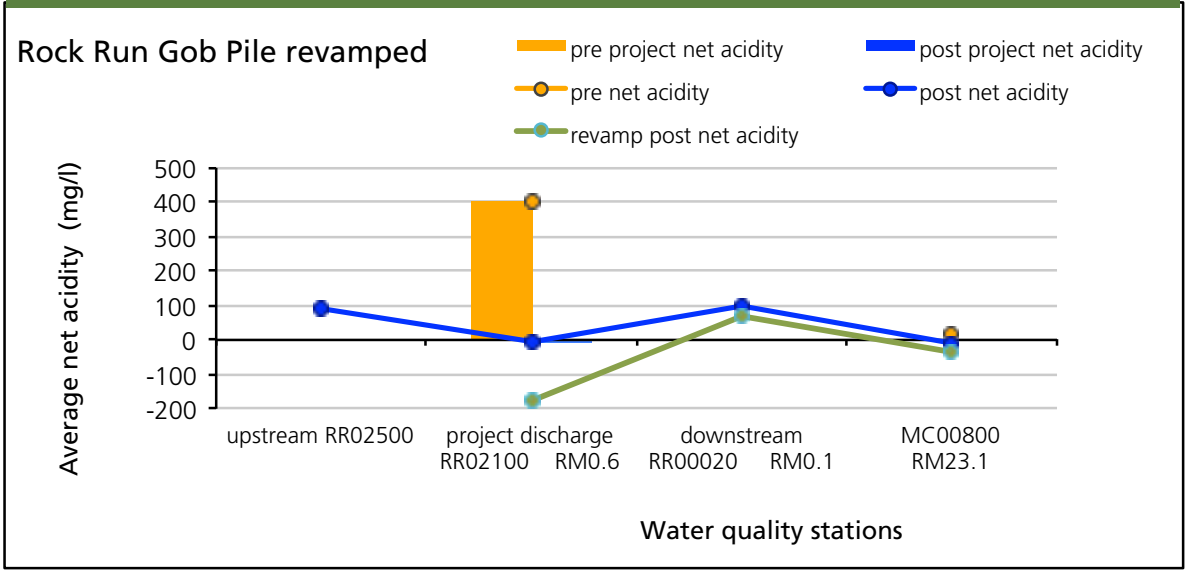


Figure 2. Pre and Post Acidity



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, 8/31/1998 for pre-construction and from 10/1/1999 to 12/31/2009 for post-construction. Only one sample was recorded during the pre-construction time period. (year 2008, no data collected). Site ID: RR02100 The green represents the data for the time period 2011 after the maintenance and revamp project was completed. The site RR02100 was net alkaline during 2011.

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.

Figure 3. Acid Load Reduction

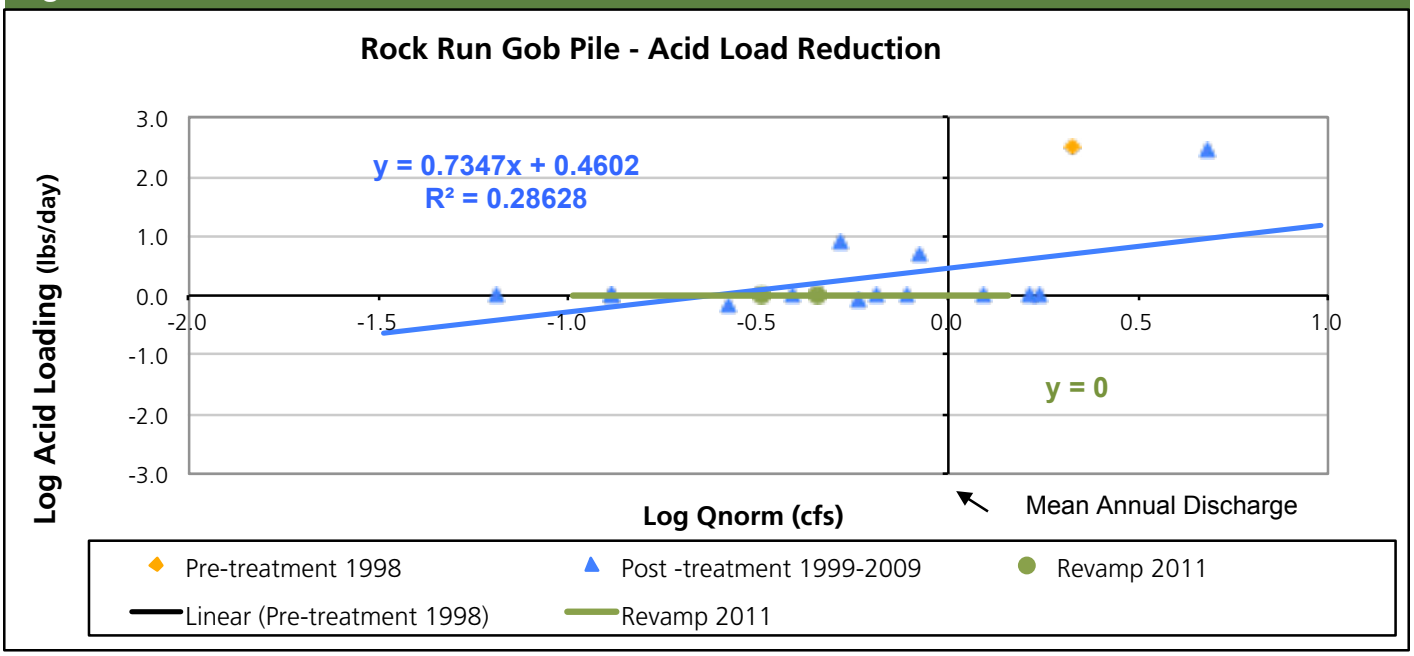
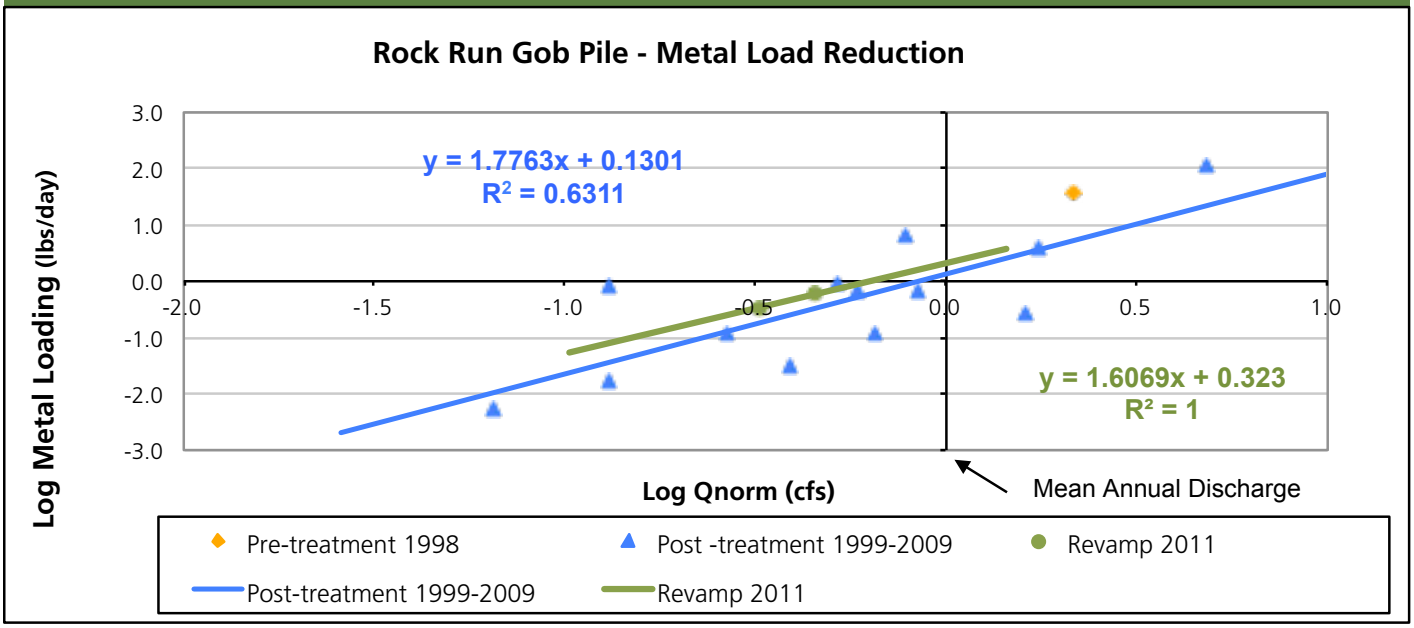
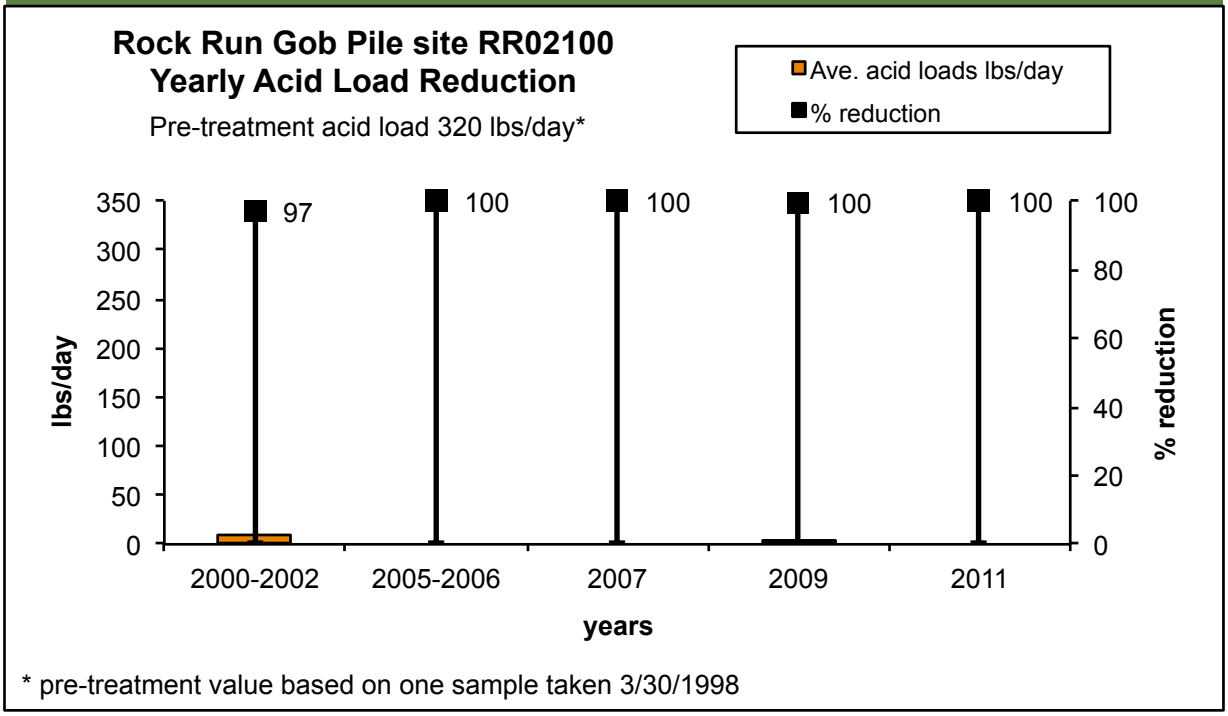


Figure 4. Metal Load Reduction



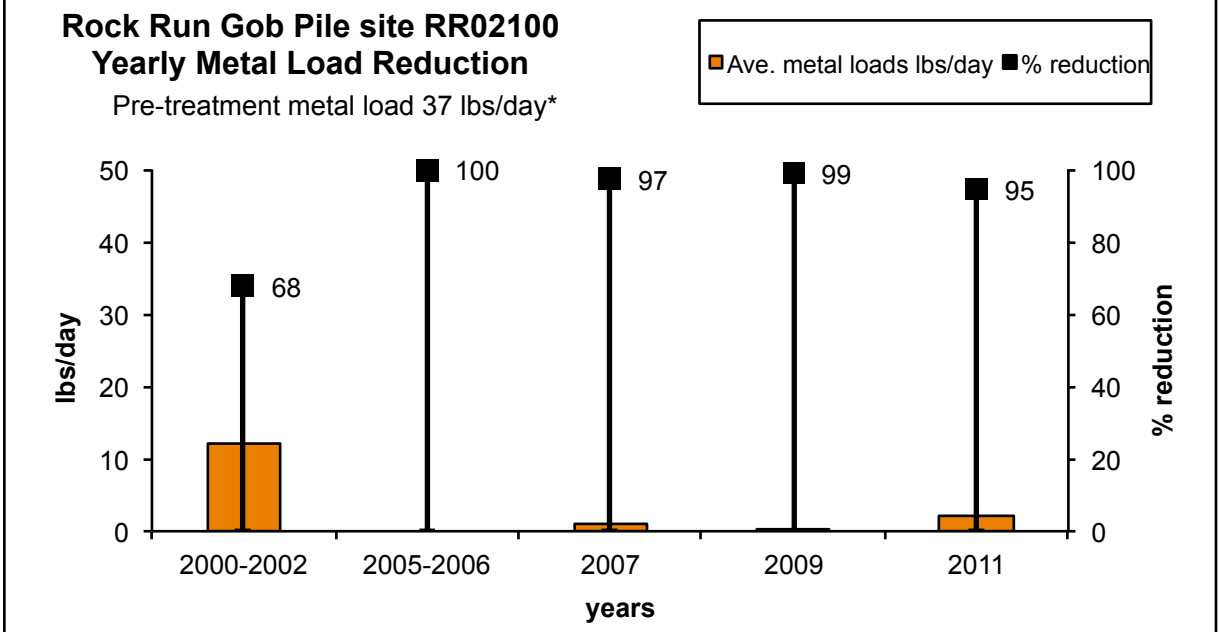
Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figure 5 and 6 show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figure 5 and 6.

Figure 5. Yearly Acid Load Reduction



* pre-treatment value based on one sample taken 3/30/1998

Figure 6. Yearly Metal Load Reduction



* pre-treatment value based on one sample taken 3/30/1998

Section III – AMD project reports

Sunday Creek Watershed comprehensive acid mine drainage projects progress report for 2011.

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 2011 NPS monitoring report:

1. Rodger's Hollow Stream Capture
2. West Branch Headwaters Phase I & II
3. West Rendville Stream Capture

Archived

4. WB 43 stream capture* archived in 2011
5. Pine Run Stream Capture* archived in 2009
6. Little Hocking* archived in 2009
7. Congo Run Stream Capture (CR-15)* archived in 2009
8. Corning Gob Floodplain* archived in 2009

* "Status Completed" projects are no longer being monitored

2011 NPS Report - Sunday Creek Watershed - Rodgers Hollow Stream Capture

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete: 12/14/2007 ODNR Project Number: PR-Mn-16

Pre-construction

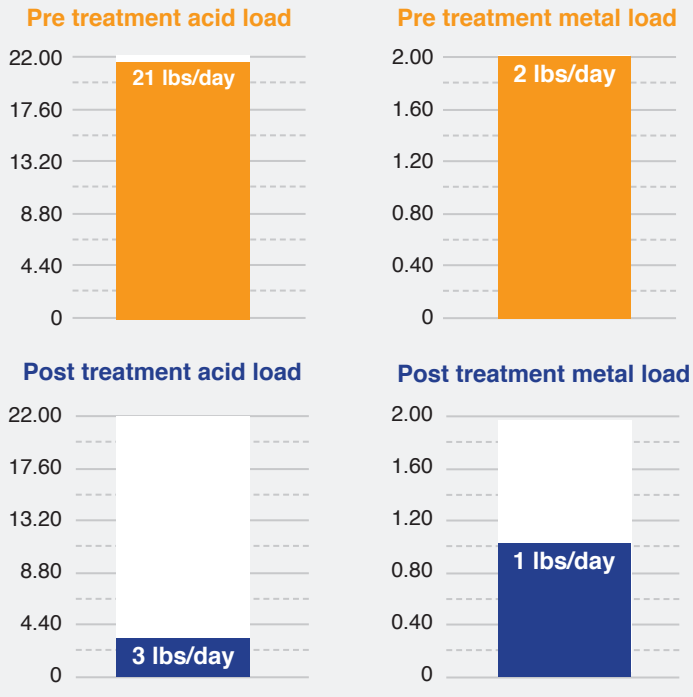
One of Rodger's Hollow primary stream captures during wet conditions, Photo by Sunday Creek Watershed Group

Post-construction

Completed natural channel stream, Photo by Kaabe Shaw

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 $109,725. The treatment approach was to close primary and secondary stream captures and divert the channel, using natural stream design concepts (900 linear feet), away from the existing location which is an unstable abandoned coal pit along a highwall as well as add 879 linear feet of open limestone channels. 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 (WB 49 and 49/36). The goal of the design is to return 100 percent of stream water back into Congo Run thus adding alkalinity to Rodger's Hollow/Congo Run and reducing acid mine discharges in Drakes. Construction was completed December 14, 2007 by Tucson Inc. for $266,826. The funding source for the project design was ODNR-DMRM and construction was OEPA 319. Figures 4 and 5 (shown on page 3 of this report) estimate approximately 18 lbs/day of acid and 1 lbs/day of metals were reduced from entering West Branch of Sunday Creek from Drakes seep WB 49 as a result of the subsidence closures in the up-dip adjacent Rodgers Hollow. Reduction of acid and metals from the Drakes wetlands (site 36 and 49/36) has not been documented due to changes in flow route. However, WB 49 is seen as the primary source of AMD in Drakes and has seen a 81% reduction in flow following the subsidence closures. In addition Congo Run the receiving stream from the Rodgers Hollow project as expected has seen, on average, an increase in pH from 6.71 to 6.96, a decrease in net acidity from -39.01 to -47.35 mg/l and an increase in flow from 0.69 to 1.30 cfs as of 2009.

Site: WB 49



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

Post-Construction Estimated Effects

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

Gallons/yr = 589,290,000

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

Alkalinity load = 758 lbs/day

Water quality report

Water quality data was collected at the suspected AMD 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 West Branch in Drakes. This stream was been monitored because of its possible connected to the Rodgers Hollow deep mine where the subsidence closures were constructed.

Data analysis

Rodgers Hollow subsidence closure project monitoring along the West Branch of Sunday Creek in Drakes show pH and net acidity upstream, at the Drakes Seep WB 49, and along the mainstem of West Branch downstream of the seep discharge. Pre-construction data show pH in the range of 3.8 to 6.95, at the AMD discharge and downstream. Post-construction data show pH in the range of 3.8 to 6.7. Net acidity has decreased at the Drakes Seep by 6% and flow has decreased by 81%.

Figure 1. Pre and Post pH

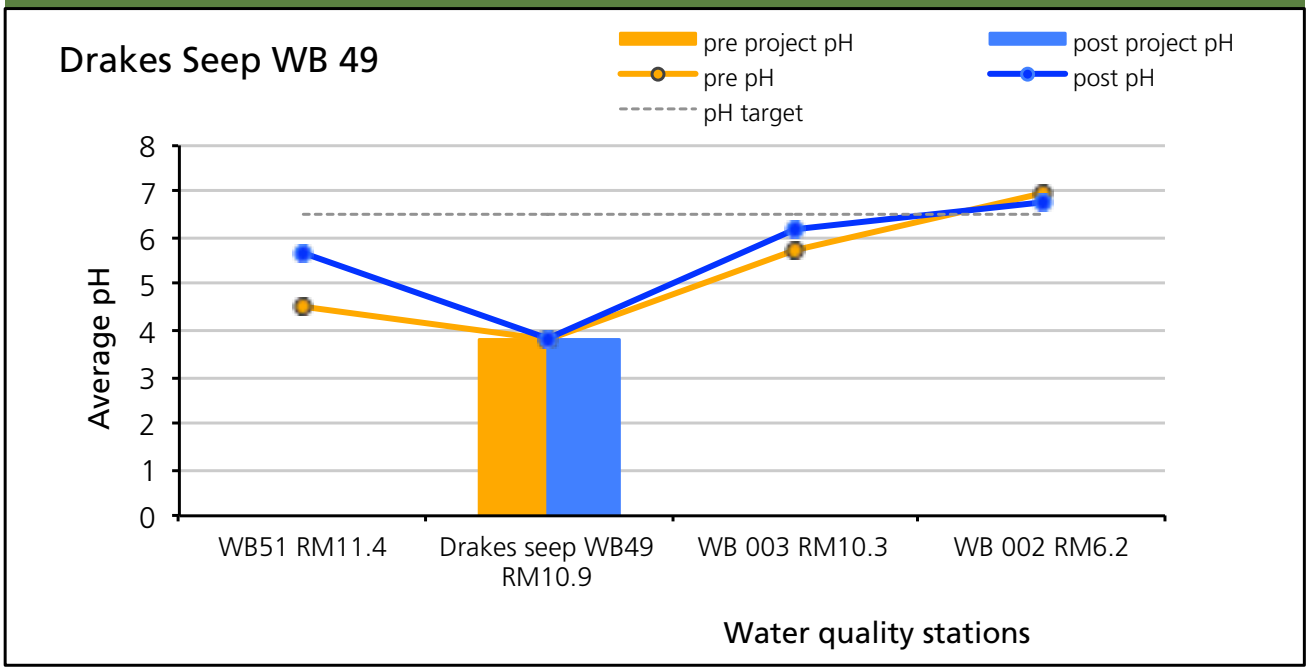
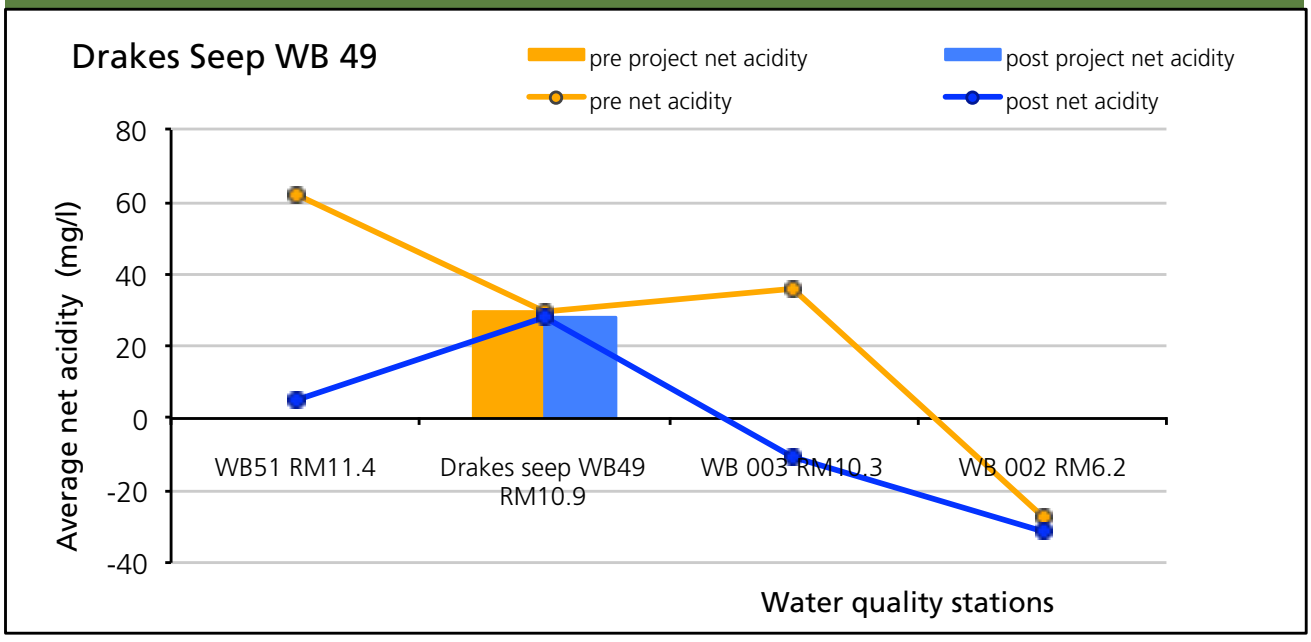


Figure 2. Pre and Post Acidity



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- construction at the project discharge from 4/24/2001 to 1/29/2009 for pre-construction and 1/15/2008 to 12/31/2011 for post-construction.

As expected a substantial difference in discharge has been recorded at the Drakes Seep site WB49 from pre-subsidence closure to post-closure in Rodger's Hollow. Therefore, when determining the mean annual average discharge for this site for use in the "Mean Annual Acidity Load" calculation, the mean annual discharge was determined separately for each time period (pre-closure 0.16 cfs, post-closure 0.03 cfs).

Figure 3. Acid Load Reduction

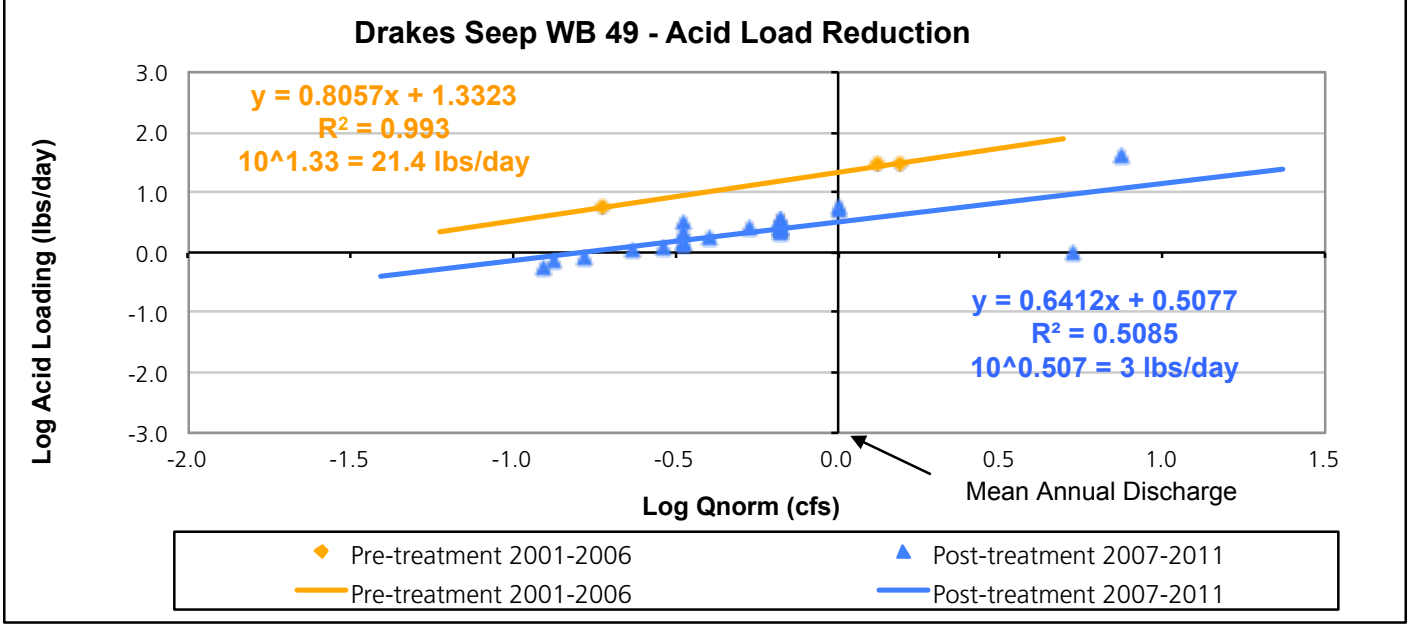
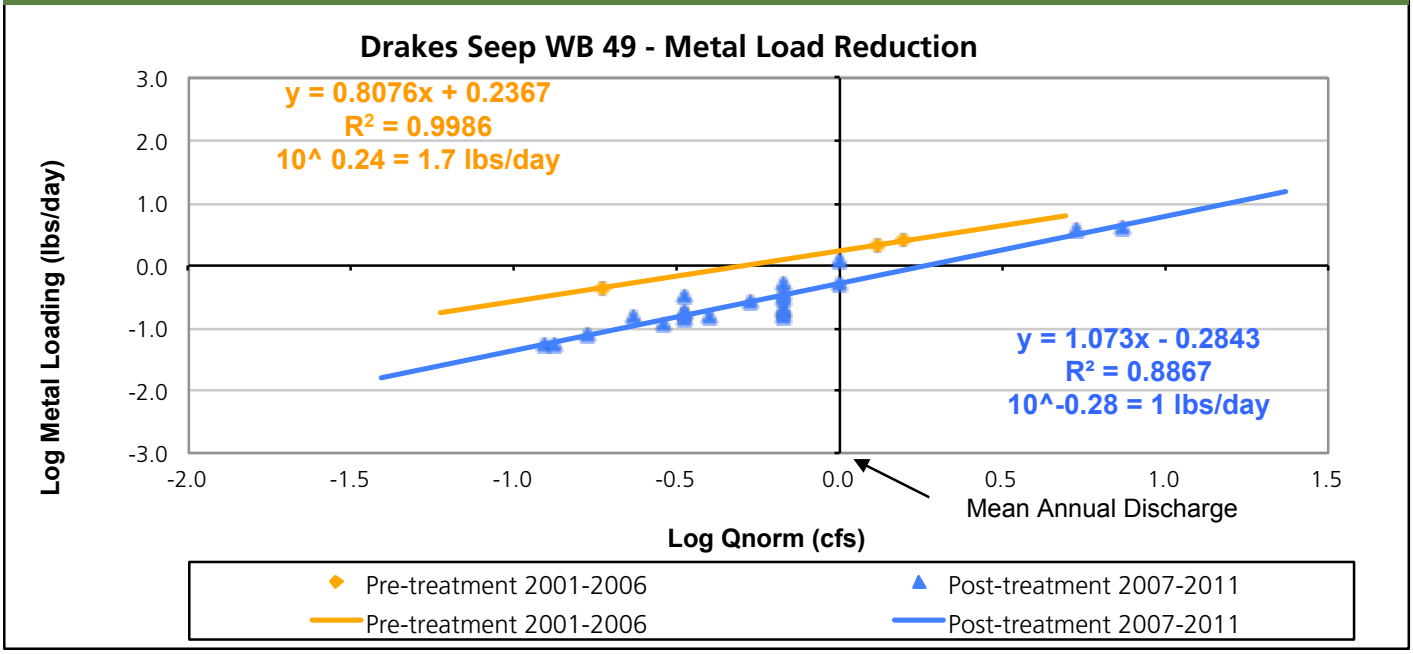
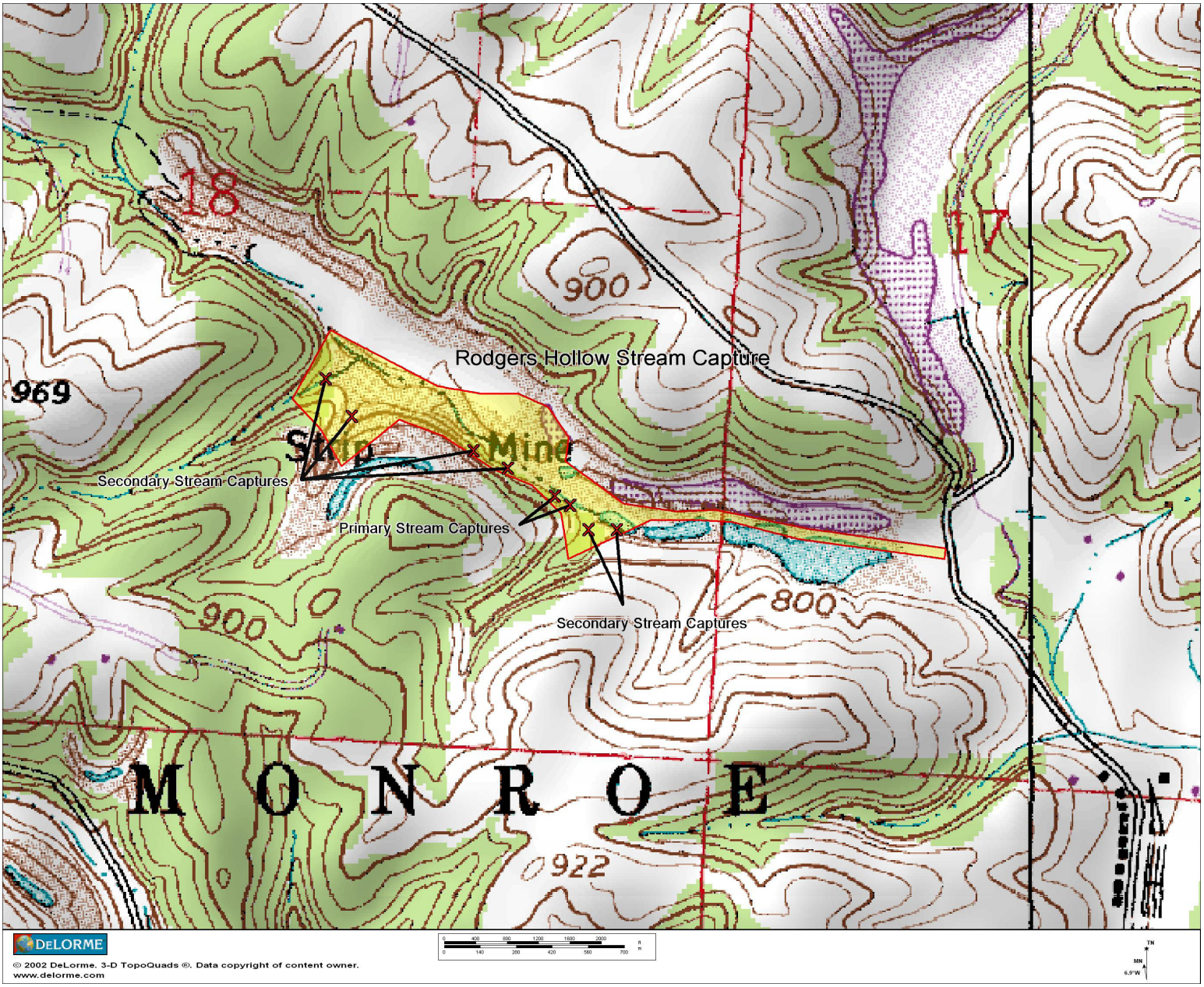


Figure 4. Metal Load Reduction



2011 NPS Report - Sunday Creek Watershed - Rodgers Hollow Stream Capture

Generated by Non-Point Source Monitoring System
www.watersheddata.com



2011 NPS Report - Sunday Creek Watershed - West Branch Sunday Creek Headwaters Phase I & II

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Completed Fall 2010 ODNR Project Number: Pr-SI-16/Pr-SI-25

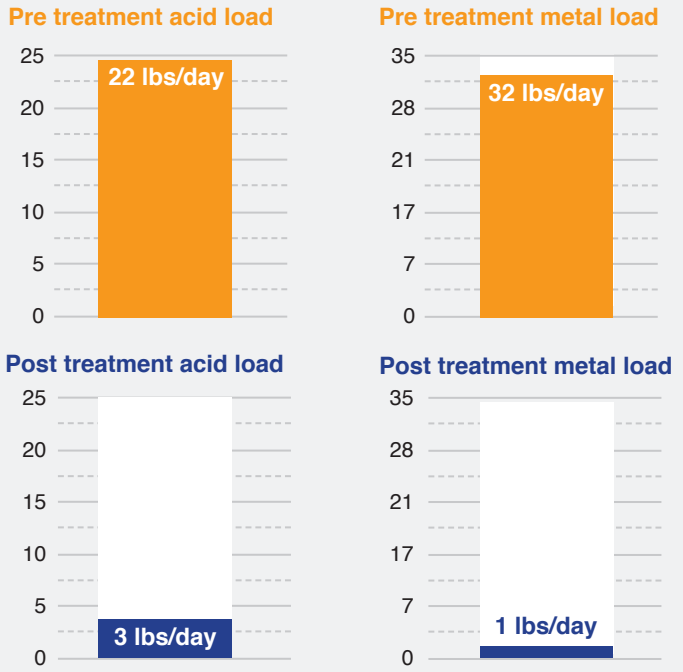
Pre-construction

1.3 acre gob pile along West Branch Headwaters
Photographer: Dave Agnor, OSM

Post-construction

West Branch Sunday Creek Phase I post reclamation featuring a limestone channel. Photographer: Sunday Creek Watershed Group

Site: WBHW 03



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

Post-construction

West Branch Headwaters limestone leach bed. Photographer: Michelle Shaw

West Branch Headwaters Phase I is located in Section 24 of Salt Lick Township in Perry County and lies within the 14-digit HUC unit #05030204070030. The West Branch Headwaters (WBHW 03) meets with tributary Pine Run to form the West Branch of Sunday Creek at site WB004. The West Branch Headwaters (WBHW) project area consists of several subsidence features, gob and spoil piles (approx. 8 acres), one large deep mine discharge, and several smaller AMD seeps. The treatment approach for this project area has been split into two phases. Phase I included approximately 2,200 linear feet of limestone channel for new drainage at the four subsidence features, additional earthwork reclaimed one acre of gob, seven acres of spoil, two acres of pit impoundments, and 1,200 linear feet of highwall. The design was completed in-house by ODNR-DMRM. The goal of the design for phase II will reduced the amount of AMD being produced while phase II added alkalinity and reduced metals at WBHW 17 and 19 AMD discharge locations. Phase I construction completed 2010 by McMillan Inc. for a cost of $270,161.20. Phase II construction completed late 2011 installed a 12,544 sq. ft. limestone leach bed and a small 0.1 acre wetland to settle metals. Total costs for Phase II were $325,000. The funding sources for this project are ODNR/DMRM for the design and OSM Clean Streams and OEPA 319 grant for construction. While acid and metal load reductions are not being observed at site WBHW 03, further downstream at site WB 003 pH values have increased with net alkaline conditions.

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre 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.

Data analysis

West Branch Headwaters Phase I and II pre-construction monitoring was conducted for pH and net acidity upstream of the project area and along the mainstem of the West Branch Headwaters downstream of the project. Pre-construction data show pH at the project effluent as 5.3. Post-construction at the project effluent show pH value of 6.01.

Figure 1. Pre and Post pH

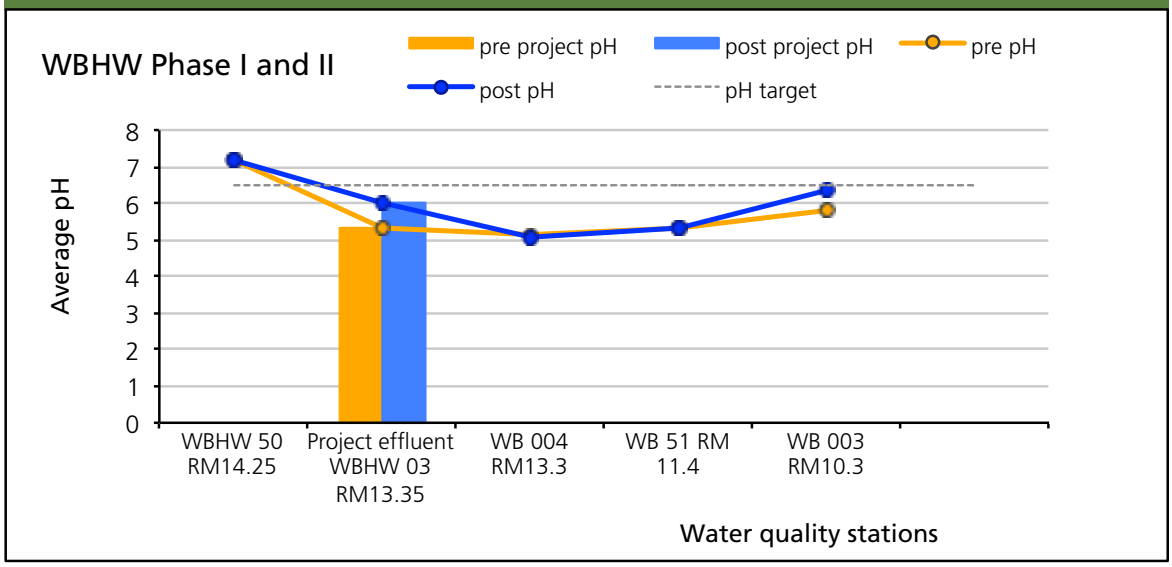
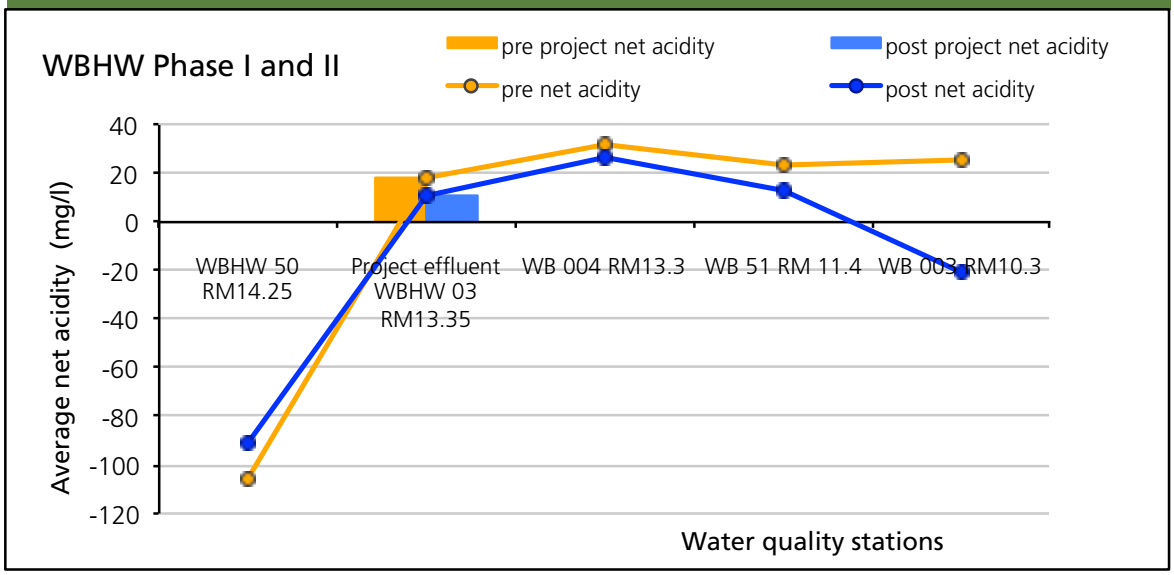


Figure 2. Pre and Post Acidity



2011 NPS Report - Sunday Creek Watershed - West Rendville Stream Capture

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Completed 2011 ODNR Project Number: Archived PR-Mn-19

Pre-construction

West Rendville subsidence stream capture with Michelle Shaw collecting a sample of water prior to stream loss underground
Photographer: Dave Agnor

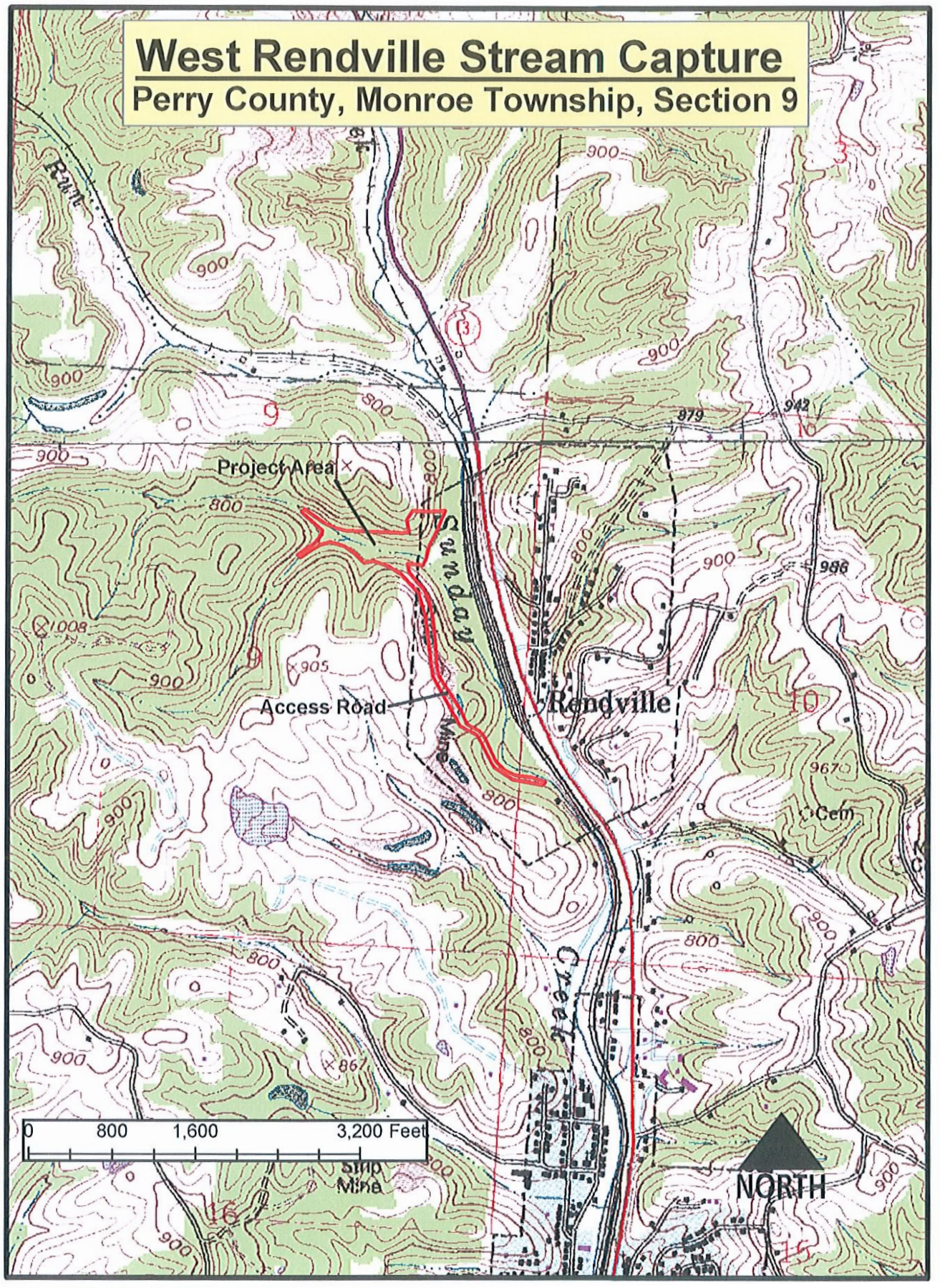
Post-construction

West Rendville newly constructed connector channel
Photographer: Michelle Shaw

West Rendville stream capture is located in Section 15 of Monroe Township in Perry County and lies within the 14-digit HUC unit #05030204070010. The site is located in an unnamed tributary draining to the mainstream of Sunday Creek north of Corning. The West Rendville sites consists of two subsidence holes, one on each branch of a small-unnamed tributary to Sunday Creek. The site captures a drainage area of 0.38 square miles (240 acres). The treatment approach was to seal off the deep mine access areas and direct stream flow from the two drainages into one stream and re-establish hydrologic flow to Sunday Creek mainstem thus by-passing the subsidence holes that allowed fresh water to enter the deep mine. The design was completed by ODNR-DMRM. The treatment consisted of 14 acres of extensive earthwork and re-vegetation. Landowners requested a grass-lined channel as opposed to a rock channel. As a result, erosional features are developing and will need to be addressed in 2012. The goal of the design was to eliminate net alkaline water from entering the abandoned mine complex and re-connect the stream to mainstem Sunday Creek, adding alkalinity directing to Sunday Creek while circumventing the generation of acid mine drainage in the deep mine complex underlying Corning. The deep mine discharge located at the Corning Park (site SC078) is being monitored for changes in volume of flow and chemical water quality in response to the West Rendville subsidence closure project. Results will be presented in the 2012 report. Construction was completed in October 2011 by Stimmel for a cost of $308,736. The funding sources for this project were ODNR/DMRM and OSM.

Post-construction Estimated Effects

Expected amount of water to return gallons/yr = 88,464,000


West Rendville Stream Capture
Perry County, Monroe Township, Section 9
Project Area
Access Road
Sunday Creek
Rendville
Mine
Cem
0 800 1,600 3,200 Feet
NORTH

Section III – AMD project reports

Huff Run Watershed comprehensive acid mine drainage projects progress report for 2011.

Section III for the Huff Run Watershed contains, in addition to the individual AMD project, one comprehensive report listing completed 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 1997-2011 for post construction. Acidity and pH graphs have been generated for all completed projects. Acid and metal load reductions were calculated with limited data for: Linden, Lindentree, Lyons, Farr, Acid Pit#1, Harsha, Fern Hill HR-42 (pits A, B, C), Thomas, and Belden. Mineral Zoar lacks discharge data to generate the acid and metal load reductions, due to the nature of the site.

List of acid mine drainage reclamation projects reported on in the 2011 NPS monitoring report:

1. Farr project
2. Linden Bioremediation project
3. Acid Pit #1 (Phase I) project
4. Lyons project
5. Fern-Hill HR-42 project + Pond A
6. Belden project + Belden Gob Pile
7. Thomas project
8. Mineral Zoar Road AMD project

Archived

9. Huff Run AML project*
10. Lindentree project*
11. Harsha North project*

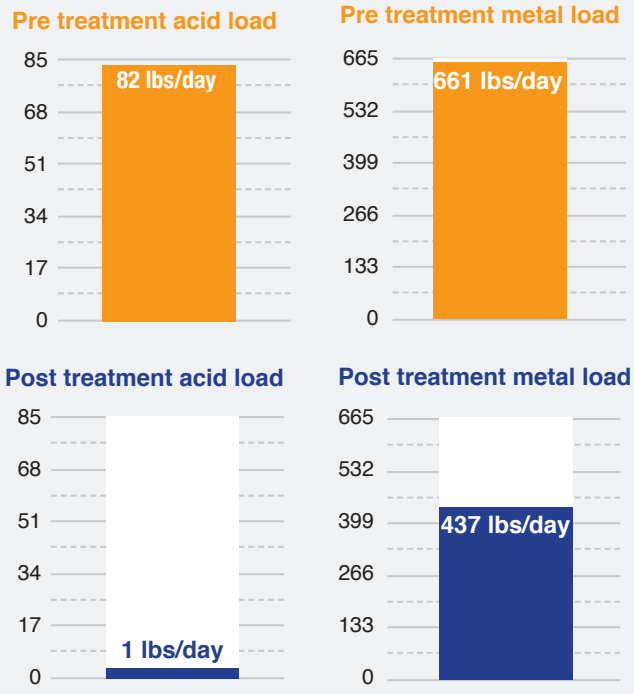
* "Status Completed" projects are no longer being monitored

2011 NPS Report - Huff Run Watershed - Overview

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: All completed projects since 1999

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, 13 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 were ODNR-DMRM, Ohio EPA 319, and OSM Clean Streams. Figure 3 and 4, estimate that approximately 81 lbs/day of acid and 224 lbs/day of metals were reduced from entering Huff Run as a result of these AMD reclamation projects.



Mouth of Huff Run used for this analysis

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

List of construction projects completed since 1999:

1. Huff Run AML 1999 “status complete”
2. Farr 2003
3. Linden Bioremediation 2003
4. Acid Pit #1 2004
5. Lindentree 2005
6. Lyons 2005
7. Harsha North 2006
8. Fern Hill 2008 + HR-42 pond A 2010
9. Belden 2008 + Belden Gob Pile 2010
10. Mineral Zoar 2009
11. Thomas 2010

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.

As a result of these projects completed in Huff Run Watershed, the pH and net acidity has improved downstream of the reclamation sites for 5 miles to the mouth. Pre-construction data shows average pH in the range of 4.5 – 7.0 along the mainstem. However after the completion of 13 major AMD reclamation projects, post-construction data shows average pH in the range of 6.5 – 7.1. The net acidity concentrations decreased resulting in net alkaline conditions the entire length of Huff Run, 10 miles. In 2011, the three downstream sites gained net alkalinity while the upstream sites lost alkalinity.

Figure 1. Pre and Post pH

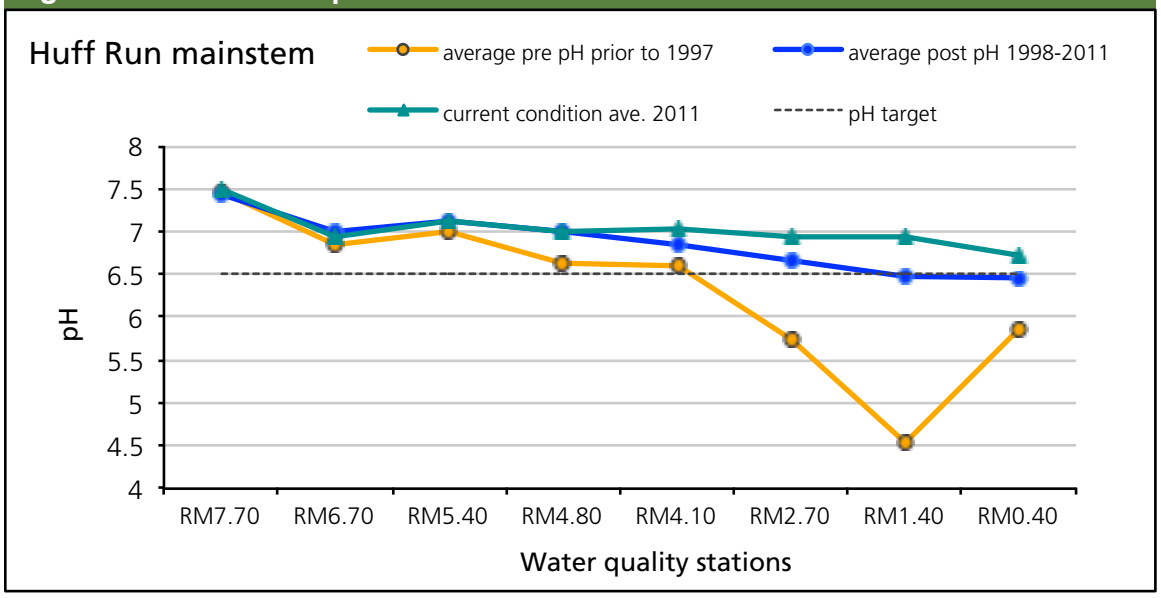
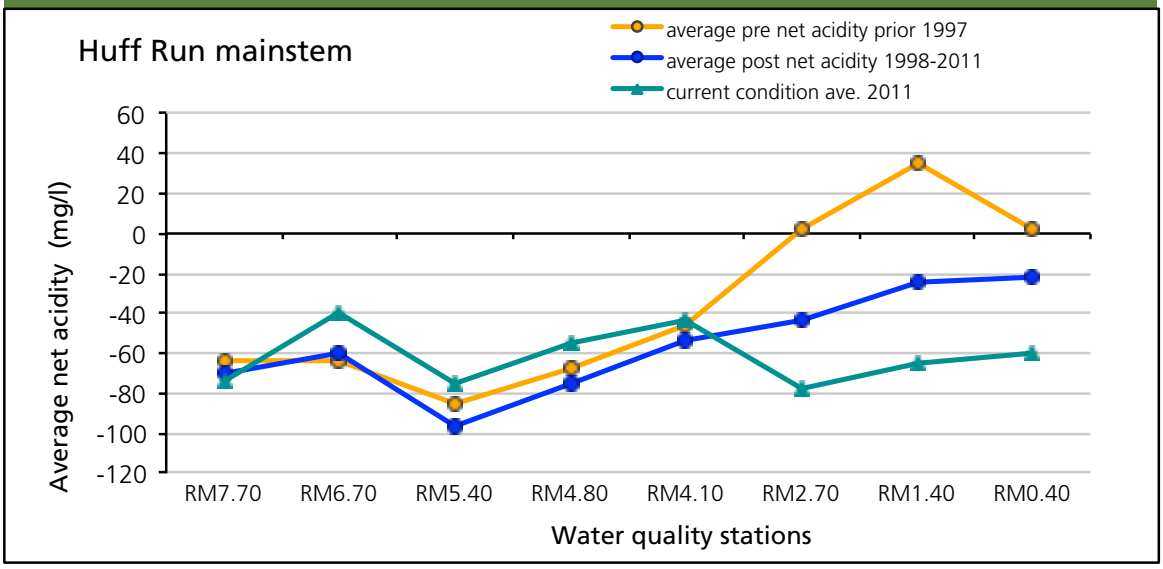


Figure 2. Pre and Post Acidity



Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project (site HRR08) 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 1997 for pre-construction and from 1998 – 2011 for post-construction.

Figure 3. Acid Load Reduction

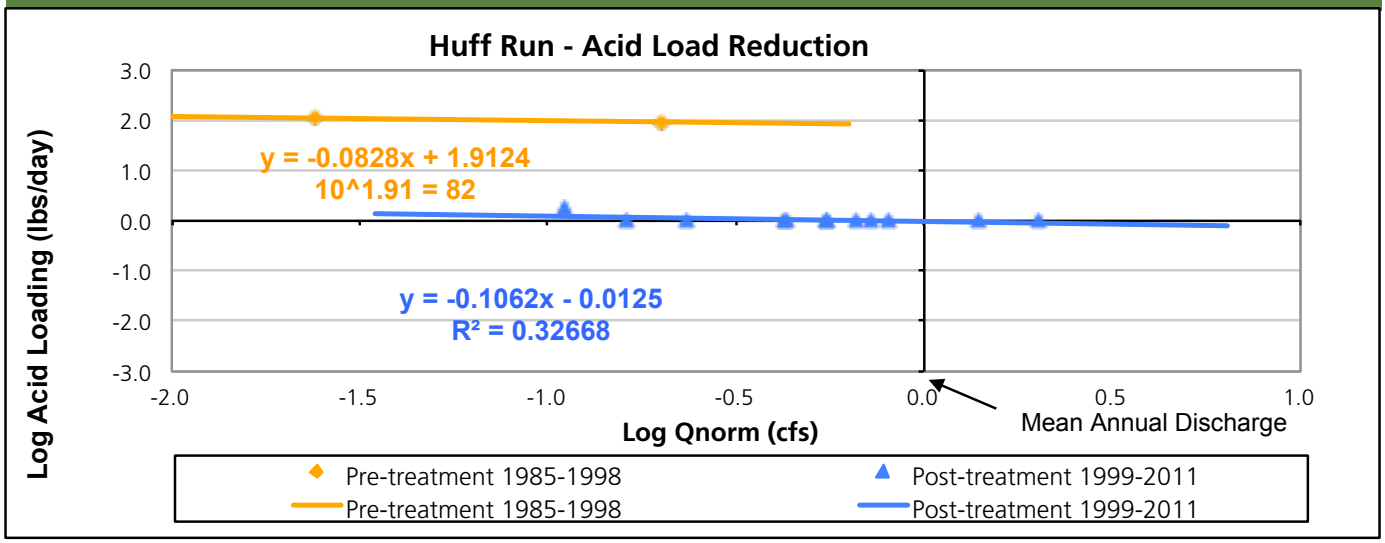
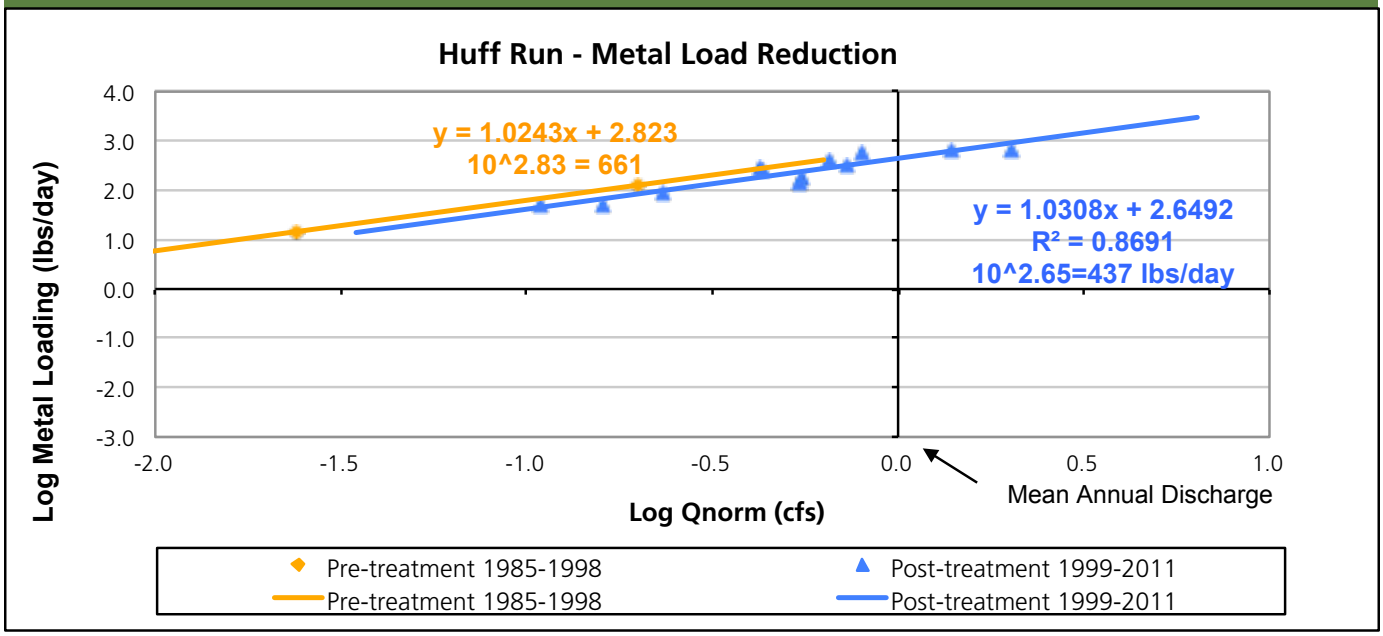


Figure 4. Metal Load Reduction



2011 NPS Report - Huff Run Watershed - Farr Project

Generated by Non-Point Source Monitoring System
www.watersheddata.com

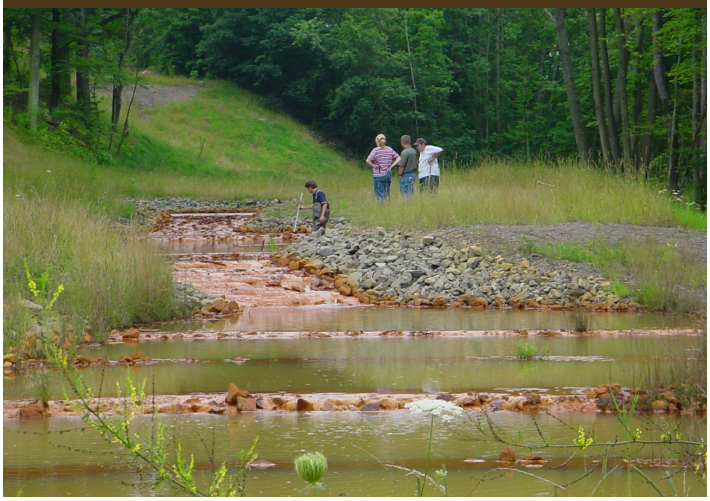
Project Status: Complete 2003 Project Number: TS-SN-06 and TS-SN-20

Site: Pre FAR01/02, Post FAR09

Pre-construction

Farr AMD discharge pre-construction
Photo by Huff Run Watershed

Post-construction



View from finishing cells looking upstream
Photo by Douglas Leed

The Farr Project is located in Sandy Township in Tuscarawas County. The site is located at the open limestone channel before entering Huff Run. The Farr Project discharges into Huff Run at river mile 1.0. This area was affected by unreclaimed gob piles and an impoundment fed by deep mine discharge. 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 discharges to the 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, ODNR-DMRM for the design and for construction was OSM Clean Streams, ODNR/DMRM and Ohio EPA. Pre-construction is not available for this site. However post-construction data has been collected since 2004. Figures 3 and 4 show yearly average acid and metal loads measured at the project discharge site FAR09.

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.

As a result of the Farr Project, pH and net acidity have improved downstream approximately 1.0 mile. Pre-construction data shows pH range of 5.25-5.97 at the project discharge and downstream. After installation of the Farr Project, post-construction data shows pH range of 6.3-6.5 at the discharge and downstream. The net acidity concentration decreased 100% at the project discharge and downstream on Huff Run.

Figure 1. Pre and Post pH

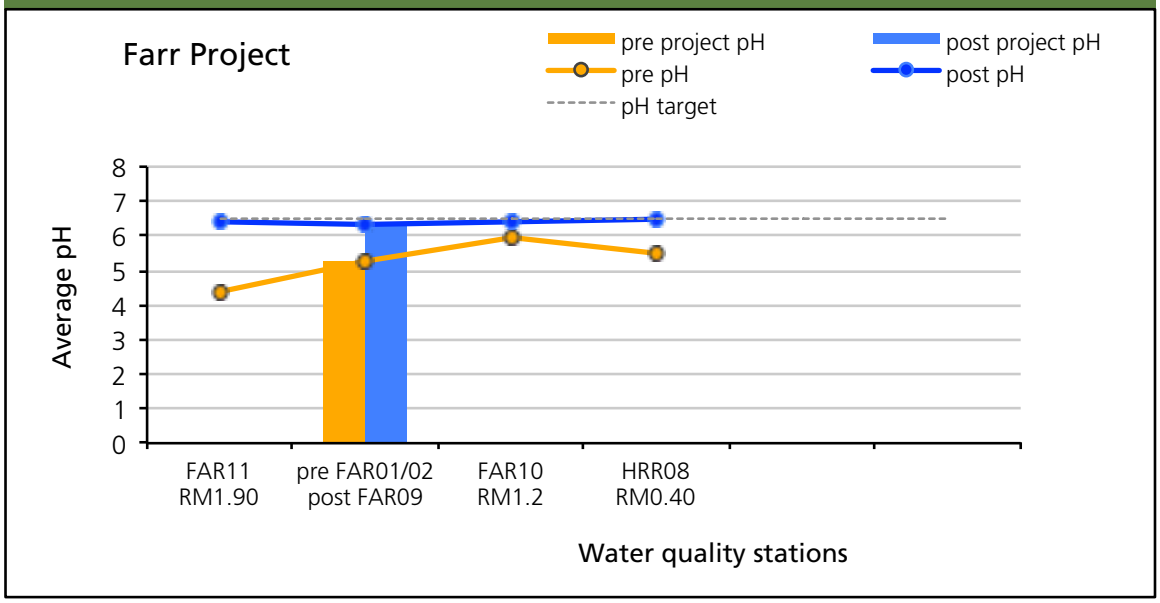
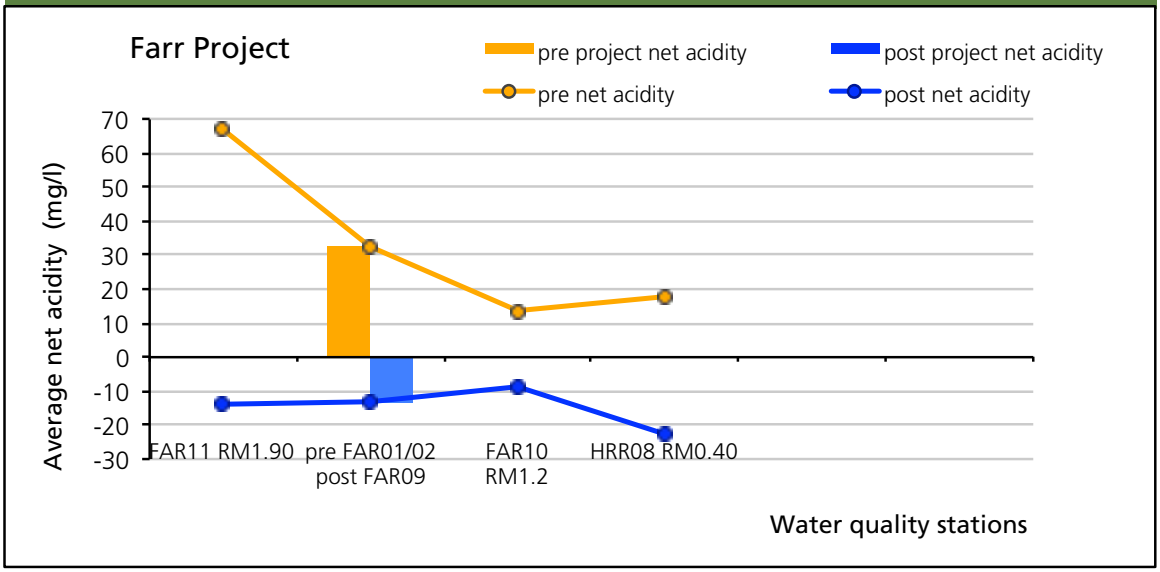


Figure 2. Pre and Post Acidity



Water quality – acid and metal load reduction

Similar to other environmental best management practices (BMPs), performance of acid mine drainage reclamation projects are also expected to decline with time. Currently, operation and maintenance plans are being designed for each existing system and for future projects. Figures 3 and 4, show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-construction from the project effluent. These graphs show the rate of decline (and/or improvement) with time in the performance of the treatment system. Knowing this rate of decline will aid in the implementation of operation and maintenance plans for each site. Yearly load reductions are plotted and shown in Figures 3 and 4.

Figure 3. Yearly Acid Load Reduction

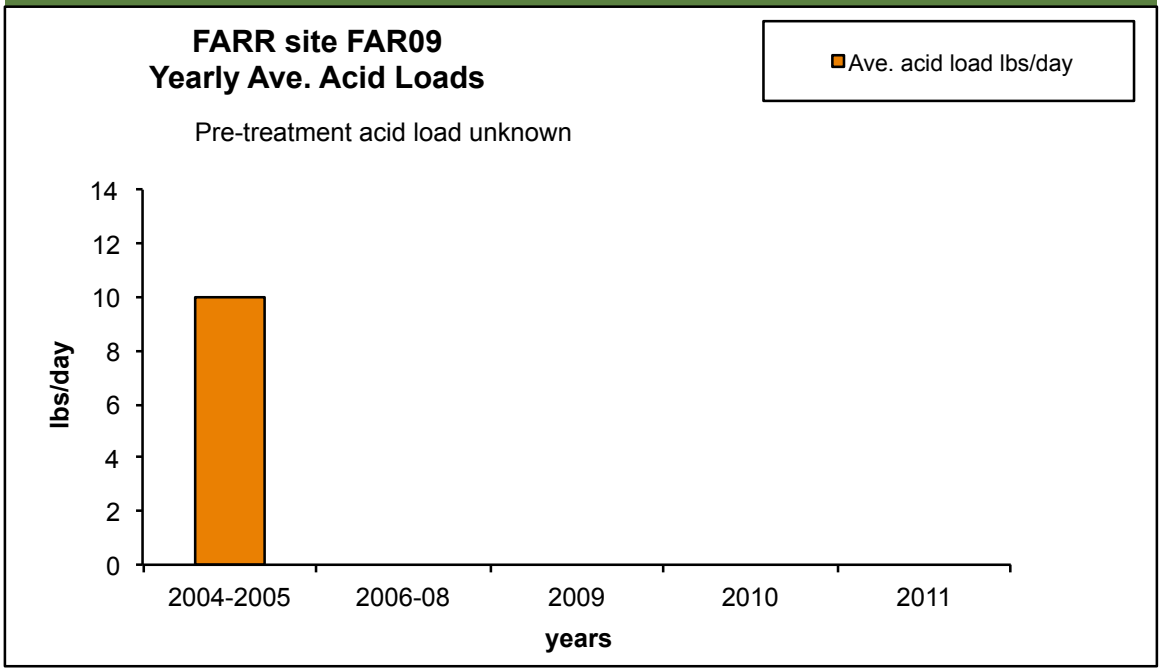
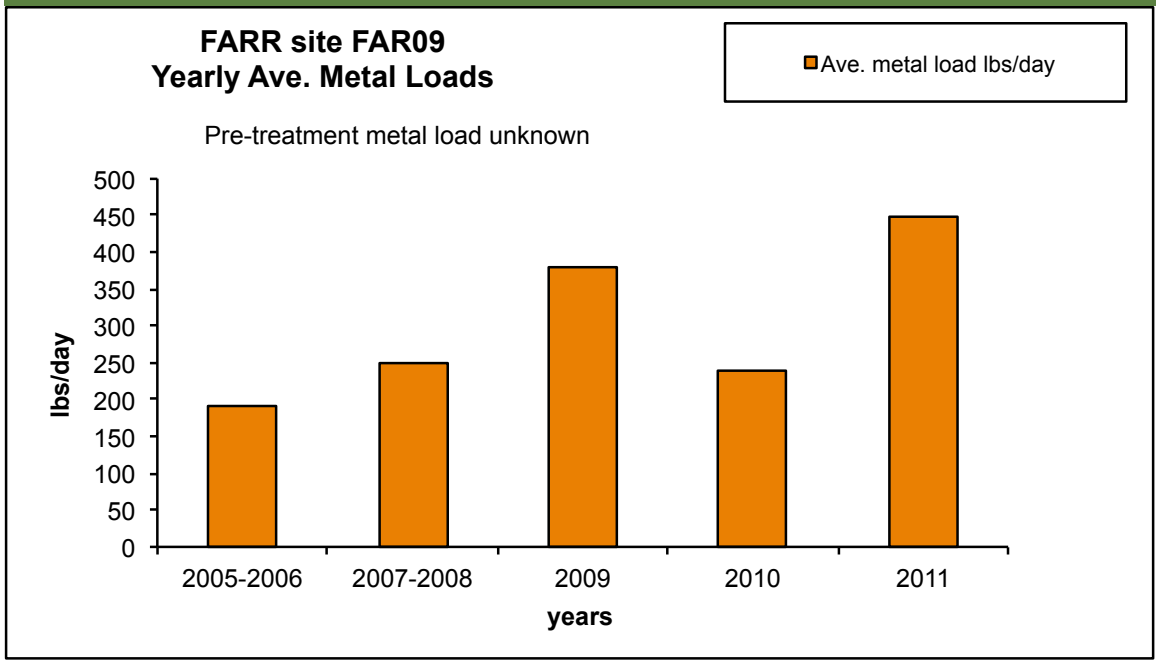


Figure 4. Yearly Metal Load Reduction



2011 NPS Report - Huff Run Watershed - Linden Bioremediation Project

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete 2003 Project Number: CR-RS-04

Pre-construction

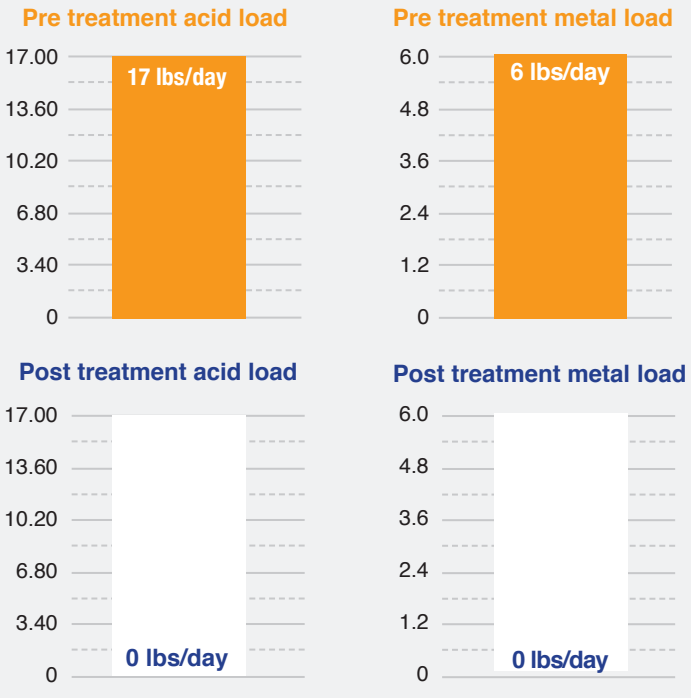
Farr AMD discharge pre-construction, Photo by Huff Run Watershed

Post-construction

Huff Run Awareness Day 2003, Photo by Huff Run Watershed

Linden Bioremediation Project is located in Rose Township in Carroll County. The Linden project discharges into Huff Run near river mile 4.6. The Linden project consists of treating a deep mine discharge by directing the water sequentially through a flow control system with a wetland to reduce metal concentrations and provides microbial nutrients. This water then flows through an inoculated Pyrolusite limestone treatment bed, discharge structures, and diversion ditches, before being discharged to the receiving stream. The design was completed by Office of Surface Mining (OSM) engineers at no cost. The treatment consisted of installing a 0.5 acre Pyrolusite limestone bioremediation treatment bed and a 0.3 acre passive wetland. The goal of the design was to generate alkalinity in the upper reaches of Huff Run, with the potential for reduction in metals requiring low maintenance. Construction was complete June 16, 2003 by Tucson Inc. for a cost of $321,619. Problems encountered included complications with the bedrock for liner installation, unknown pre-existing gas well in location of treatment bed, and high expense of the inocculant. The funding sources for this project were Ohio EPA, OSM, and ODNR/DMRM. Figure 3 & 4 (shown page 3 of this report) estimate approximately 17 lbs/day of acid and 6 lbs/day of metals were reduced from entering into Huff Run.

SITE: PRE LIN01, POST LIN08



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

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.

Data Analysis

As a result of the Linden Project, pH and net acidity have improved downstream approximately 0.5 miles. Pre-construction data shows pH in the range of 5.34 – 6.26 at the project discharge and downstream. After installation of the Linden Bioremediation Project, post-construction data shows pH in the range of 6.9 -7.2 at the discharge and downstream. The net acidity concentration decreased 100% at the project discharge.

Figure 1. Pre and Post pH

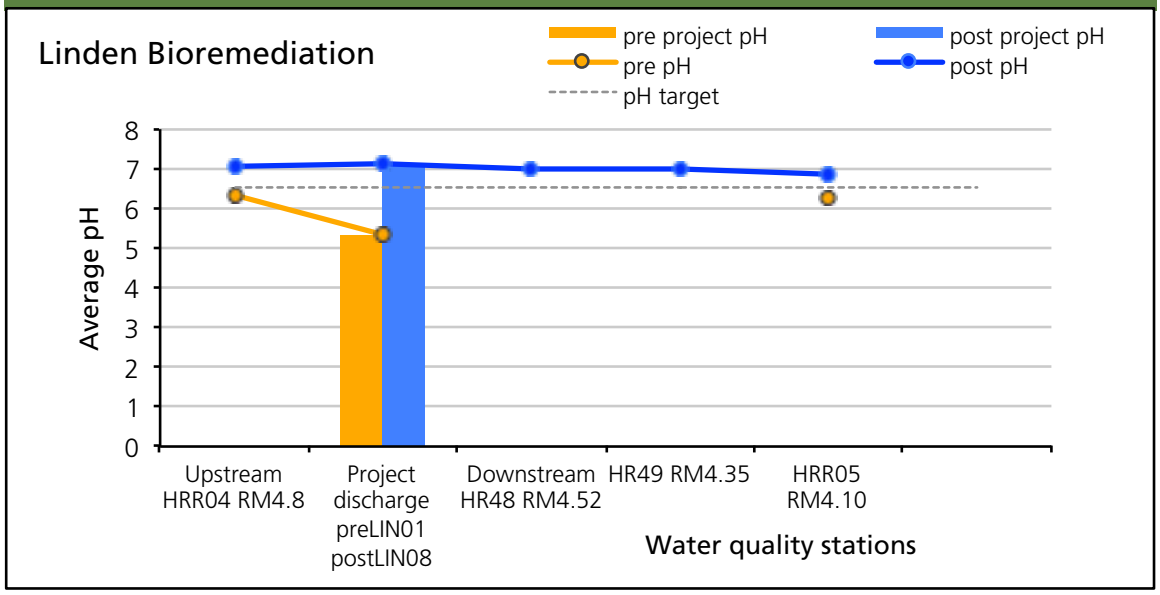
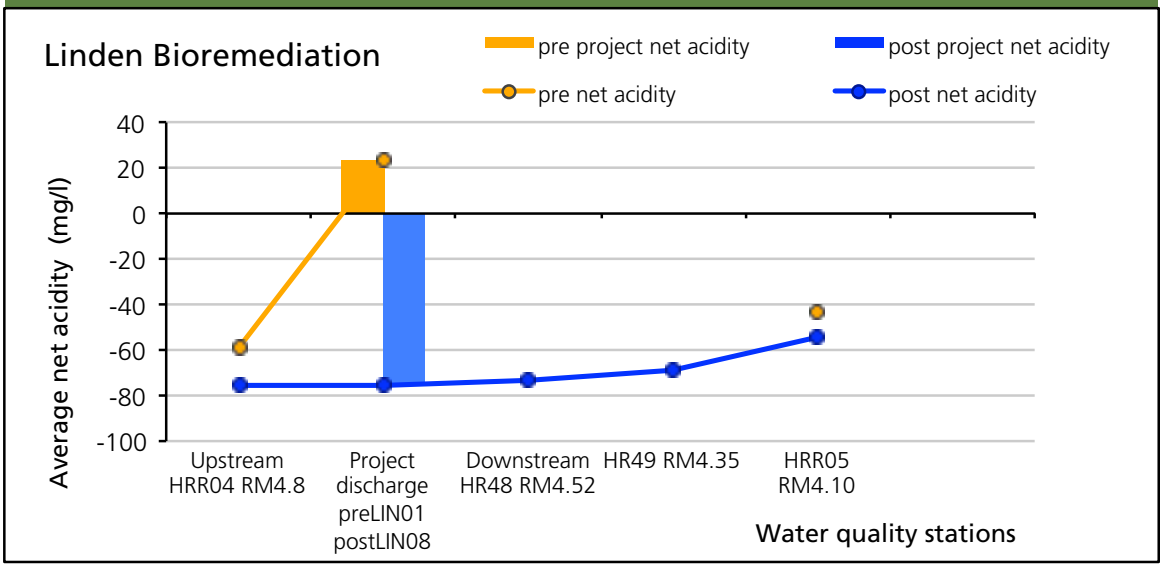


Figure 2. Pre and Post Acidity



Water quality – acid and metal load reduction

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 6/17/1998 to 6/21/1999 for pre-construction and from 8/4/2005 – 12/31/2011 for post-construction. Post-construction data with discharge measurements all occurred during base to low flow. No sampling events were measured greater than the mean annual discharge.

Figure 3. Acid Load Reduction

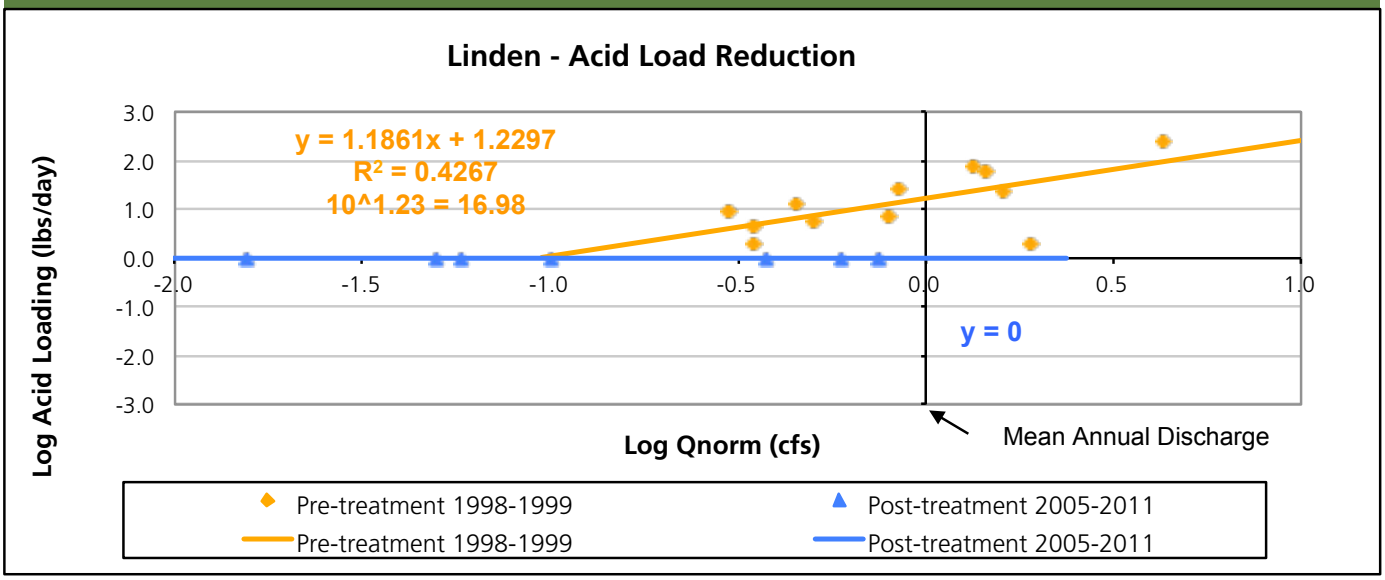
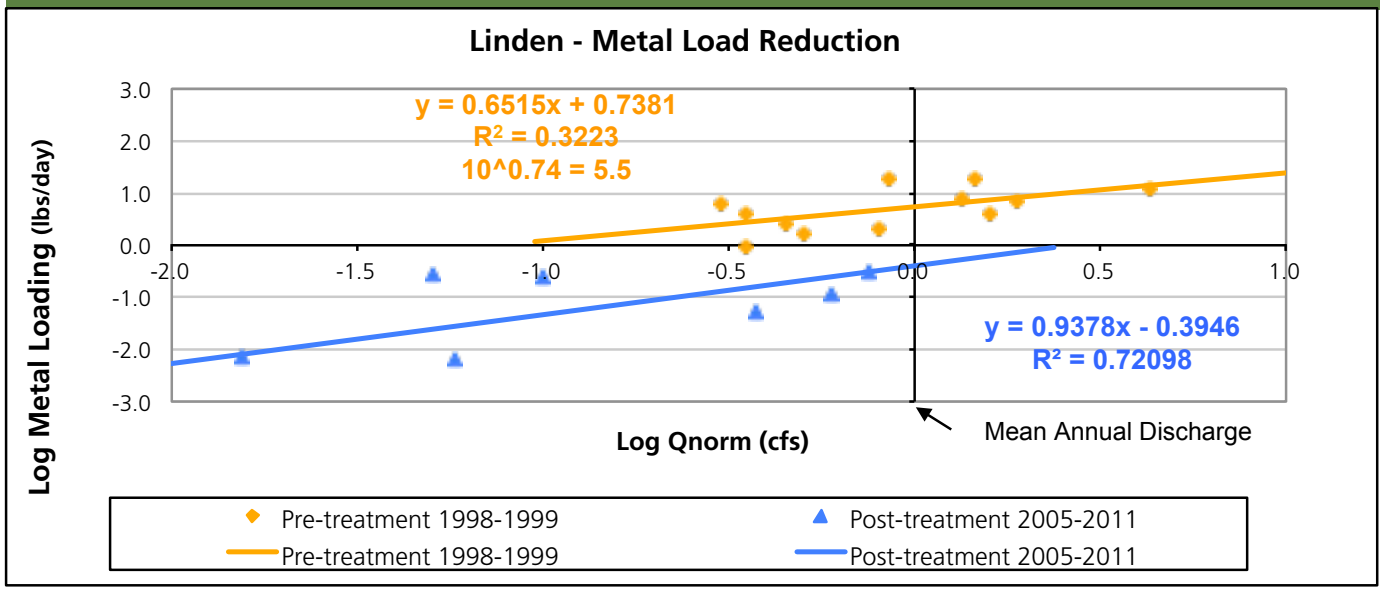


Figure 4. Dissolved Metal Load Reduction



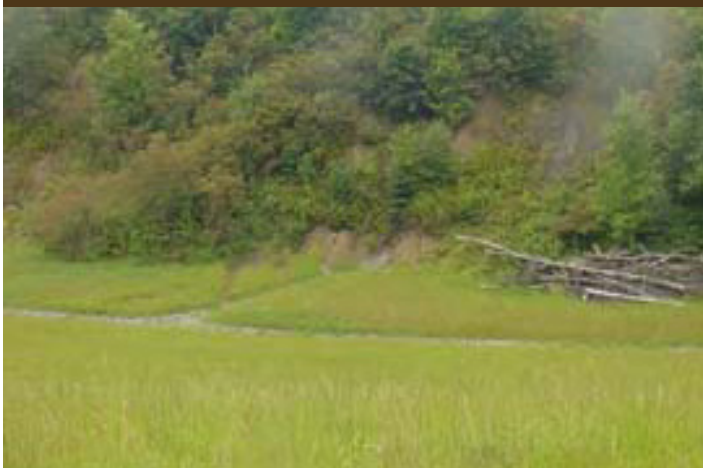
2011 NPS Report - Huff Run Watershed - HRWRP Acid Pit #1 Project

Generated by Non-Point Source Monitoring System
www.watersheddata.com

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

Pre-construction

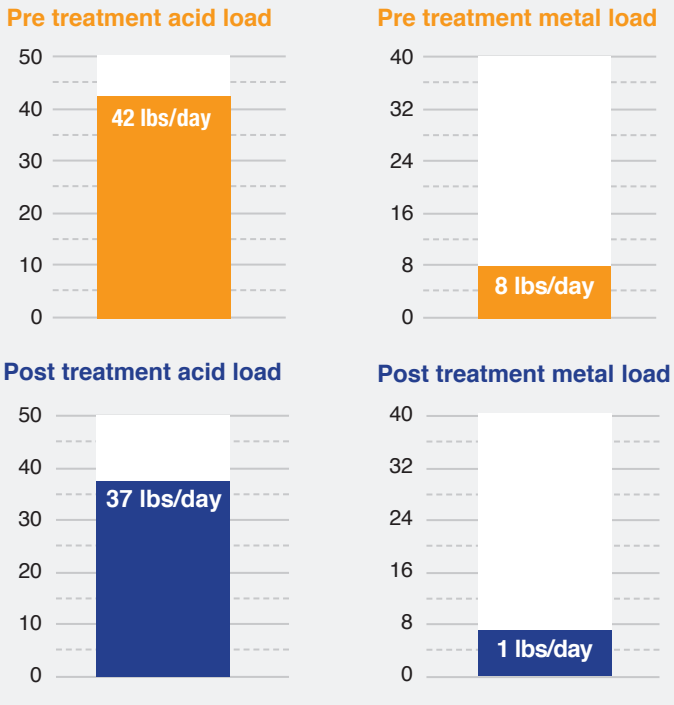
Post-construction



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 for a cost of $14,000. The treatment approach was to eliminate the acid-filled impoundments, reclaim 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 reclaim 15 acres of gob spoil. The goal of the design was to eliminate the and recharge of extremely acidic water through spoil material and draining into the mainstem Huff Run. Construction was complete March 2004 by Tucson Inc. for a cost of $150,000. The problem encountered during construction was the lack of 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 Streams, ODNR/DMRM. Figures 3 and 4 (shown on page 3 of this report) estimate approximately 5 lbs/day of acid and 7 lbs/day of metals were reduced from entering into Huff Run as a result of the Acid Pit #1 project.

SITE: ACP01



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

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.

Data Analysis

As a result of the Acid pit #1 Project, pH and net acidity have improved downstream approximately 2.4 miles. Pre-construction data shows pH in the range of 3.38–5.8 at the project discharge and downstream. After installation of the Acid Pit #1 Project, post-construction data shows pH in the range of 3.6-6.7 at the discharge and downstream. The net acidity concentration decreased 38% at the project discharge.

Figure 1. Pre and Post pH

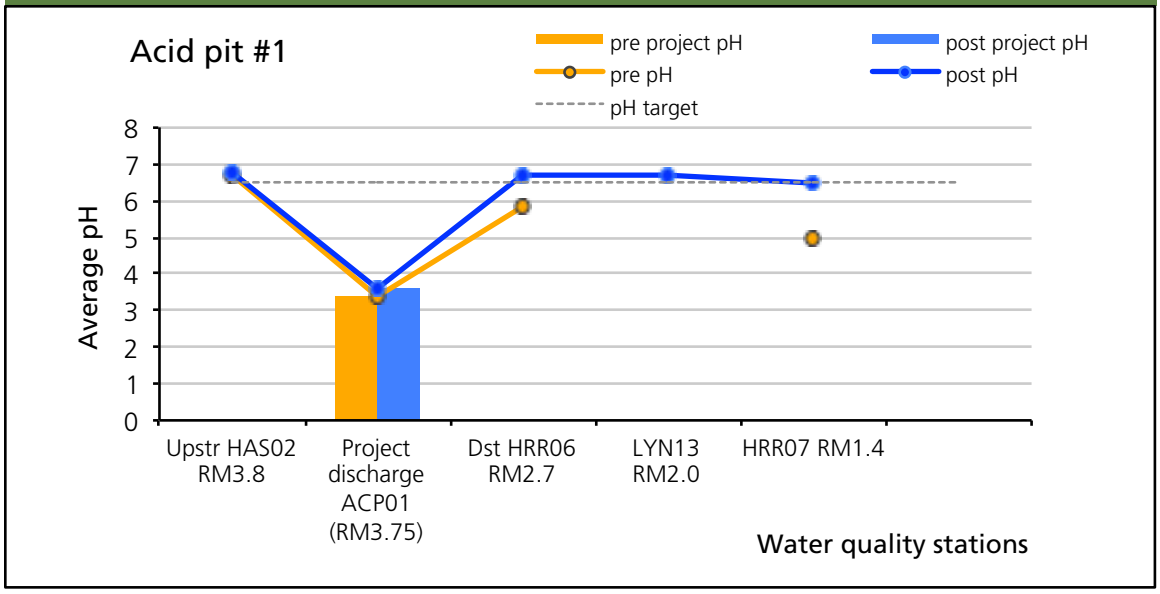
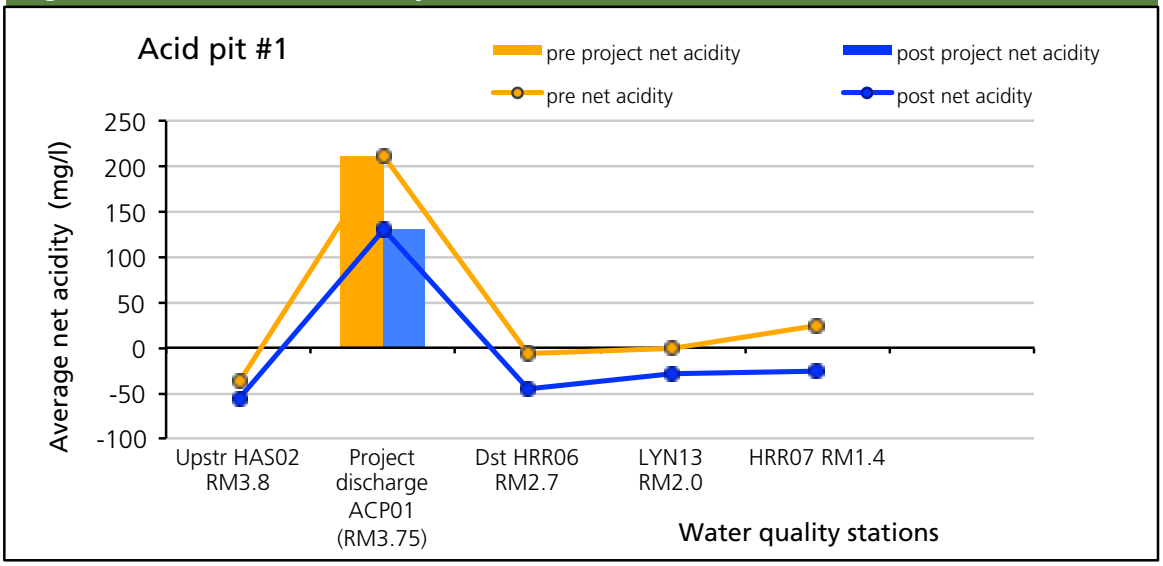


Figure 2. Pre and Post Acidity



2011 NPS Report - Huff Run Watershed - Lyons Project

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete 2005 Project Number: TS-SN-3

Pre-construction

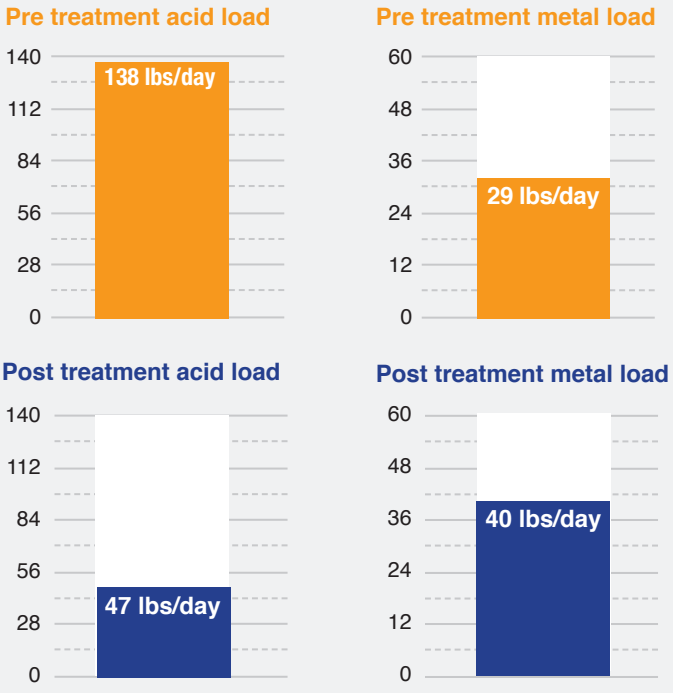
Overview of gob on the project site, Photo by Brent Miller

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 Lyons site was one of the highest contributors of AMD within the lower reaches of the watershed. The AMD problems were caused by unvegetated coal refuse, highwalls, acid pits and exposed spoil. The design was completed by ATC Associates for $53,335. The treatment approach was to reclaim eroding mine spoils, eliminate acid impoundments, install alkaline recharge with steel slag berms and open limestone channels. The treatment consisted of installing 3,000 linear feet of limestone channels and 1,500 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, decrease AMD discharges and neutralize acidic discharges prior to draining into the mainstem. 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. Figure 3 & 4 (shown on page 3 of this report) estimate approximately 91 lbs/day of acid were reduced from entering into Huff Run. No reduction in metals were measured.

SITE: LYN01



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

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.

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 3.3 – 5.6 at the project discharge and downstream. After installation of the Lyons Project, post-construction data shows pH in the range of 6.14-6.57 at the discharge and downstream. The net acidity concentration decreased 39% at the project discharge.

Figure 1. Pre and Post pH

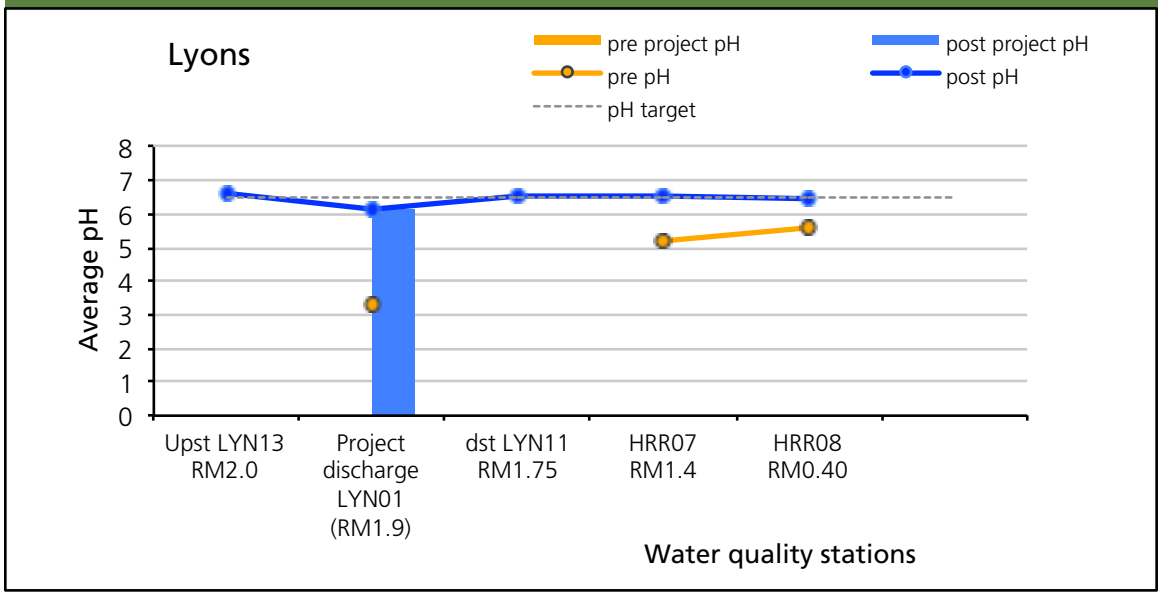
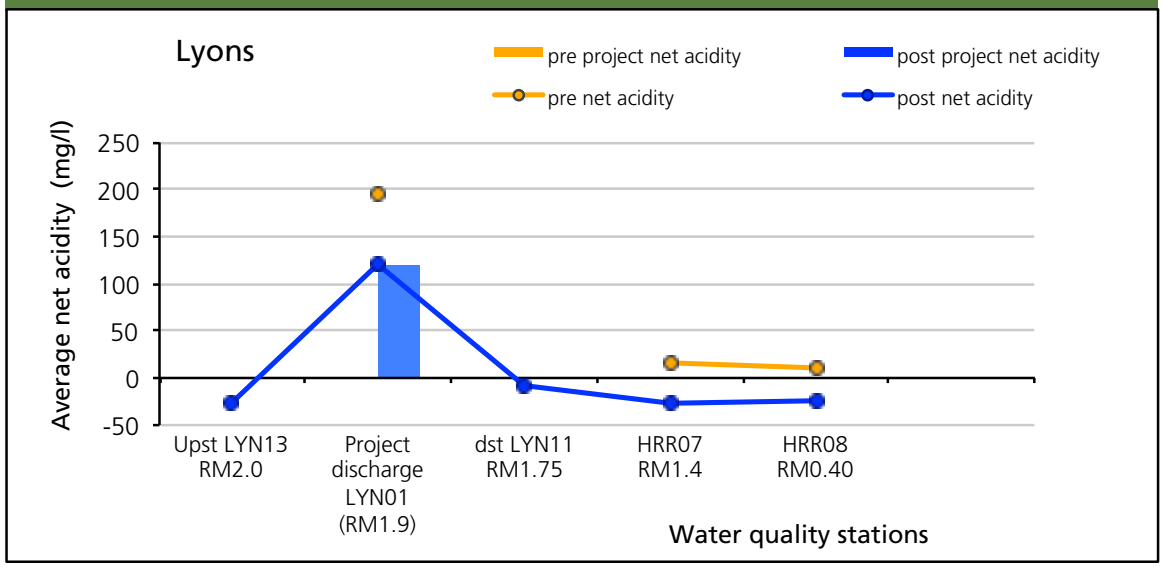


Figure 2. Pre and Post Acidity



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 8/25/76 to 6/21/1999 for pre-construction and from 1/4/2006 to 12/31/2011 for post-construction.

Figure 3. Acid Load Reduction

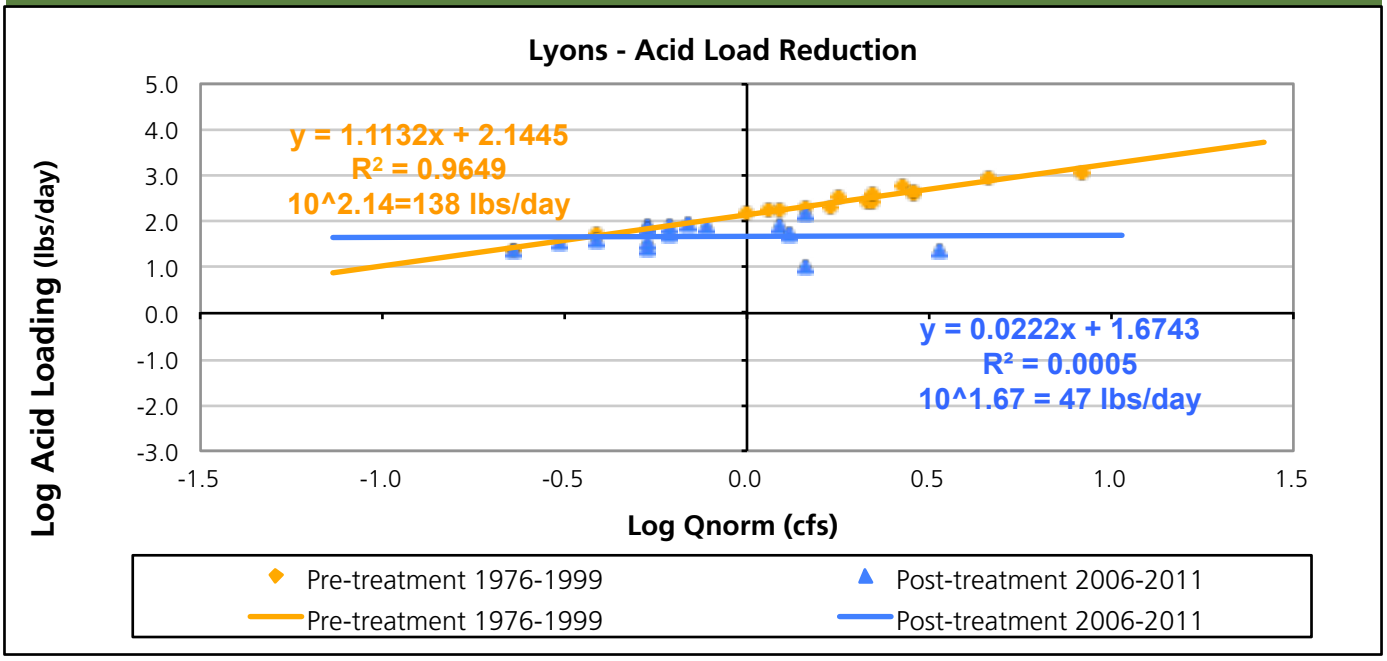
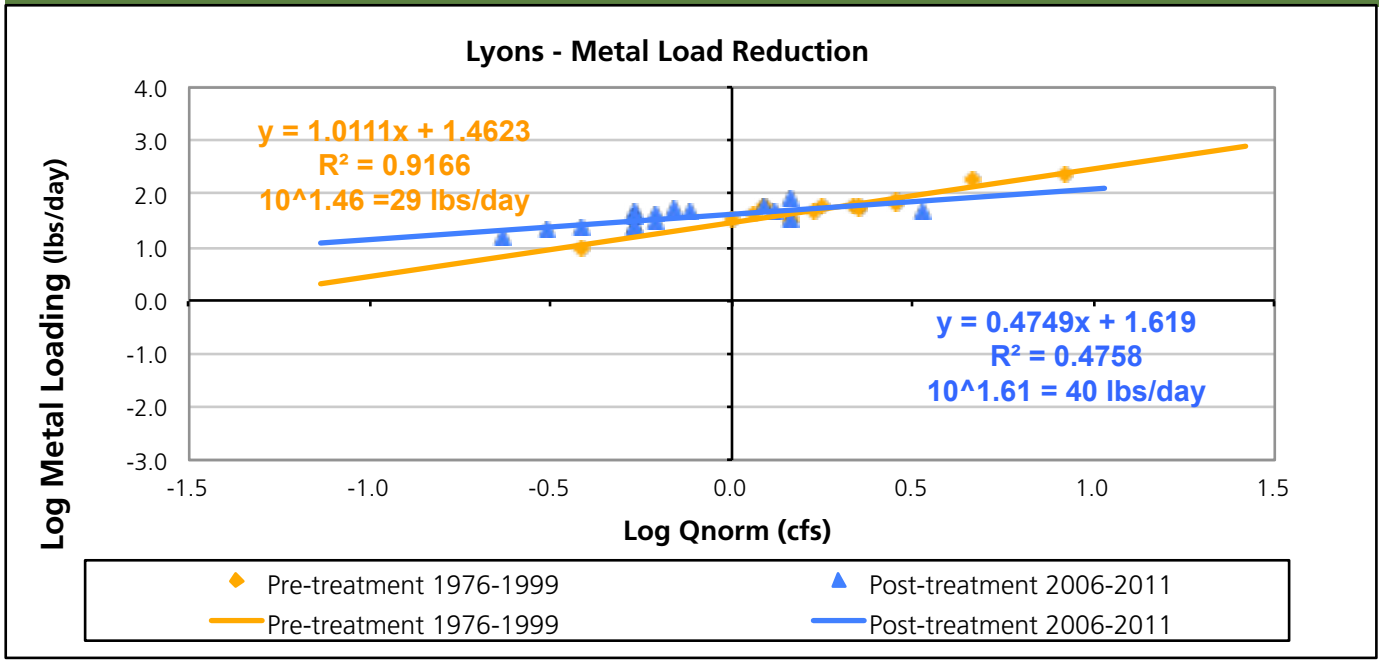


Figure 4. Metal Load Reduction



2011 NPS Report - Huff Run Watershed - Fern Hill HR-42 Pits A, B, & C

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete 2008 Project Number: CR-RS-15 & CR-RS-21

Pre-construction

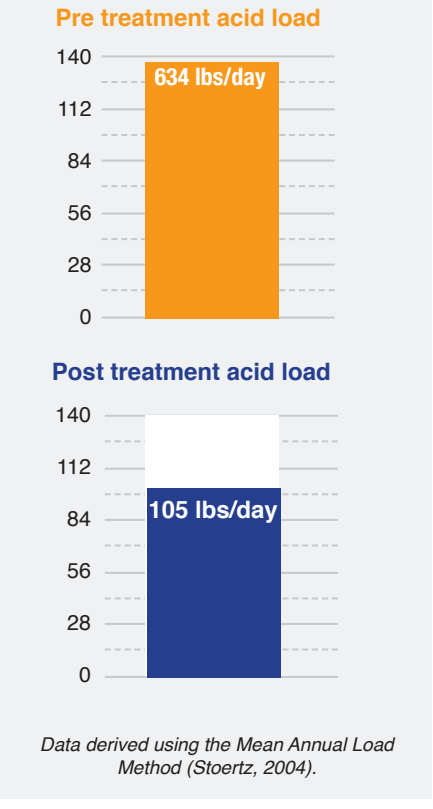
AMD plume, Photo by Maureen Wise

Post-construction

Caption: Fern Hill AMD project entrance, Photographer: Linda March

Fern Hill is located in Section 27 and 33 of Rose Township in Carroll County and lies within the 14-digit HUC unit #05040001080050. Fern Hill site FRN01, discharges into Huff Run at river mile 4.9. Fern Hill HR-42 consists of a few acid pits and a large AMD plume that sits directly beside Huff Run and discharges AMD directly into Huff Run. The treatment approach was to reclaim three acidic ponds that were situated up-dip from the AMD plume on the site through basic surface reclamation and open limestone channels. Reclamation of these impoundments is believed to have diminished flow to the seep at the base of the hill. Figures 3 & 4 estimate approximately 529 lbs/day of acid were reduced from entering into Huff Run. No reduction in metals were measured. The design was completed in-house by ODNR-DMRM. The treatment consisted of 6.0 acres of surface reclamation reclaiming a small gob pile (1 ac.), small settling pond (200 sq. ft) and 500 linear feet of limestone channels. The goal of the design was to reduce flow of the underground mine seep and reduce acidity and metal loadings to Huff Run. Construction of first two pits was complete October 2008 by Malcuit for a cost of $106,573.75. Construction of the final pit (pond A, “June’s Pond”) was completed late 2010 by Red Malcuit for a cost of $69,754. The funding sources for this project were ODNR/DMRM for the design and OSM Clean Streams (strip pit B & C) and ODNR-DMRM for construction (strip pit A).

SITE: FRN01



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

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.

Data Analysis

Fern Hill HR-42 Project pre-construction monitoring show pH and net acidity upstream, at the project discharge and along the mainstem of Huff Run downstream of the project. Pre-construction data show pH in the range of 4.7 to 6.9, at the project discharge and downstream. Post-construction data show pH in the range of 5.81 to 7.0. Acidity concentrations decreased by 37% at the project discharge site FRN01.

Figure 1. Pre and Post pH

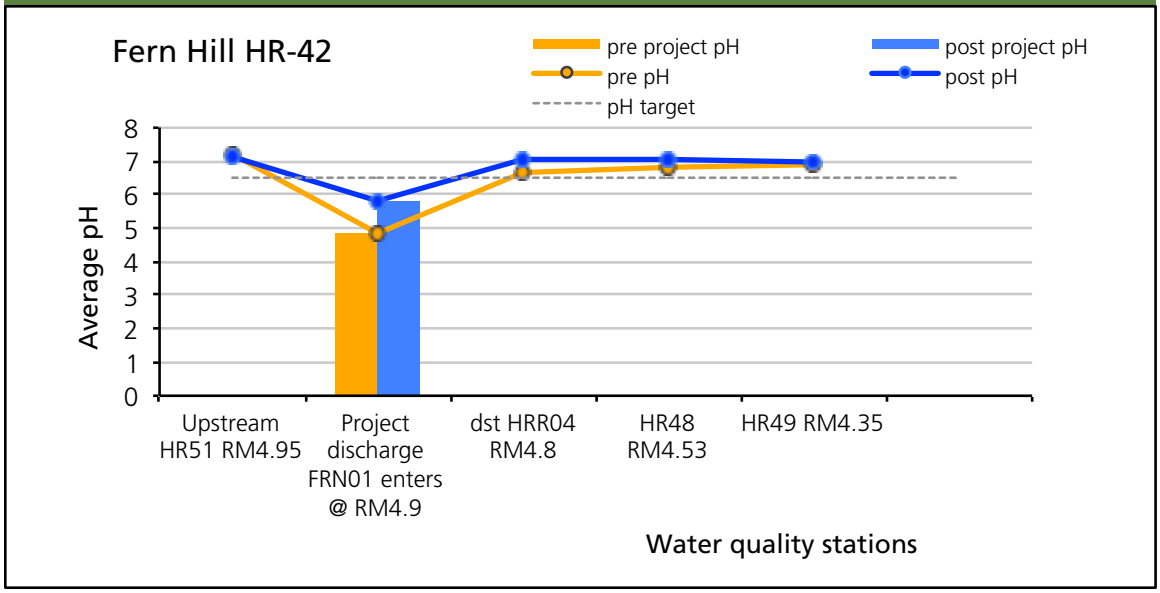
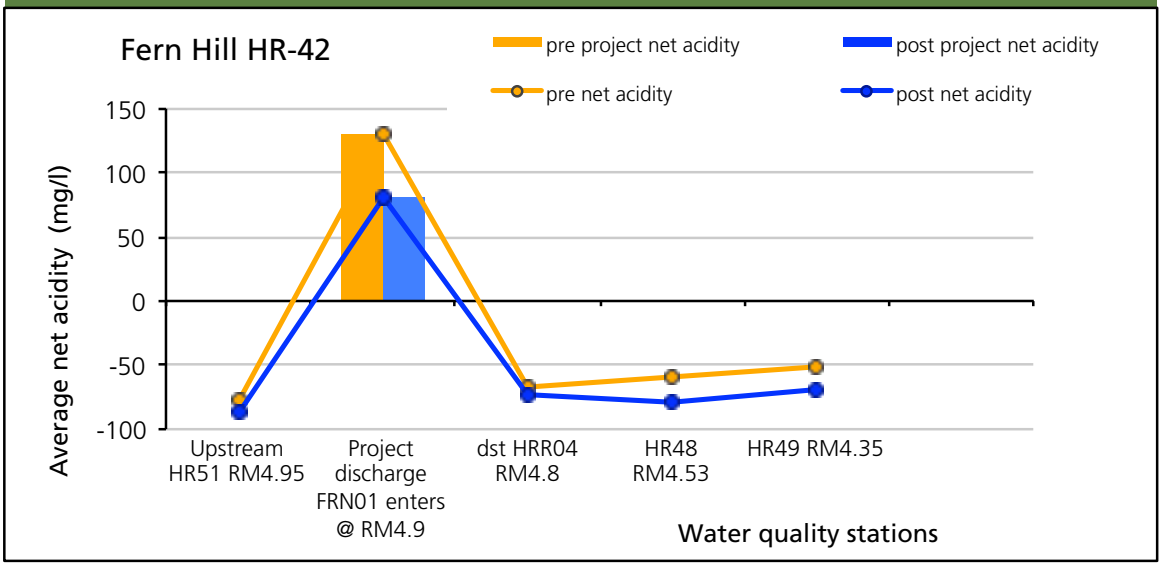


Figure 2. Pre and Post Acidity



2011 NPS Report - Huff Run Watershed - Belden

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Complete 2008 Project Number: CR-RS-10

Pre-construction

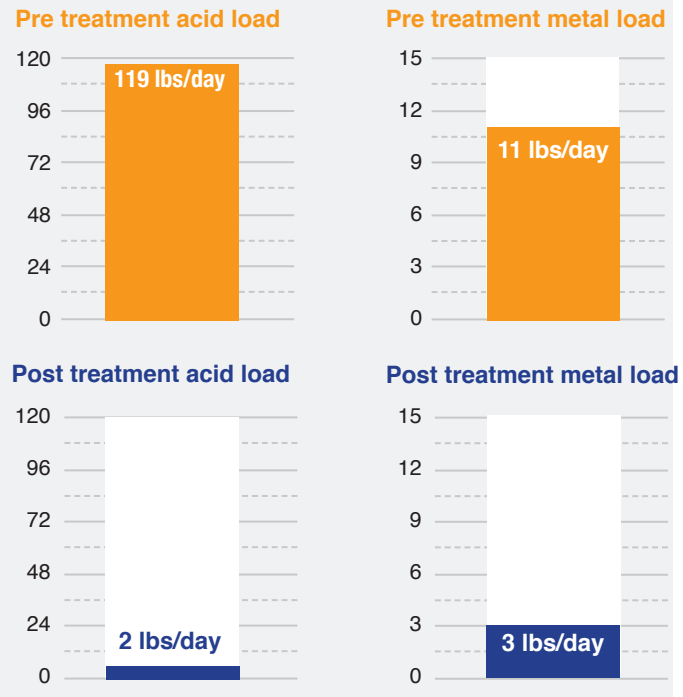
Gob pile with impounded acidic water, Photo by Huff Run Watershed

Post-construction

Caption: Steel Slag Bed #3, Photographer: Maureen Wise

Belden is located in Section 33 of Rose Township in Carroll County and lies within the 14-digit HUC unit #05040001080050. Belden site BLD01, discharges into Huff Run at river mile 4.5. The Belden site consists of large gob piles, exposed toxic clay, and strip pits north of the former Kopp Clay Plant. These sources contributed to the degradation of a 20-acre area in the Huff Run watershed. The treatment approach was to conduct surface reclamation, install steel slag beds to boost alkalinity, and install a sediment pond to allow metals to precipitate. The design was completed by ATC Associates for $123,000. The treatment consisted of 4.0 acres of surface reclamation, 10 acres of gob pile reclamation, install 9,600 square foot steel slag leach bed and a 7 acre settling pond. The goal of the design was to boost alkalinity and reduce iron metals and acidity from entering Huff Run. Construction was complete December 2008 by Tuscon for a cost of $660,285. The funding sources for this project were ODNR/DMRM for the design and USEPA Targeted Watershed Grant and ODNR-DMRM for construction. Figure 3 and 4 (shown on page 3 of this report) estimates approximately 116 lbs/day of acid were reduced from entering into Huff run and 8 lbs/day of metals. The Belden Gob Pile is an addition to the Belden Project and was reclaimed in just two weeks over the summer of 2010. The project footprint was less than one acre. Twelve oak trees were planted on the crown of the hill at the request of the landowner. Less than 100 feet of limestone channel convey water at the base of the hill. The total project cost was just $12,000 and was constructed by Red Malcuit. The design for this project was engineered by ODNR-DMRM. The project was funded solely by ODNR-DMRM.

SITE: BLD01



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

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, as a result of the AMD reclamation project.

Data Analysis

Belden Project pre-construction monitoring show pH and net acidity upstream, at the project discharge and along the mainstem of Huff Run downstream of the project. Pre-construction data show pH in the range of 3.4 to 6.7, at the project discharge and downstream. Post-construction data show pH in the range of 6.01 to 7.01. Acidity concentrations decreased by 87% at the project discharge site BLD01.

Figure 1. Pre and Post pH

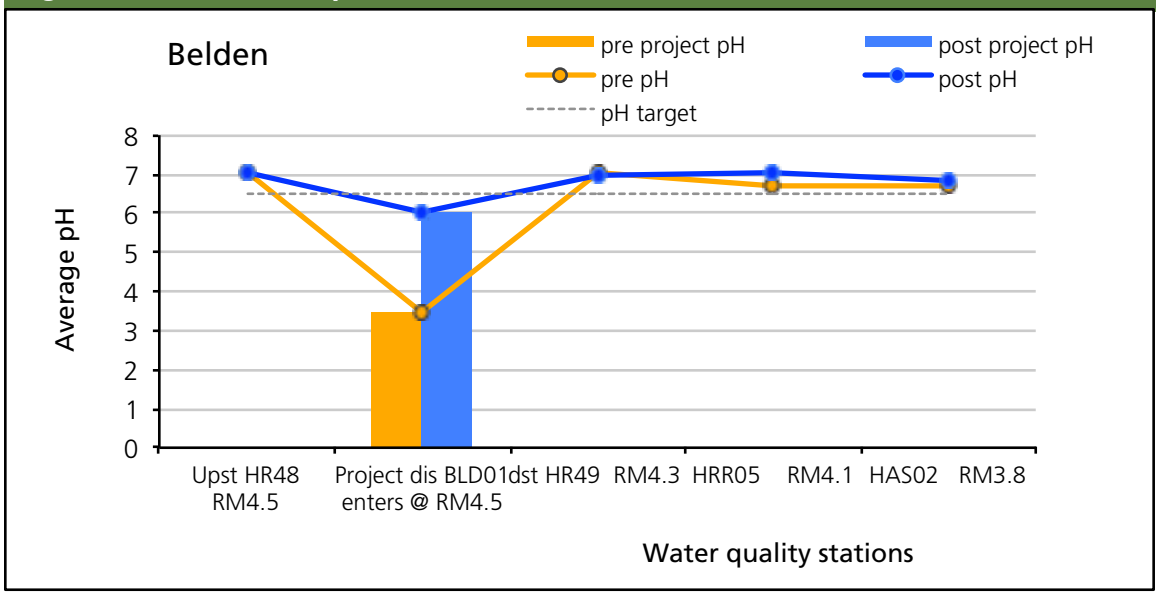
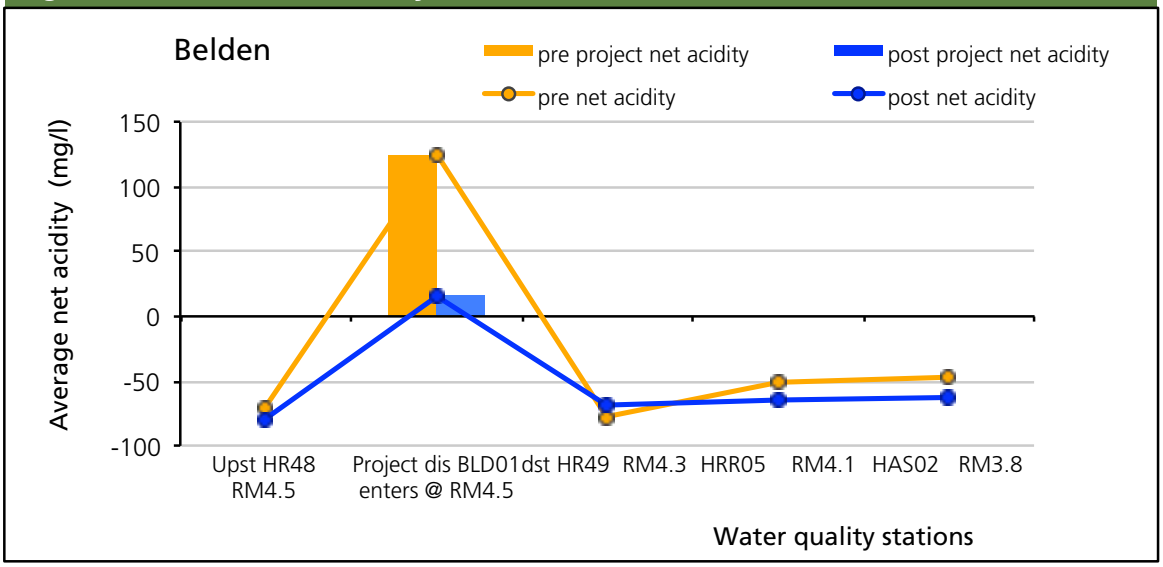


Figure 2. Pre and Post Acidity



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 8/1/1985 to 10/7/2008 for pre-construction and from 1/12/2009 to 12/31/2011 for post-construction.

Figure 3. Acid Load Reduction

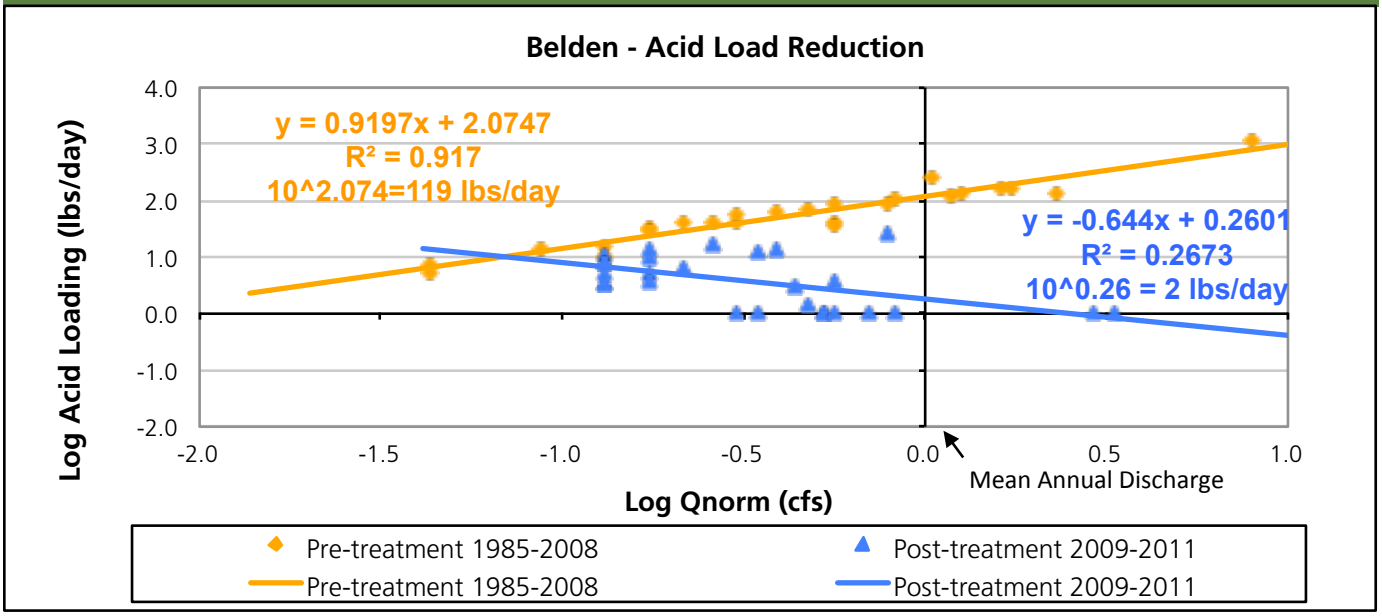
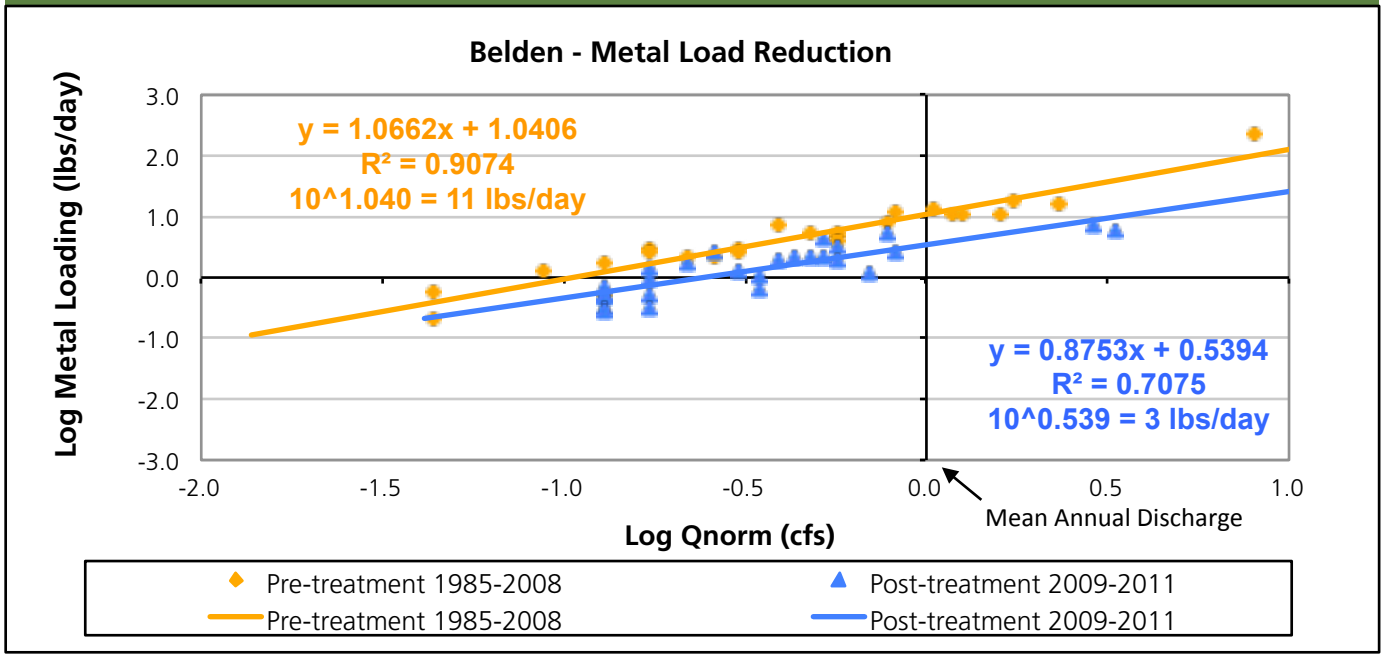


Figure 4. Dissolved Metal Load Reduction



2011 NPS Report - Huff Run Watershed - Thomas

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: Completed 2010 Project Number: CR-RS-08

Pre-construction

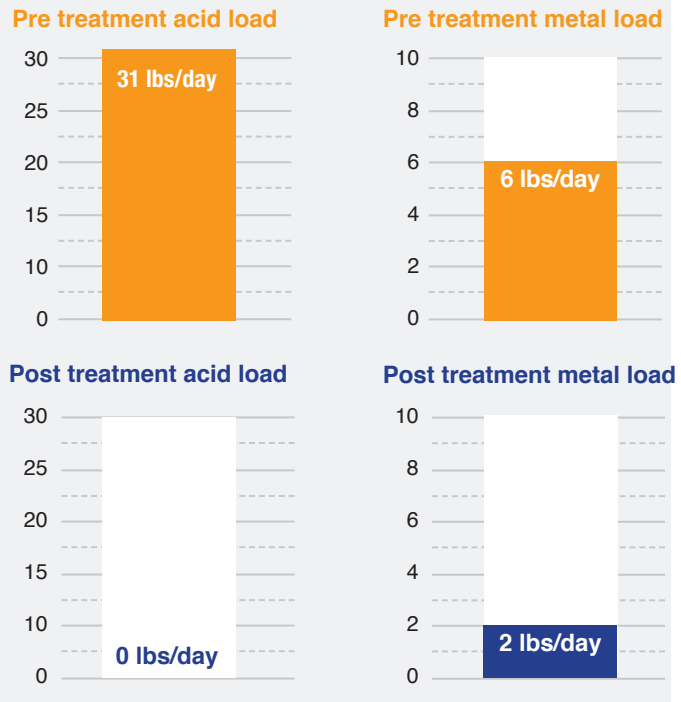
Southern area with large beaver ponds, Photo by Maureen Wise

Post-construction

Site two settling pond, Photo by Paul Greco

Thomas reclamation project is located in Section 33 of Rose Township in Carroll County and lies within the 14 digit HUC unit #05040001080050. Thomas reclamation project discharge is site THM01. The Thomas site consists of approximately 20 acres of surface mine water impoundments and toxic mine spoil. The impoundments are recharging a shallow deep mine, allowing for metals such as iron to flow into Huff Run. The design was completed by ODNR-DMRM in-house for a cost of $60,620. Plans for reclamation include surface mine and gob pile reclamation, limestone channels, and two settlings ponds. Construction is expected to be complete in 2010 by Red Malcuit Inc. for a cost of $495,000. Funding source for the project design and construction is ODNR-DMRM, OEPA 319, and OSM. Thomas project contains two separate discharge points, LIN01 and THM01/THM06 both discharge/monitoring locations contain settling ponds. The site LIN01 shows acid and metal reductions, while site THM01/THM06 shows only minor metal reduction since the site was net alkaline and low metals prior to construction. Figures 3 & 4, estimate approximately 31 lbs/day of acid and 4 lbs/day of metal load reduction from site LIN01 and 1 lbs/day reduction in metal loads.

SITE: LIN01 & THM01/THM06



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

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre-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.

Data analysis

Thomas reclamation project monitoring show pH and net acidity at two discharge sites THM01 and LIN01 (Figures 1 and 2). Pre-construction data shows average pH of 6.73 and net alkaline at site THM01 before discharging into Huff Run and average a pH of 5.67 and net acidity value of 12.59mg/l at discharge site LIN01. Post-construction data at THM06 has an average pH of 7.14 and net alkaline (-155 mg/l) and at site LIN01, pH was 6.5 and net alkaline (-26 mg/l).

Figure 1. Pre and Post pH

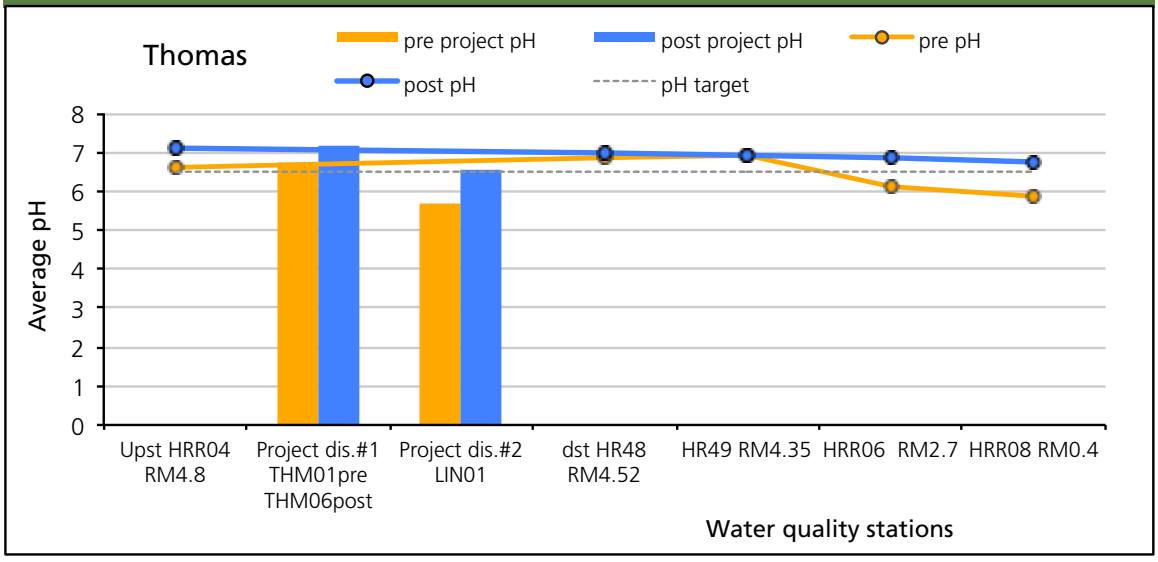
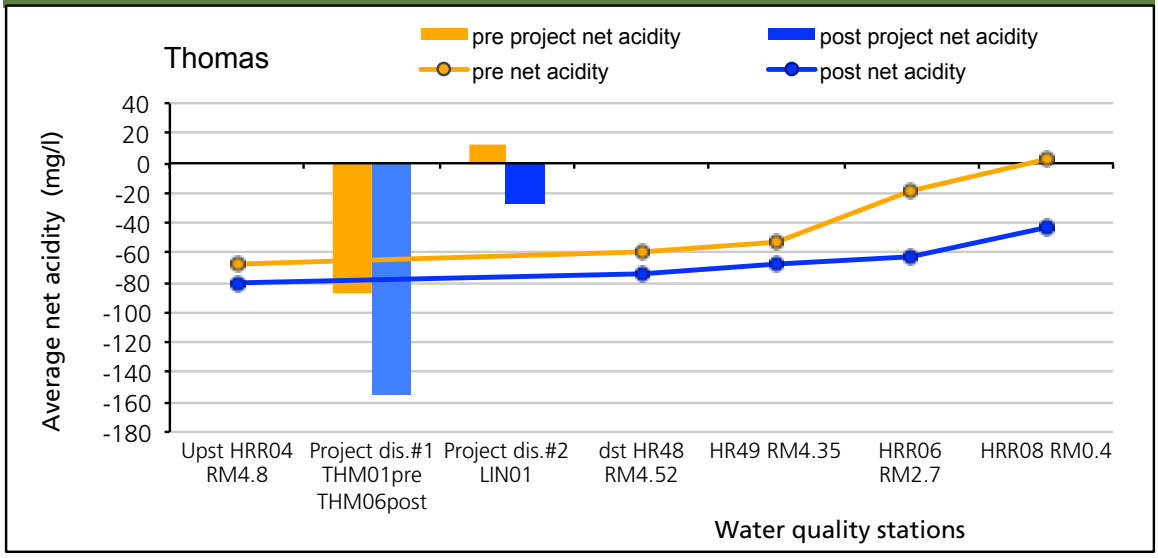


Figure 2. Pre and Post Acidity



Water Quality Report

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal load reduction occurring at this project were plotted and shown in Figures 3 and 4. Acidity, iron, aluminum, and discharge were measured pre-construction at the project effluent LIN01 and THM01 from 6/17/1998 to 6/15/2009 for pre-construction and from 4/14/2010 to 11/16/2011 for post-construction at site LIN01 and THM06. Figures 3 and 4 show load reductions for site LIN01.

Figure 3. Acid Load Reduction

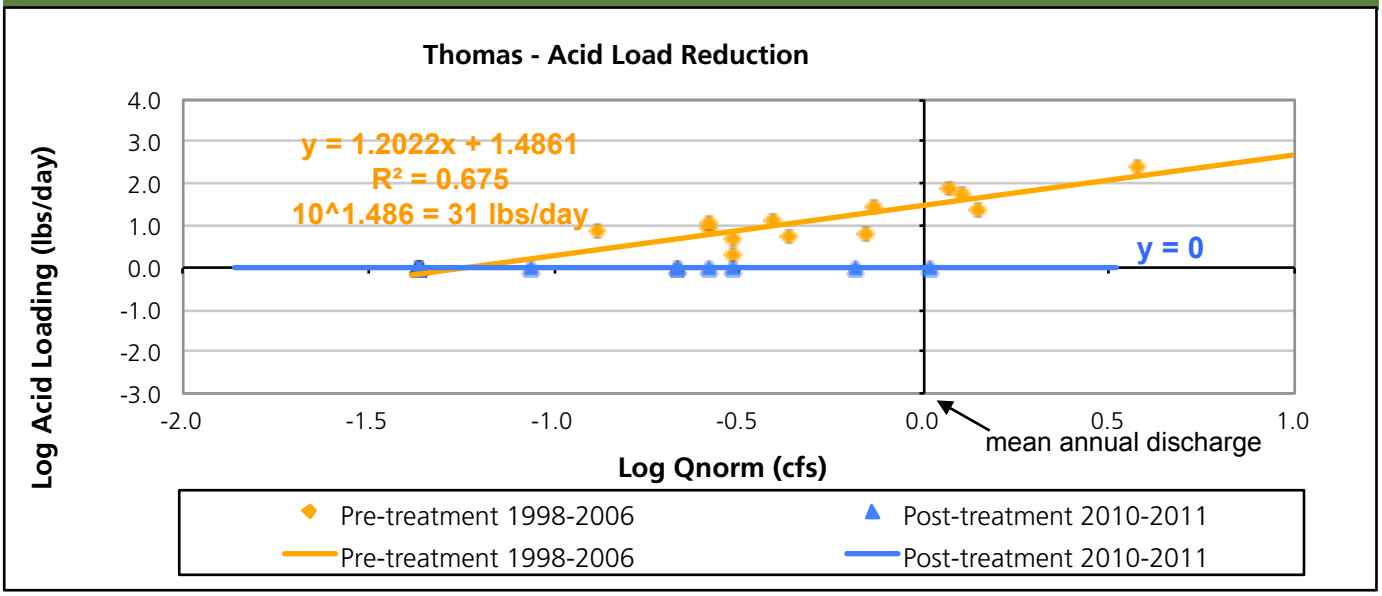
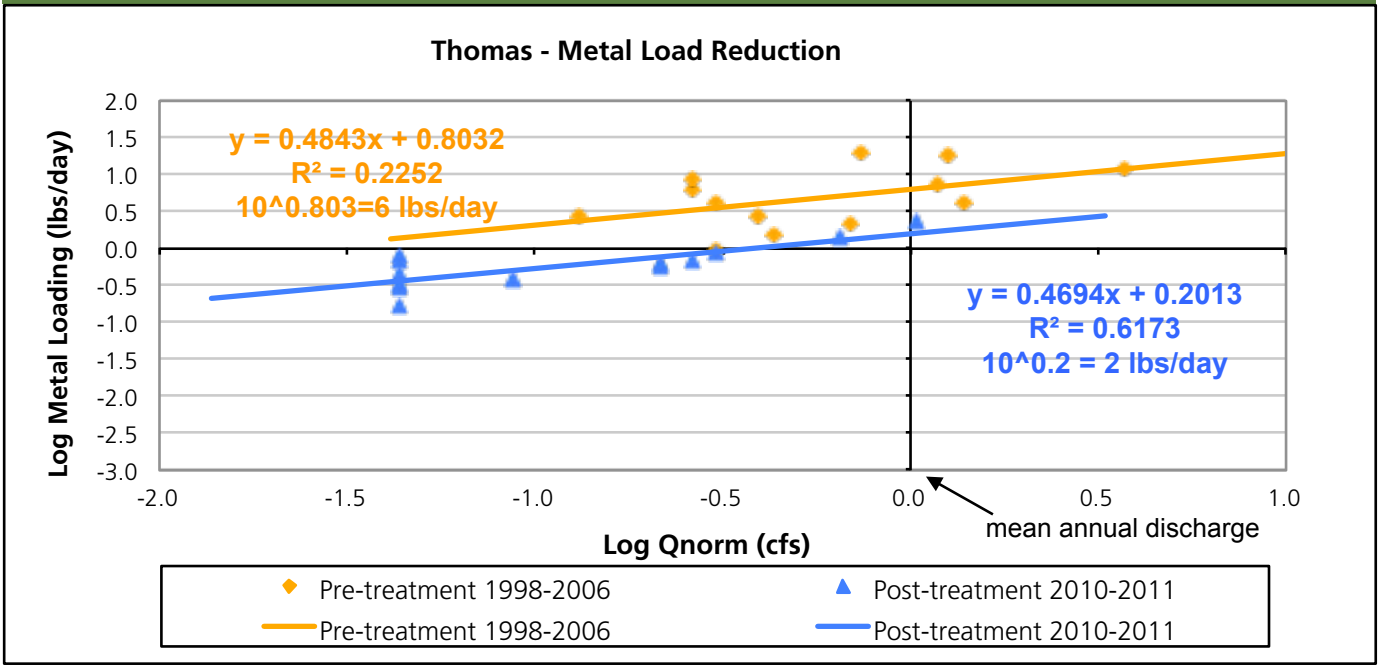


Figure 4. Metal Load Reduction



2011 NPS Report - Huff Run Watershed - Mineral Zoar

Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project Status: completed November 2009 Project Number: TS-Sn-23

Pre-construction

Future Reserve Alkaline Producing System and Aerobic Wetland site, Photograph by Maureen Wise

Post-construction

Mineral Zoar Overview and Aerobic Wetland Photograph by Maureen Wise

Mineral Zoar is located in Sandy Township in Tuscarawas County. The Mineral Zoar project discharge, site MZR08, is located under the railroad bed at the Mineral Zoar Road final project exit point. Mineral Zoar is the largest tributary to Huff Run and runs through the Mineral City Park. The project consists of two deep mines that discharge acidic water. The design was completed by Baker Consulting and ODNR in-house for $53,780. The treatment approach for this site is to treat the two deep mines with a reverse alkaline producing system (RAPS) (1,400 sq. ft) while utilizing an existing wetland and 100 linear feet of open limestone channels. The goal of the design is to reduce 100% of the acidity on site. Construction was complete Fall 2009 by Beaver Consulting for a cost of $373,268. Funding source for the project design and construction is ODNR-DMRM and OSM.

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.

Data analysis

Very limited data is available for the Mineral Zoar project prior to construction. Values of pH and net acidity were monitored post construction and show a pH of 6.35 at the project discharge from Mineral Zoar project area, site MZR08. The net acidity concentration at site MZR08 is net alkaline with a value of -30.83 mg/l. Future data results can be monitored through time for changes, unfortunately pre-construction versus post-construction analysis can't be completed given the lack of pre-construction data. No discharge off the site is monitored.

Figure 1. Pre and Post pH

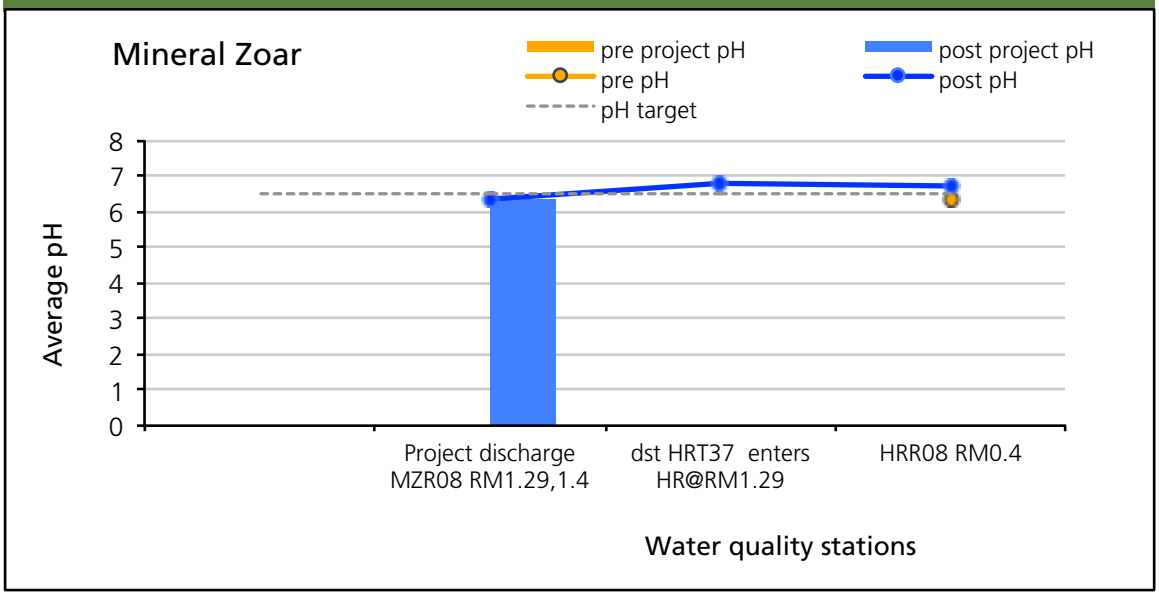
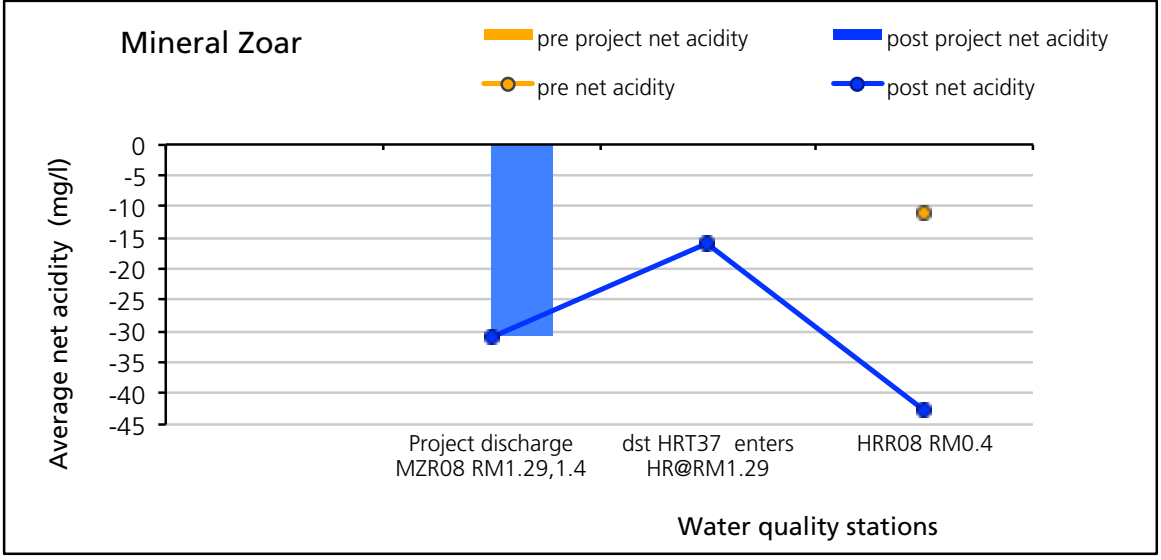


Figure 2. Pre and Post Acidity



Section III – AMD project reports

Leading Creek Watershed comprehensive acid mine drainage projects progress report for 2011.

Section III contains Leading Creek's first AMD funded project report displaying photos of the project site, a description of the project, and initial water quality data. After reclamation this report will display, 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 in the 2011 NPS monitoring report:

1. Thomas Fork Doser

2011 NPS Report - Leading Creek Watershed - Thomas Fork Doser

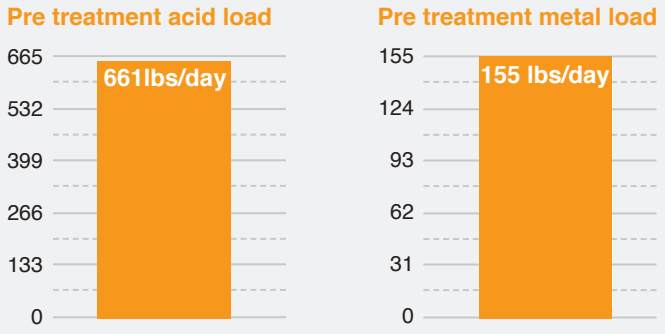
Generated by Non-Point Source Monitoring System
www.watersheddata.com

Project status: Funded, expected completion Winter 2012 **ODNR project number: Mg-Sb-83**

Pre-construction

Caption: Confluence of the 'Unnamed Tributary' and Thomas Fork
Photo by Meigs SWCD Leading Creek Watershed

Site: TF1502



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

Thomas Fork Doser Project located in Fractional Section 24 of Meigs County and lies within the 14-digit HUC unit #05030202090060. The project site, 0.25 acres, is located in the Thomas Fork Subwatershed of the Leading Creek Watershed and is in its pre-construction phase. The majority of AMD in the Thomas Fork Subwatershed originates from seven above drainage mines as well as from: sub-surface mine drains, two buried / clogged drains, and two seeps draining into Thomas Fork's 15th tributary, 'The Unnamed Tributary'. The primary purpose for remediation of this tributary is the detrimental effects its level of acidity and heavy metals has on Thomas Fork's aquatic life. Project goals include restoration of aquatic communities in Thomas Fork, but do not include improvements to the 'Unnamed Tributary'. Restoration consists of constructing an active treatment calcium oxide doser to treat all the acidity produced in 'The Unnamed Tributary' by determining required lime material based on water quality monitored at the mouth (TF1502). The design was completed by ODNR staff, and the pre-bid for the project was held on May 11, 2011, with an engineer's estimate of $355,316. Construction completion date is set for January 2012. After construction and monitoring are complete the acid and metal reduction will be reported in the 2012 annual report. Funding sources for the construction of this project are ODNR-DMRM and the US Fish and Wildlife Service. Figure 3 and 4 estimate approximately 661 lbs/day of acid and 155 lbs/day of metal loadings entering Thomas Fork from the 'Unnamed Tributary' during pre-construction. Reduction rates will be evaluated in 2012.

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 net acidity (Figure 2) along the mainstem of the receiving stream, Thomas Fork upstream and downstream of the project discharge (TF1502) during pre-construction 2003-2011.

Data analysis

Data collected during pre-construction, 2003-2011, shows an average pH value of 2.9 at the mouth of the 'Unnamed Tributary', site TF1502. Downstream of the confluence with the 'Unnamed Tributary' along Thomas Fork, average pre-construction pH is in the range of 4.1 to 5.6. Thomas Fork is net alkaline upstream of the confluence with the 'Unnamed Tributary' however is net acidic downstream and continues to be net-acidic for approximately six miles until the mouth of Thomas Fork, which is only slightly net alkaline during this pre-construction time period.

Figure 1. Pre pH

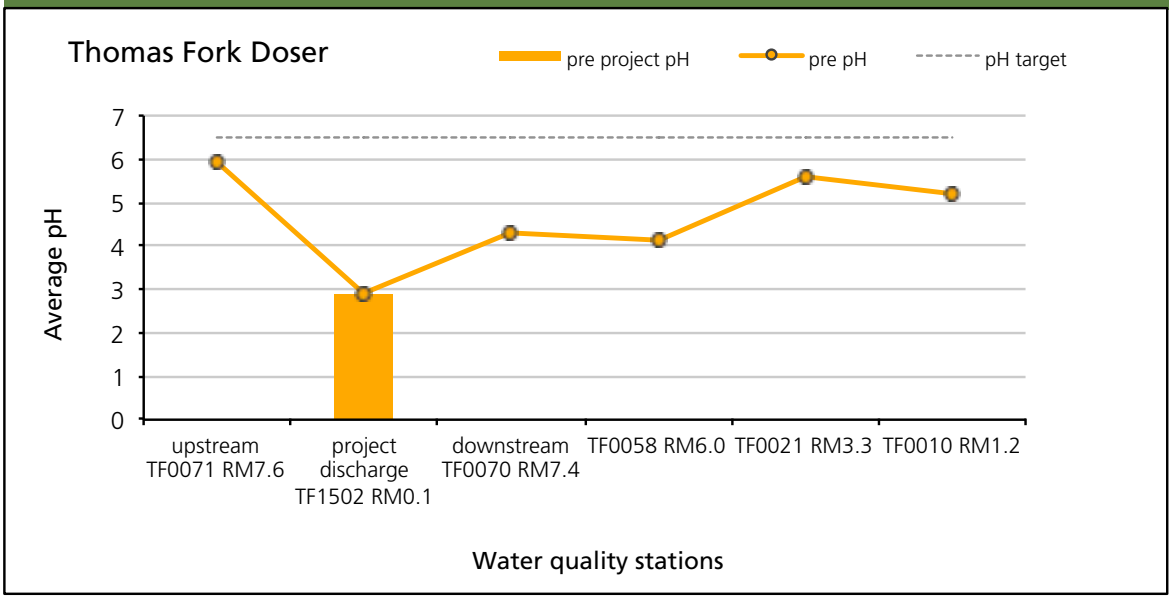
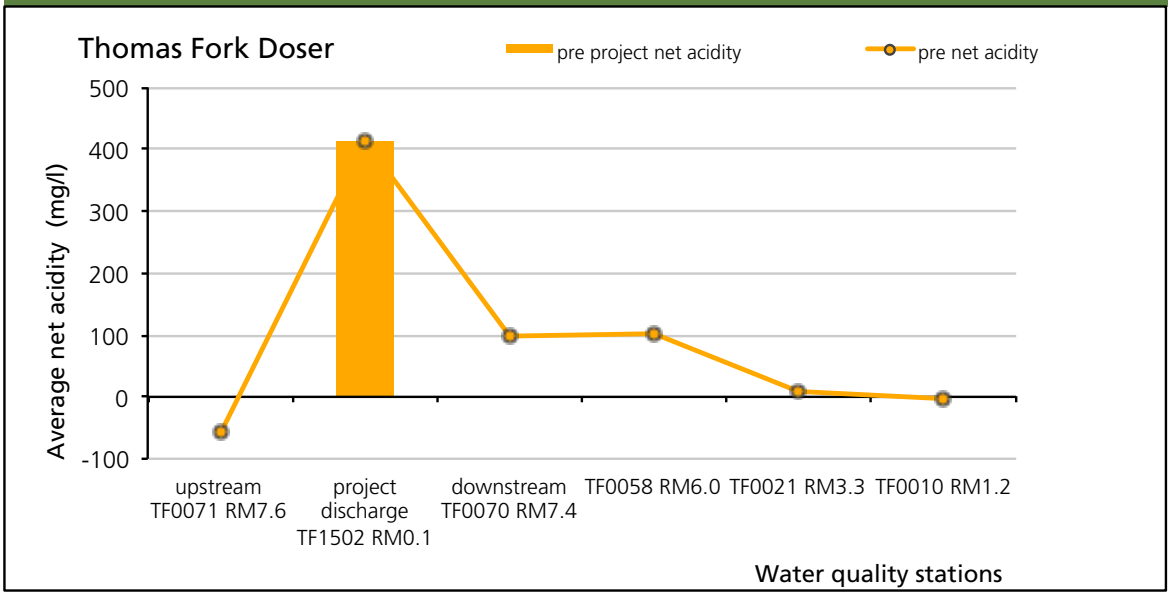


Figure 2. Pre Acidity



Water Quality - Load Reductions

Using the Mean Annual Load Method (Stoertz, 2004) acid and metal average annual loadings occurring at this project, site TF1502, were plotted and shown in Figure 3 and 4. Acidity, iron, aluminum, and discharge were measured pre- construction at the project discharge from 6/9/03 to 8/23/11 for pre-construction.

Figure 3. Acid Load Reduction

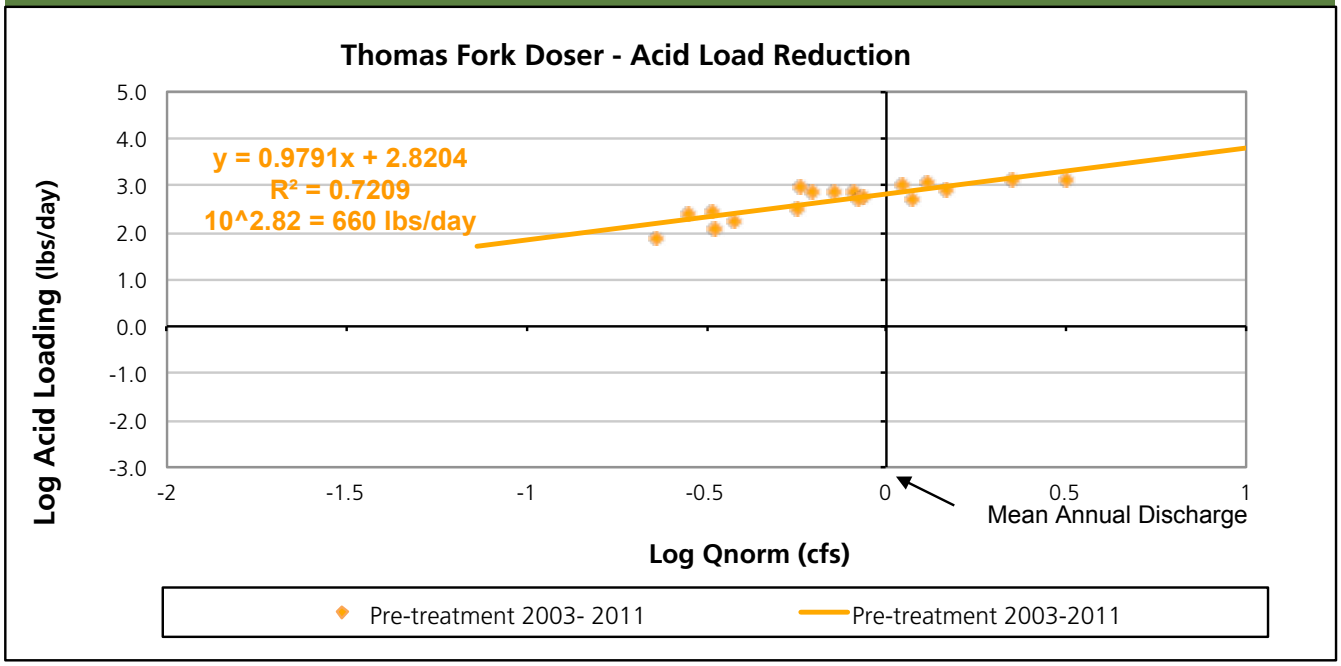
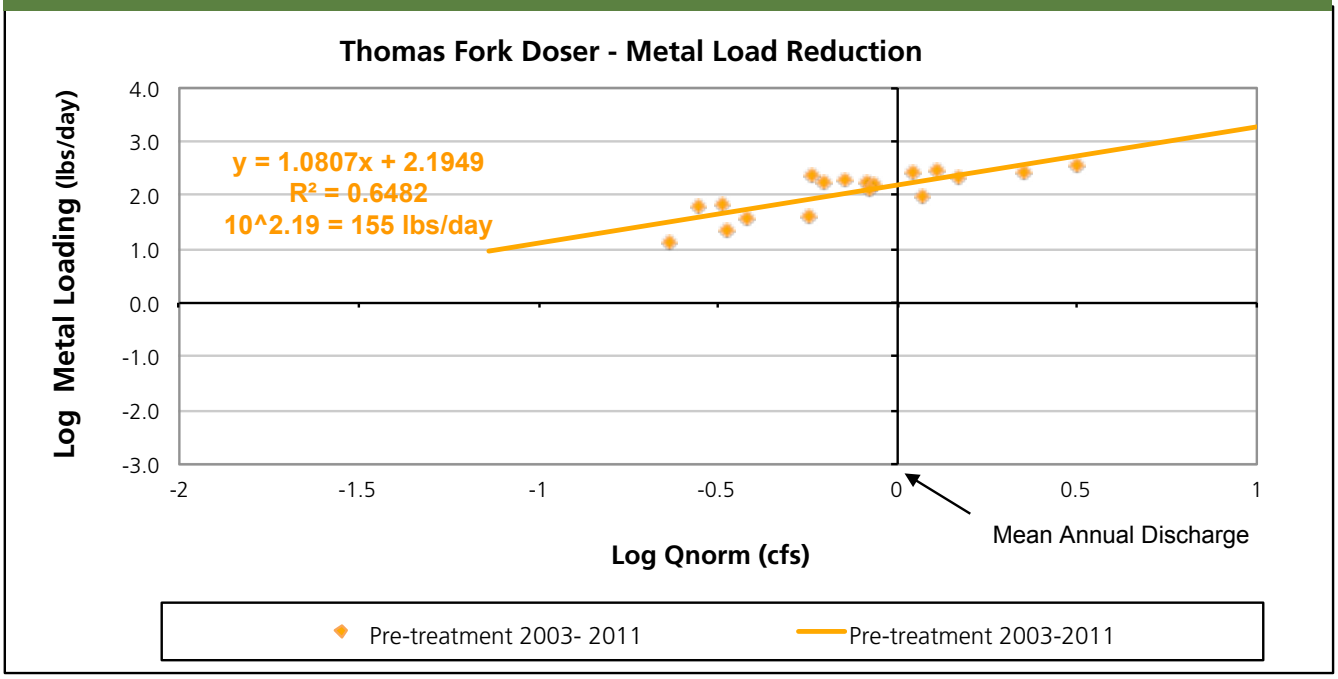


Figure 4. Metal Load Reduction



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http://water.usgs.gov/osw/streamstats version 2