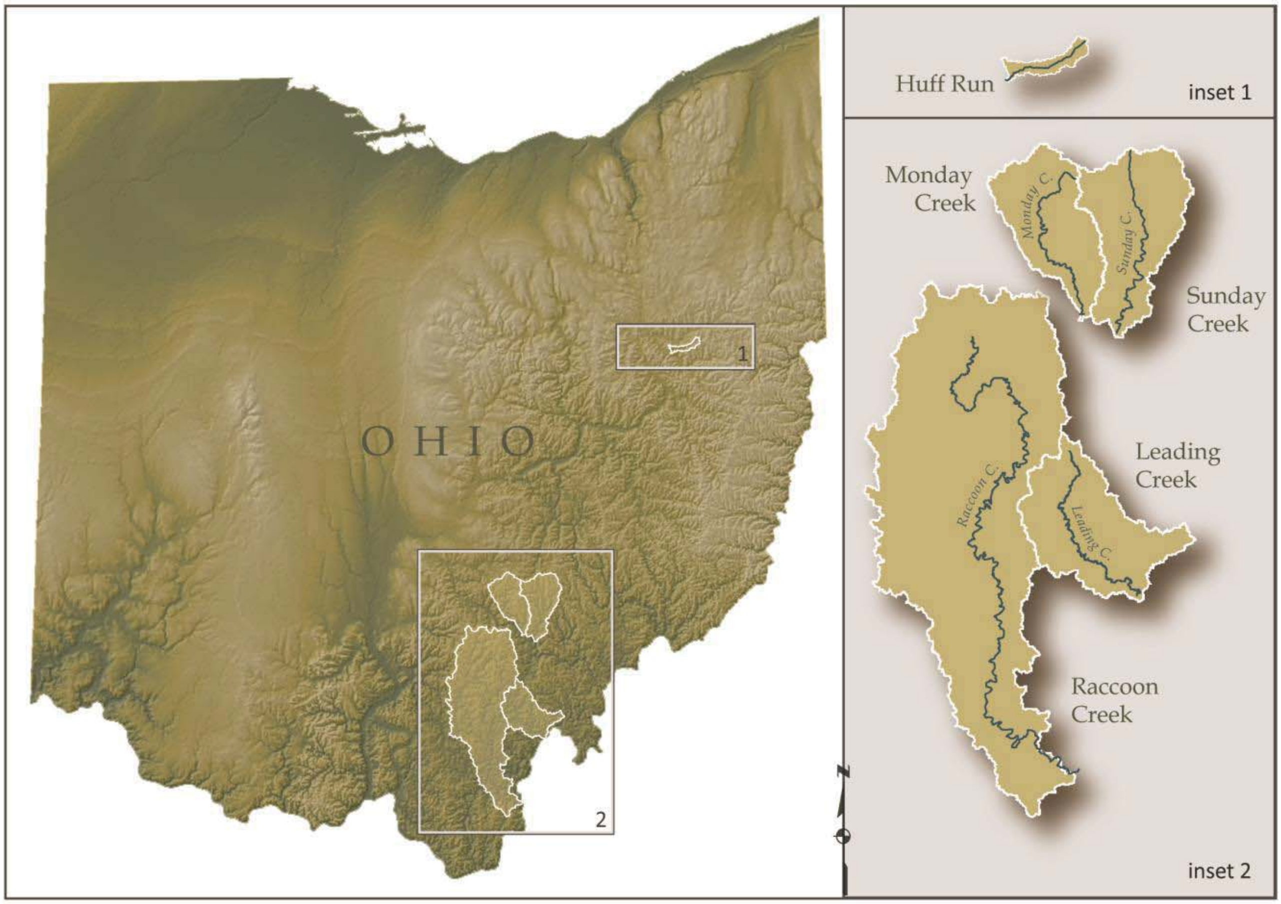
2012 Stream Health Report

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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11-21-13

Table of Contents

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 Stream Health Report 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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Monday Creek: Nate Schlater and Tim Ferrell
Sunday Creek: Michelle Shaw
Huff Run: Marissa Lautzenheiser
Leading Creek: Jim Freeman
I would like to thank the watershed groups for their cooperation and patience in this project for doing everything from data collections, participation in trainings, gathering historical data, and data entry on top of their busy work schedules.

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ODNR-DMRM summer interns – 2012 field crews for data collection and data entry

Ohio University Biological Sciences - Kelly Johnson – conducting the MAIS training, macroinvertebrate laboratory identification, data analysis, macroinvertebrate data collection, method development, and guidance.

Voinovich School – Steve Porter (GIS and data analysis), Taeil Kim (program designer), Lindsey Siegrist (communications), Kyoung Lim (assistant programmer), and Natalie Kruse (research).

Ohio University students – Bruce Underwood, Aaron Coons, and Liz Migliore

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 committed to 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 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, net acidity, iron, and aluminum are reported along stream reaches within key restoration areas, identified by river mile and sample site IDs.

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 162 miles of stream meetings the pH 6.5 water quality standard in 2012.

Net acidity, iron, aluminum, pH, and macroinvertebrates were evaluated annually from 2006-2012. Incremental changes from year to year can be tracked using these indicators. Net acidity and pH values

have improved from 2006 to 2012. The family-level biological indicator, Macroinvertebrate Aggregated Index for Streams (MAIS), were measured annually from 2006 to 2012, 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.

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 to 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 Annual NPS report is presented in a new format this year. The report is now titled "2012 Stream Health Report". All AMD project descriptions (Section III of previous annual reports) have been removed from this annual report and compiled in a separate document containing pertinent static information describing the AMD project, titled "Collection of Acid Mine Drainage (AMD) Reclamation Projects in the Coal-Bearing Region of Ohio". This will eliminate redundancy in printing static information each year. This report is available online at watershedata.com as well as with all partner organizations.

The "AMD project collection" report includes: a chronological collection of all projects completed since late 1990s. The 'AMD project collection' report displays general information about the AMD issues prior to reclamation and the AMD project description. Specifically the 'AMD project collection' report includes: pre and post construction photos, description of AMD problem, design and construction information, costs, contractors, dates of construction, identification of project discharge, map of site (optional), and pre-water quality data at project discharge. 'AMD project collection' report is a compilation of all projects completed since the late 1990s in chronological order including all past archived reports. This report is a stand-alone document. Each year, the newly completed project reports will simply be added to the collection.

The "Annual Stream Health" report contains the dynamic yearly chemical and biological data that changes each year. This report includes the chemical and biological water quality data analysis for all target stream reaches within the five key watersheds. Stream reaches are identified as: Raccoon Creek Mainstem, Hewett Fork, Little Raccoon Creek, Monday Creek Mainstem, Sunday Creek Mainstem, West Branch of Sunday Creek, Huff Run, and Thomas Fork (Leading Creek). Data from these stream reaches are analyzed each year for changes and trends in pH, net acidity, iron, aluminum, and macroinvertebrates. Yearly trends of acid loading and metal loading reduction from each AMD project discharges are also displayed in this report. Long-term monitoring data, family-level macroinvertebrate data, and pre/post project discharge data collected by watershed groups and DMRM staff are utilized to generate the graphs of water quality trends along the stream reaches.

To track the overall health of Raccoon Creek, Monday Creek, Sunday Creek, Leading Creek and Huff Run, the watersheds where acid mine drainage reclamation is active, chemical data were collected annually since 2005 (2009 in Leading Creek). 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. 2010 fish and macroinvertebate data suggest a total of 47 miles of stream meet the use attainment criteria for WWH, with 51 stream miles evaluated. 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 1. Figures 2 and 3 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. Year 2015 will mark the next full biological evaluation across watershed sites.

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 track progress toward the overarching goal of meeting targets. Incremental changes are tracked at the acid mine drainage project level reports and at the watershed level reports.

Raccoon Creek

Sunday Creek

Huff Run

Monday Creek

Leading Creek

Figure 1: Biological health improvements in Raccoon Creek from baseline (1997) to 2005.

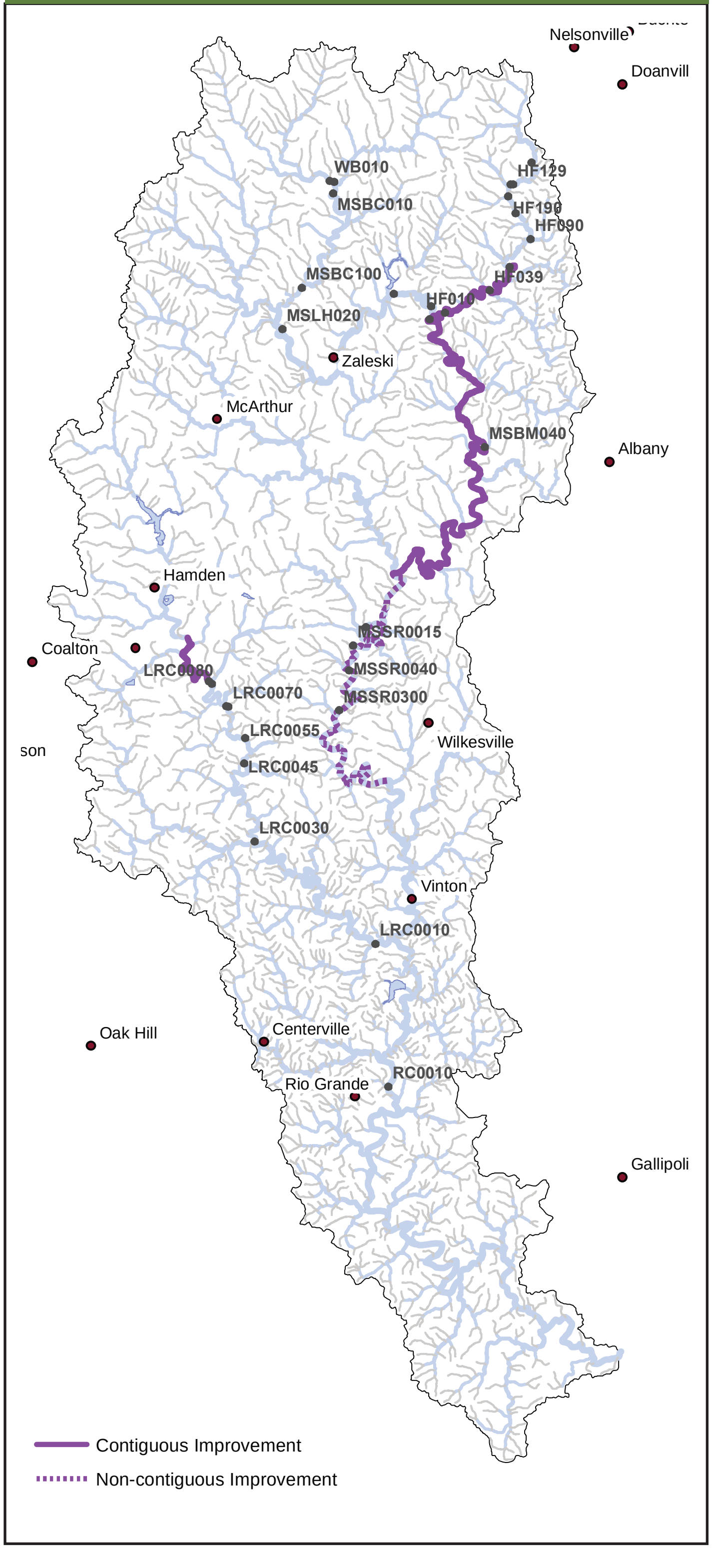

Figure 2: Biological health improvements in Raccoon Creek from 2005 to 2010.

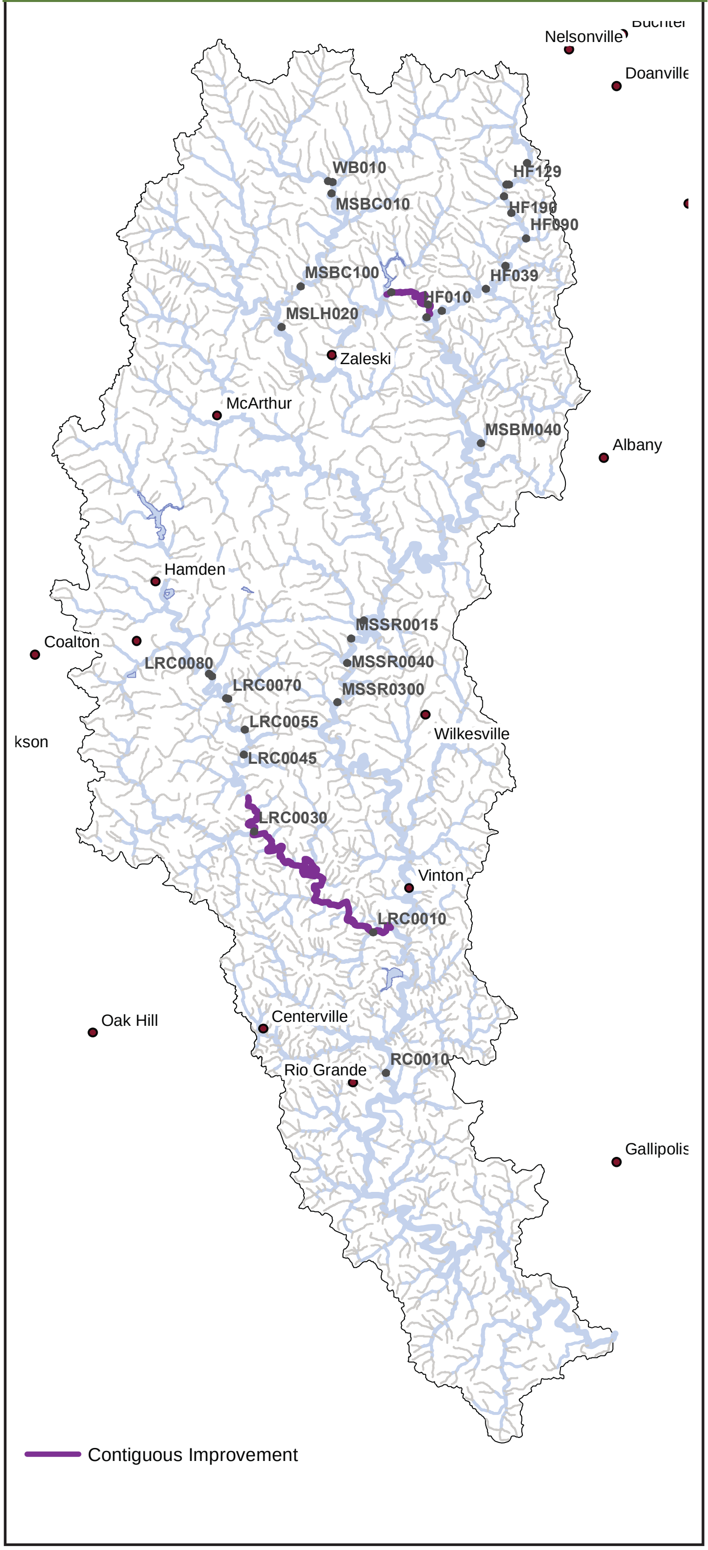

Figure 3: Biological health improvement in Sunday Creek West Branch from 2005 to 2010.

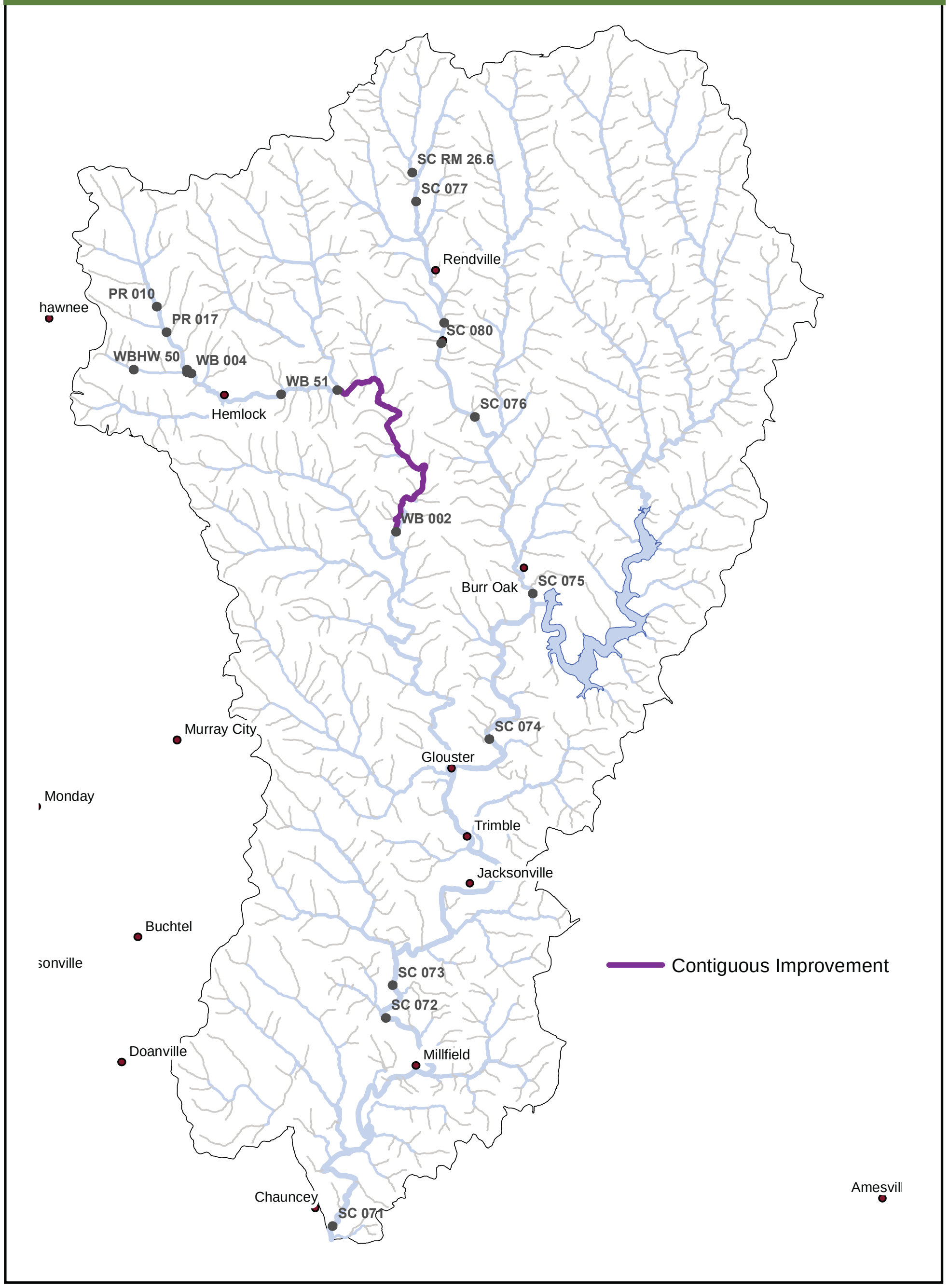

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Table 1. Summary of results for each of the five watersheds evaluated in 2005 to 2012: Raccoon Creek, Monday Creek, Sunday Creek, Huff Run, and Leading Creek.

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	Stream miles that met the pH target	Total stream miles monitored
Raccoon Creek	17	$11,977,853	6,030	23.3/18.42 (41.7)	111	117
Monday Creek	16 (plus 5 subsidence projects, costs are not included)	$6,570,507	3,759	0/0	23	33
Sunday Creek	10 (7 of 10 are sub-sidence projects)	$2,173,229	22	0/5.26 (5.26)	18	19
Huff Run	12	$4,695,302	1,075	0/0	10	10
Leading Creek	1	$415,437	661	NA/0	0	7
Total	56	$25,832,328	11,547	23.3/23.7 (47.0)	162	186

Reductions

2012 total acid load reductions = 11,547 lbs/day

Costs

2012 total reclamation costs = $25,832,328

Reductions

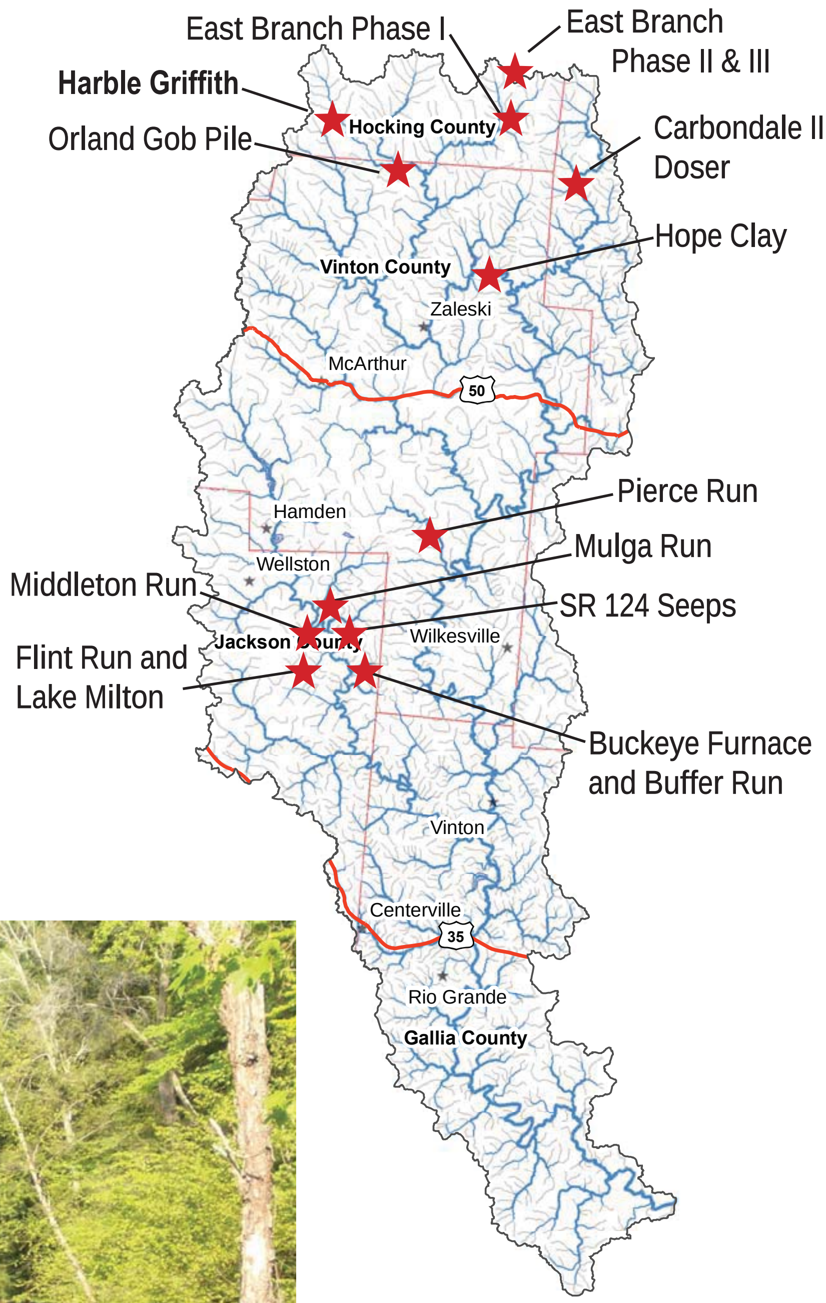
Total acid load reduction = 6030 lbs/day
Total metal load reduction = 775 lbs/day

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

Cost

Design = $1,811,264
Construction = $10,136,562

Total Costs through 2012 = $11,947,826



Raccoon Creek near Moonville, Photo by Ben McCament

2012 NPS Report - Raccoon Creek Watershed

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Timeline of the Raccoon Creek Watershed Project Milestones and AMD Projects

1980s	• Formation of Raccoon Creek Improvement Commitee (RCIC): Grassroots citizens group to address water quality issues in Raccon Creek
Early **1990s**	• RCIC invites citizens from all six counties to join efforts
Late **1990s**	• Formation of Raccoon Creek Watershed Partnership,a loosely based partnership of agencies to address technical AMD issues
1999	• State Route 124 Strip Pit and Buckeye Furnace Project completed
2000	• Little Raccoon Creek AMDAT completed • Watershed Coordinator position funded for six years
2001	• Headwaters AMDAT completed • State Route 124 seeps project completed
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 Mission to Establish a water trail on Raccoon Creek • Flint Run and Lake Milton Projects completed Watershed Coordinator three year extension funded
2007	• Raccoon Creek Watershed Partnership formed 501 (c) 3 • Waterloo Aquatic Education Center opened
2008	• East Branch Phase I AMD Project
2009	• Pierce Run AMD Project began • East Branch Phase II Project began
2010	• East Branch Phase II completed
2012	• Water Trail map created by Ohio University Environmental Studies student, Karla Sanders • Orland Gob Pile and Harble Griffith Reclamation Projects completed • Pierce Run AMD treatment project 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.

Raccoon Creek Projects

Acid mine drainage reclamation projects completed in the Raccoon Creek Watershed:

1999 Buckeye Furnace/Buffer Run

2001 State Route 124 Seeps

2004 Carbondale II Doser

Mulga Run

2005 *Hope Clay*

Salem Road/Middleton Run

2006 Flint Run East

Lake Milton

2007 East Branch Phase I

2010-2011 East Branch Phase II & III

2012 East Branch Phase I Maintenance

Jackson Area AMD Maintenance-Flint Run and Lake Milton

Orland Gob Pile

Harble Griffith* no high flow data

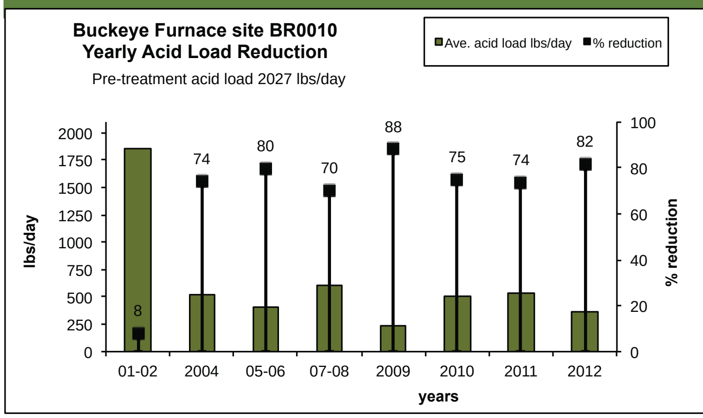
Pierce Run * completed 11/2012

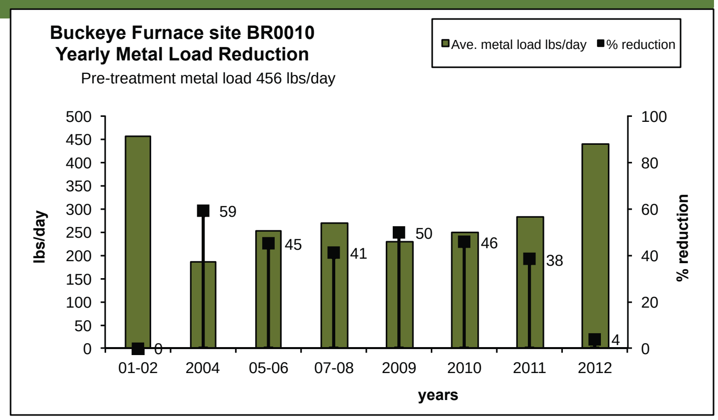
Italicized projects indicates not actively monitored
* Indicates no post yearly trend graphs due to lack of data

Yearly acid and metal load reduction trends per project

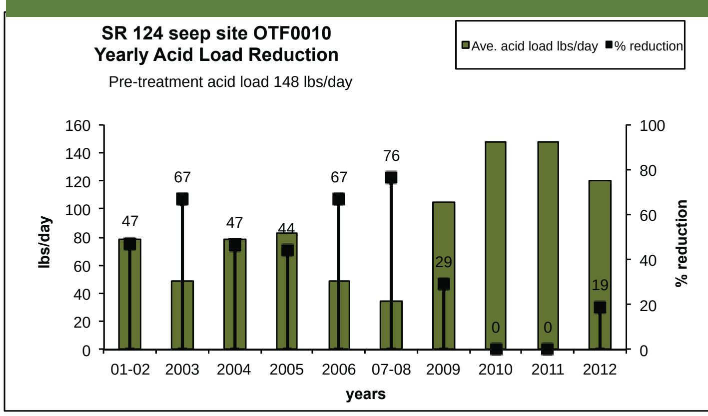
Similar to other environmental best management practices (BMPs), performance of passive acid mine drainage reclamation projects are also expected to decline with time. Active treatment systems are not expected to decline with time but sometimes need maintained to perform adequately. Currently, operation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

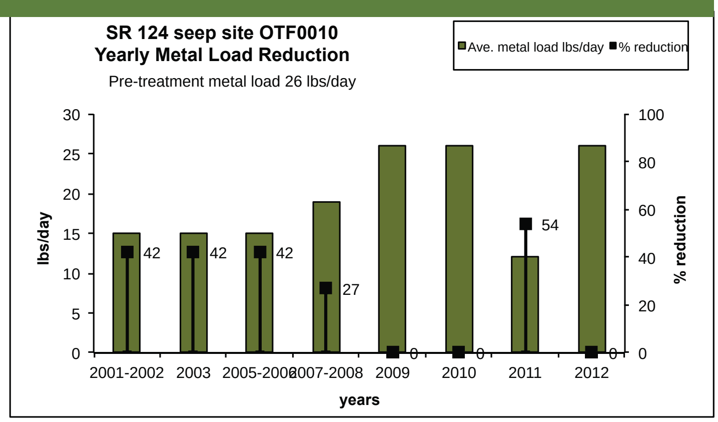
Buckeye Furnace site BR0010



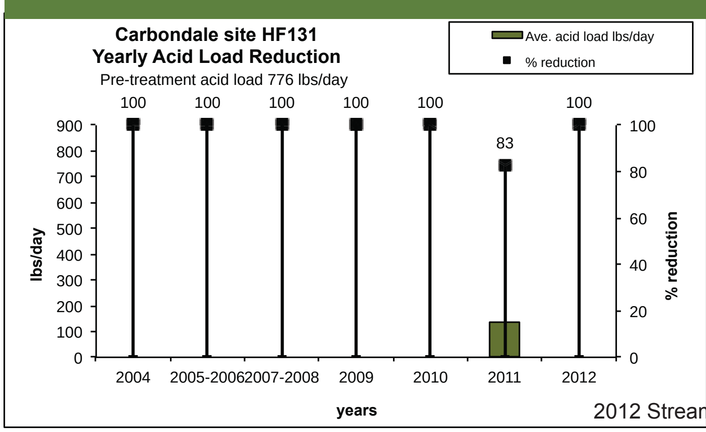


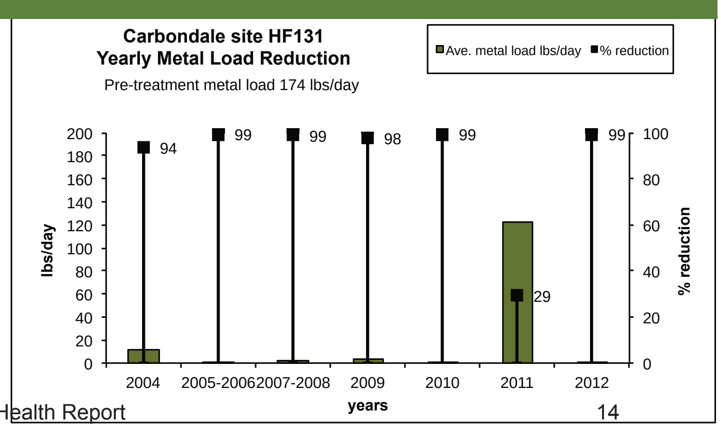
State Route 124 seep site OTF0010





Carbondale site HF131





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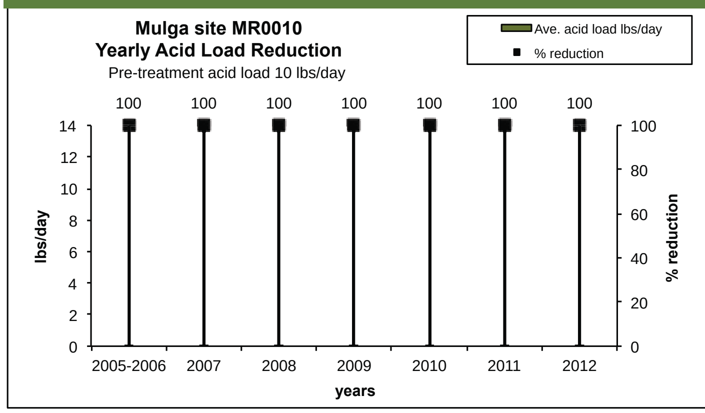
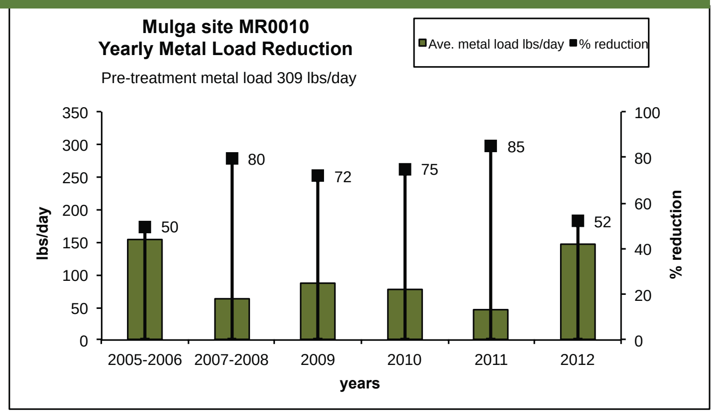
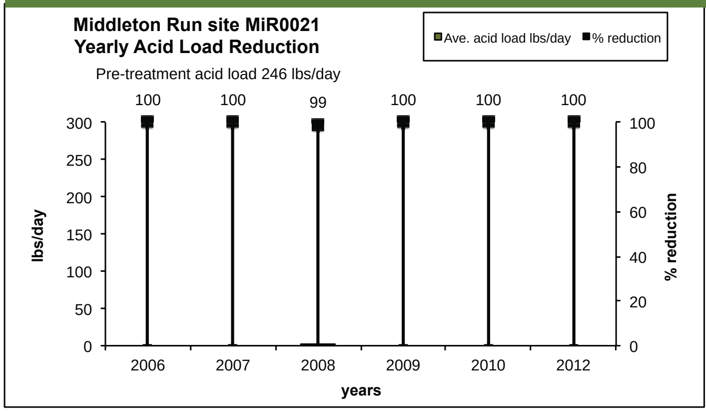
Yearly acid and metal load reduction trends per project

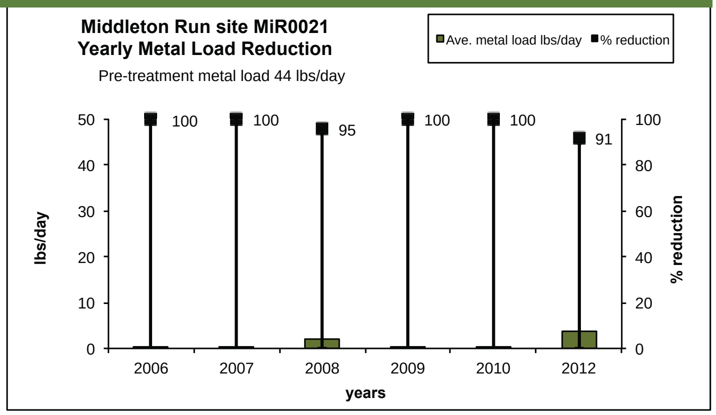
Mulga site MR0010



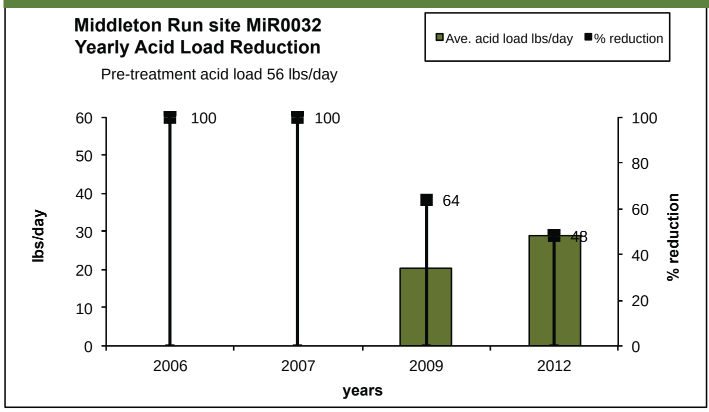


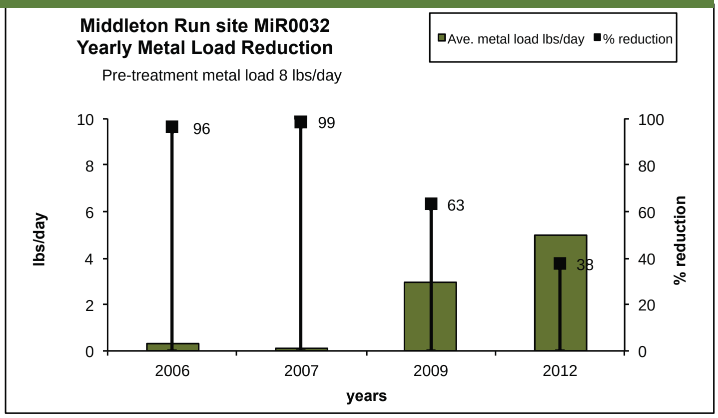
Middleton Run site MiR0021





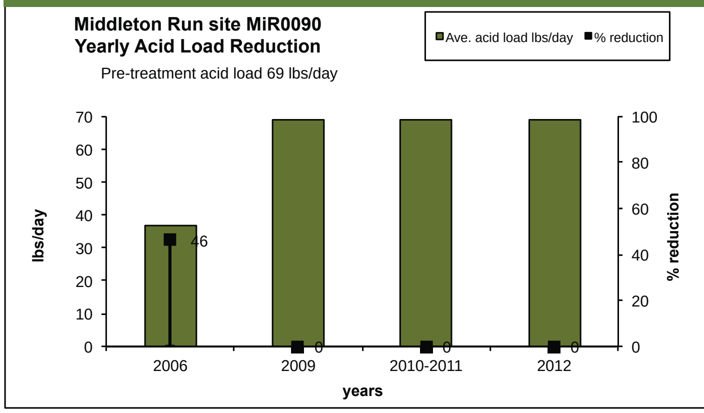
Middelton Run site MiR0032

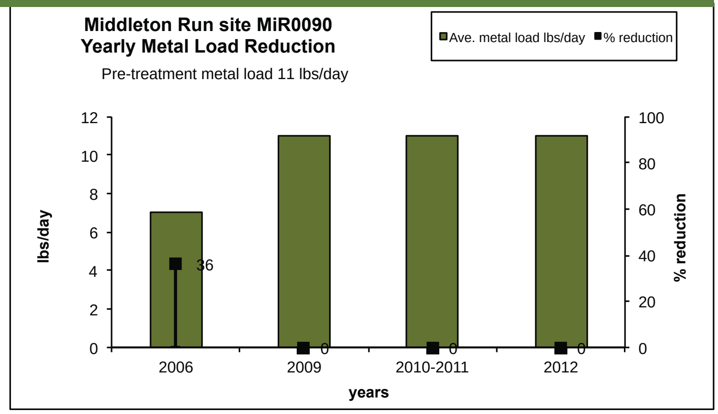




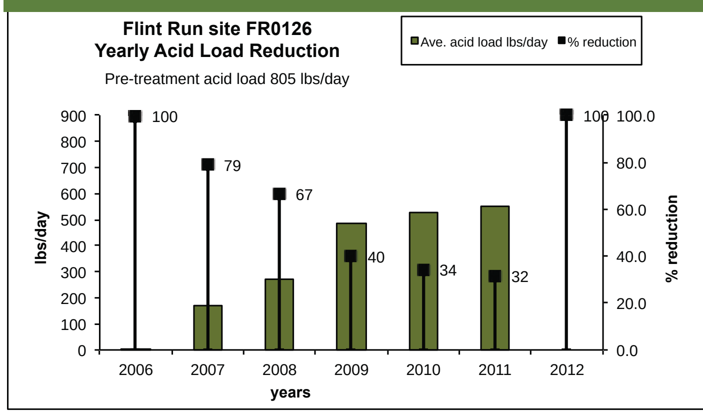
Yearly acid and metal load reduction trends per project

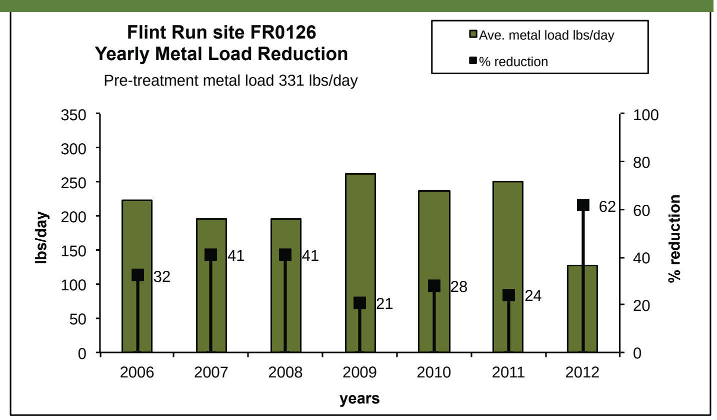
Middelton Run site MiR0090



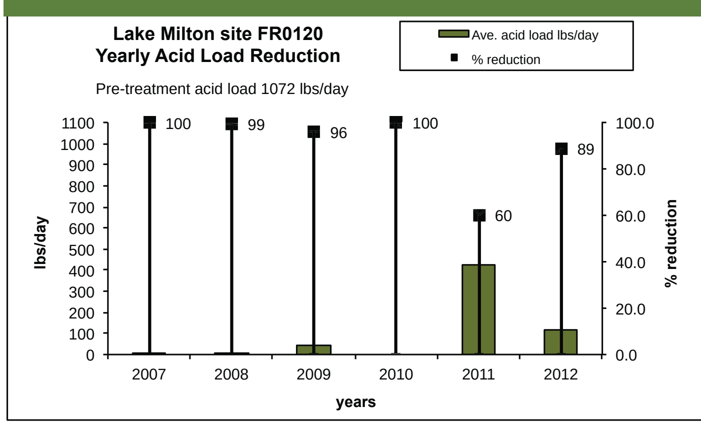


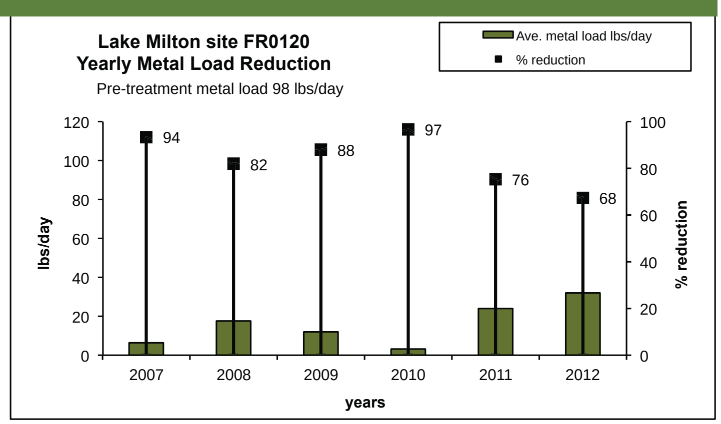
Flint Run site FR0126





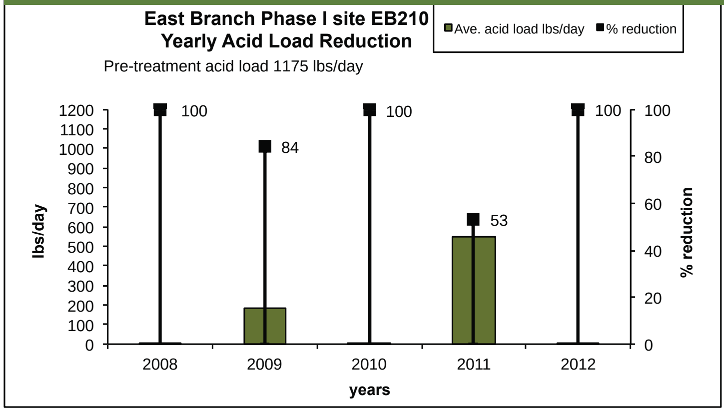
Lake Milton site FR0120

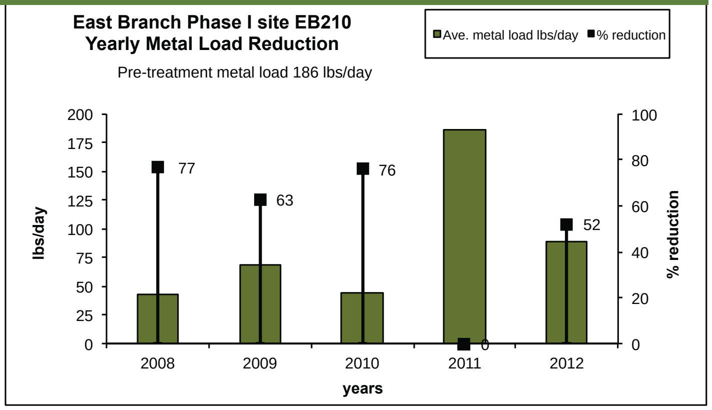




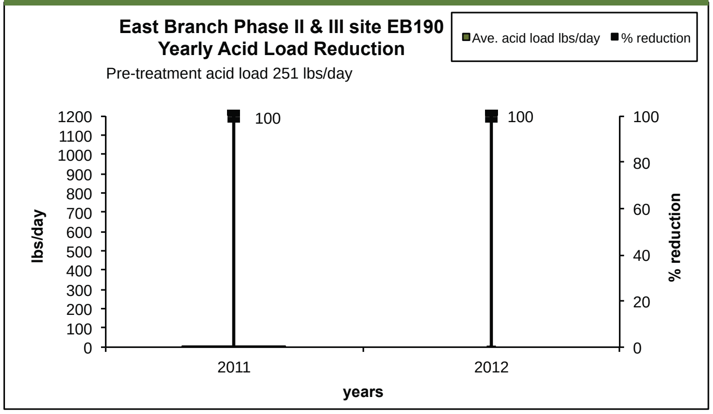
Yearly acid and metal load reduction trends per project

East Branch Phase I site EB210

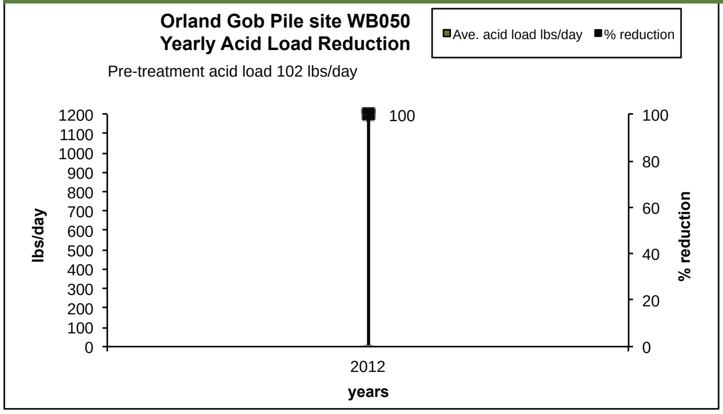


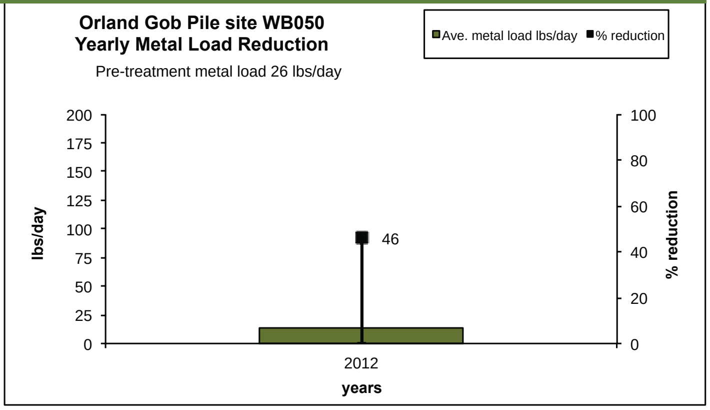


East Branch Phase II & III site EB190



Orland Gob Pile site WB050





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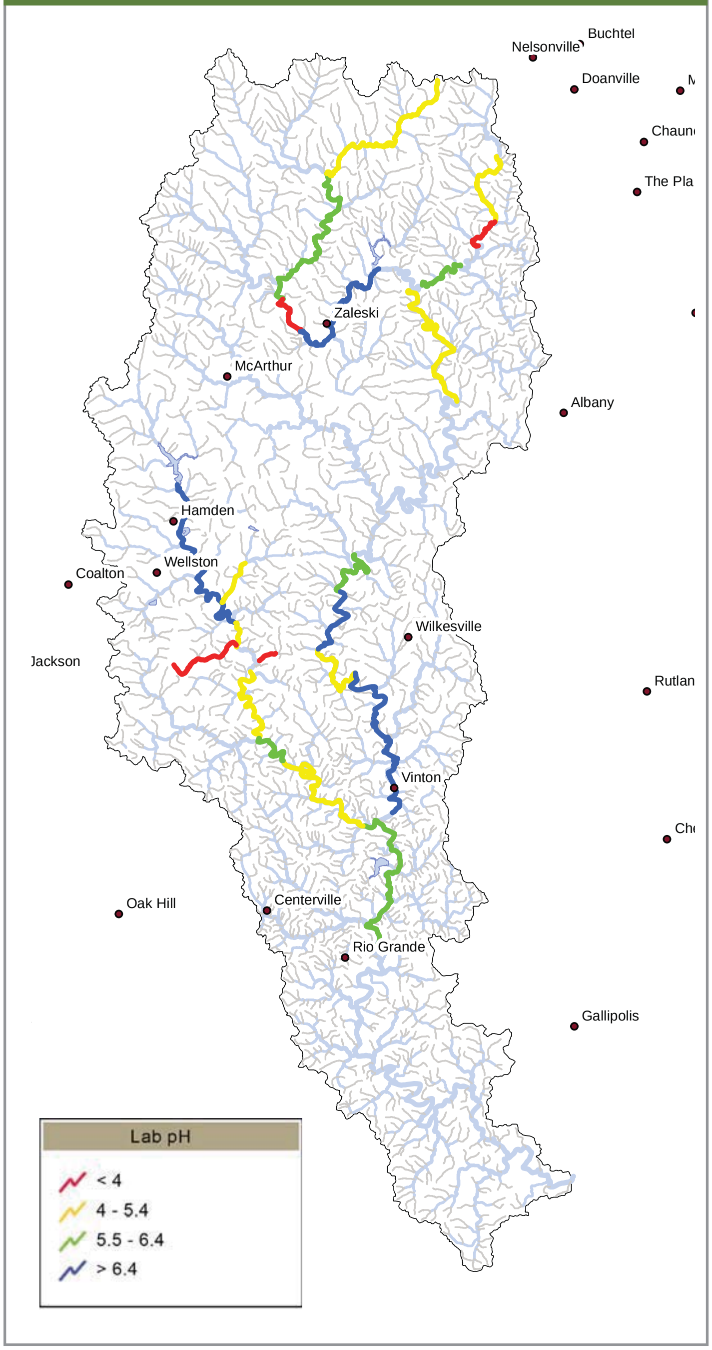
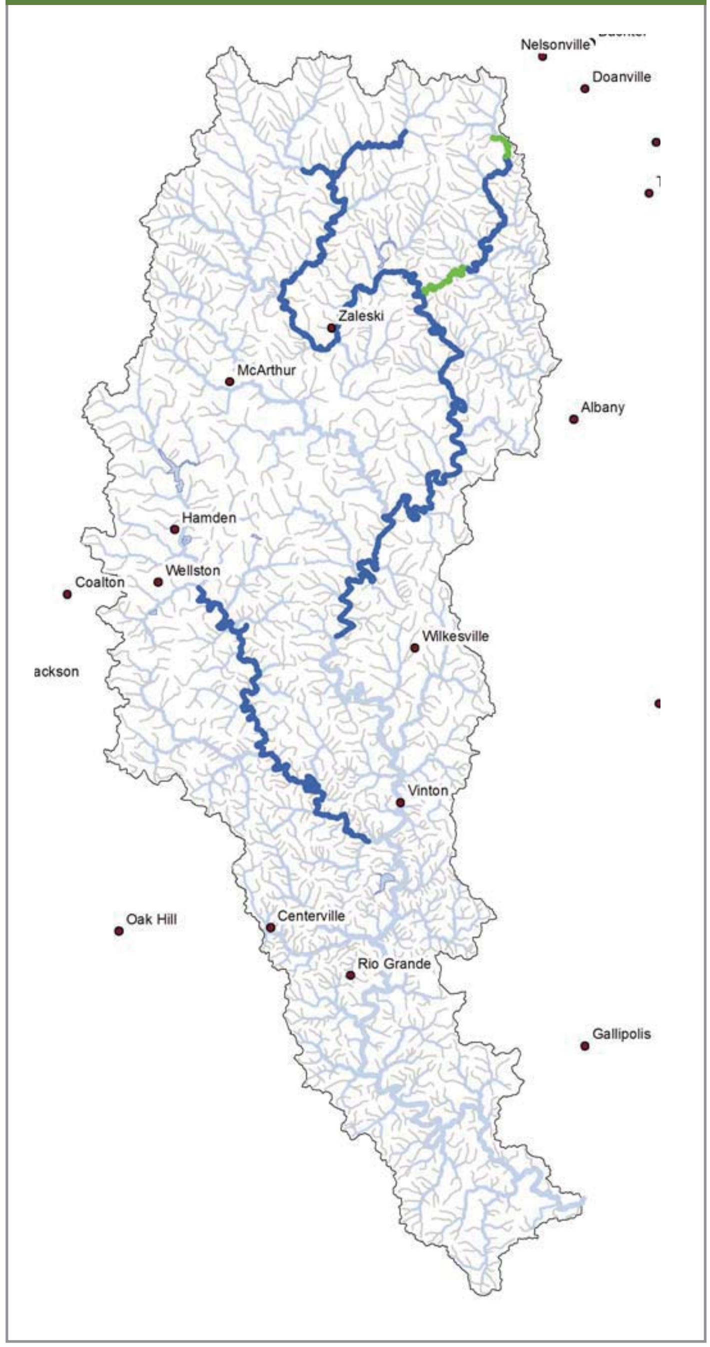
Chemical Water Quality

Raccoon Creek baseline pH



Raccoon Creek 2012 pH



In Raccoon Creek pH values have improved throughout the watershed from baseline conditions (1994-2001) to 2012. 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. Of the miles of stream monitored in 2012, 9 river miles in Hewett Fork, 1.6 miles in West Branch, 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).

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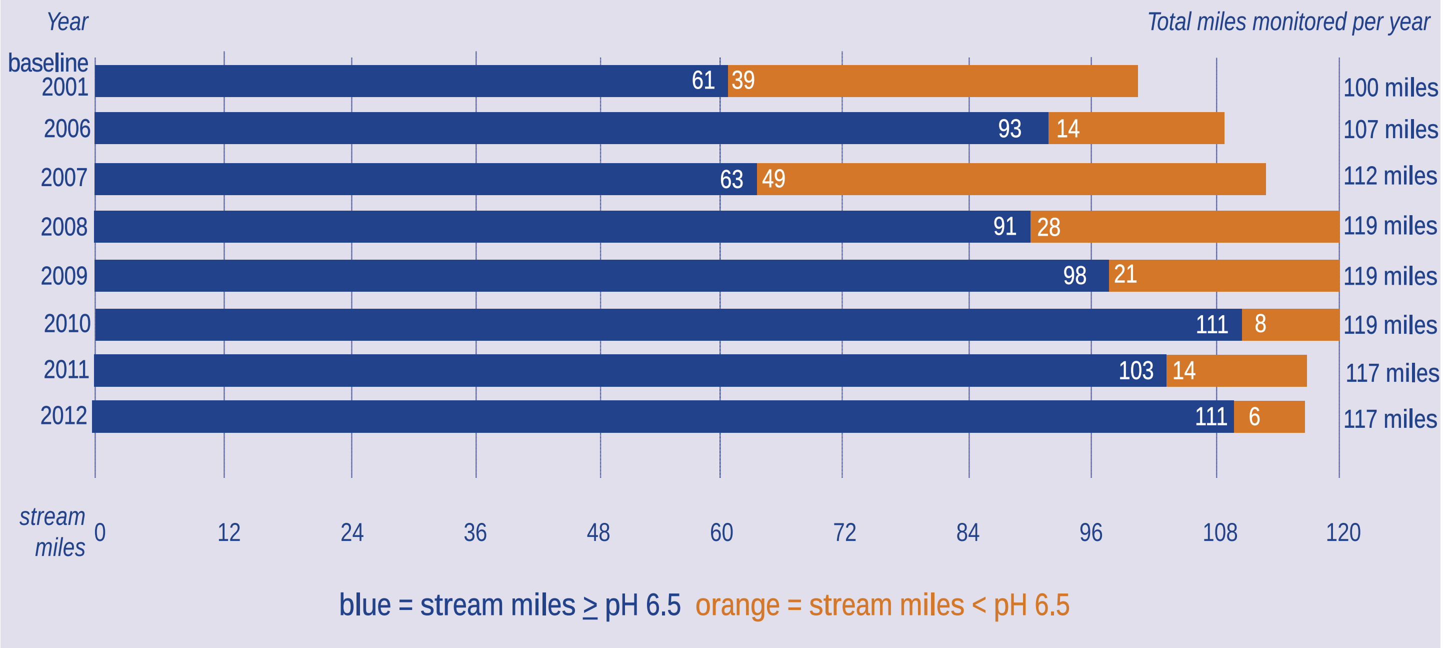
Chemical Water Quality

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. In 2011, 103 of the 117 miles of stream monitored met the pH target, a slight decrease from 2010. Currently in 2012, 111 of 117 miles of stream miles monitored met the pH target (Figure 1).

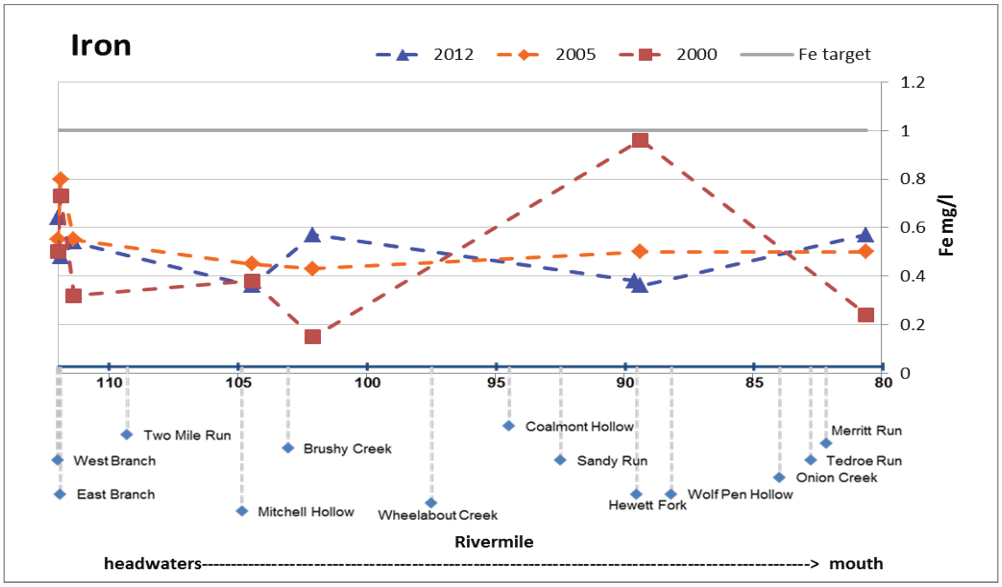
Figure 1. Raccoon Creek total stream miles monitored for pH through time

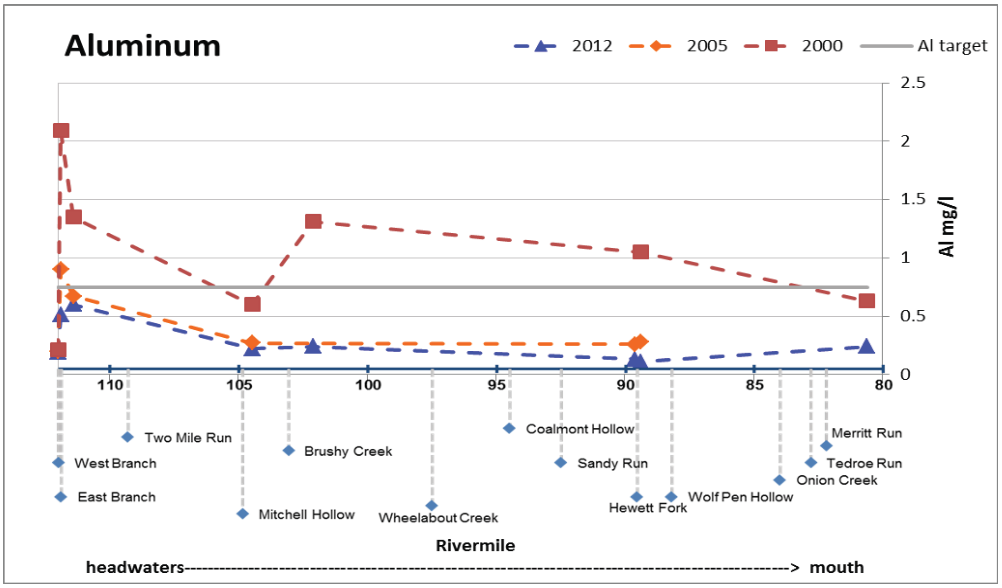


For purposes of analyzing chemical water quality changes along the mainstem of receiving stream where AMD reclamation projects have been completed, Raccoon Creek has been divided into the following stream segments: Raccoon Creek Mainstem, Little Raccoon Creek, and Hewett Fork. Within these stream reaches, chemical long-term monitoring data is utilized to generate line graphs along the stream gradient from headwaters to the mouth. Along the x-axis named tributaries are shown to illustrate new sources of water entering the mainstem. A list of long-term monitoring sites utilized to generate the graphs with their river miles are shown before each set of stream reach graphs.

Raccoon Creek Mainstem

Site ID	Rivermile
WB010	112
EB010	111.89
MSBC010	111.39
MSBC100	104.46
MSLH020	102.1
MSBM004	89.6
MSBM010	89.36
MSBM040	80.6

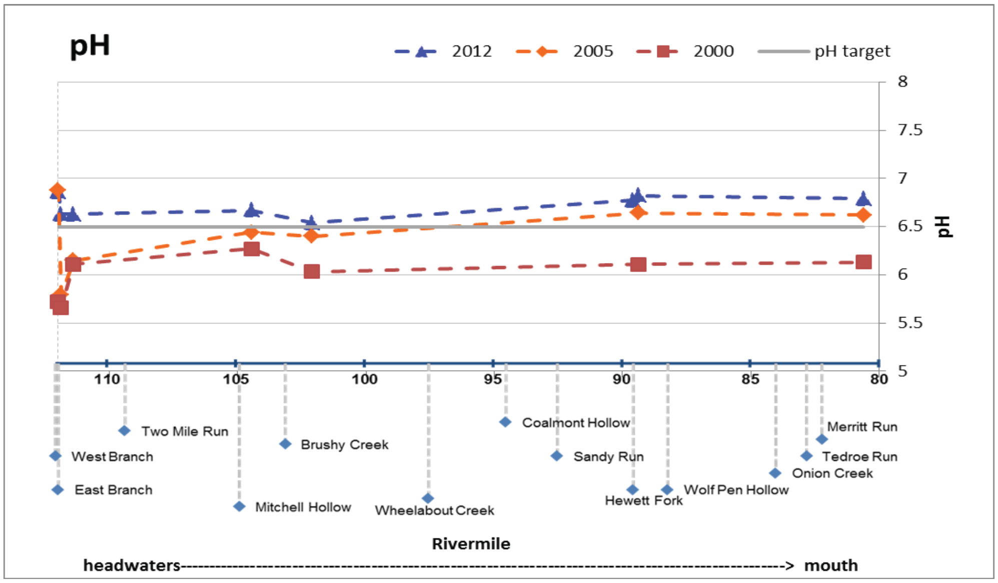


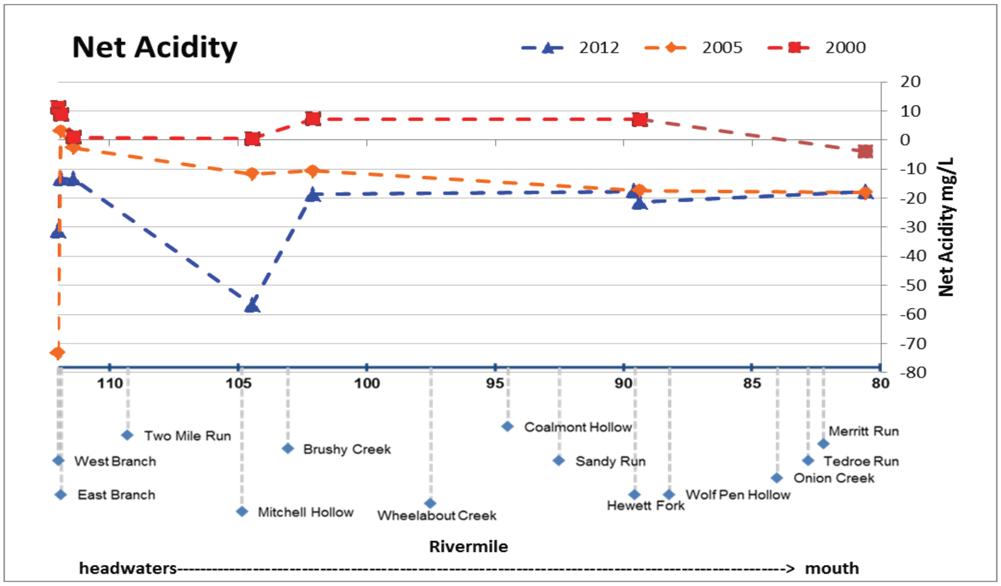


Chemical water quality analysis per stream reach

Raccoon Creek Mainstem

Site ID	Rivermile
WB010	112
EB010	111.89
MSBC010	111.39
MSBC100	104.46
MSLH020	102.1
MSBM004	89.6
MSBM010	89.36
MSBM040	80.6

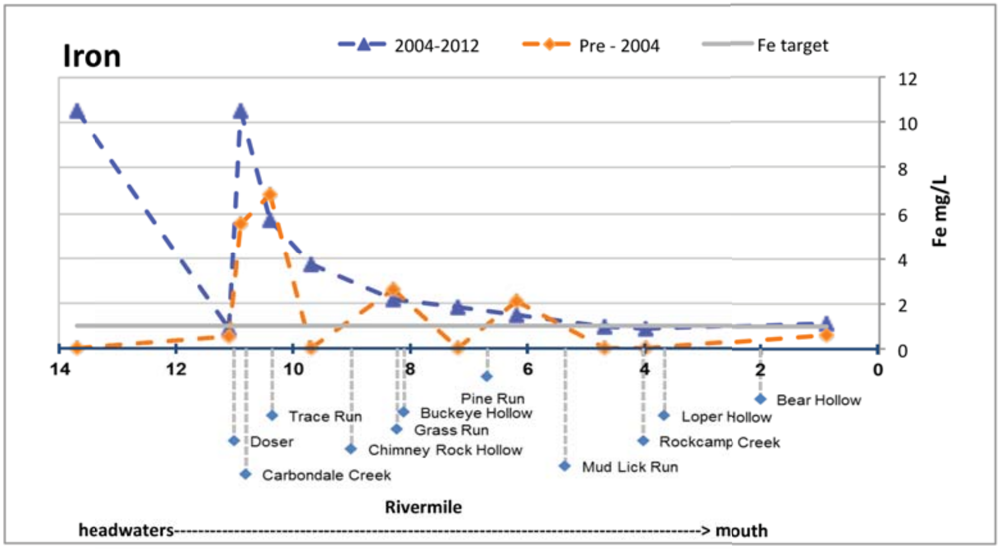


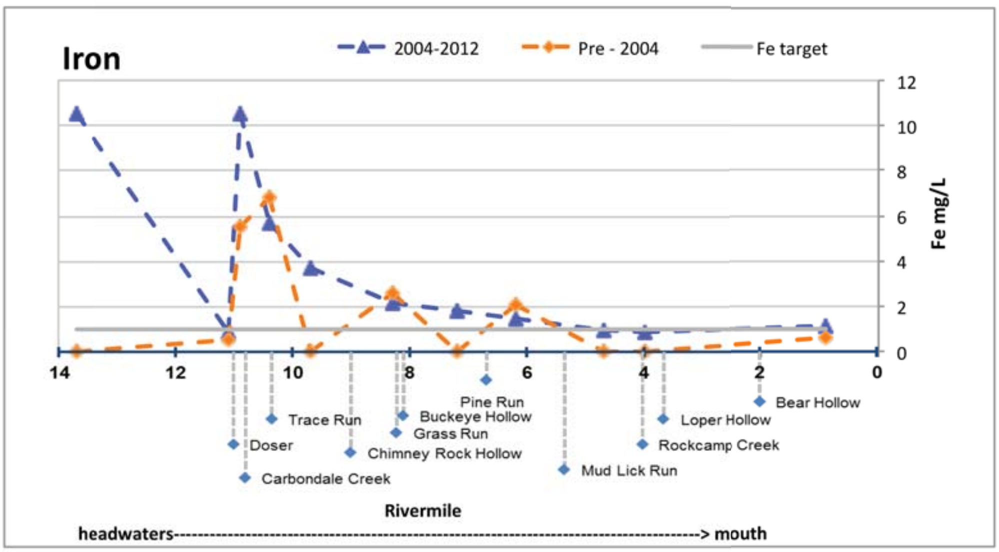


Chemical water quality analysis per stream reach

Hewett Fork

Site ID	Rivermile
HF137	13.7
HF129	11.1
HF130	10.9
HF190	10.4
HF095	9.7
HF090	8.3
HF075	7.2
HF060	6.2
HF045	4.7
HF039	4
HF010	0.9

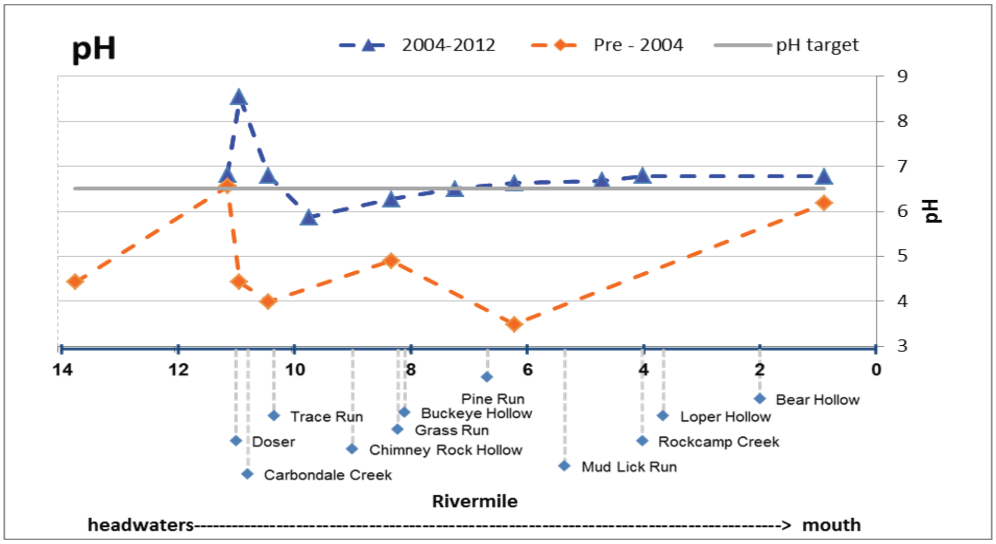


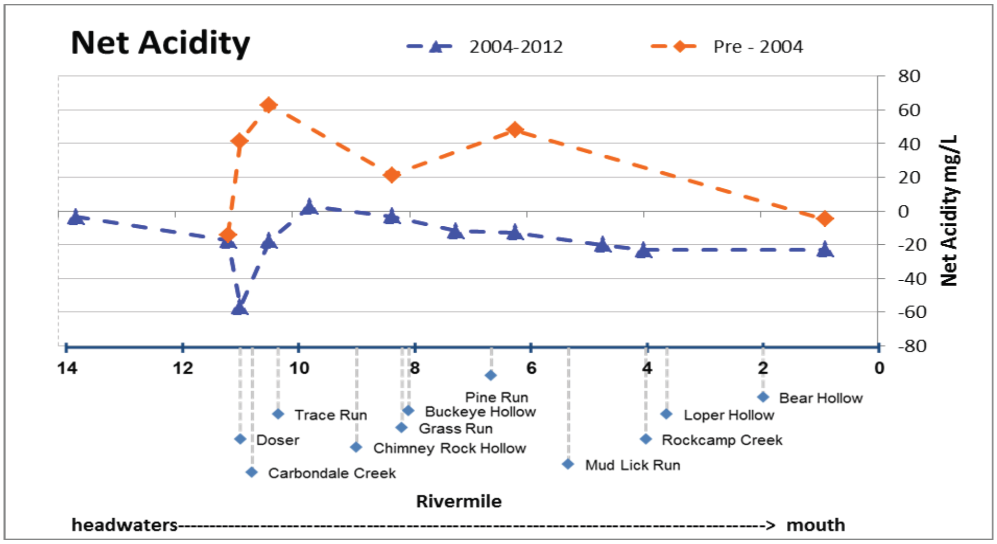


Chemical water quality analysis per stream reach

Hewett Fork

Site ID	Rivermile
HF137	13.7
HF129	11.1
HF130	10.9
HF190	10.4
HF095	9.7
HF090	8.3
HF075	7.2
HF060	6.2
HF045	4.7
HF039	4
HF010	0.9

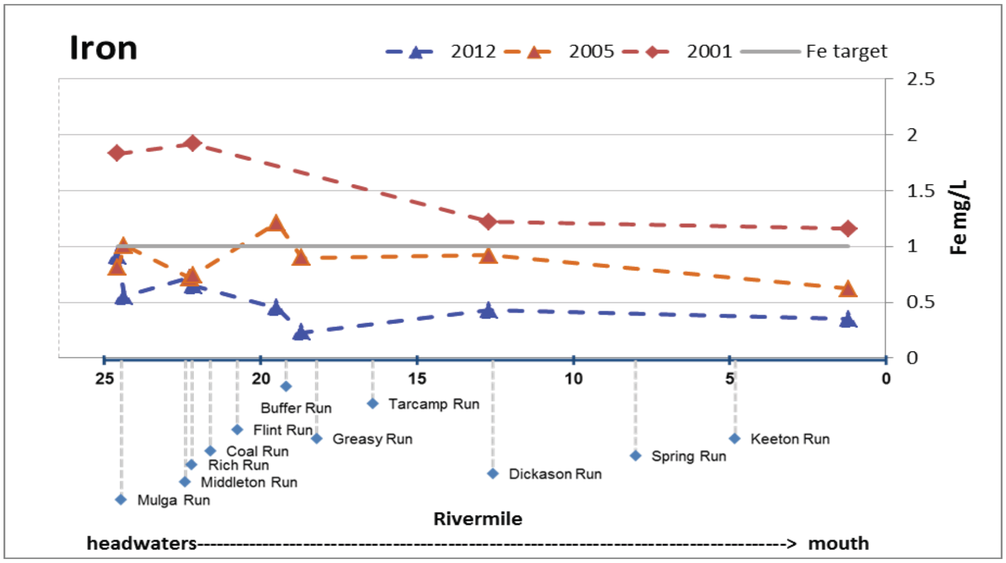


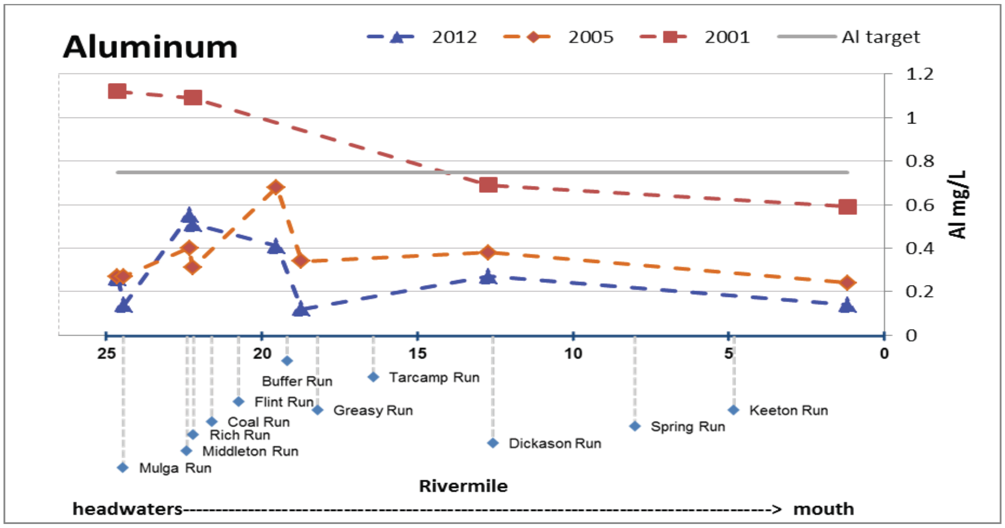


Chemical water quality analysis per stream reach

Little Raccoon Creek

Site ID	Rivermile
LRC0090	24.6
LRC0080	24.4
LRC0071	22.3
LRC0070	22.2
LRC0055	19.5
LRC0045	18.7
LRC0030	12.7
LRC0010	1.2





Little Raccoon Creek

Site ID	Rivermile
LRC0090	24.6
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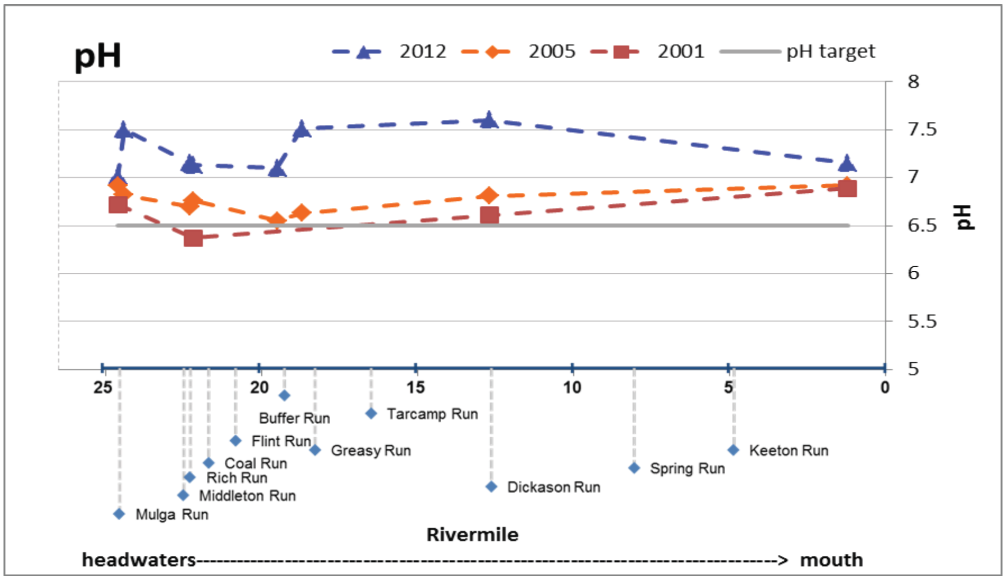
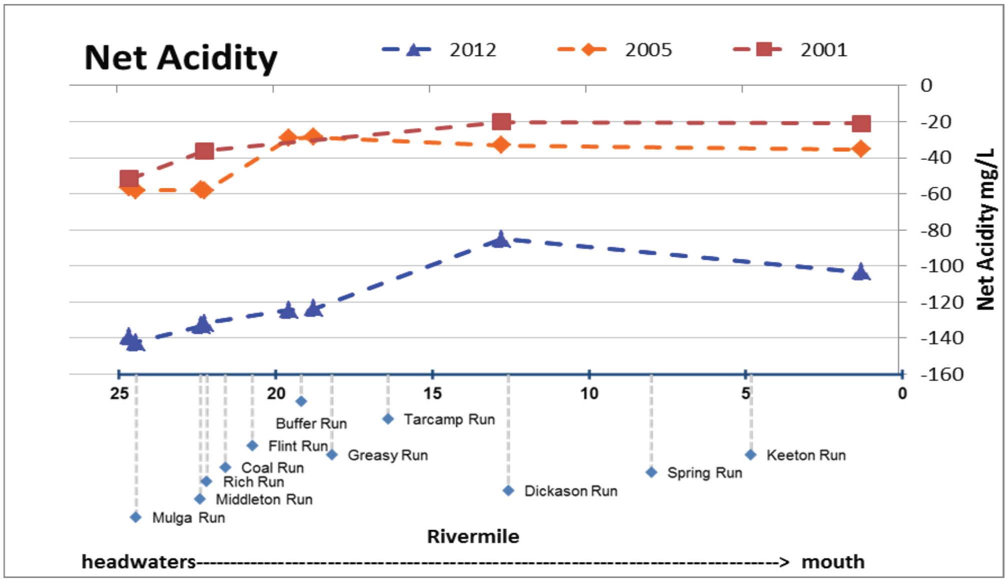
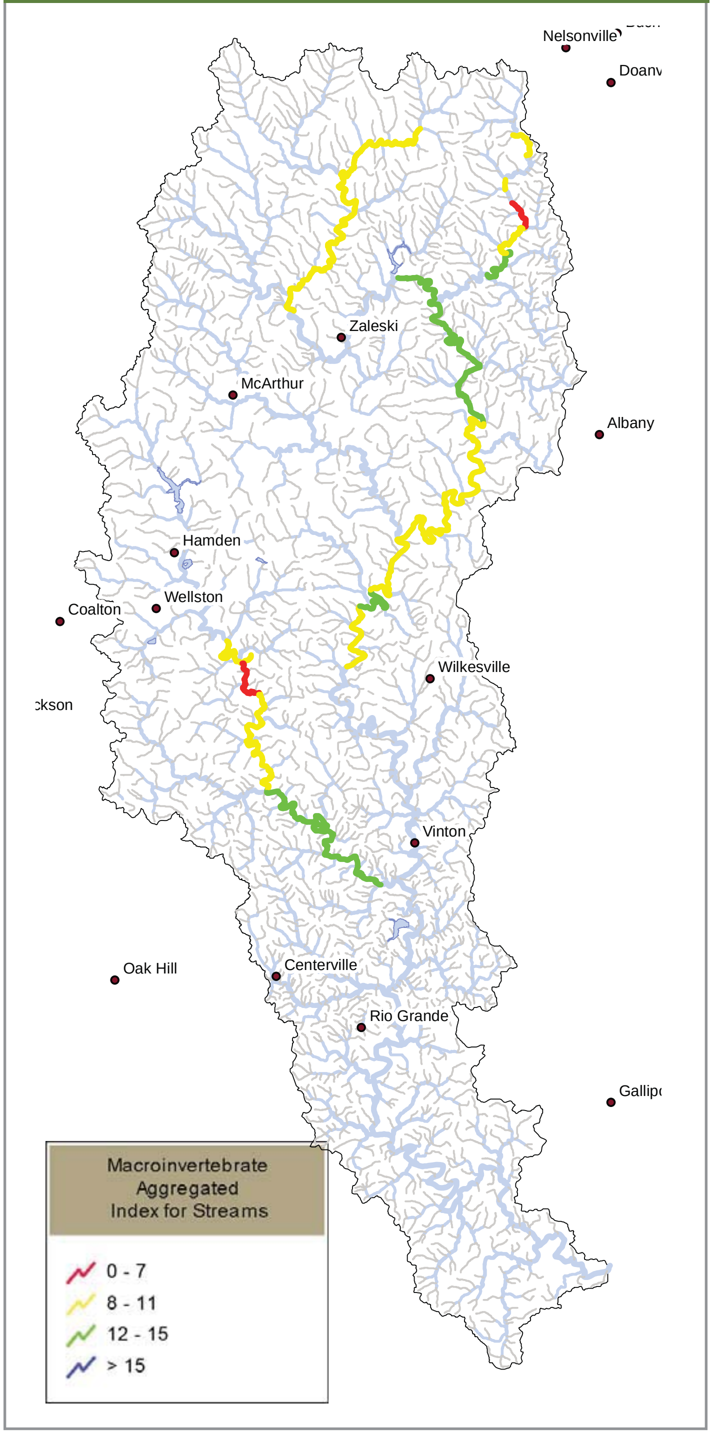
LRC0010	1.2



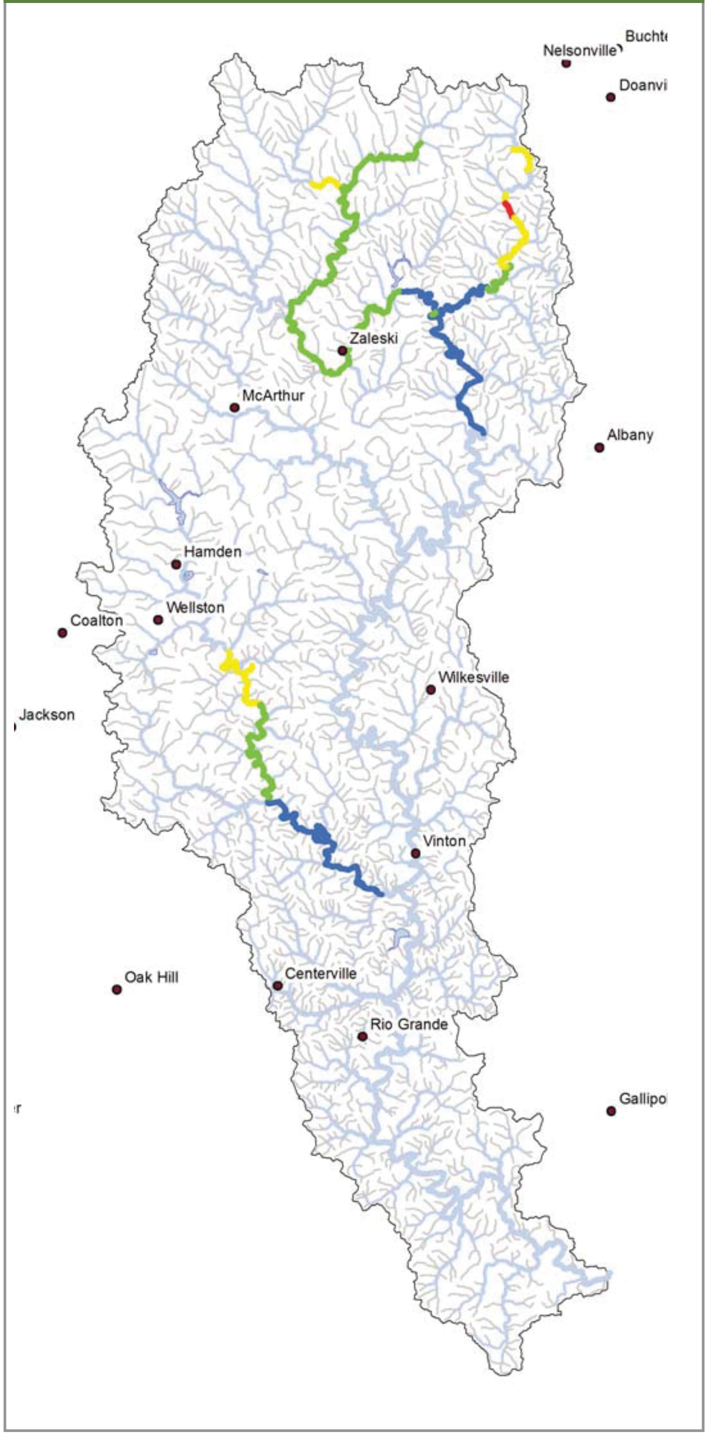


Biological Water Quality

Raccoon Creek baseline MAIS



Raccoon Creek 2012 MAIS



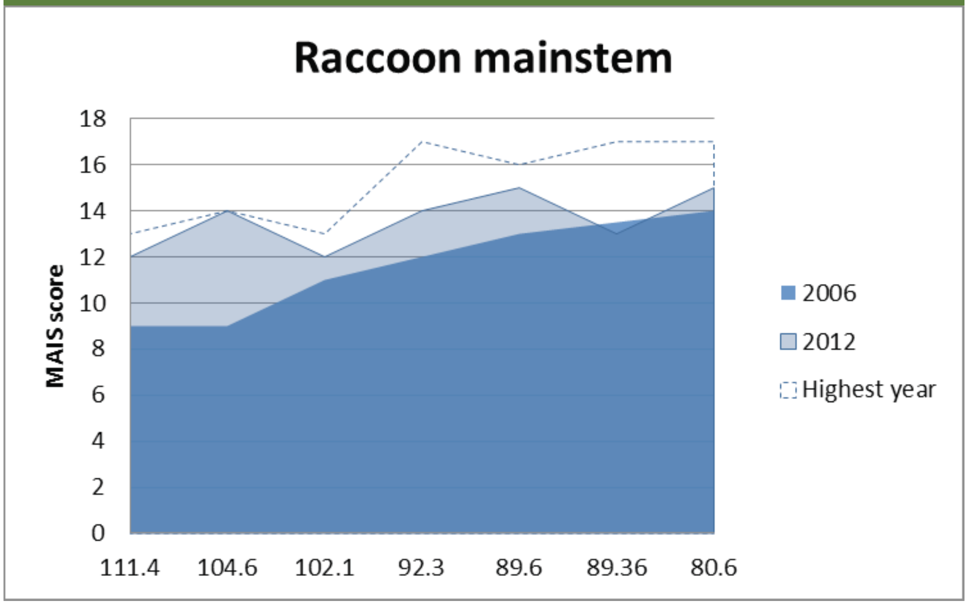
MAIS samples were collected throughout Raccoon Creek in 2012 (excluding Middle Basin sites). These stations have been established as annual monitoring stations for macroinvertebrates. The sites are used to track incremental changes each year.

Biological Water Quality

Raccoon Creek - Mainstem

In 2012, all seven of the long term monitoring sites along the thirty or more miles of the Raccoon Creek Mainstem scored a "12" or higher on the macroinvertebrate (MAIS) index for the first time since 2006 (figure 1). The score at RM 104.6 established a new high of "14" for this site. Several sites have had better biological quality in previous years, especially in 2009 and 2012 when several sites scored 16-17 ('Very Good' quality), but these high scores have not recurred consistently every year. Perhaps because the macroinvertebrate scores in the mainstem were already moderately high in 2006, or perhaps because of high year-to-year variability, improvements at most sites since 2006 have remained statistically non-detectable even though scores remain relatively good. Only one, the uppermost site at RM 111, has shown statistically significant improvement over the past 7 years (figure 2).

Figure 1. Area of Degradation



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

Figure 2. Raccoon Creek - Mainstem - MAIS Regressions

RM	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*Linear trends*	*R sq.*	P-value	No. of years	Yrs
111	8	9	12	9	10	12	13	12	improved	0.60	0.024	8	6
105		9	11	12	9	11	10	14	no change	0.27	0.229	7	6
102		11	11	10	13	10	11	12	no change	0.05	0.641	7	6
92.3		*	*	10	10	17	11	14	no change	0.22	0.428	5	10
89.6		13	14	11	16	12	16	15	no change	0.19	**0.330**	7	6
89.4		*	12	16	14	17	13	13	no change	0.001	0.958	6	6
80.6		14	14	17	16	12	14	15	no change	0.009	0.839	7	6

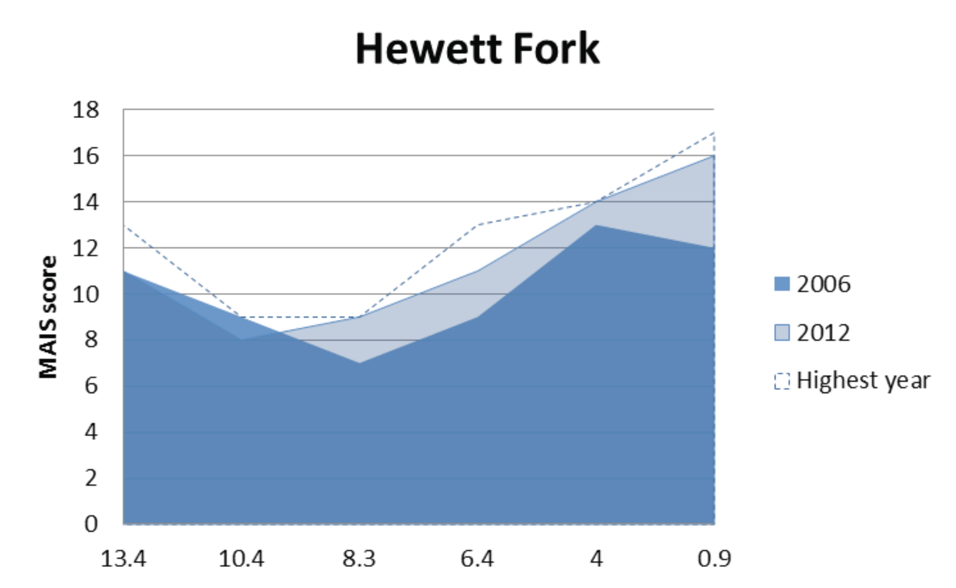
*scores illustrated in the figure were estimated as the mean of sites immediately upstream and downstream that year

Biological Water Quality

Raccoon Creek - Hewett Fork

In 2012, the biological quality of the eleven mile reach below the Carbondale doser remained relatively unchanged from 2011, with the sites immediately downstream of the doser (RM 10.4-8.3) still showing reduced scores due to episodic pulses of acidity and/or precipitated metals, but slightly improved from prior years (figure 3). The statistical decline in scores observed at RM 10.4 since 2006 reversed this year, and the site at RM 8.3 achieved a new high score of “9” compared to its usual “6-7”. Both scores still indicates poor biological quality, however. Macroinvertebrate scores further downstream, from RM 8.3 to 0.9 were consistently higher in 2011 and 2012 compared to 2006, potentially reflecting the long term effectiveness of the doser installed in 2004. At RM 6.4, scores in 2012 solidly met the statistical criteria for “improvement’ (P-value < 0.05), and as was the case in 2011, the four most downstream miles of Hewett Fork scored above ’12’, the MAIS target that approximates the biocriteria for warm water habitat (figure 4).

Figure 3. Area of Degradation



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

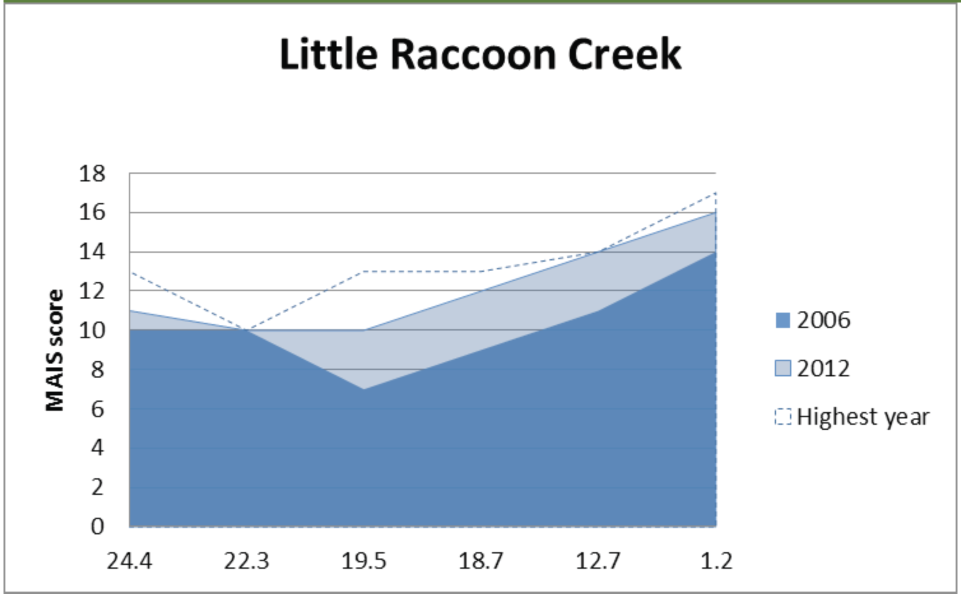
Figure 4. Raccoon Creek - Hewett Fork MAIS Regressions

RM	2001	2002	2003	2005	2006	2007	2008	2009	2010	2011	2012	Linear trends	R sq.	P-value	Yrs.
13.4					11	8	9	12	13	11	11	no change	0.20	0.308	7
10.4					9	3	7	6	6	5	8	no change	0.001	1	7
9.8					4	3	6	3	3	8	4	no change	0.08	0.537	7
8.3	2	3	3	5	7	3	5	6	3	6	9	no change	0.13	0.429	11
6.4					9	9	8	10	10	13	11	improved	0.57	0.049	7
4					13	13	14	13	13	14	14	no change	0.33	0.175	7

Raccoon Creek - Little Raccoon Creek

Little Raccoon Creek biological quality in 2012 was similar to 2011, with most sites showing notable improvement since 2006, after 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). Three out of the six long term monitoring sites achieved target macroinvertebrate scores of '12' (figure 5 and 6).

Figure 5. Area of Degradation



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

Figure 6. Raccoon Creek Mainstem MAIS Regressions

RM	2005	2006	2007	2008	2009	2010	2011	2012	Linear trends	R sq.	P-value	No. of years
24.4	8	10	11	11	9	9	13	11	no change	0.266667	0.190116	8
22.3	8	10	10	9	10	10	1t0	10	no change	0.345622	0.125347	8
19.5		7		9	11	12	13	10	improved	0.617347	0.036238	7
18.7	14	9	12	9	13	11	11	12	no change	0.002449	0.907363	8
12.7	3	11	13	13	14	14	14	14	improved	0.548571	0.035566	8
1.2	14	14	13	15	17	16	16	16	improved	0.566343	0.031195	8

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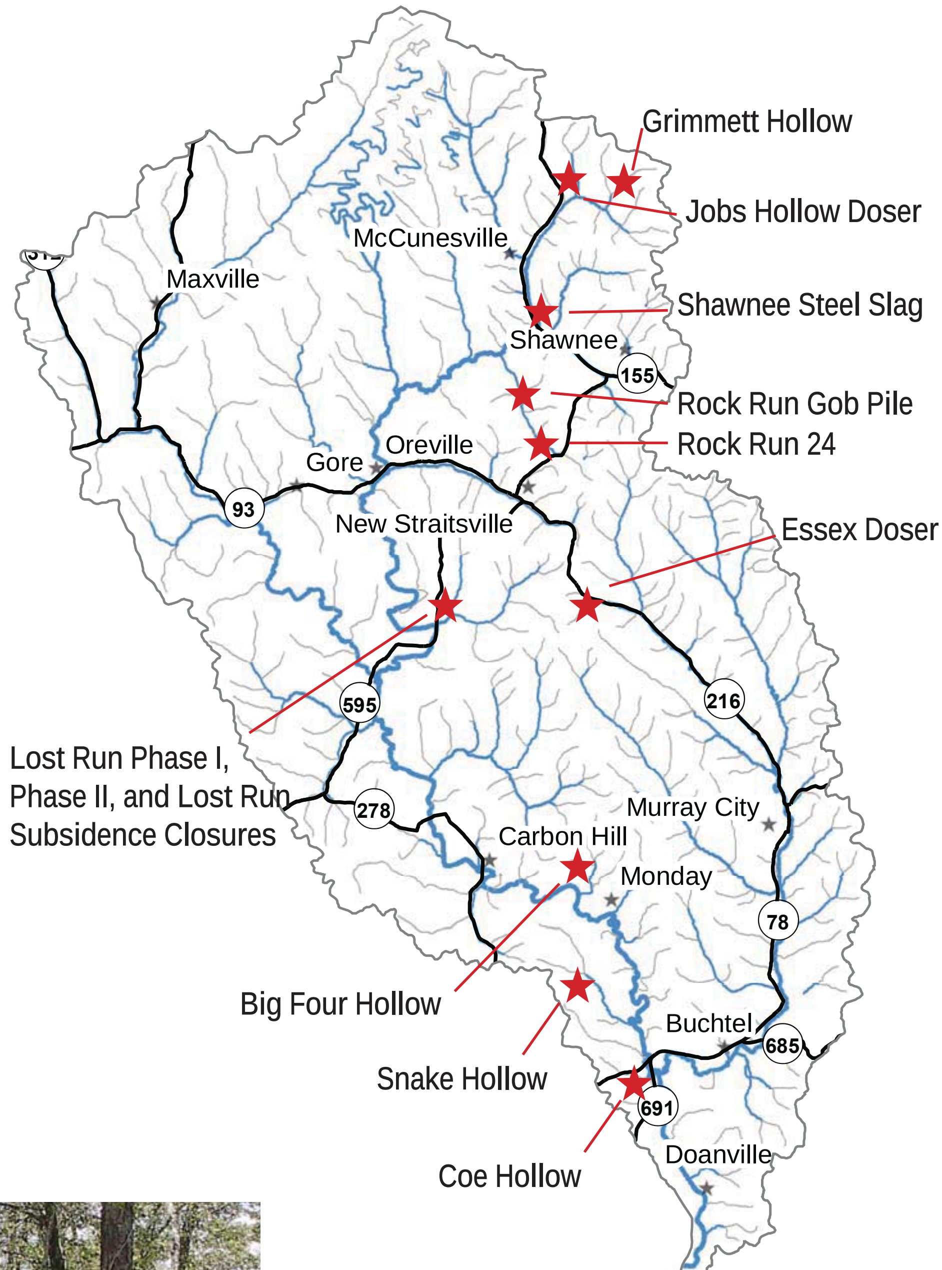
Monday Creek Restoration Project



Reductions

Total acid load reduction = 3759 lbs/day

Total metal load reduction = 412 lbs/day

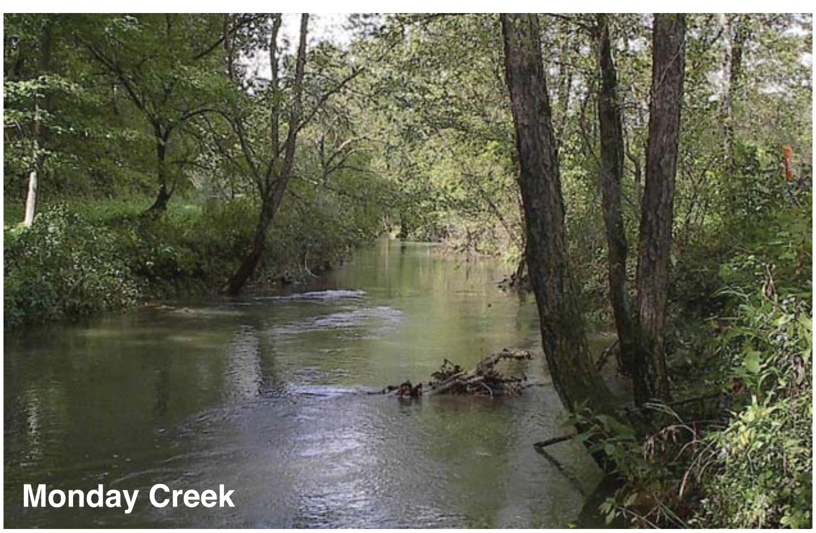
Data derived using the Mean Annual Load Method (Stoertz, 2004). (excludes Rock Run Gob Pile Project)

Costs

Design $374,593
(excluding Jobs Doser & Lost Run maintenance and Snake Hollow)

Construction $6,286,891

Total costs through 2012 = $6,661,484


Monday Creek

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

Timeline of the Monday Creek Watershed Project Milestones & AMD Projects

1994

- Formation of Monday Creek Restoration Project

1995

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

1996

- Ohio EPA awards Monday Creek with a 319 grant for Rock Run

1997

- "Monday Creek Watershed AMDAT Acid Mine Drainage Abatement and Treatment Plan I" published
- Ohio EPA awards Ohio University with a 319 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" is produced

1998

- Grant from CURSML for capping Jobs 13 gob pile

1999

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

2000

- Ohio EPA awarded a 319 grant for work at Jobs Hollow (Grimmett Site) and Monkey Hollow
- MCRP receives Watershed Coordinator Grant

2001

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

2002

2003

- Jobs 13 gob pile capping is underway.
- Video about Monday Creek entitled "Cool Waters" is released

continued on next page

Timeline of the Monday Creek Watershed Project Milestones & AMD Projects *(continued)*

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 a 319 grant for work at Lost Run

2005

- U.S. Army Corps of Engineers Civil Works Review Board approves 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 has been approved
- Essex Doser (319 grant) is operational
- U.S. Forest Service constructed open limestone channels, closed subsidence and established positive drainage at New Straitsville North area, Monkey Hollow, and Elm Rock area
- The MCRP Watershed Management Plan was fully endorsed by the Ohio DNR and Ohio EPA
- Lost Run Phase I reclamation and OEPA 319 grant was completed

2007

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

2008

- U.S. Forest Service completes reclamation in Valley Junk area
- ODOT mitigation funds in the amount of $200,000 have been secured for work at Lost Run Phase 2

2009

- ODOT mitigation funds are 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 completes phase II of Shawnee steel slag bed

2010

- U.S. Forest Service closed subsidences along Snow Fork, Rock Run, and New Straitsville South

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 completes construction to minimize sediment transport at Big Four Hollow

2012

- 3 limestone leach beds installed in Big Four Hollow.
- MCRP, Perry Co. Health Department, Village of New Straitsville and watershed residents installed a community garden in New Straitsville.
- Major AMD maintenance projects completed in Lost Run and Jobs Hollow

Monday Creek Projects

Acid mine drainage reclamation projects completed in Monday Creek Watershed:

1999 Rock Run Gob Pile (revamped 2011)

2001 *Rock Run 24*

2003 Grimmett Hollow

2004 Jobs Hollow Doser
Big Four Hollow
Snake Hollow

2006 *Essex Doser*
Lost Run Phase I

2007 Lost Run Phase II
Lost Run Subsidence and Portal Closures

2008 *Shawnee Steel Slag Bed*

2010 Jobs Hollow Doser Maintenance II
Coe Hollow

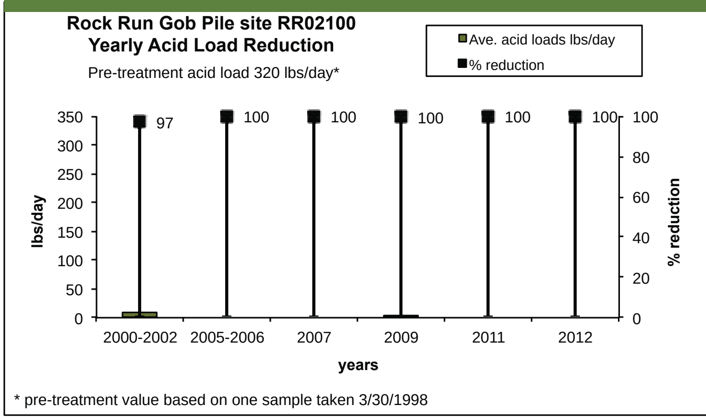
2012 Lost Run II Maintenance
Big Four Hollow LLB

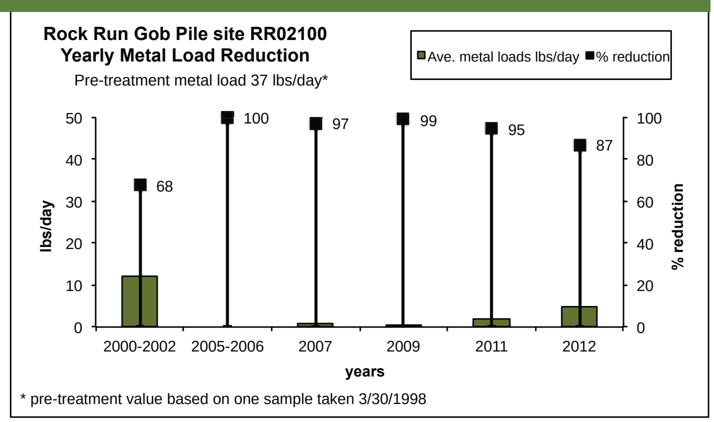
Italicized indicates projects are not actively monitored for acid and metal load reduction purposes

Yearly acid and metal load reduction trends per project

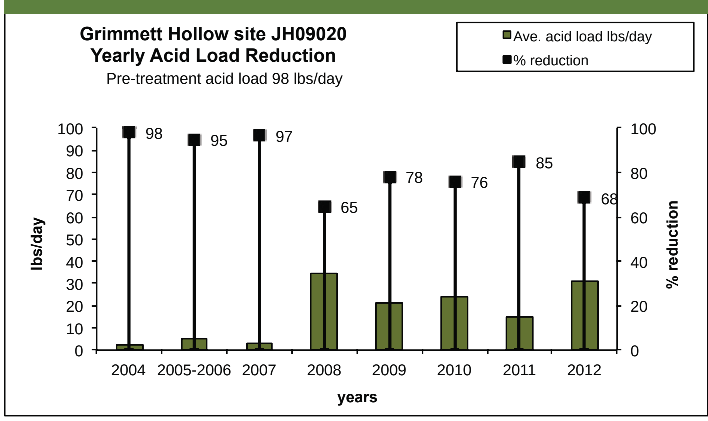
Similar to other environmental best management practices (BMPs), performance of passive acid mine drainage reclamation projects are also expected to decline with time. Active treatment systems are not expected to decline with time but sometimes need maintained to perform adequately. Currently, operation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

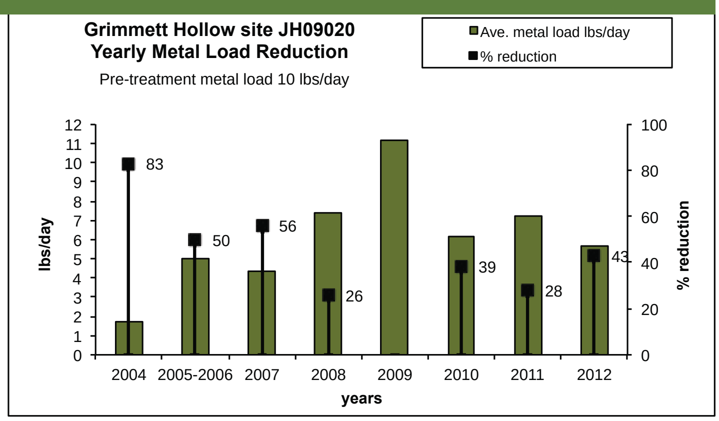
Rock Run Gob Pile site RR02100





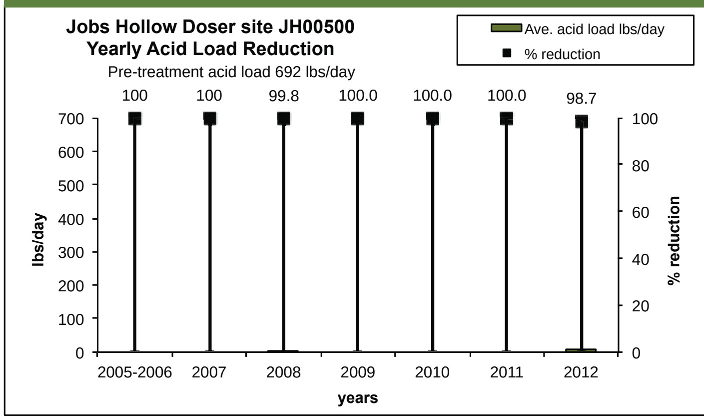
Grimmett Hollow site JH09020

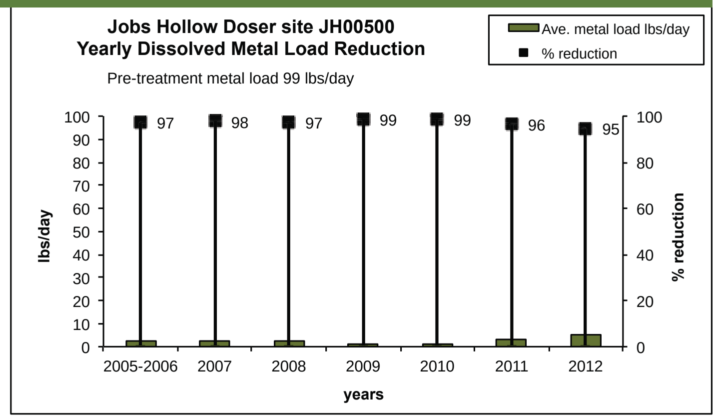




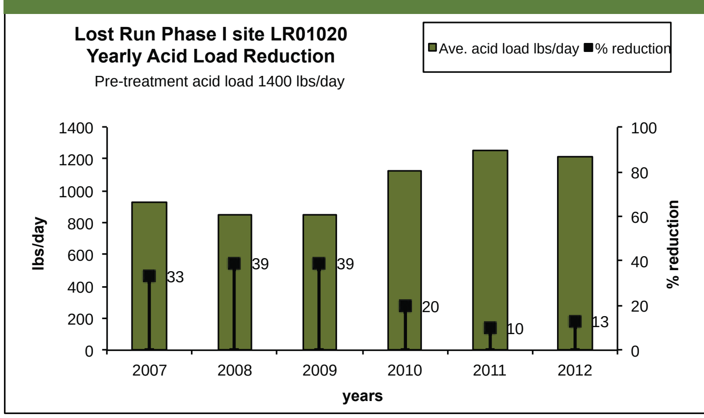
Yearly acid and metal load reduction trends per project

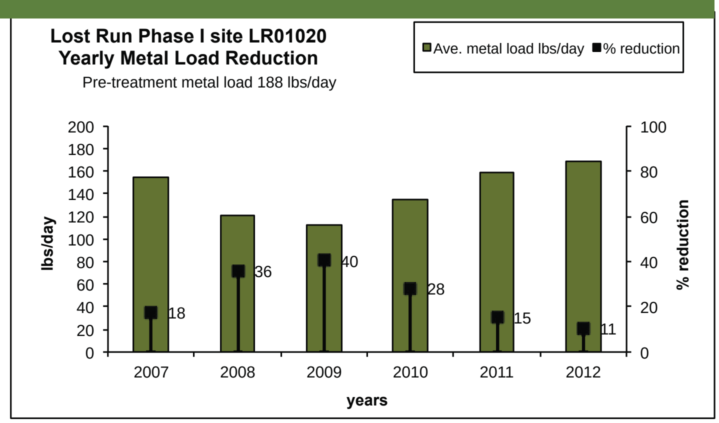
Jobs Hollow Doser site JH00500



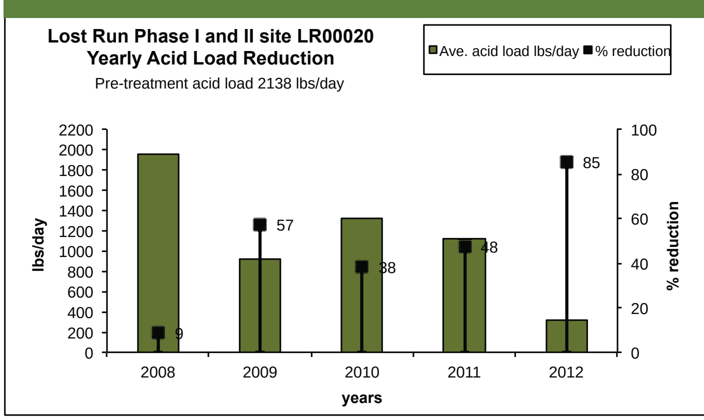


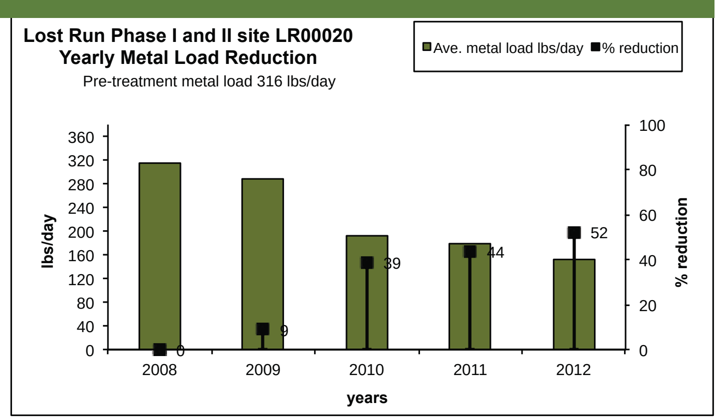
Lost Run Phase I site LR01020





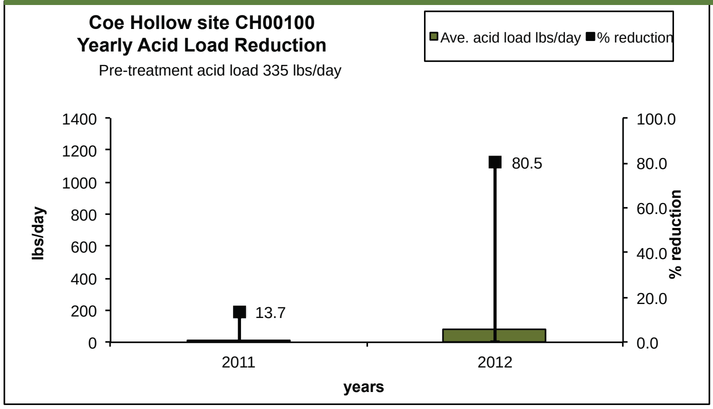
Lost Run Phase I and II site LR00020

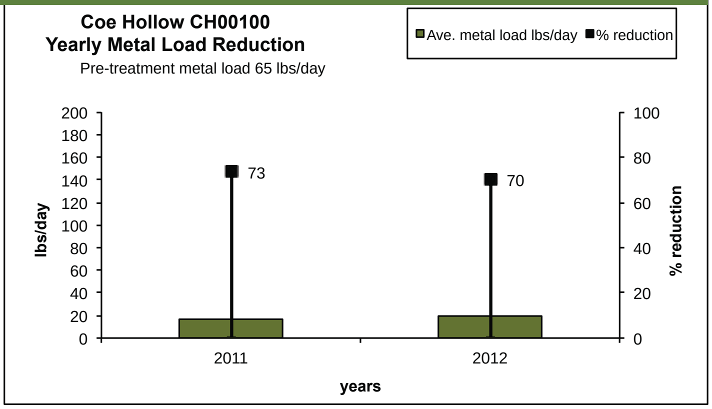




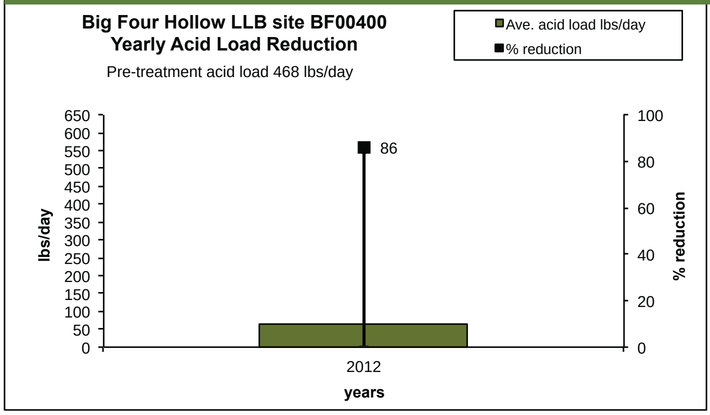
Yearly acid and metal load reduction trends per project

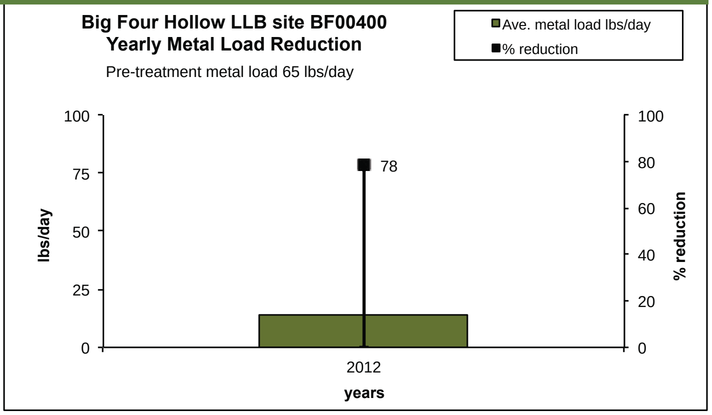
Coe Hollow site CH00100





Big Four Hollow LLB site BF00400





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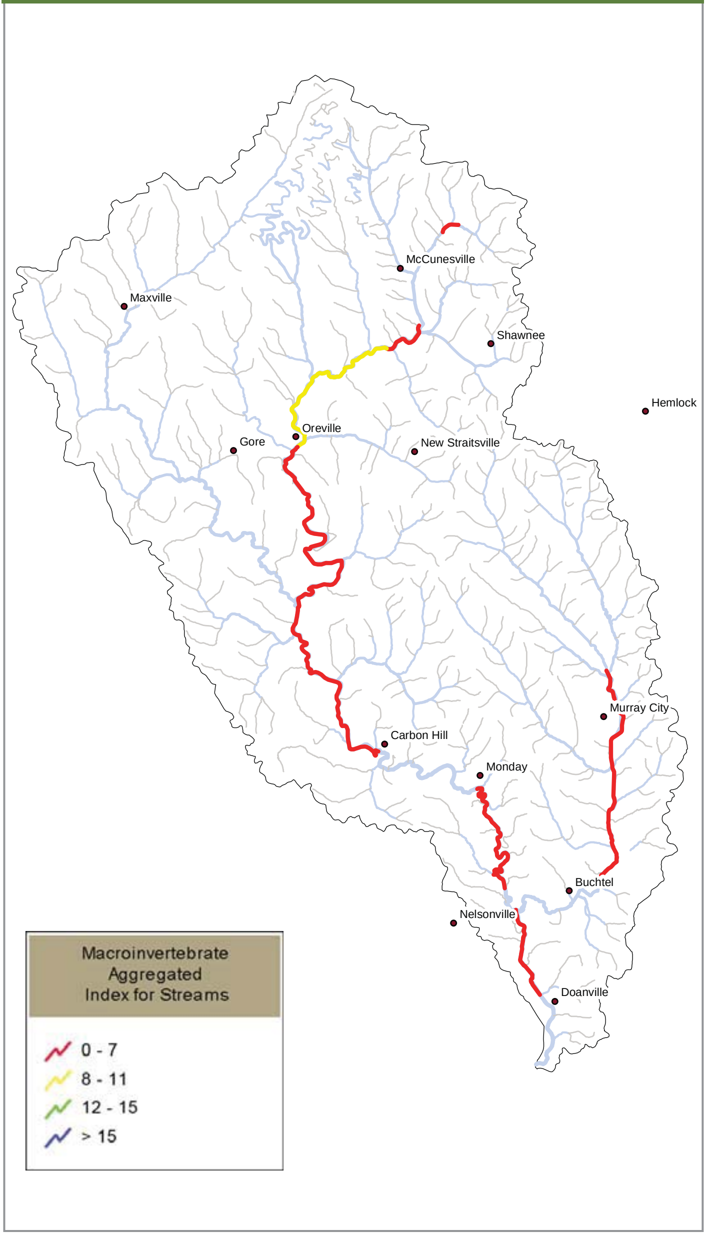
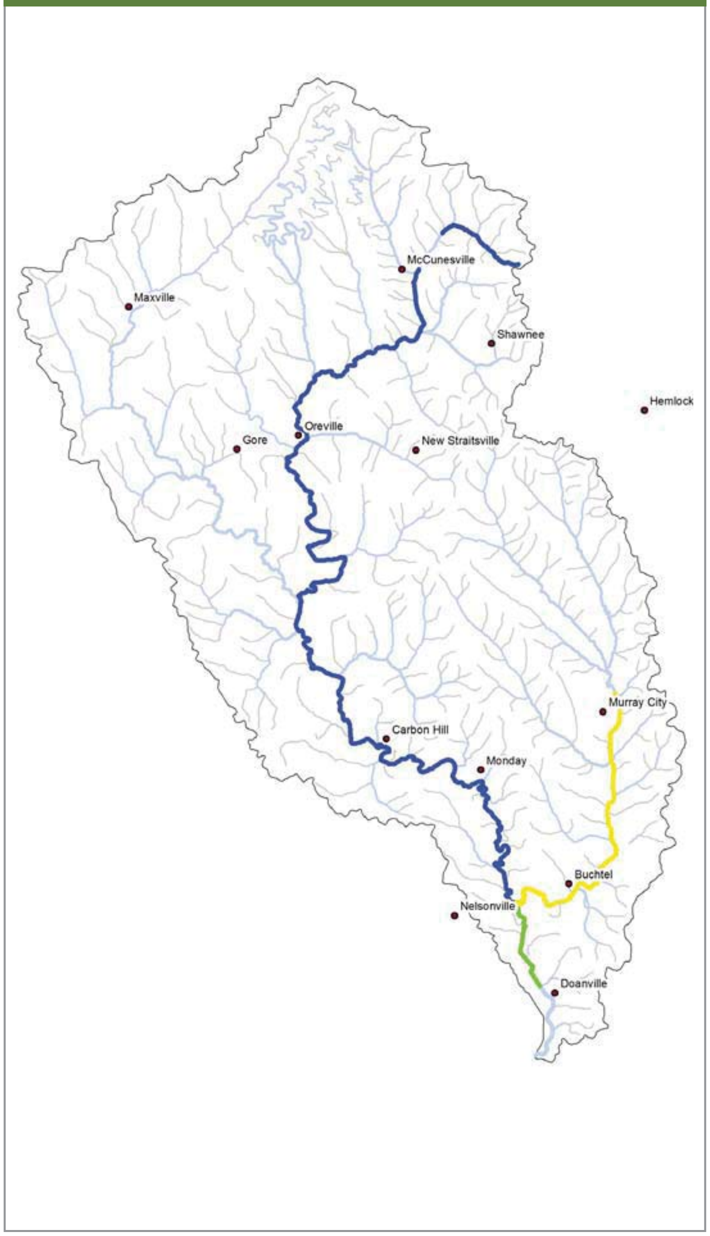
Chemical Water Quality

Monday Creek baseline pH



Monday Creek 2012 pH

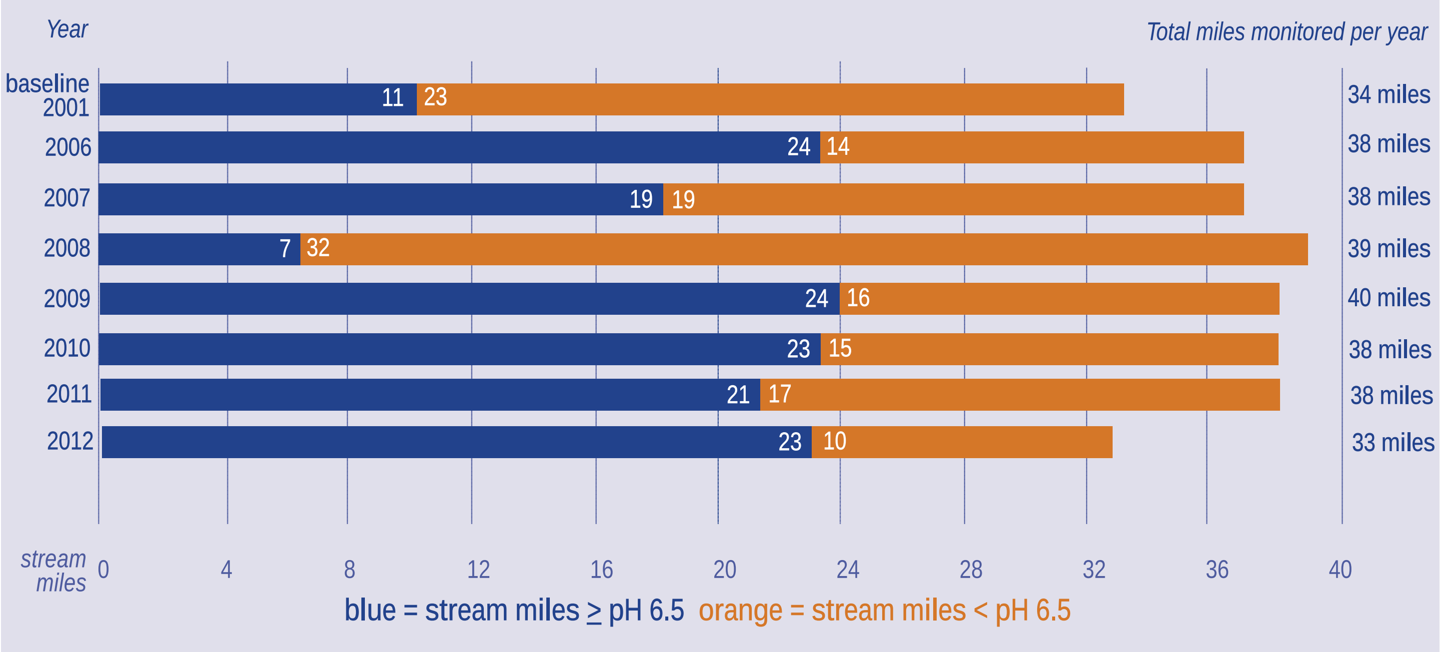


In Monday Creek pH values have improved throughout the watershed from baseline conditions (2001) to 2012. From 2001 (32%) to 2012 (70%) there has been 38% increase in the number of stream miles that meet the pH target of 6.5.

Chemical Water Quality

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. 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. In 2012, stream miles meeting the pH target match 2010. The mainstem of Snow Fork, downstream of Essex Doser has been discontinued for monitoring. Site SF00940 represents the five miles missing from the total miles monitored in past years. This site still fails to meet the pH target of 6.5. (figure 1)

Figure 1. Monday Creek pH

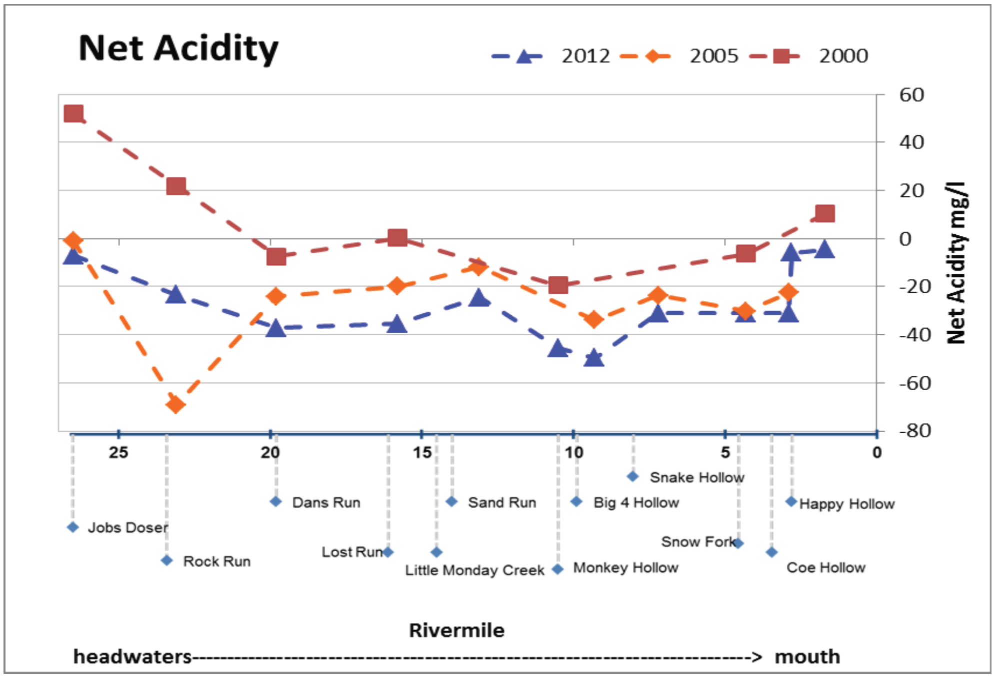


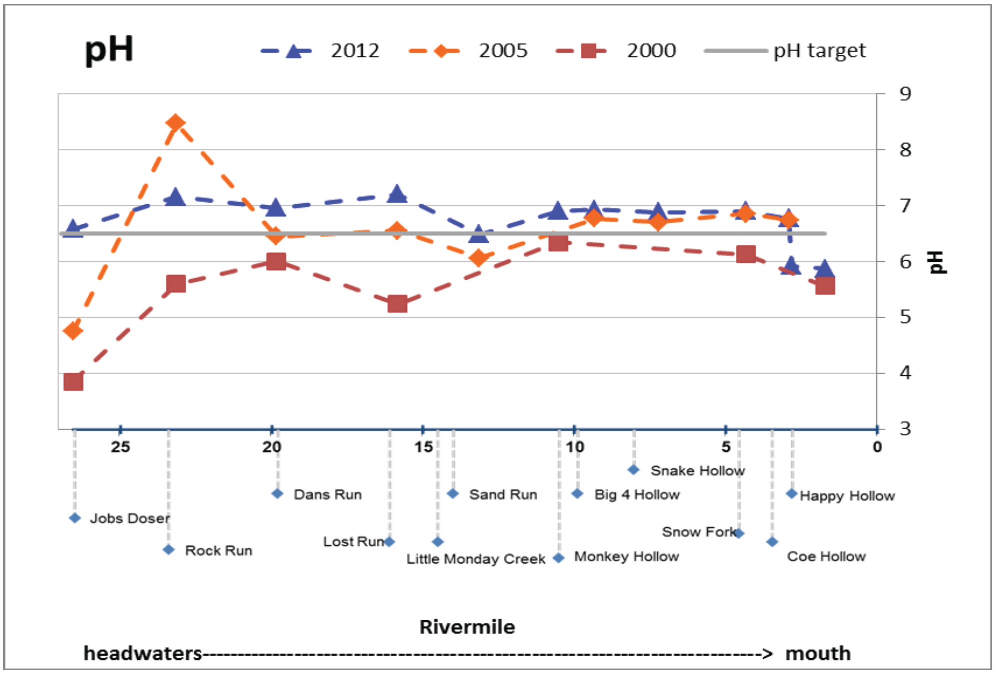
Chemical water quality analysis per stream reach

Chemical water quality changes along the mainstem of Monday Creek are shown in the stream reach graphs below. Chemical long-term monitoring data is utilized to generate line graphs along the stream gradient from headwaters to the mouth. Along the x-axis named tributaries are shown to illustrate sources of water entering the mainstem. A list of long-term monitoring sites utilized to generate the graphs with their river miles are shown below.

Monday Creek Mainstem

Site ID	Rivermile
JH00500	26.5
MC00800	23.1
MC00580	19.8
MC00500	15.8
MC00400	13.1
MC00300	10.5
MC00280	9.3
MC00240	7.2
MC00180	4.3
MC00165	2.9
MC00160	2.8
MC00060	1.7





Chemical water quality analysis per stream reach

Monday Creek Mainstem

Site ID	Rivermile
JH00500	26.5
MC00800	23.1
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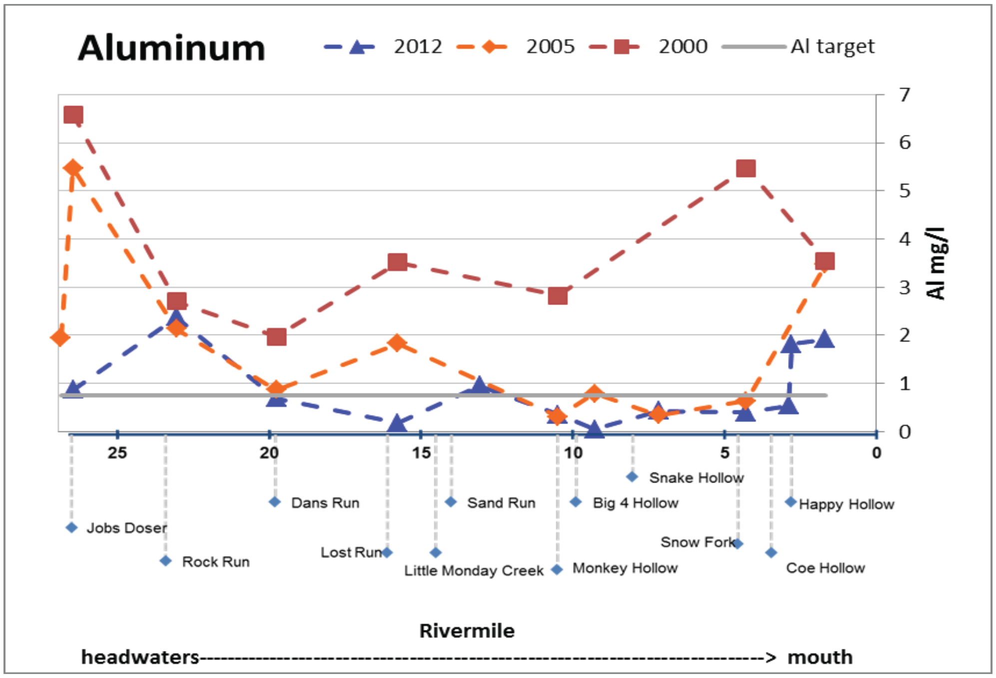
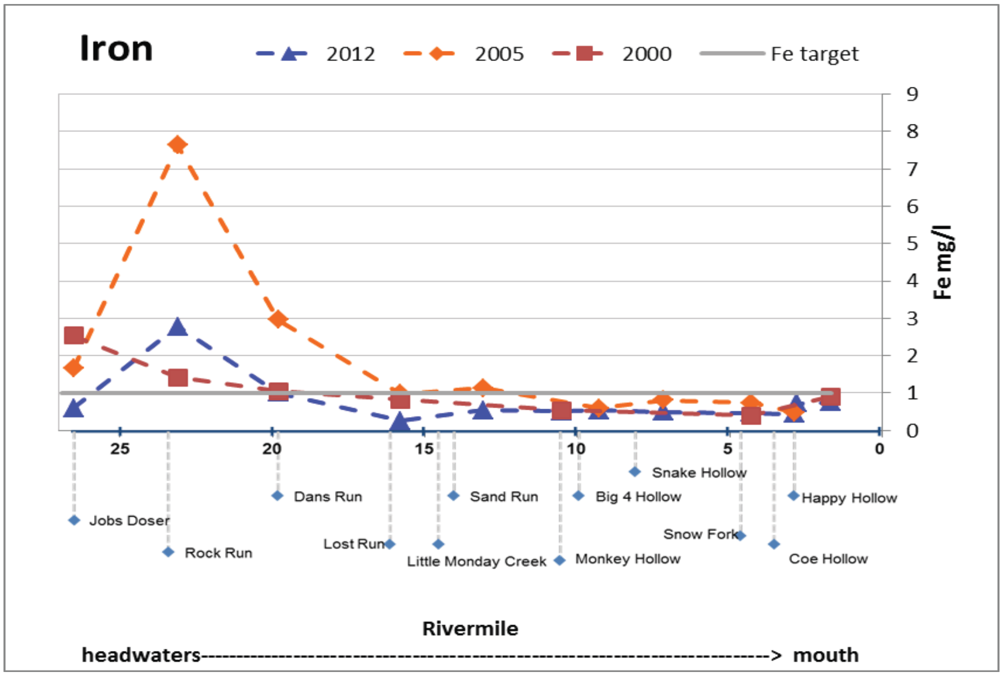
MC00060	1.7





2012 NPS Report - Monday Creek Watershed

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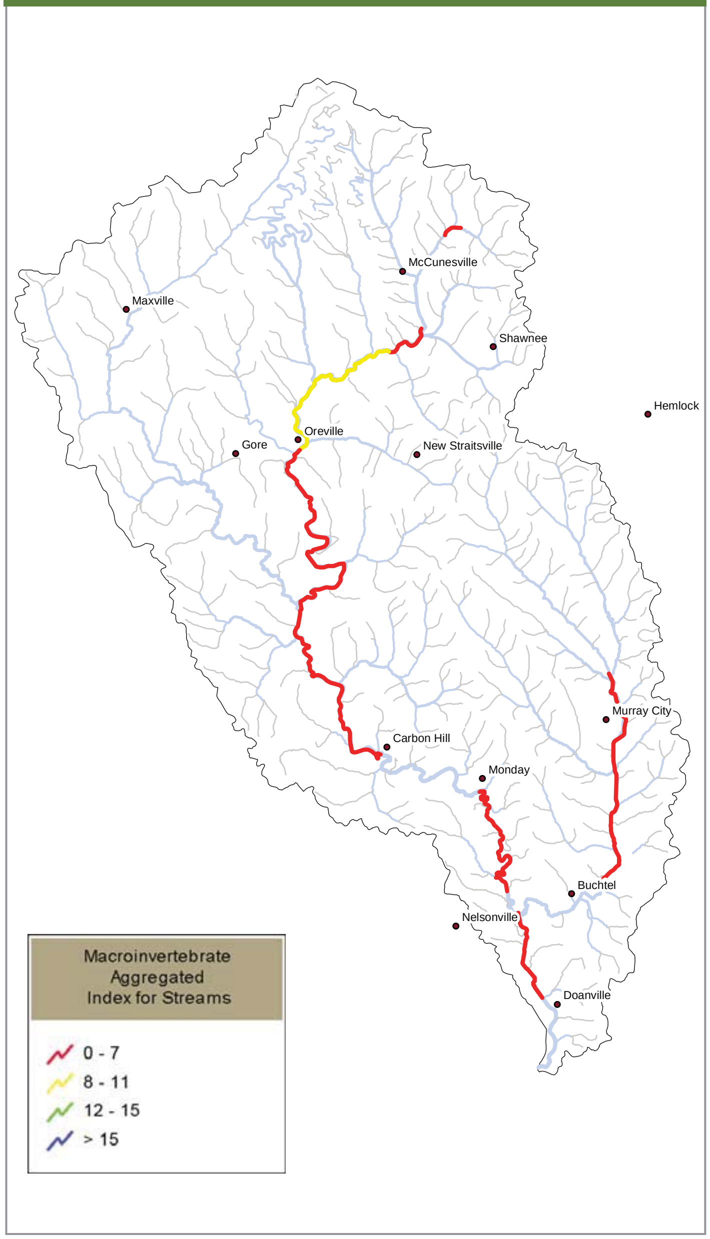
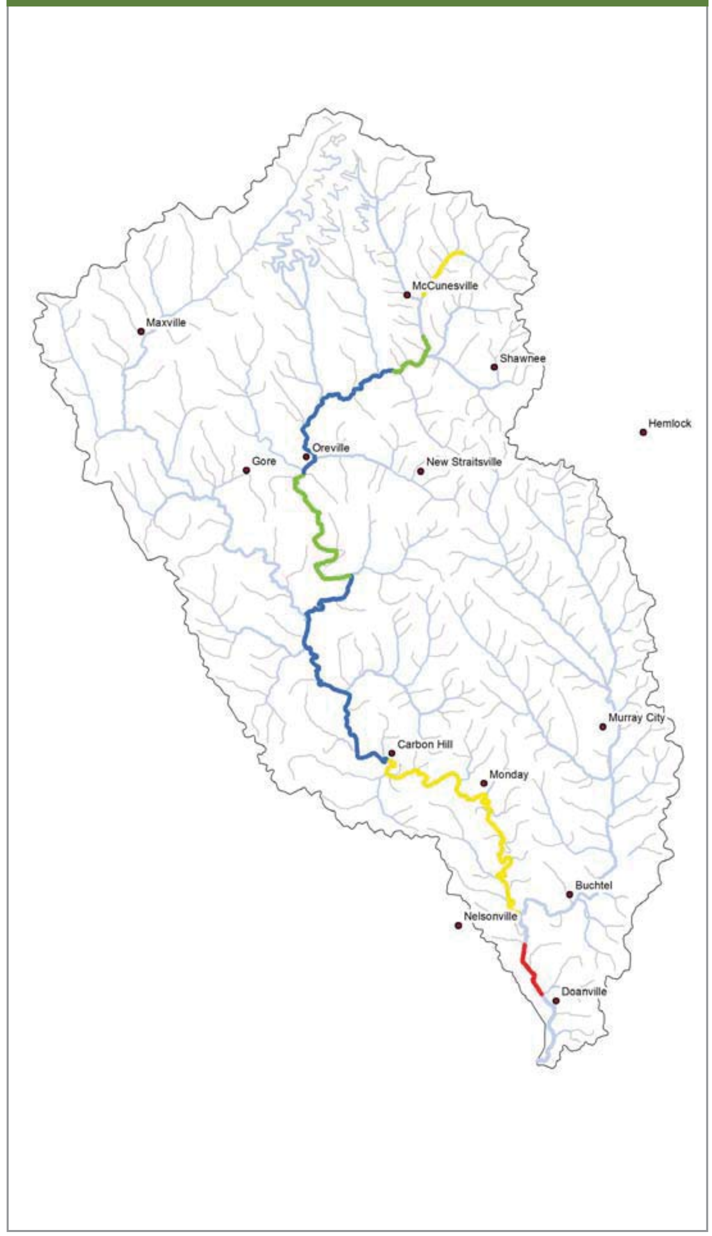
Biological Water Quality

Monday Creek baseline MAIS



Monday Creek 2012 MAIS

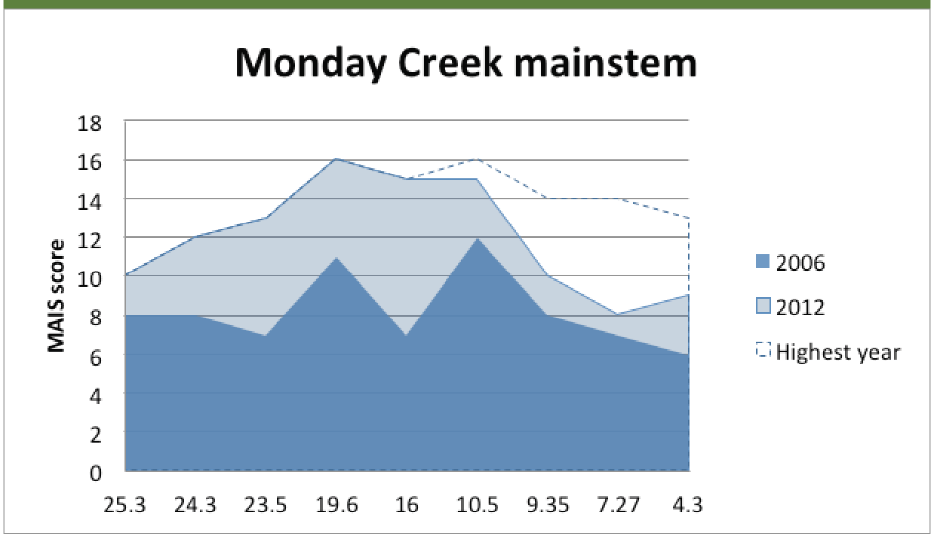


MAIS samples were collected throughout Monday Creek at established annual monitoring stations from 2001 through 2012.

Biological Water Quality

The majority of long-term monitoring sites along the Monday Creek mainstem have shown steady improvements in biological quality over the last ten years (figure 2). By 2012, nine of thirteen sites show statistically significant ($P < 0.05$) improvements in biological scores (figure 3). Sites in the upper most half of the watershed (RM 25.3 to 16) achieved their highest scores to date, matching what many had attained in 2010. A notable improvement was at river mile 16, which achieved a new high MAIS score of “14” this year. The site immediately downstream the doser (JH00500) also continued to show improvement, sustaining a 2-3 year trend. The long-term sites in the lower half of the mainstem, however, did not achieve their highest possible scores. Lastly, the site that has declined in quality since 2005 (JH00902) is immediately downstream the Jobs Hollow doser and not expected to support high quality biological life, as it is located in the designated ‘sacrificial’ or ‘mixing zone’. It was not sampled in 2012 for this reason. The treatment doser located at Essex Mine on Sycamore Hollow was turned off in 2008. Site SY0080 and SY RM 0.1 are no longer sampled.

Figure 2. Area of Degradation



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

Figure 3. Monday Creek MAIS Regressions

RM	2001	2002	2003	2005	2006	2007	2008	2009	2010	2011	2012	Linear trends	R sq.	P-value	Yrs.*
JH00902				8	6	6	4	4	4	4		declined	0.78	0.009	7
JH00500	4	6	4	7	6	5	4	7	8	9	11	improved	0.56	0.008	11
25.3				7	8	7	4	9	6	10	10	no change	0.22	0.245	8
24.3				6	8	12	12	11	11	12	12	improved	0.56	0.034	8
23.5	5	3	1	11	7	9	12	7	13	11	13	improved	0.64	0.003	11
19.6	8	9	10	13	11	12	12	13	16	14	16	improved	0.85	0.0005	11
16	2	6	6		12	11	10	10	10		14	improved	0.76	0.0004	11
10.5	5	10	13	13	12	14		12	16	16	15	improved	0.64	0.003	11
9.4					8	9	10	9	14	12	10	improved	0.36	0.015	7
7.3				8	7	7	8	10	14	10	8	no change	0.23	0.23	8
4.3	2	6	2	8	6	9	7	4	13	9	9	improved	0.47	0.020	11
SY00080				9	4	13	6	7	8			no change	0.009	0.880	6
SYRM0.1				6	3	5	8	10	10			improved	0.93	0.008	6

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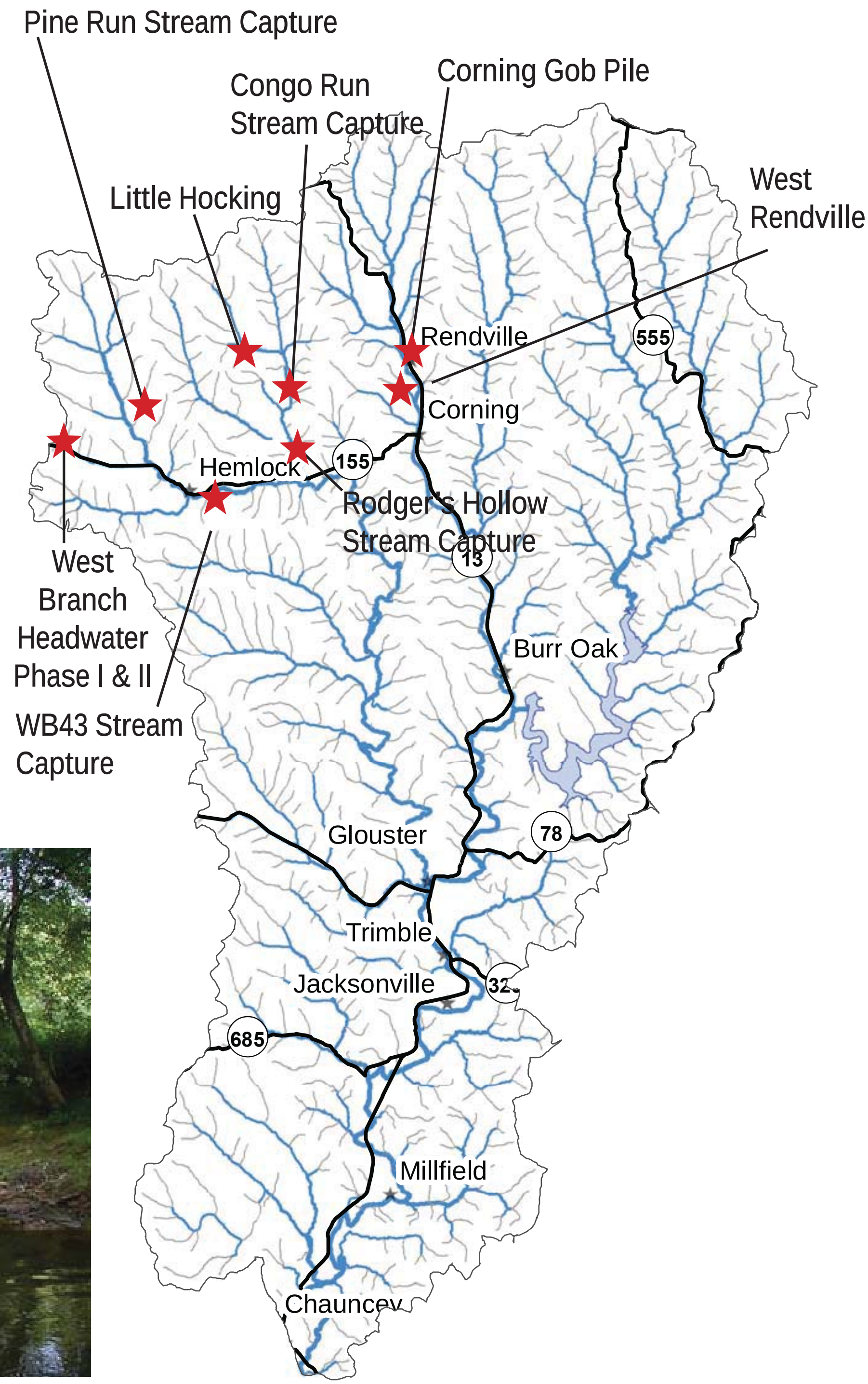


Costs

Design = $454,109

Construction = $1,719,120

Total costs through 2012 = $2,173,229
(excluding Congo Run CR-15 &
Pine Run Stream Capture maintenance
WB 43 design)

Sunday Creek

Six stream captures located in the Sunday Creek Watershed were closed and completed from 2004-2011. A total of 2,401 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 receiving 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.

Timeline of the Sunday Creek Watershed Project Milestones and AMD Projects

1999	• Sunday Creek Watershed Group Founded
2000	
2001	• Rural Action adds VISTA volunteer to SCWG staff
2002	• SCWG Hired First Watershed Coordinator, funded for six years
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 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 adds 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
2012	• Pine Run Doser installed

Sunday Creek Projects

Acid mine drainage reclamation projects completed in Sunday Creek Watershed:

2004 *Congo Stream Capture*

2007 *Pine Run Stream Capture*

Corning Gob Floodplain

Rodger's Hollow Stream Capture

2009 *Little Hocking Stream Capture CR 11*

2010 *West Branch 43 Stream Capture*

Pine Run Stream Capture Maintenance

West Branch Sunday Creek Headwaters Phase I & II

2011 *West Rendville Stream Capture*

Italicized indicates projects are not actively monitored for acid and metal load reduction purposes

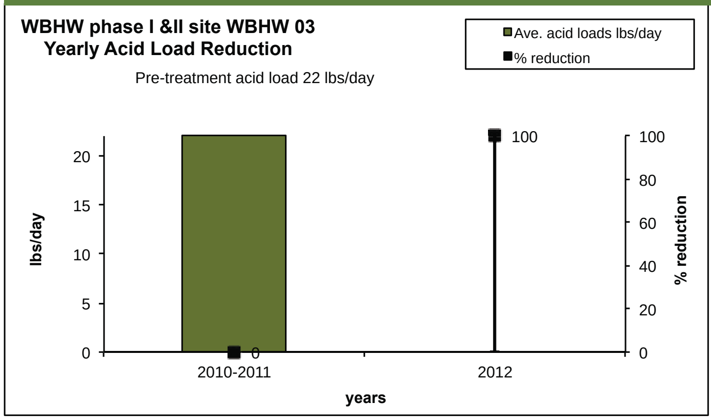
Most of the remediation in Sunday Creek consists of source control (i.e. stream capture, gob pile capping, etc…) and aren't actively monitored for acid and metal load reductions. Therefore target restoration sites along the West Branch of Sunday Creek mainstem have been selected to analyze the acid and metal load reductions, these sites include:

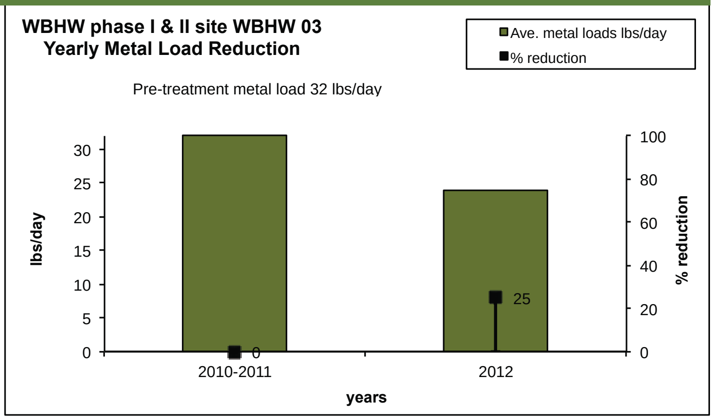
WBHW 03, WB 51, and WB 002. Yearly load reductions for these mainstem sites are shown on the next few pages.

Yearly acid and metal load reduction trends per project

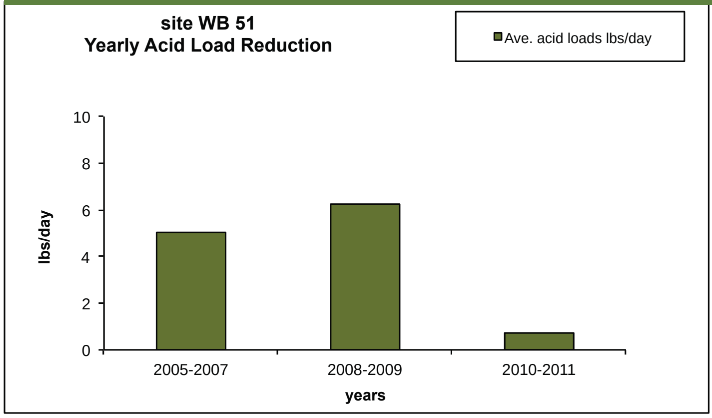
Similar to other environmental best management practices (BMPs), performance of passive acid mine drainage reclamation projects are also expected to decline with time. Active treatment systems are not expected to decline with time but sometimes need maintained to perform adequately. Currently, operation and maintenance plans are being designed for each existing system and planned for future projects. The list of graphs below show the mean annual acid and metal load reduction (Stoertz, 2004) for each year (or group of years) during post-reclamation from the project effluent and/or along mainstem sites. From these graphs the rate of decline (and/or improvement) with time of the treatment system are implied. Knowing the rate of decline will aid in the implementation of operation and maintenance plans for each project site. Yearly load reductions are plotted and shown in the figures below.

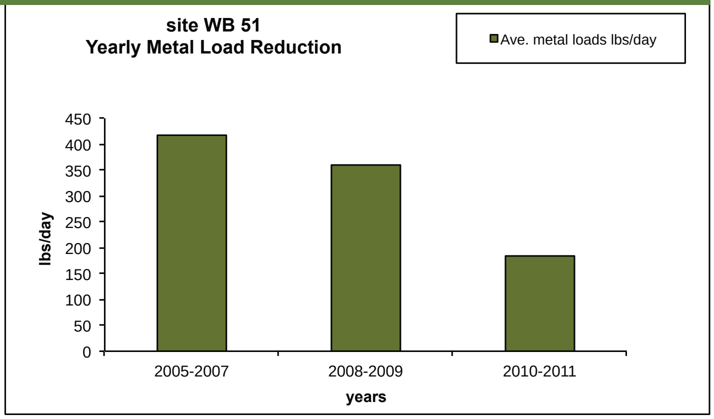
WBHW phase I & II site WBHW 03



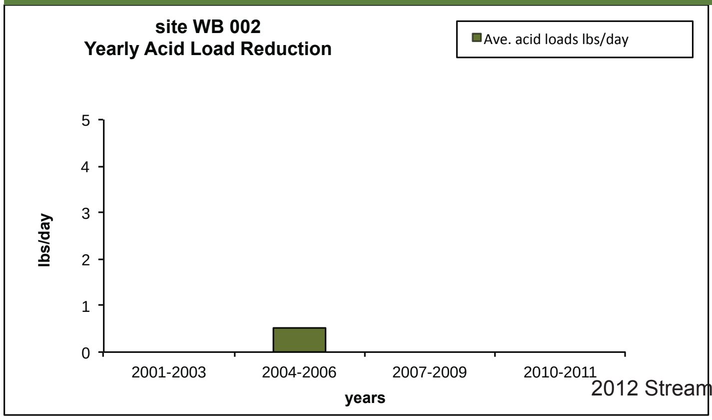


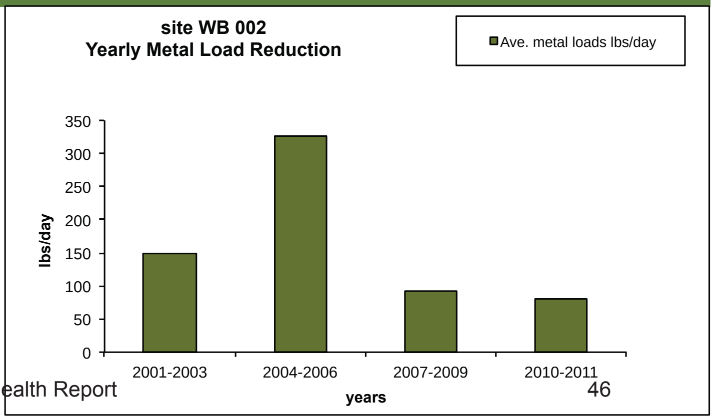
Site WB 51



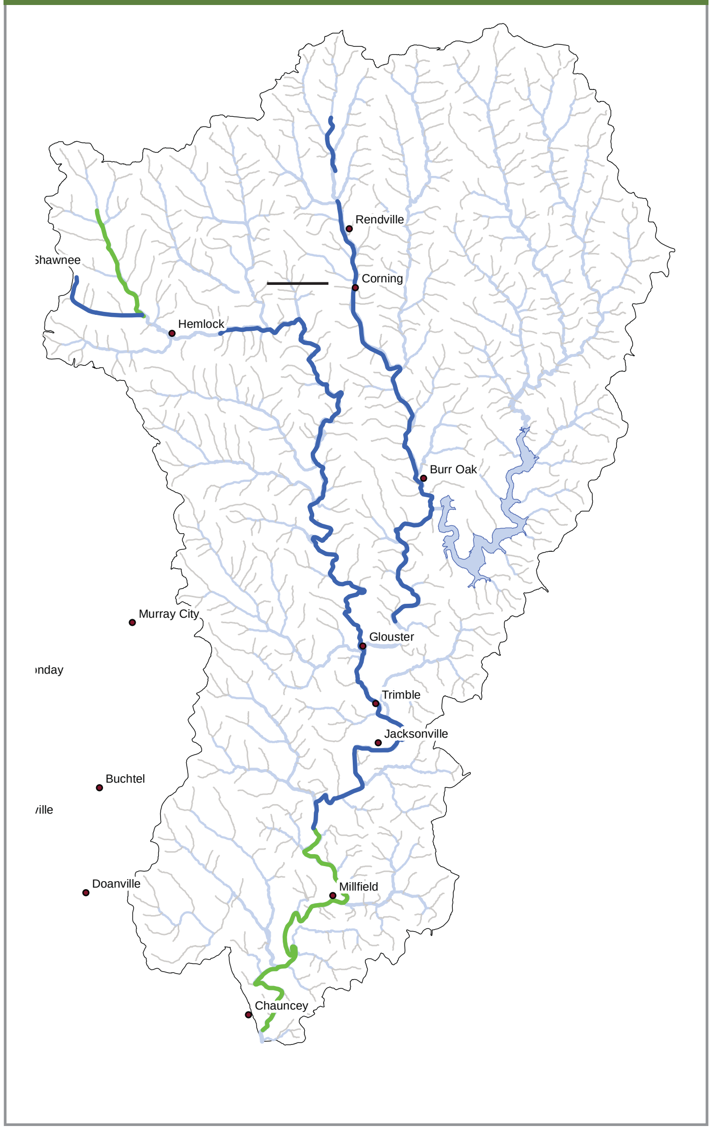


Site WB 002

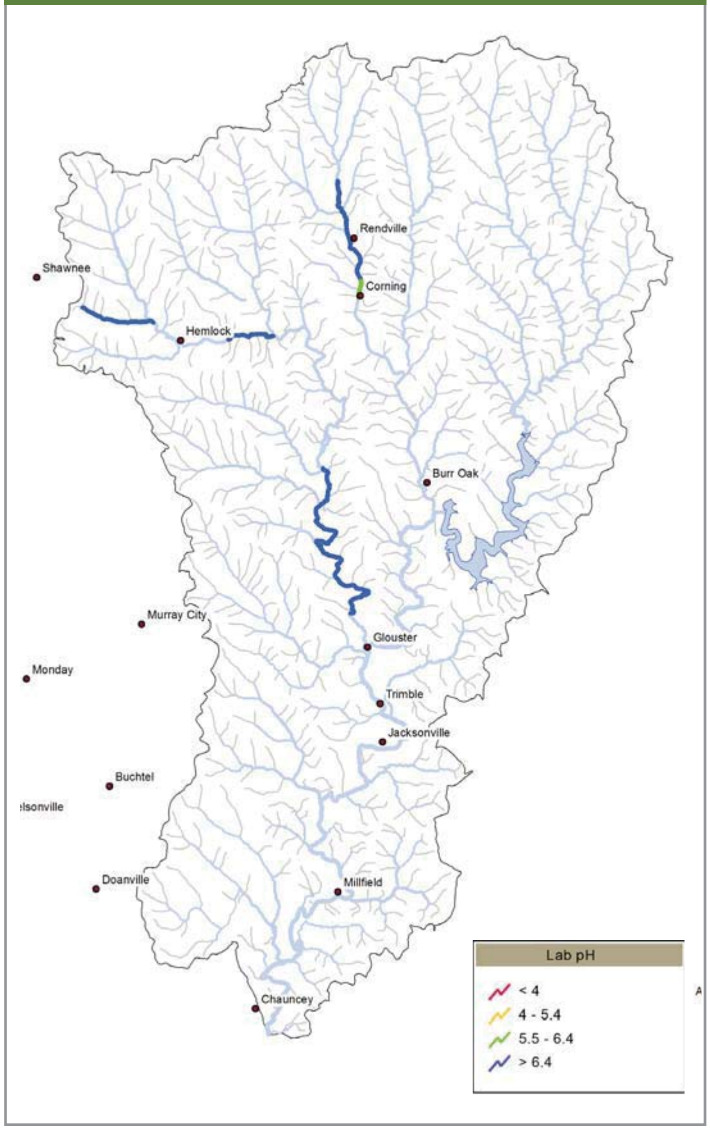




Sunday Creek baseline pH



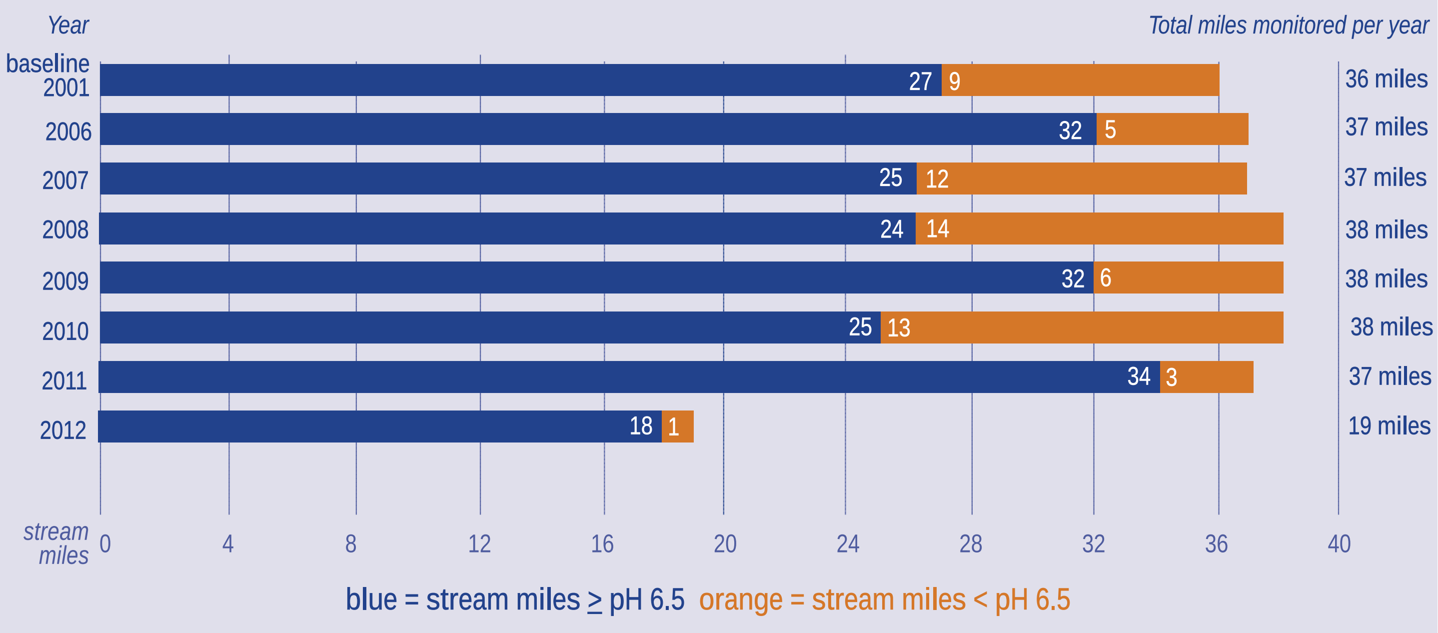
Sunday Creek 2012 pH



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. In 2012, many long-term monitoring stations were not sampled, only 19 of the 38 stream miles were monitored showing little difference with 2011 data. The average pH in 2007 at site WB 003 was 4.83, in 2008 5.97, in 2009 6.08, in 2010 6.25, 6.51 in 2011, and 6.78 in 2012.

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. In 2012, many long-term monitoring stations were not sampled, only 19 of the 38 stream miles were monitored showing little difference with 2011 data. However, site WB51 on the mainstem of West Branch Sunday Creek showed an increase in pH from 5.86 to 6.6 from 2011 to 2012. This site is a target site for restoration (Figure 1).

Figure 1. Sunday Creek pH

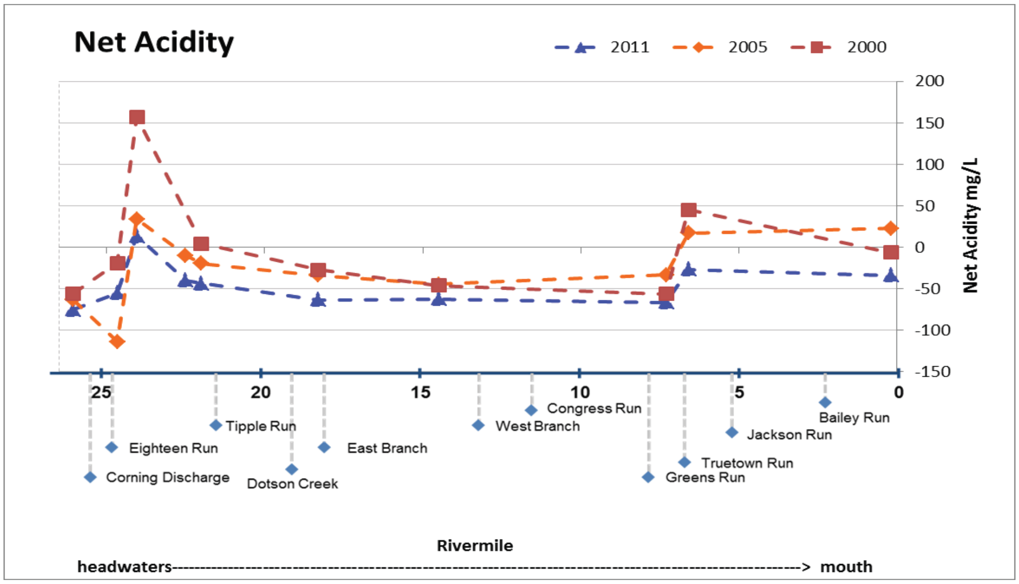


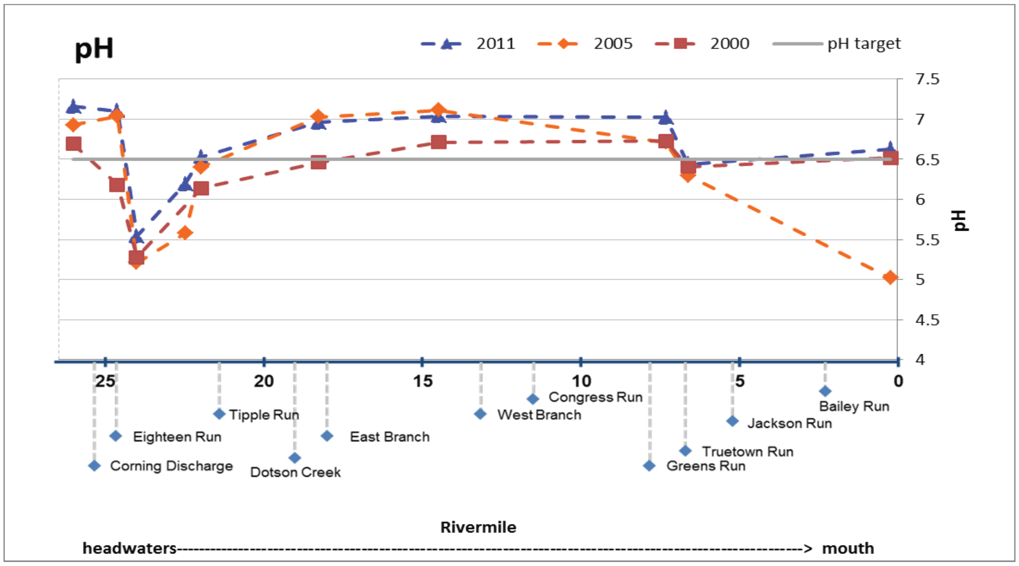
Chemical water quality analysis per stream reach

For purposes of analyzing chemical water quality changes along the mainstem of receiving stream where AMD reclamation projects have been completed, Sunday Creek has been divided into the following stream segments: Sunday Creek Mainstem and West Branch of Sunday Creek. Within these stream reaches, chemical long-term monitoring data is utilized to generate line graphs along the stream gradient from headwaters to the mouth. Along the x-axis named tributaries are shown to illustrate sources of water entering the mainstem. A list of long-term monitoring sites utilized to generate the graphs with their river miles are shown before each set of stream reach graphs.

Sunday Creek Mainstem

Site ID	Rivermile
SC 077	26.05
SC 079	24.65
SC 078	24.04
SC 080	22.5
SC 076	22
SC 075	18.3
SC 074	14.5
SC 073	7.3
SC 072	6.6
SC 071	0.2

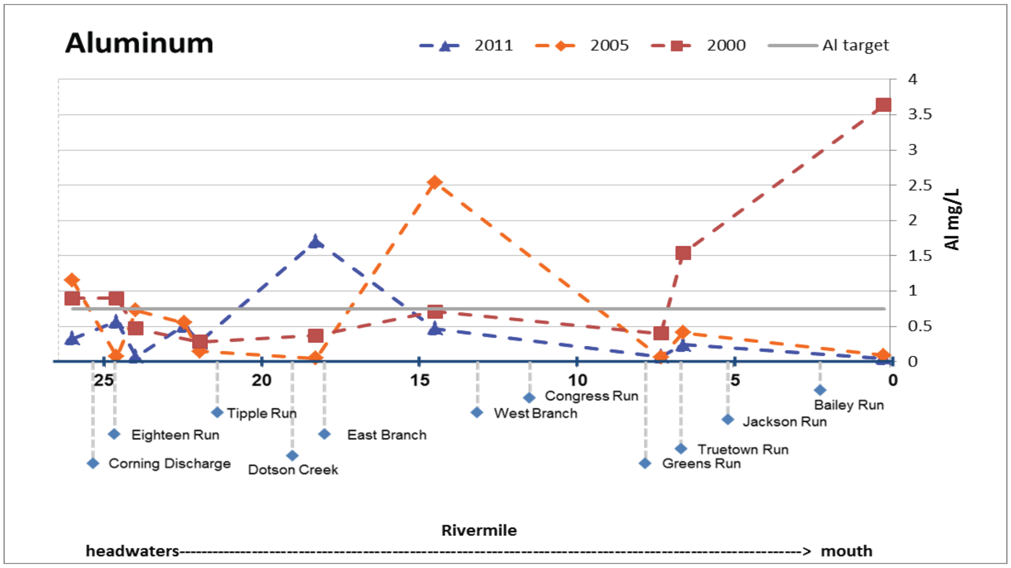


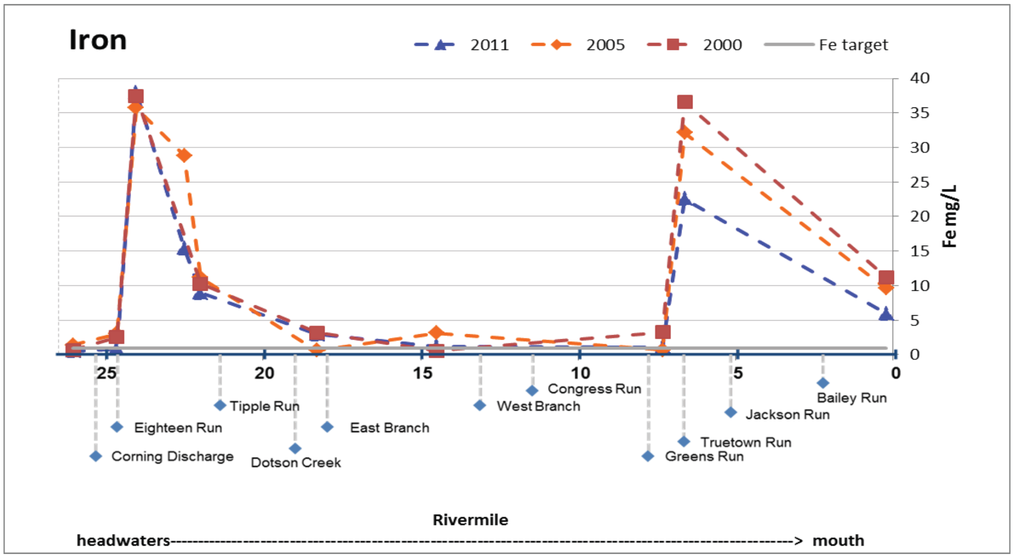


Chemical water quality analysis per stream reach

Sunday Creek Mainstem

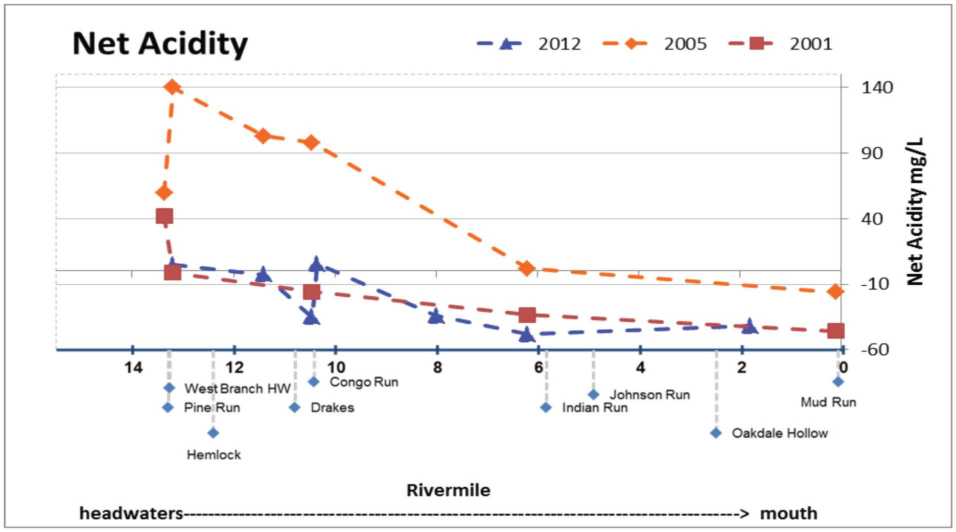
Site ID	Rivermile
SC 077	26.05
SC 079	24.65
SC 078	24.04
SC 080	22.5
SC 076	22
SC 075	18.3
SC 074	14.5
SC 073	7.3
SC 072	6.6
SC 071	0.2

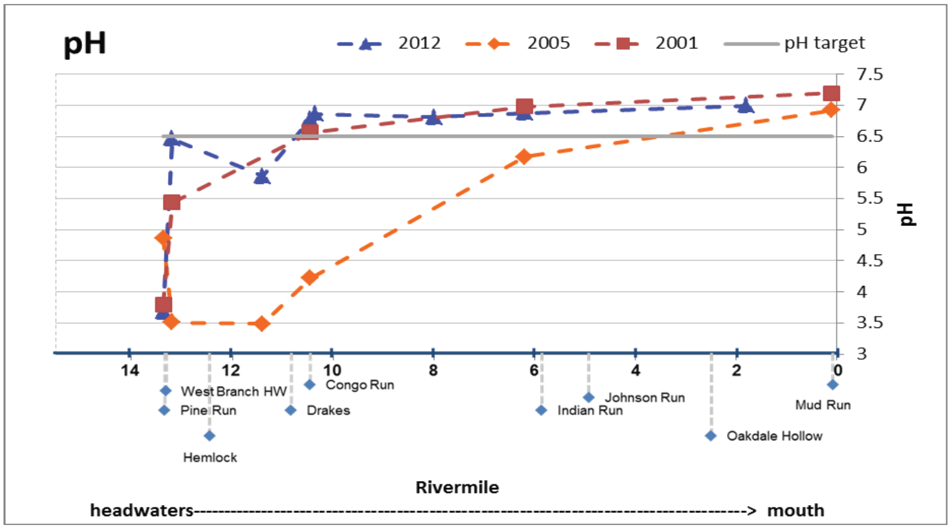




Chemical water quality analysis per stream reach

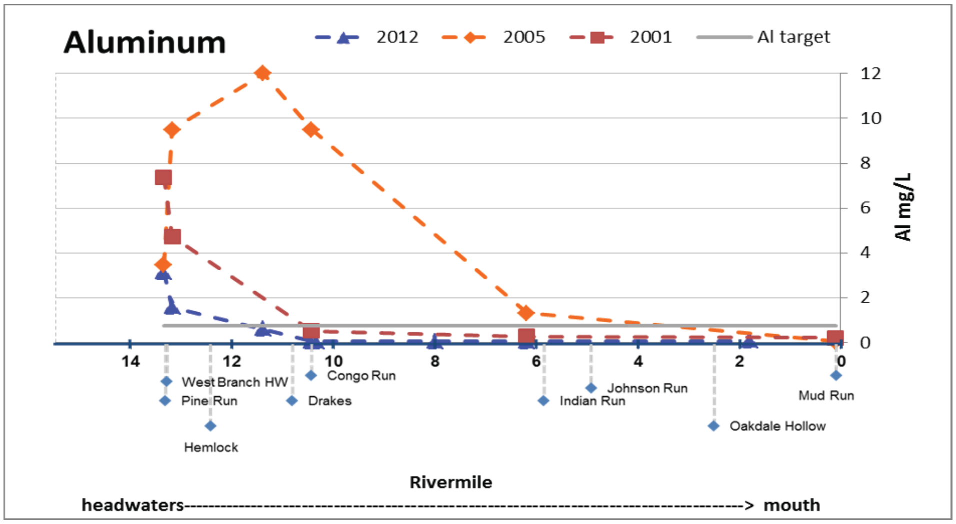
West Branch of Sunday Creek	
Site ID	Rivermile
PR 001	13.37
WB 004	13.2
WB 51	11.4
WB 003	10.45
WBSC RM 10.35	10.35
WBSC RM 8	8
WB 002	6.2
WBSC RM 1.8	1.8
SC 025	0.1
SC 071	0.2

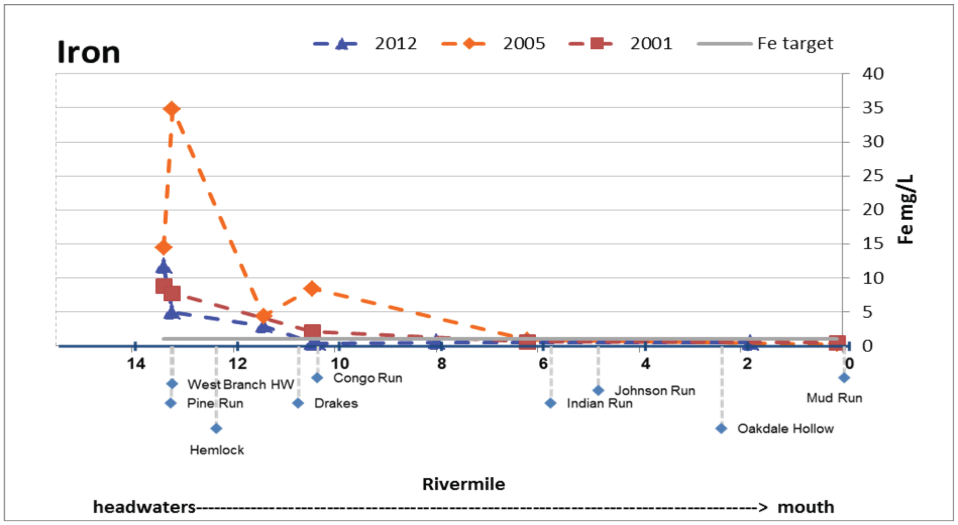




Chemical water quality analysis per stream reach

West Branch of Sunday Creek	
Site ID	Rivermile
PR 001	13.37
WB 004	13.2
WB 51	11.4
WB 003	10.45
WBSC RM 10.35	10.35
WBSC RM 8	8
WB 002	6.2
WBSC RM 1.8	1.8
SC 025	0.1
SC 071	0.2





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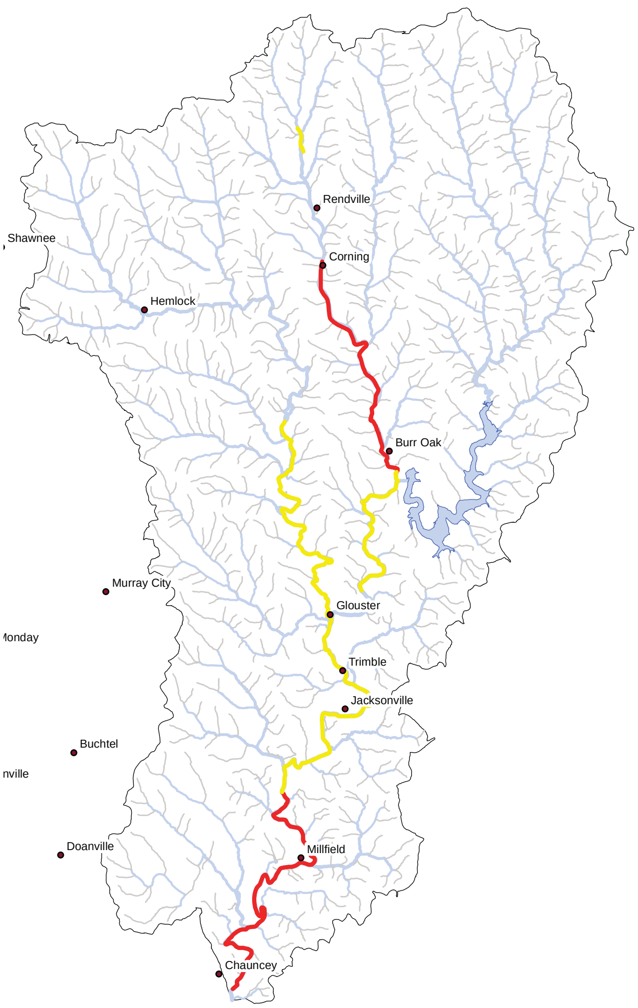
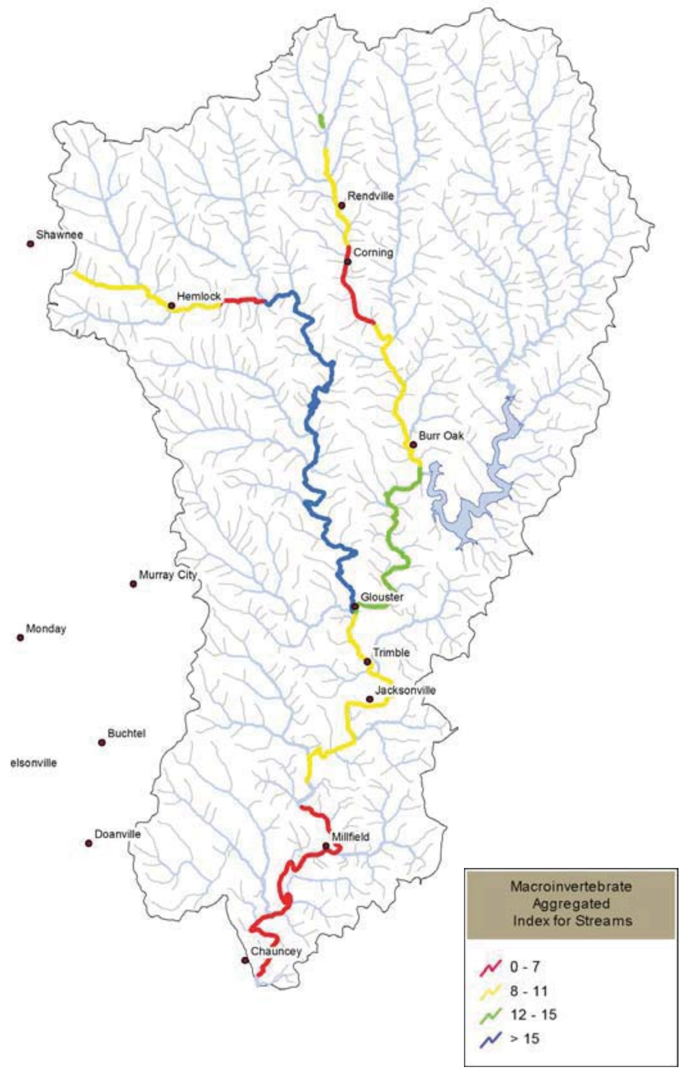
Biological Water Quality

Sunday Creek baseline MAIS



Sunday Creek 2012 MAIS



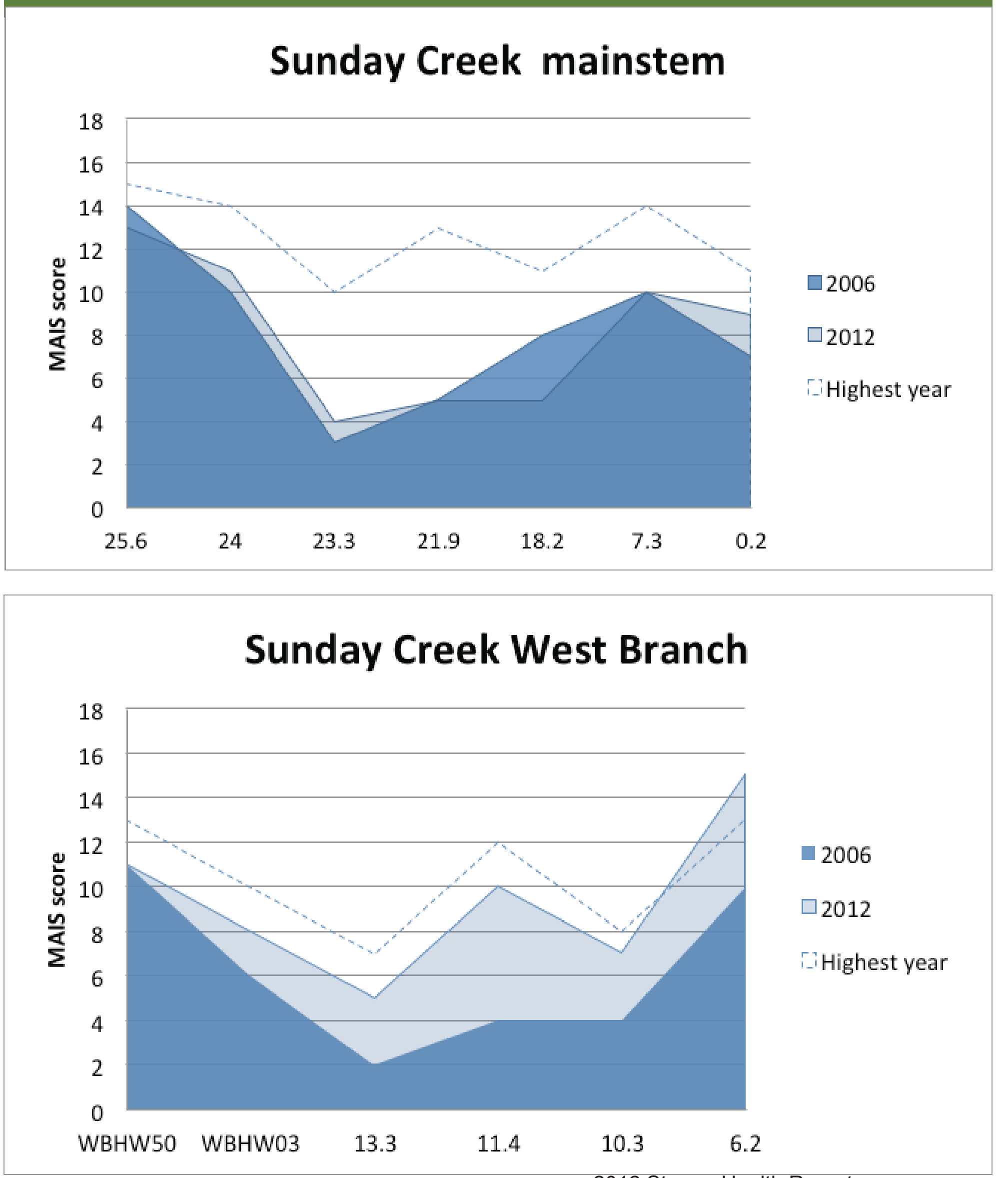
MAIS samples were collected throughout Sunday Creek at established annual monitoring stations from 2001 through 2012.

Biological Water Quality

The biological quality along the upper portion of the Sunday Creek mainstem fell uniformly below its potential in 2012, and instead generally reflected the historical (unimproved) longitudinal pattern in water chemistry (Figure 2). Scores very closely matched those of 2006, well below the highest quality scores that have been achieved in other years. In contrast, improvements in the West Branch were evident, but did not increase biological quality in the mainstem downstream of the confluence. It appears that previous years' gains along the mainstem continue to be transient and lost in some years. The reasons for this are unknown. In spite of the overall poor scores, the lowermost mainstem site near the mouth (RM 0.2) still showed a slight and statistically significant improvement, perhaps a reflection of the cumulative effects of restoration activities in the watershed.

Biological scores in the West Branch were better than in the mainstem, and were only slightly less than the unusually high scores recorded in 2011. Three sites in the West Branch continue to exhibit significant long-term improvement in macroinvertebrate scores: the headwaters site HW003, the site at RM 13.3, which supported almost no macroinvertebrates in 2005 (MAIS score of "1"), and the most downstream West Branch monitoring site (RM 6.2). This site attained a new high score of "15" in 2012 (Figure 3).

Figure 2. Area of Degradation 2006-2012



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

Figure 3. Sunday Creek MAIS Regressions

RM Mainstem	2001	2002	2003	2005	2006	2007	2008	2009	2010	2011	2012	Linear trends	R square	P-value	Yrs
24				12	10	10	14	12	13	12	11	no change	0.04	0.618	8
23.3				5	3	2	7	12	5	10	4	no change	0.13	0.390	8
21.9	2	1	2	11	5	5	9	2	3	7	5	no change	0.10	0.345	11
18.2	5	9	8	10	8	10	5	7	8	11	10	no change	0.13	0.273	11
7.3	10	11	11	11	10	10	10	12	11	14	9	no change	0.04	0.570	11
0.2	4	2	3	8	7	3	6	11	8	10	7	improved	0.49	0.016	11
West Branch															
WBHW50					11	10	11	8	12	13	11	no change	0.12	0.451	7
WBHW03				5	6	4	8	6	8	10	8	improved	0.58	0.029	8
13.3				1	2	2	5	5	7	7	5	improved	0.73	0.007	8
11.4				8	4	2	7	9	5	12	10	no change	0.33	0.139	8
10.3				8	4	3	4	8	4	7	7	no change	0.04	0.615	8
6.2				7	10	8	10	10	13	13	15	improved	0.85	0.001	8

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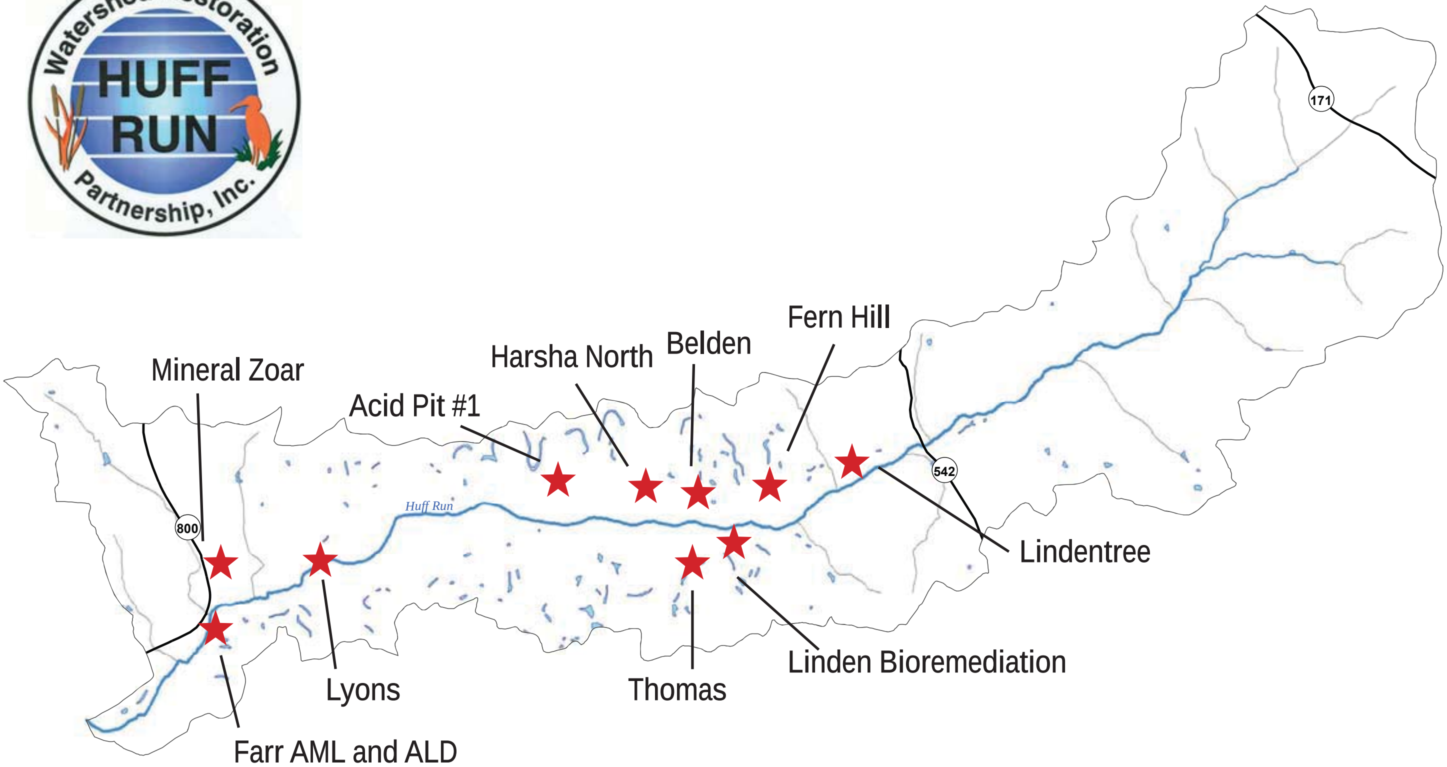

Reductions

Total acid load reduction
= 83 lbs/day at site HRR08

Total acid load reduction at
all project sites = 1075 lbs/day

excluding Mineral Zoar and Farr

Costs

Design $590,837
(excluding Linden Bioremediation)

Construction $4,104,465

Total cost through 2012
=$4,695,302

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 adds 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 adds AmeriCorps volunteer to Huff Run staff

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

2011
- Lyons II constructed

2012
- Hilltop Restoration Project started

Huff Run Projects

Acid mine drainage reclamation projects completed in Huff Run Watershed:

2003 *Farr Project*

Linden Bioremediation Project

2004 Acid Pit #1 Project

2005 Lyons Project

Lindentree Project

2006 Harsha North Project

2008 Fern Hill HR-42 Pits A, B, & C

Belden and Belden Gob Pile Project

2009 *Mineral Zoar*

2010 Thomas Project

2011 Lyons II –

Italicized indicates projects are not actively monitored for acid and metal load reduction purposes

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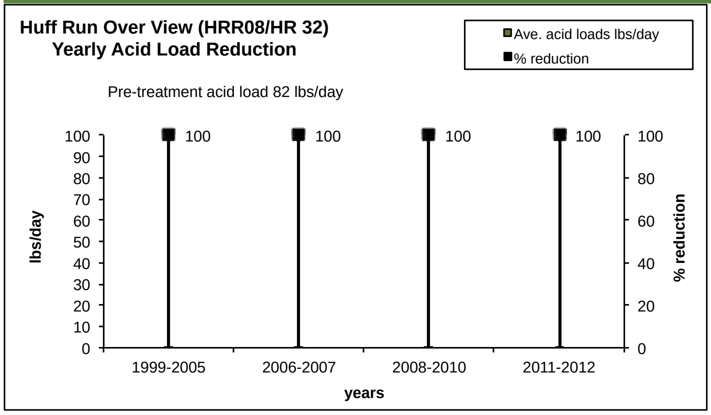
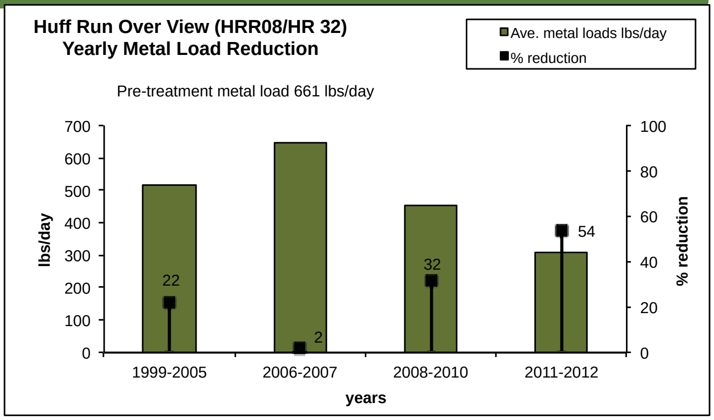
Yearly acid and metal load reduction trends per project

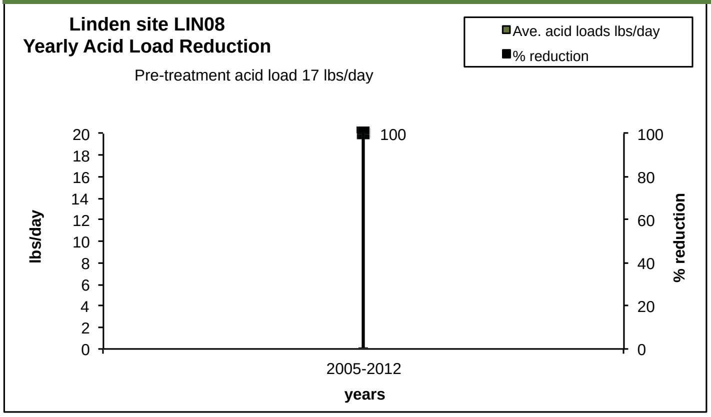
Similar to other environmental best management practices (BMPs), performance of passive acid mine drainage reclamation projects are also expected to decline with time. Active treatment systems are not expected to decline with time but sometimes need maintained to perform adequately. Currently, operation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

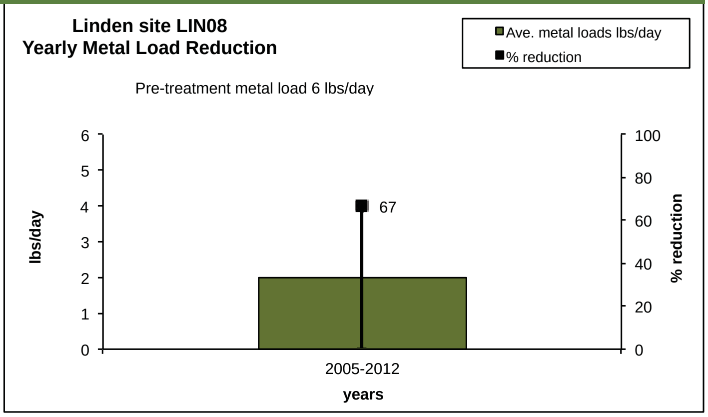
Huff Run Overview (HRR08/HR 32)



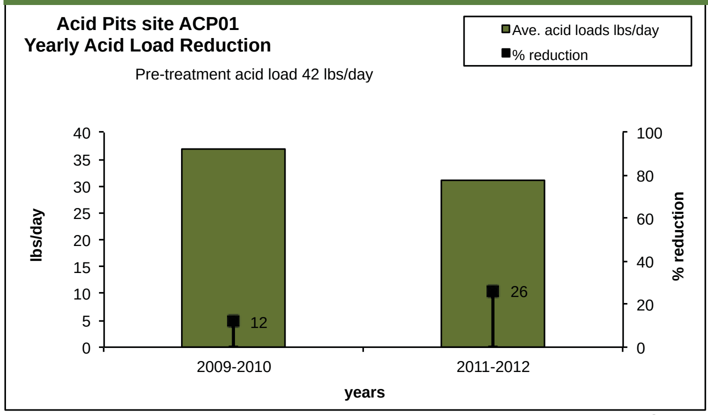


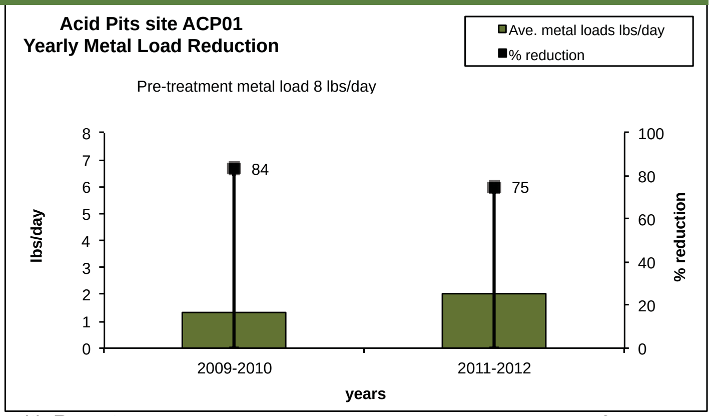
Linden site LIN08





Acid Pits site ACP01





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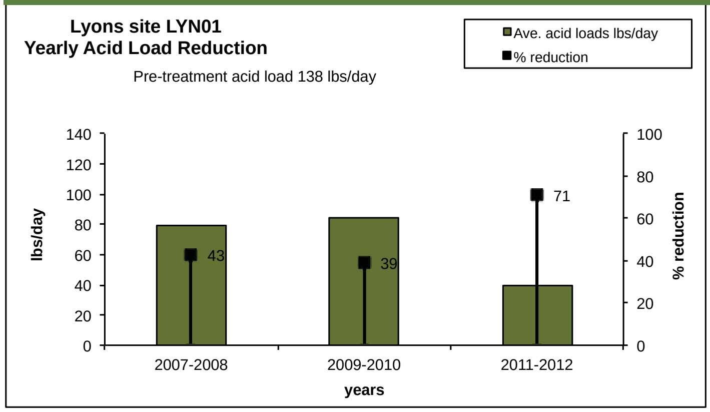
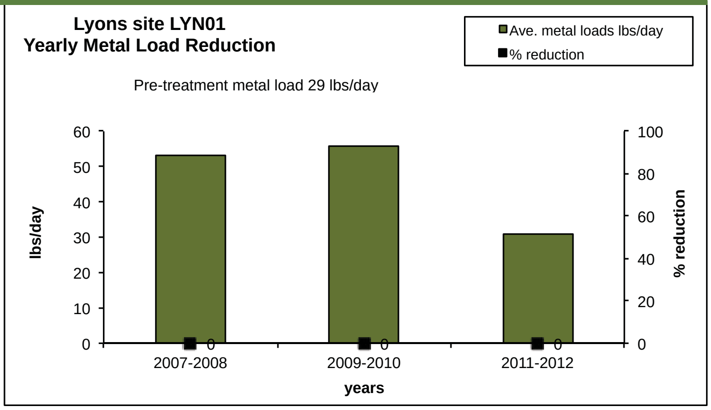
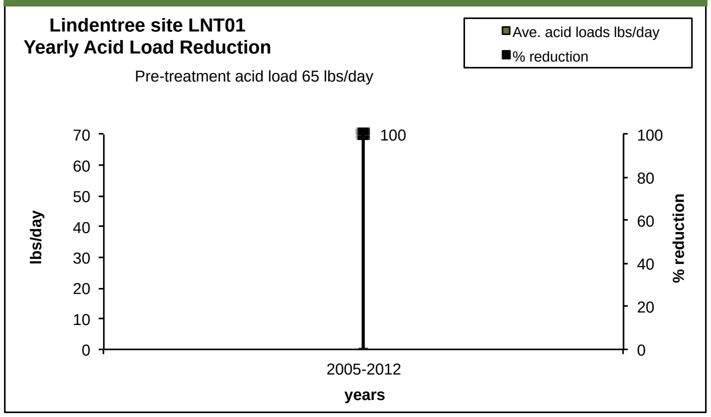
Yearly acid and metal load reduction trends per project

Lyons site LYN01

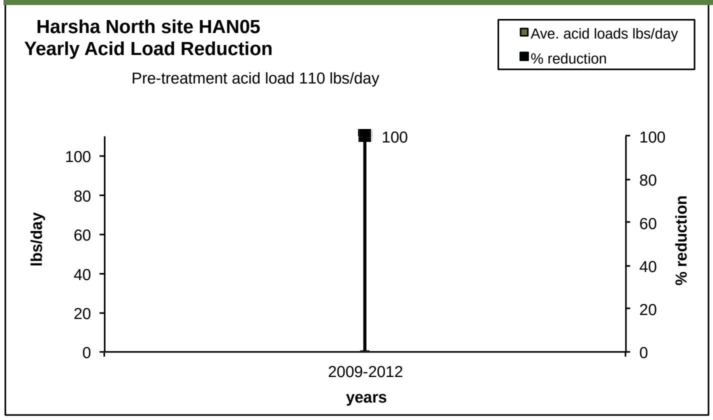


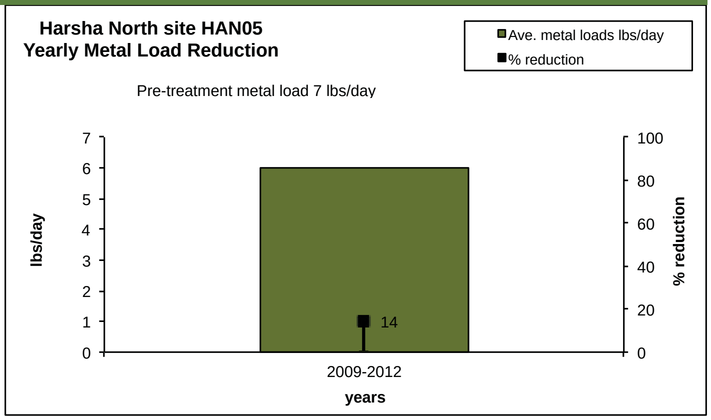


Lindentree site LNT01



Harsha North site HAN05



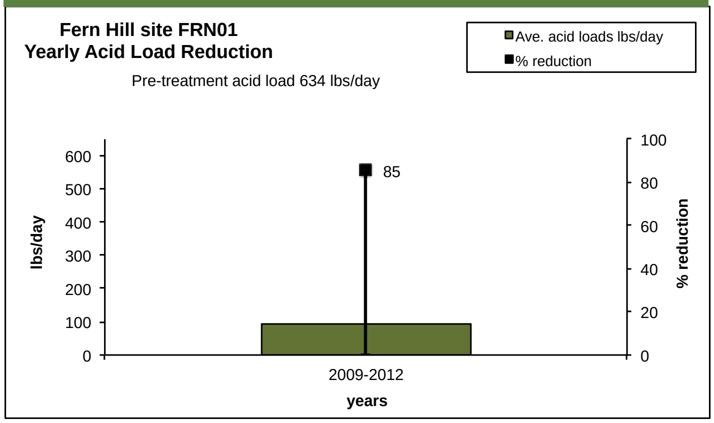


2012 NPS Report - Huff Run Watershed

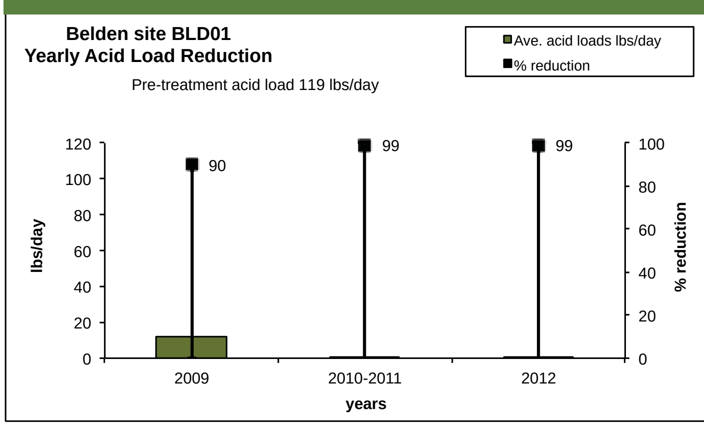
Generated by Non-Point Source Monitoring System
www.watersheddata.com

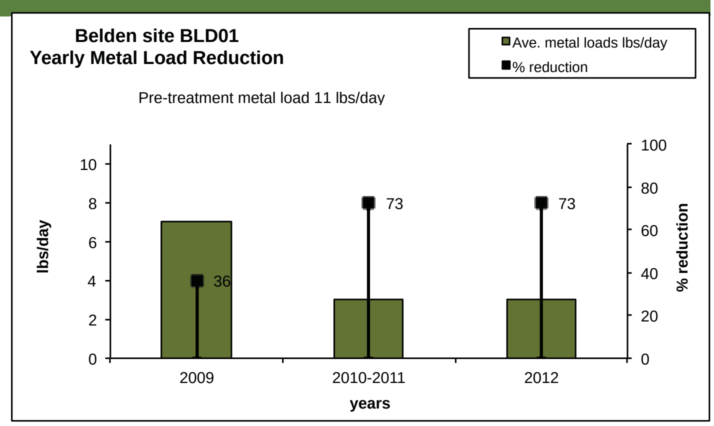
Yearly acid and metal load reduction trends per project

Fern Hill site FRN01

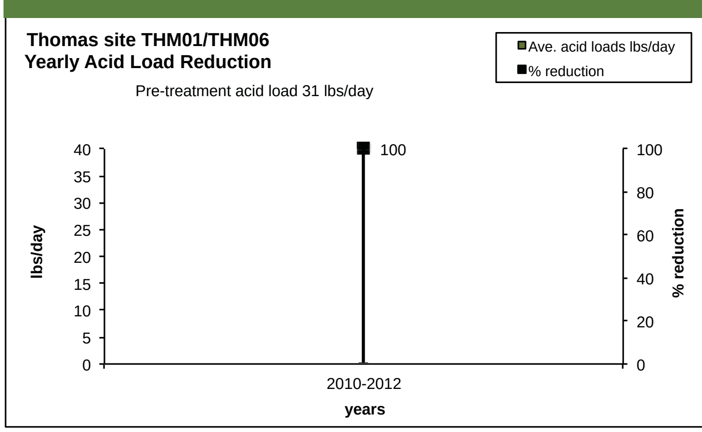


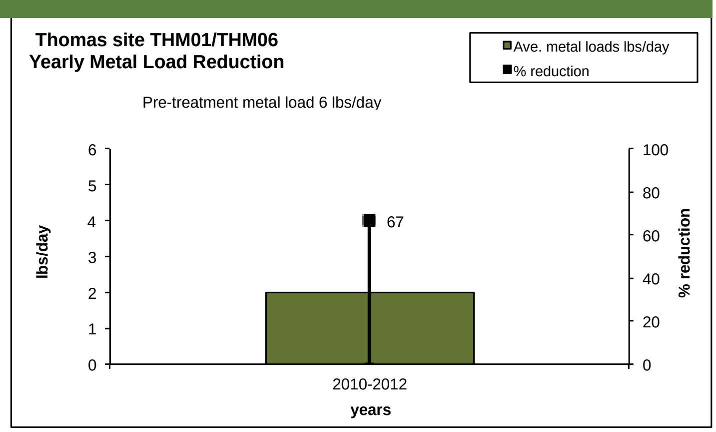
Belden site BLD01



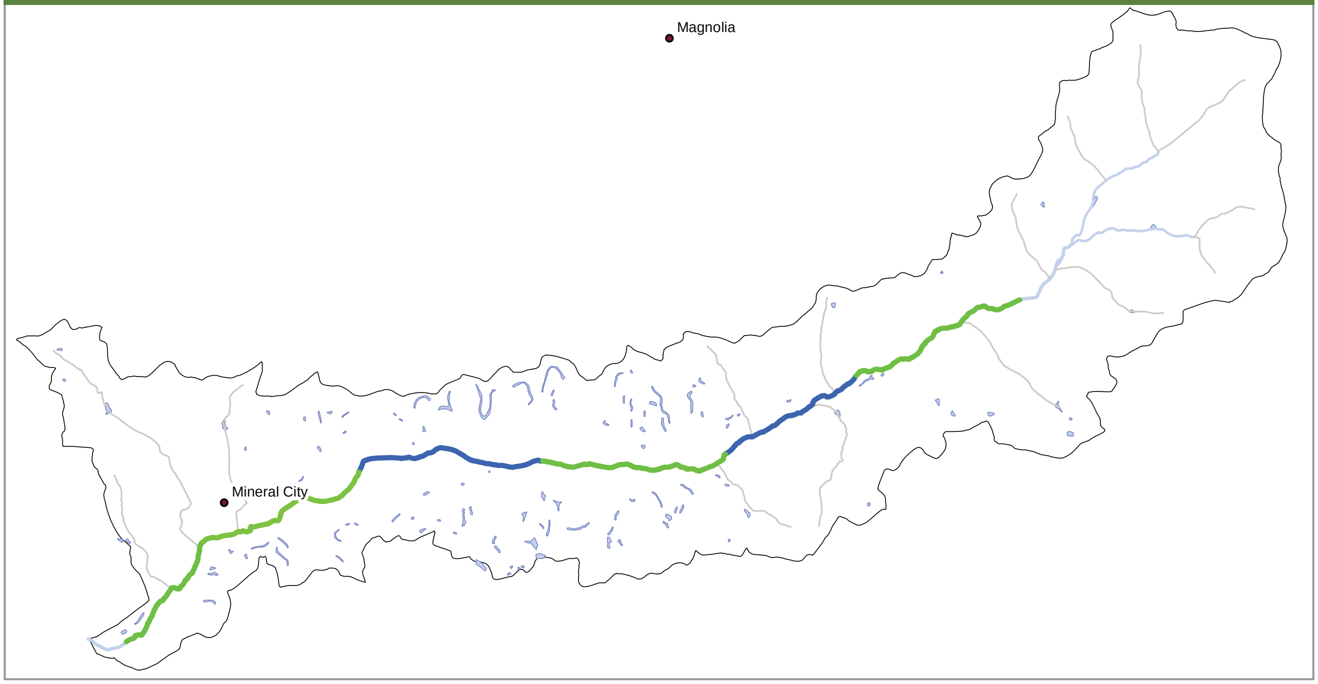


Thomas site THM01/THM06

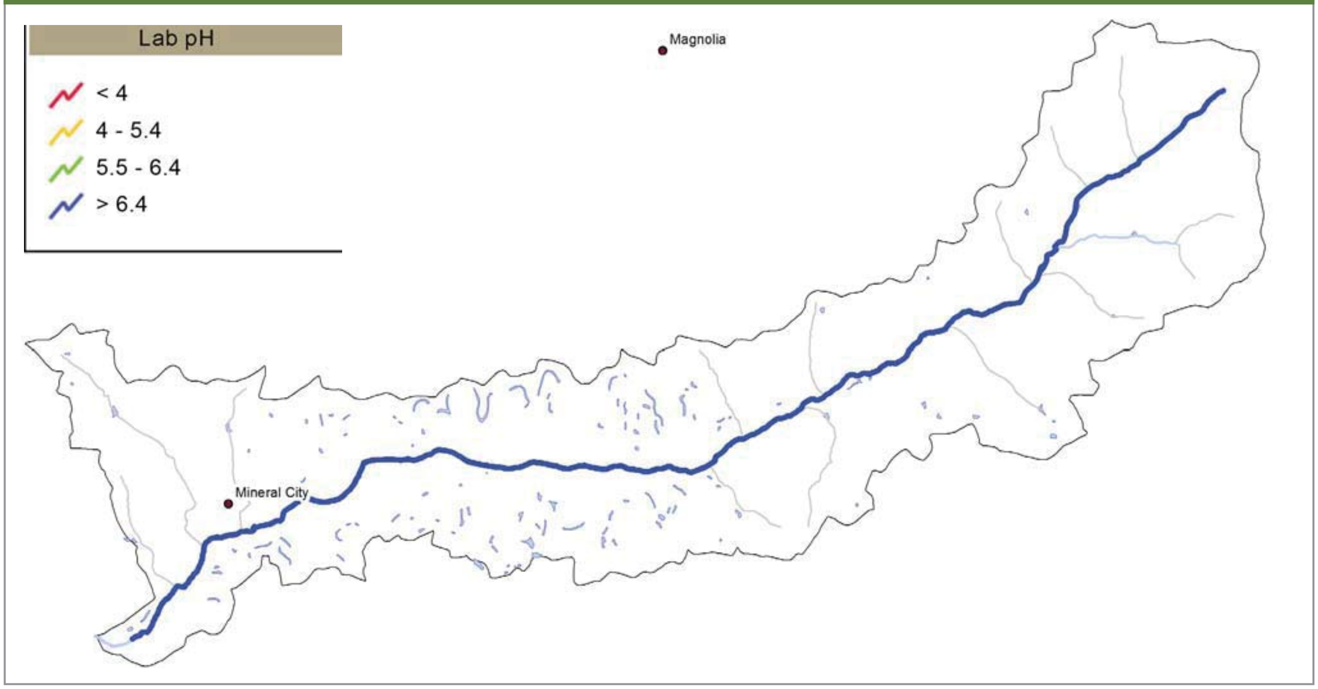




Huff Run baseline pH



Huff Run 2012 pH

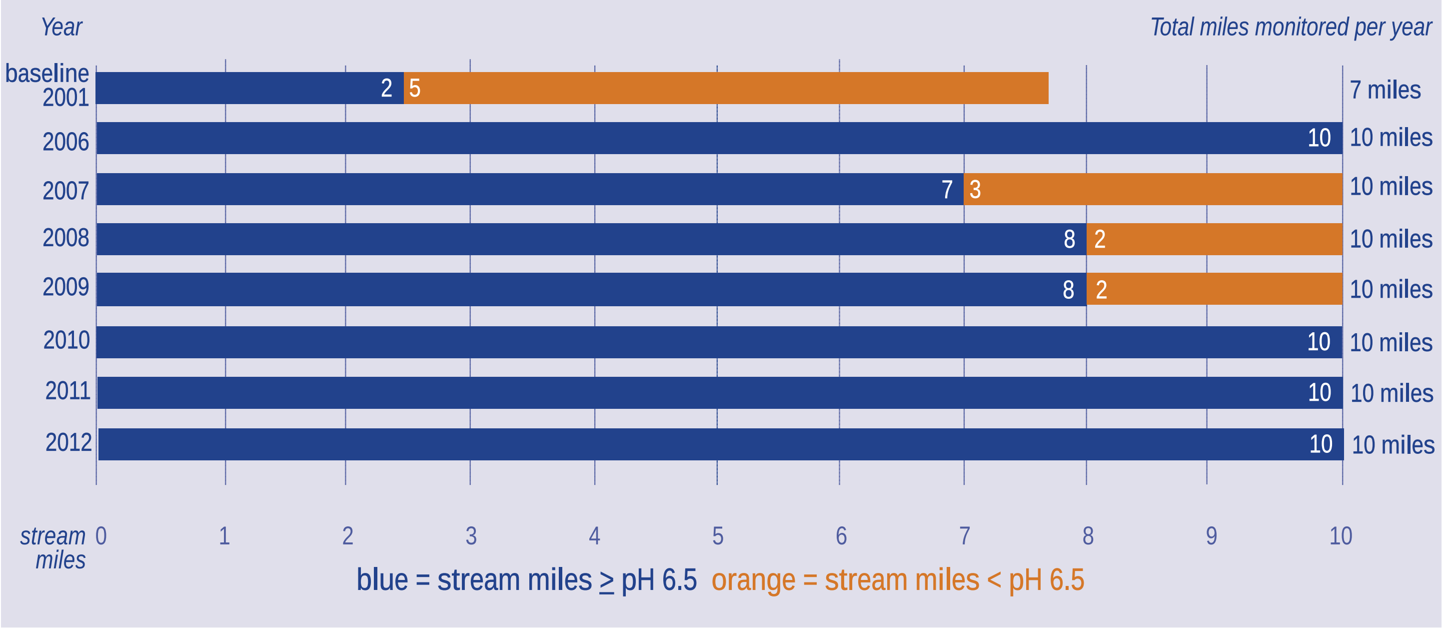


Huff Run pH values have improved from baseline conditions (1985-1998) to 2012. The entire length of Huff Run has met the pH target (6.5) for the last three years.

Chemical Water Quality

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. Since 2010 to 2012, all 10 miles met the pH target (Figure 1).

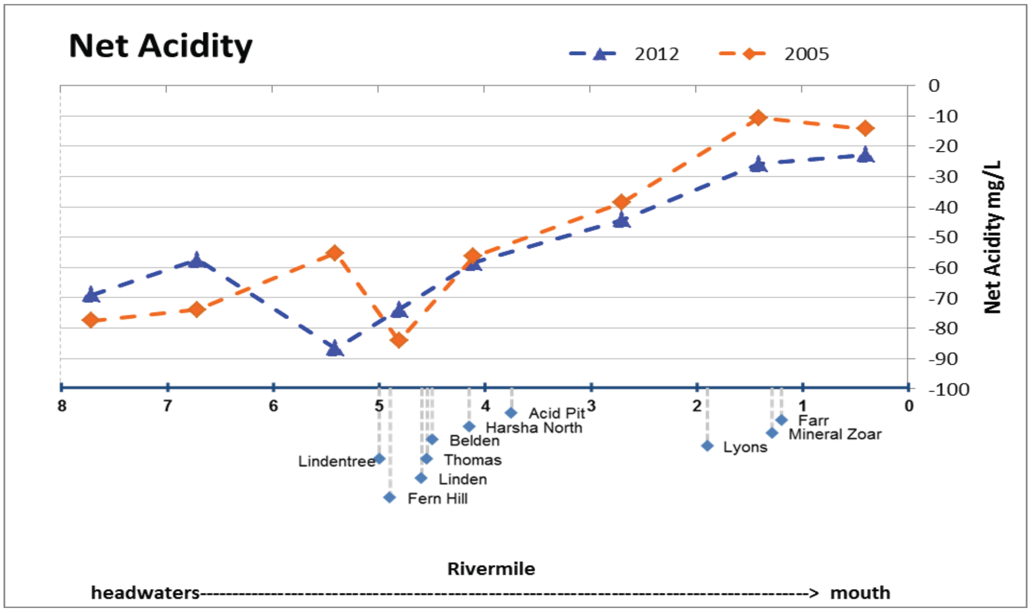
Figure 1. Huff Run pH

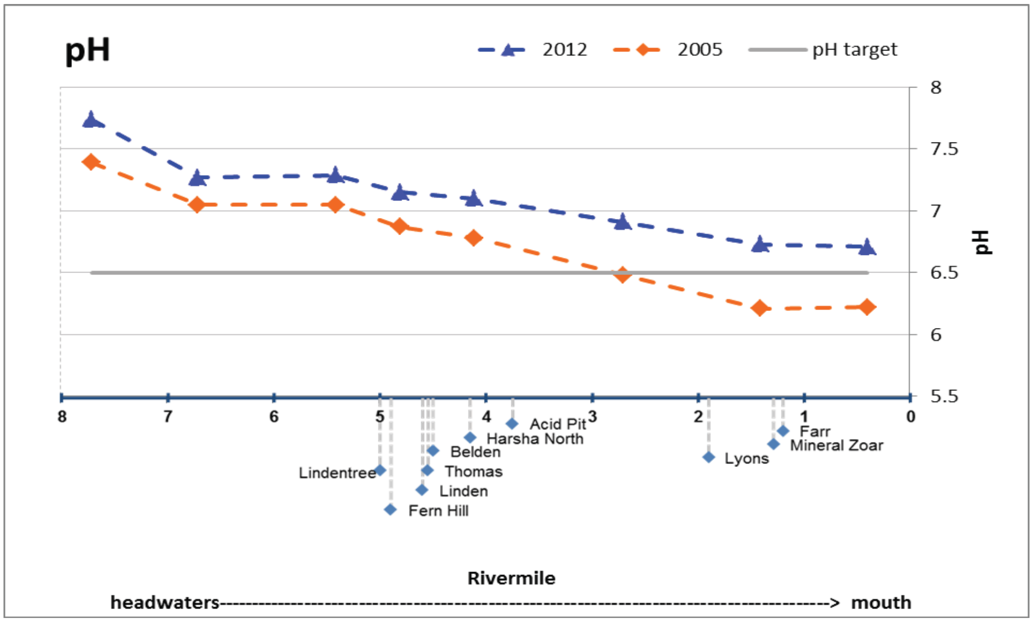


Chemical water quality analysis per stream reach

Chemical water quality changes along the mainstem of Huff Run are shown in the stream reach graphs below. Chemical long-term monitoring data is utilized to generate line graphs along the stream gradient from headwaters to the mouth. Along the x-axis named tributaries are shown to illustrate sources of water entering the mainstem. A list of long-term monitoring sites utilized to generate the graphs with their river miles are shown below.

Huff Run	
Site ID	Rivermile
HRR01	7.7
HRR02	6.7
HRR03	5.4
HRR04	4.8
HRR05	4.1
HRR06	2.7
HRR07	1.4
HRR08	0.4





Huff Run	
Site ID	Rivermile
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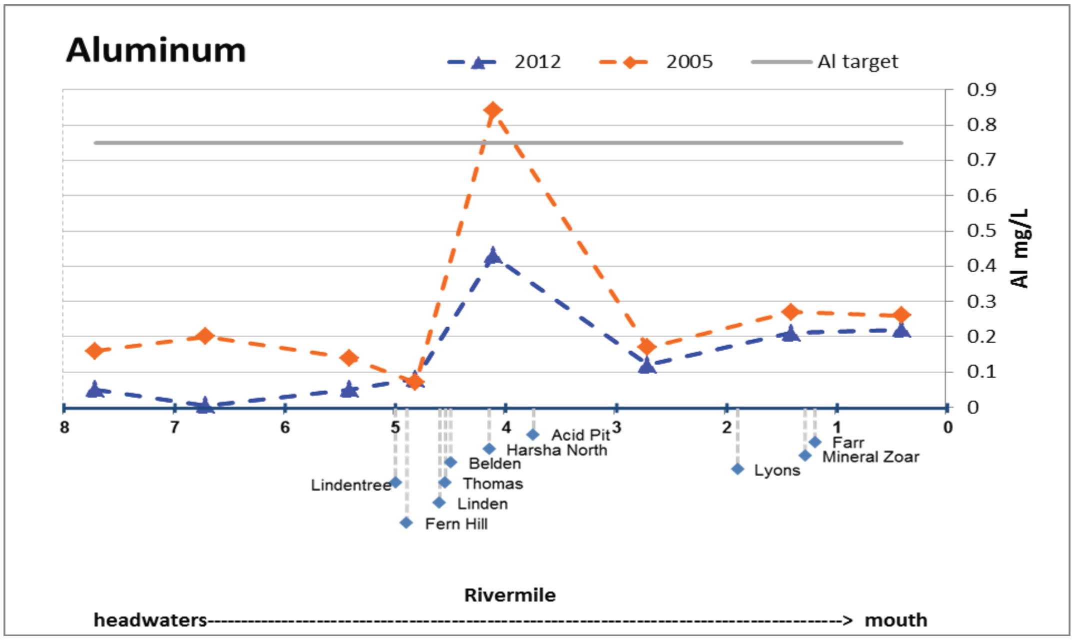
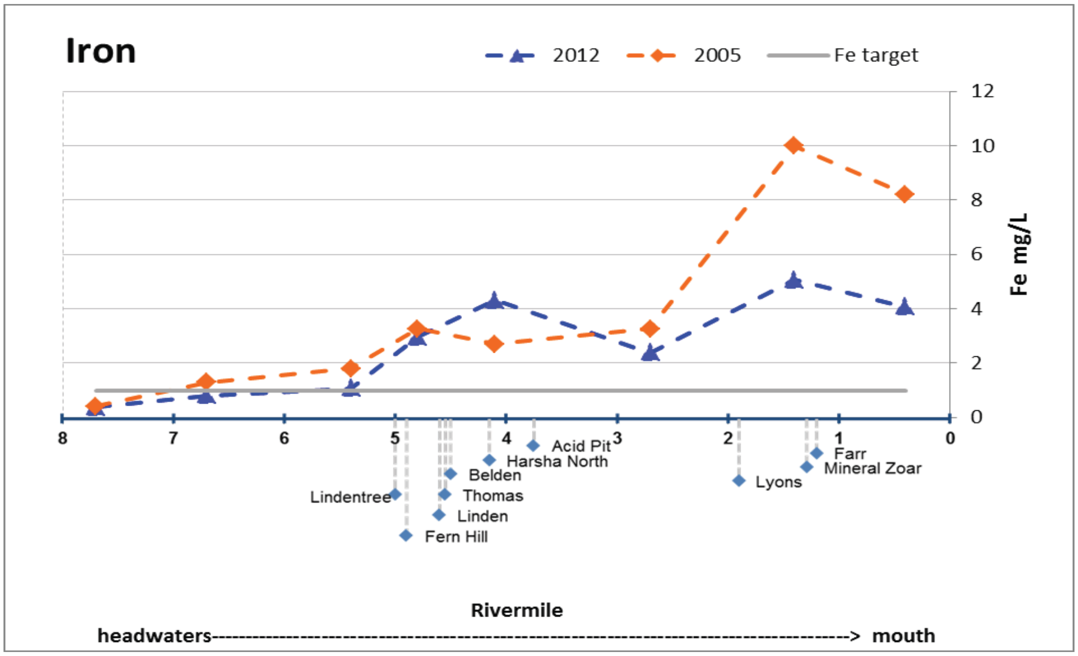
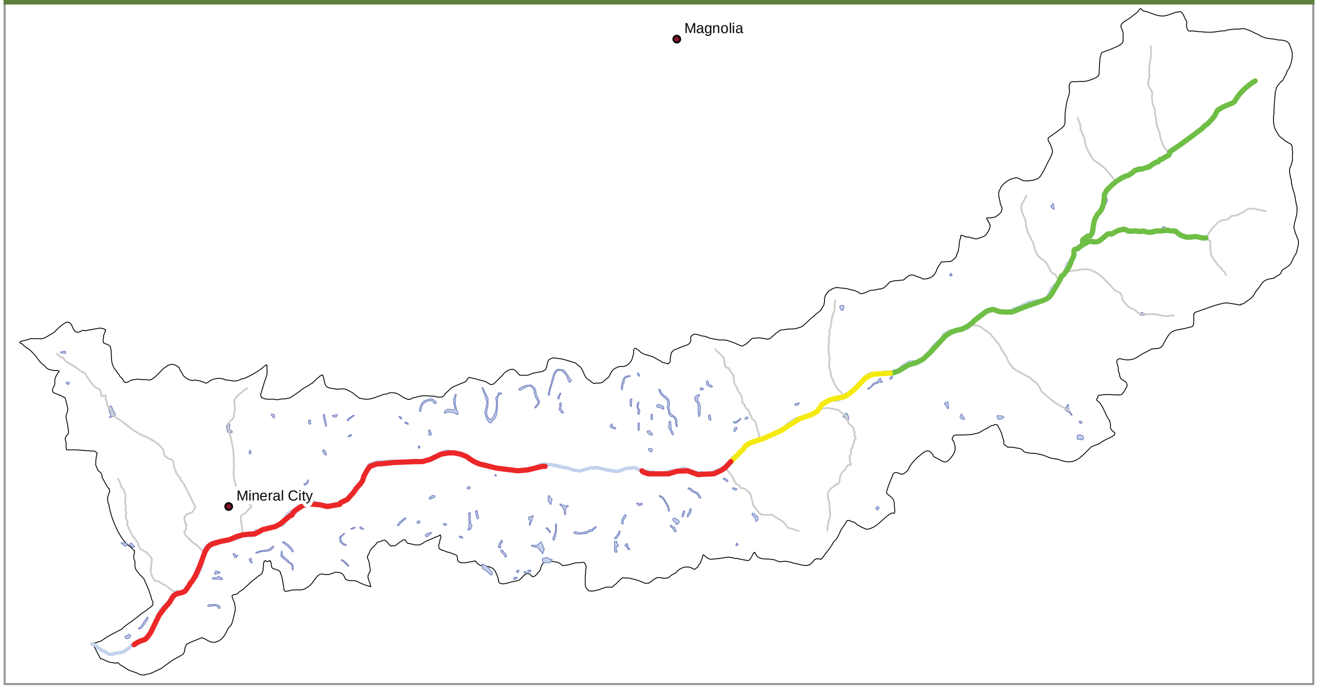
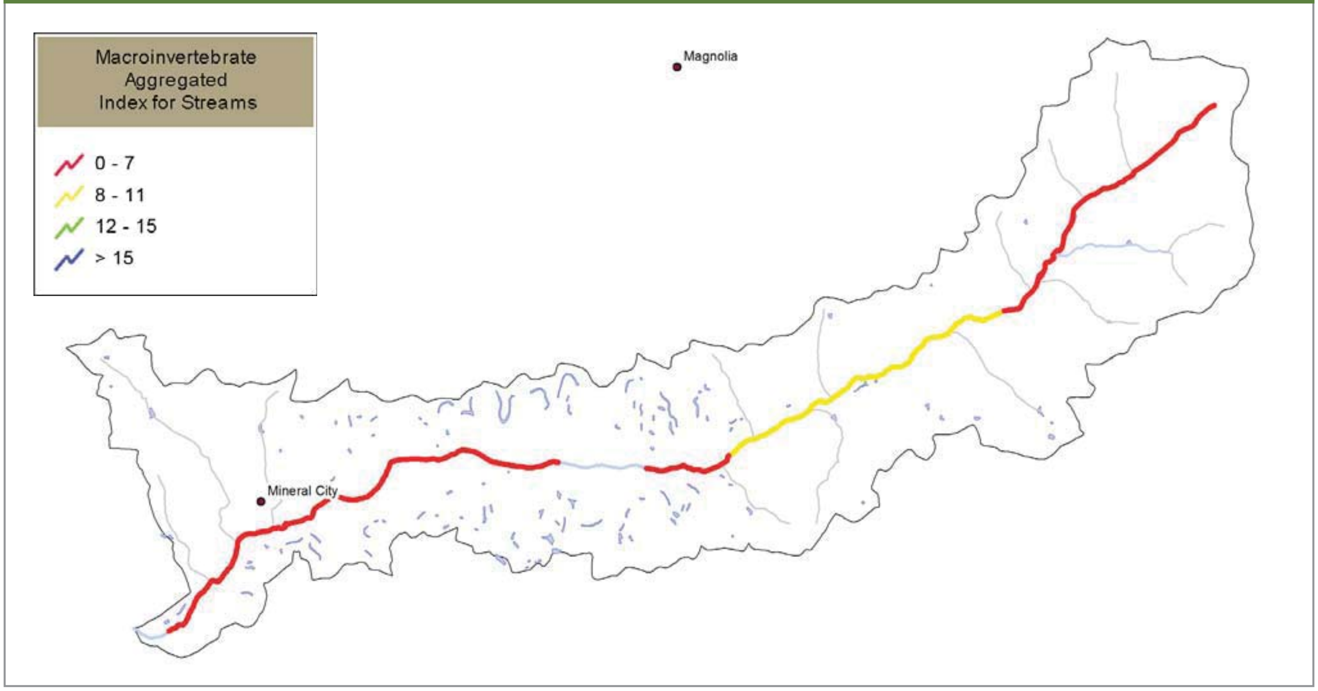




Huff Run baseline MAIS



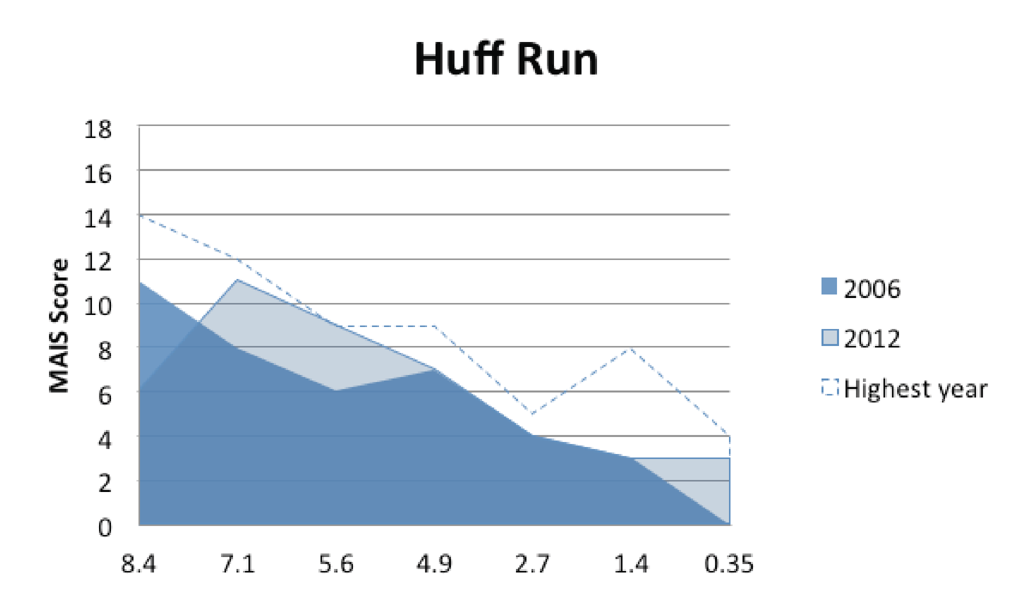
Huff Run 2012 MAIS



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

Biological quality in Huff Run (based on macroinvertebrate data) declines from the headwaters to the mouth (Figure 2). Although several stations have shown transient improvements since 2006, these trends have not been sustained long enough to reach statistical significance in 2012 (Figure 3). Based on past highest year scores, virtually all sites have potential for additional improvement, but only the two uppermost headwater sites have achieved the target MAIS score of “12” in the past 8 years of monitoring. This year, the uppermost headwater site (RM 8.4) had an unusually low score of “6”, compared to its usual average score of 12-13, because a key section of forested habitat at one end of the designated reach was inadvertently not sampled in

Figure 2. Area of Degradation



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

Figure 3. Huff Run MAIS Regressions

RM	2005	2006	2007	2008	2009	2010	2011	2012	Linear trends	R square	P-value	Years
8.4	14	11	12	12	13	9	13	6	no change	0.365	0.112	8
7.1	12	8	8	8	9	11	11	11	no change	0.099	0.448	8
5.6	8	6	7	6	8	9	7	9	no change	0.238	0.220	8
4.9	6	7	9	8	9	9	6	7	no change	0.004	0.874	8
2.7	5	4	5	3	4	5	3	4	no change	0.148	0.347	8
1.4	2	3	3	2	8	2	2	3	no change	0.005	0.866	8
0.35	3	0	4	3	4	3	3	3	no change	0.093	0.464	8

Reductions

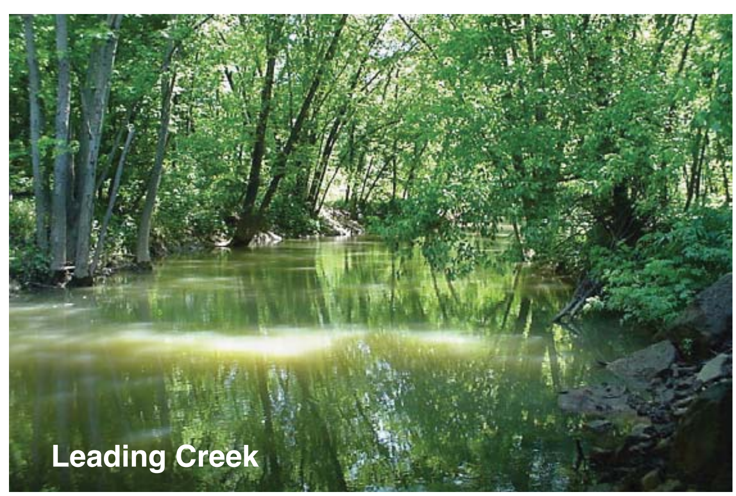
Total acid load reduction = 661lbs/day

Costs

Design $8,201

Construction $407,23

Total 2012 Costs $415,437



Timeline of the Leading Creek Watershed Project Milestones & AMD Projects

1993	• SOCCO mine release into Leading Creek
1994	
1995	• Mother's Day Flood
1996	
1997	
1998	• Leading Creek Improvement Plan by Dr. Cherry completed
1999	• USFWS began working with Meigs SWCD on watershed projects
2000	
2001	• First Leading Creek Stream Sweep conducted
2002	
2003	• Meigs SWCD Conservation Area purchased along Little Leading Creek • Meigs SWCD obtained first watershed coordinator grant
2004	
2005	• Leading Creek Watershed Management Plan completed
2006	• Pauline Atkins Memorial Trail completed • Leading Creek AMDAT Plan completed
2007	
2008	• Leading Creek TDML Report completed
2009	• Leading Creek Water Trail established • First AmeriCorps volunteer dedicated to the Leading Creek Watershed
2010	• Leading 'From the Past' book completed • Leading Creek Volunteer Monitor Program begun
2011	• Freshwater mussels reintroduced
2012	• Thomas Fork Doser Project completed

Leading Creek Projects

Yearly acid and metal load reduction trends per project

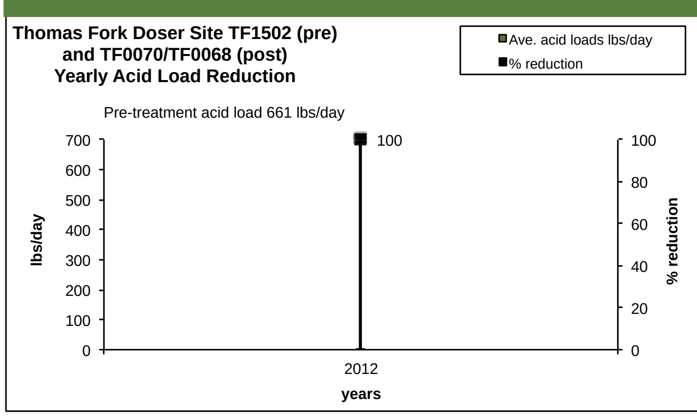
Acid mine drainage reclamation projects completed in Leading Creek Watershed:

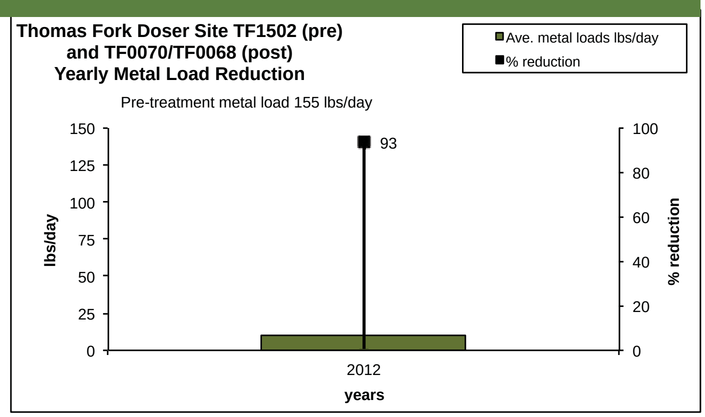
2012 Thomas Fork Doser

Yearly acid and metal load reduction trends per project

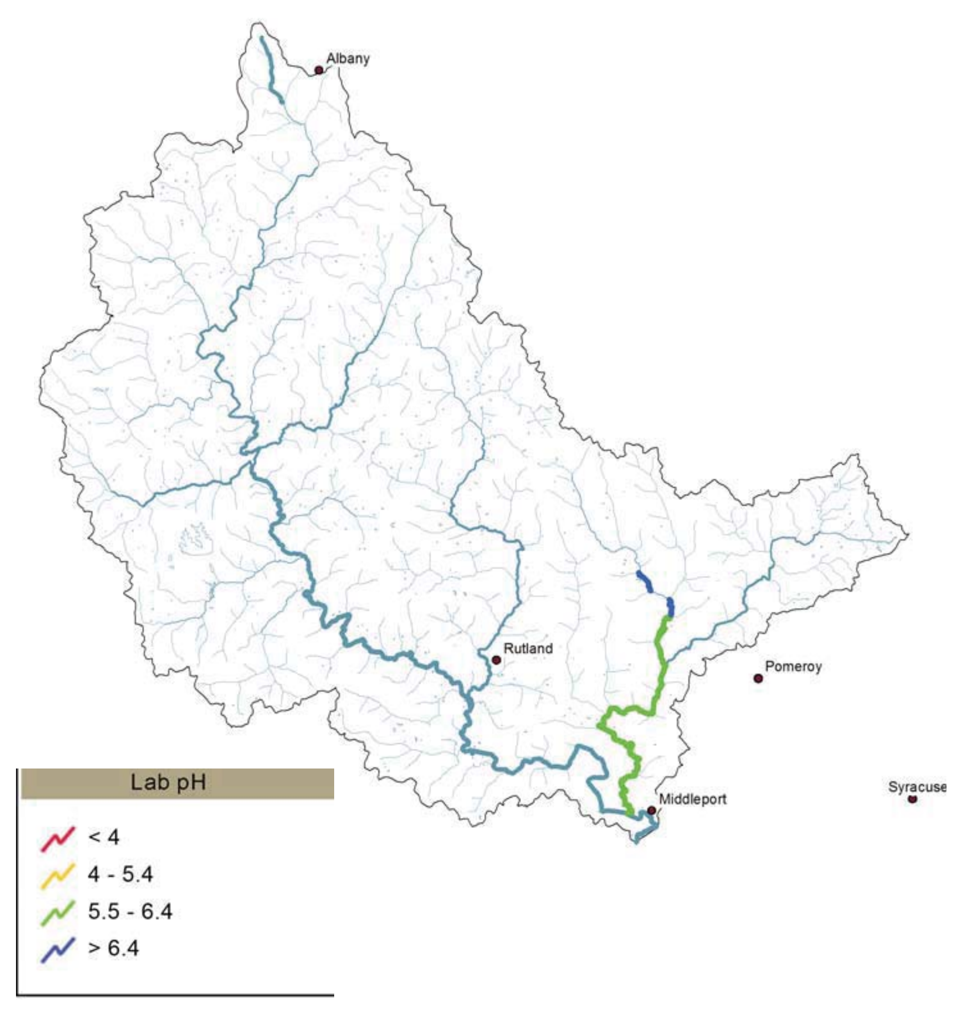
Similar to other environmental best management practices (BMPs), performance of passive acid mine drainage reclamation projects are also expected to decline with time. Active treatment systems are not expected to decline with time but sometimes need maintained to perform adequately. Currently, operation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

Thomas Fork Doser Site TF1502 and TF0070/TF0068



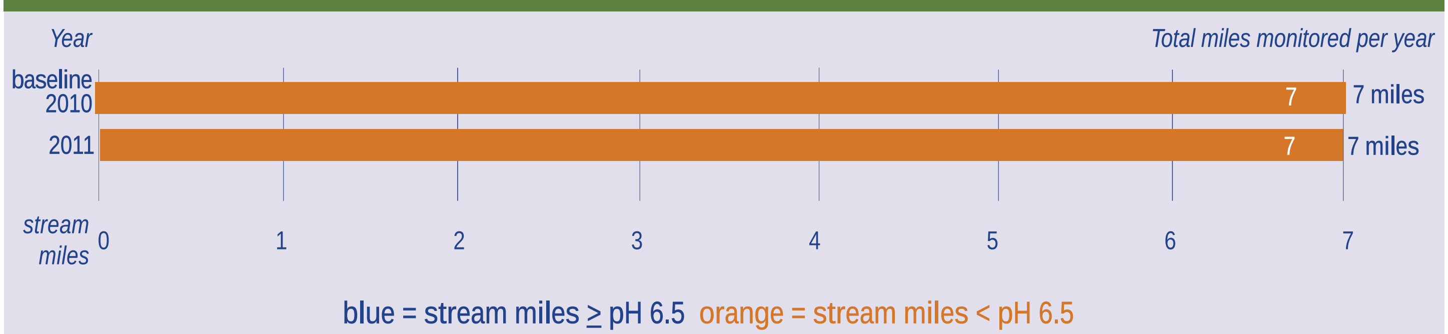


Leading Creek baseline pH



In Thomas Fork pH values on average along the mainstem do not meet the pH target of 6.5 from the 'unnamed tributary' downstream to the mouth (figure 1).

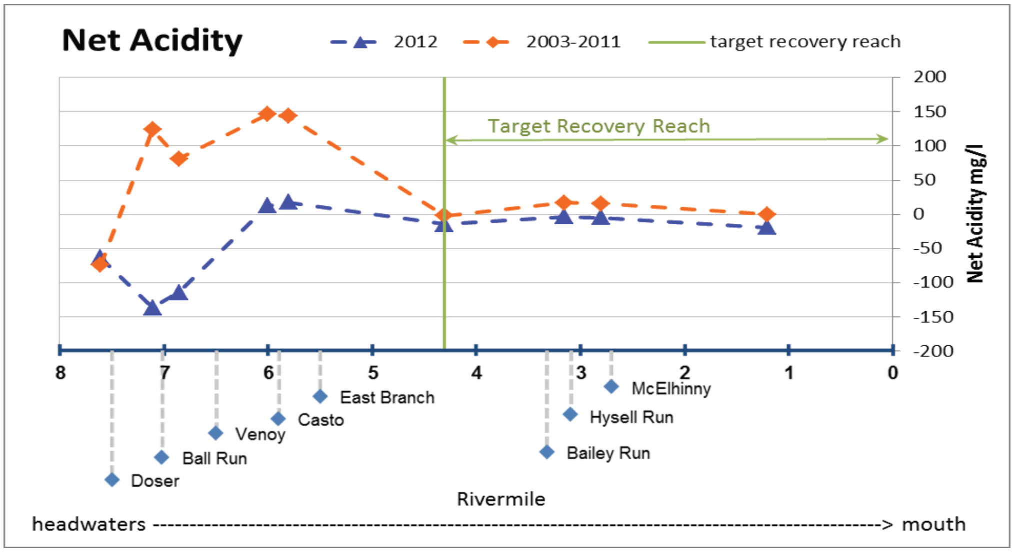
Figure 1. Thomas Fork total stream miles monitored for pH through time

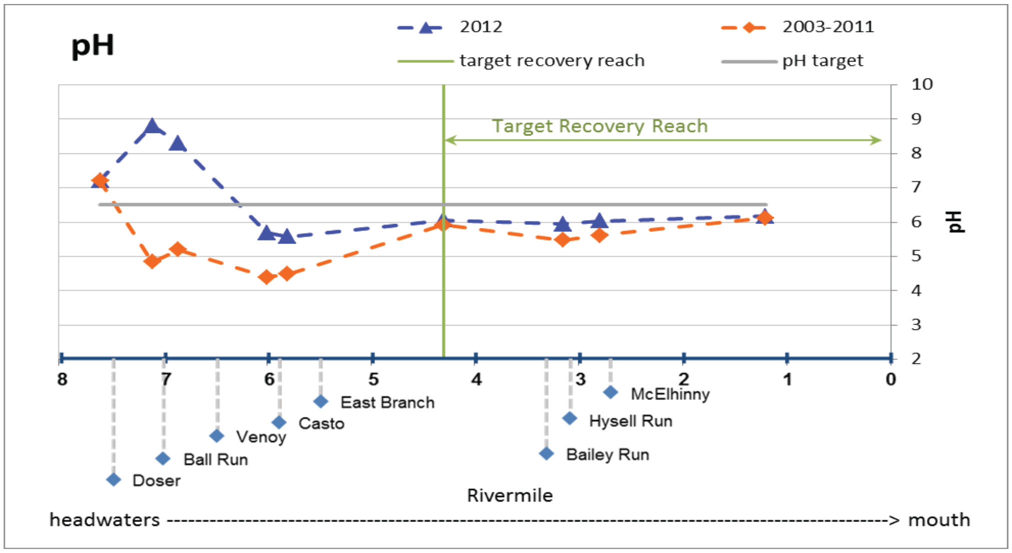


Chemical Water Quality

Chemical water quality changes along the mainstem of Thomas Fork are shown in the stream reach graphs below. Chemical long-term monitoring data is utilized to generate line graphs along the stream gradient from headwaters to the mouth. Along the x-axis named tributaries are shown to illustrate sources of water entering the mainstem. A list of long-term monitoring sites utilized to generate the graphs with their river miles are shown below.

Leading Creek Watershed	
site ID	Rivermile
TF0071	7.6
TF0068	7.1
TF0064	6.85
TF0058	6
TF0050	5.8
TF0030	4.3
TF0020	3.15
TF0015	2.8
TF0010	1.2





Chemical Water Quality

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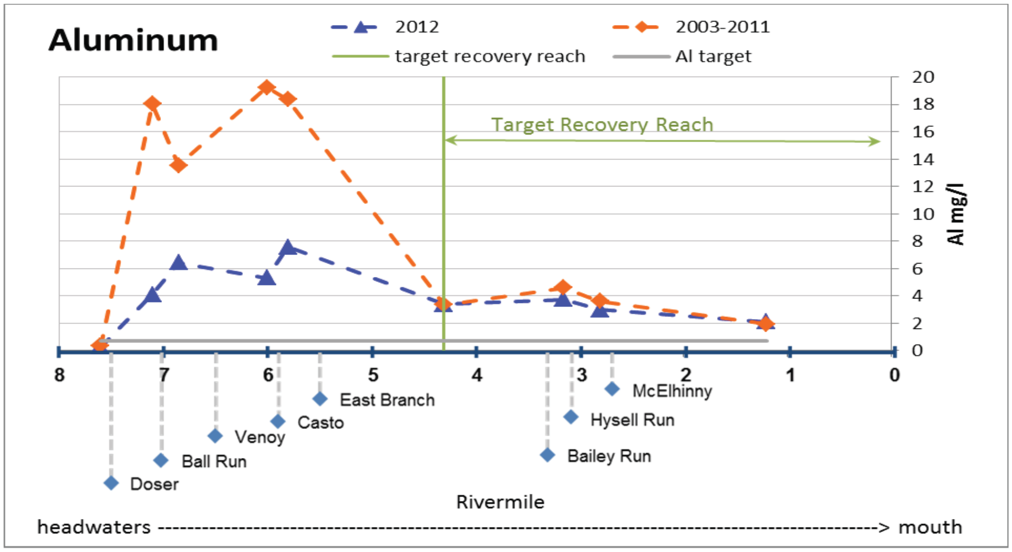
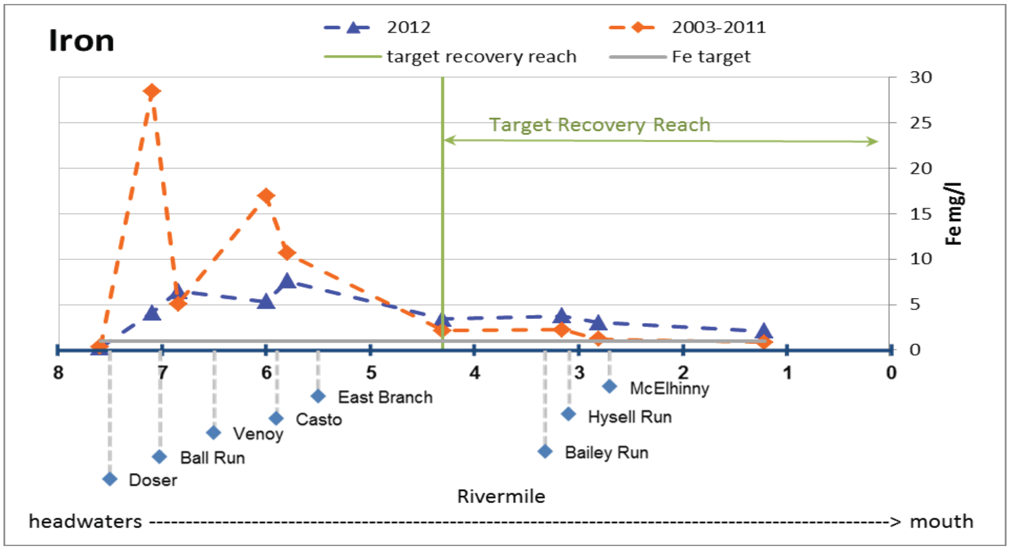
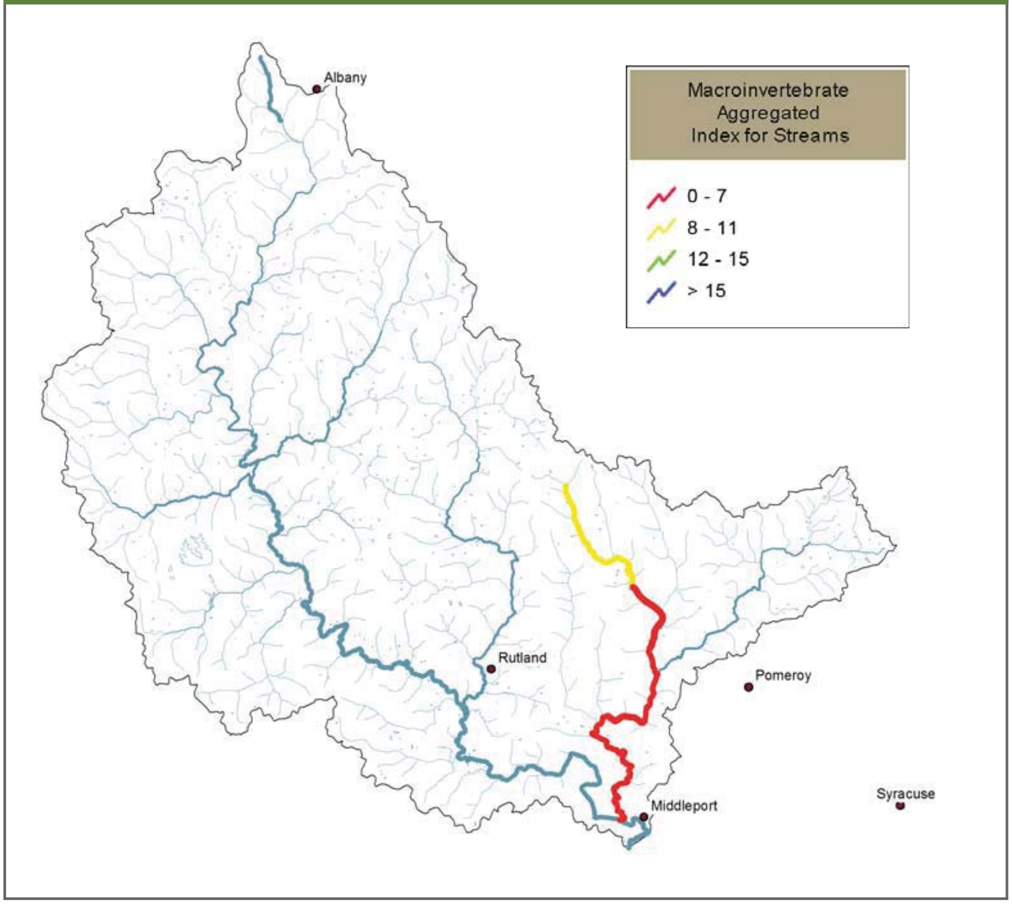




Leading Creek baseline MAIS



MAIS samples were collected along Thomas Fork a tributary to Leading Creek. These sites are along the mainstem at established long-term monitoring stations, collected from 2009 through 2012. A more in depth analysis of macroinvertebrate data (i.e. area of degradation and regressions) will be completed next year once five years of data have been collected.

References

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Kinney, Chad, 2006. A Comparison of Two Methods of Bioassessment in Streams. Master Thesis at Ohio University.

Kinney, Chad, and Ben McCament, 2010. Screening Guidelines for the Identification of Acid Mine Drainage (AMD) Impaired Watersheds and for Acid Mine Drainage Abatement and Treatment (AMDAT) Plan Selection and Prioritization. Ohio Department of Natural Resources – Division of Mineral Resources Management (ODNR-DMRM) Guidance Document

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

US Geological Survey (USGS), 2001. *Techniques for estimating selected streamflow characteristics of Rural, unregulated streams in Ohio.* Water-resources investigation report 02-4068. Columbus Ohio.

US Geological Survey (USGS) StreamStats website – flow characteristics http://water.usgs.gov/osw/streamstats version 2