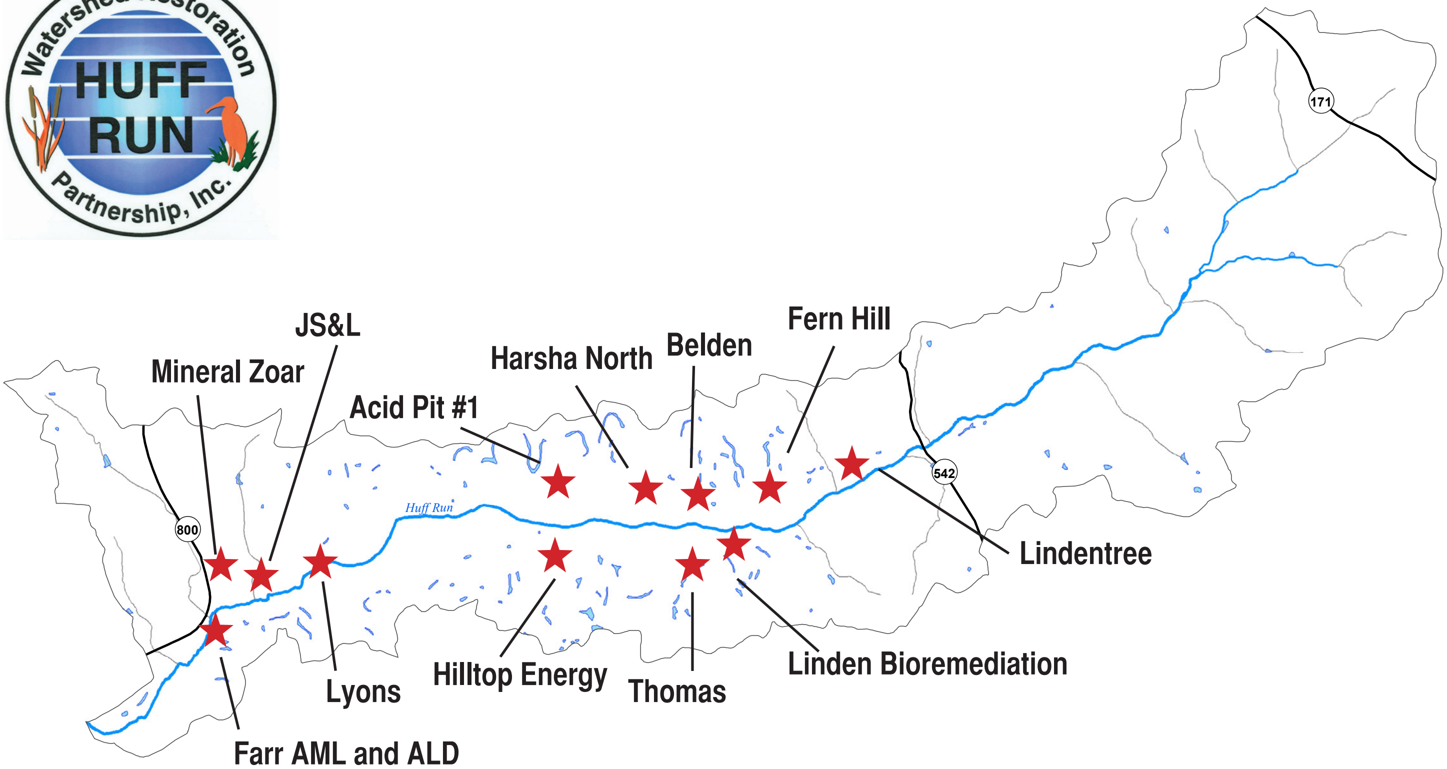
HUFF RUN
WATERSHED REPORT



Reductions

Total acid load reduction 2016 = 1,129 lbs/day

Total metal load reduction 2016 = 28 lbs/day

excluding Mineral Zoar and Farr

Acid and metal load reductions based on projects monitored during 2016 listed here: Lyons, Acid Pits, Belden, Fern Hill, Linden, Thomas, Harsha North, Lindentree, and Hilltop Energy.

Costs

Design $724,181
(excluding Linden Bioremediation and Lyons II)

Construction $4,584,172

Total cost through 2016 = $5,308,353

Timeline of the Huff Run Watershed Project Milestones & AMD Projects

1985	• Study funded by ODNR 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
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 member to Huff Run staff
2010	• Thomas Project, Fern Hill Pond A & Belden Gob pile constructed
2011	• Lyons II constructed
2012	• Hilltop Restoration Project started
2013	• Completed Hilltop Restoration Project • MWCD Partners in Watershed Management Grant awarded for environmental education and community outreach
2014	• Project development for JS&L AMD Reclamation Project and the Farr Phase II
2015	• Constructed JS&L AMD Restoration Project, funded by ODNR-DMRM and OEPA • Received $1.7M ODOT Mitigation
2016	• Huff Run Stream Mitigation project completed by Oxbow River & Stream Restoration, funded by ODOT.

Huff Run Projects

Acid mine drainage reclamation projects completed in Huff Run Watershed:

2003 *Farr Project* (FAR01/02) – Surface reclamation, limestone channels, anoxic limestone drains, and passive wetland*

Linden Bioremediation Project (LIN08) – Pyrolusite limestone bioremediation bed

2004 Acid Pit #1 Project (ACP01) – Drain impoundments and surface reclamation

2005 Lyons Project (LYN01) – Steel slag bed, limestone channels, drain impoundments, and surface reclamation

Lindentree Project (LNT01) – Steel slag bed, limestone channels, and fill acid pits

2006 Harsha North Project (HAN05) – Surface reclamation, limestone trenches, and reclaimed gob pile

2008 Fern Hill HR-42 Pits A, B, & C (FRN01) – Surface reclamation, limestone Channels and reclaim 3 acidic pits

Belden and Belden Gob Pile Project (BLD01) – Surface reclamation, steel slag beds, reclaim gob pile, and passive settling ponds

2009 *Mineral Zoar (MZR08) – Reverse alkaline producing systems (RAPS)*

2010 Thomas Project (LIN01/THM06) – Surface reclamation and passive settling ponds

2011 Lyons II maintenance Project (LYN01) – Additional steel slag installed, pipe clean-outs, and added limestone berms to settling pond

2013 Hilltop Energy Project (HRT21/HR37) – Reclaimed gob pile, surface reclamation, limestone channels, and settling pond

2015 JS&L AMD Reclamation (HR25) – Limestone channels, limestone leach bed and precipitation basin.

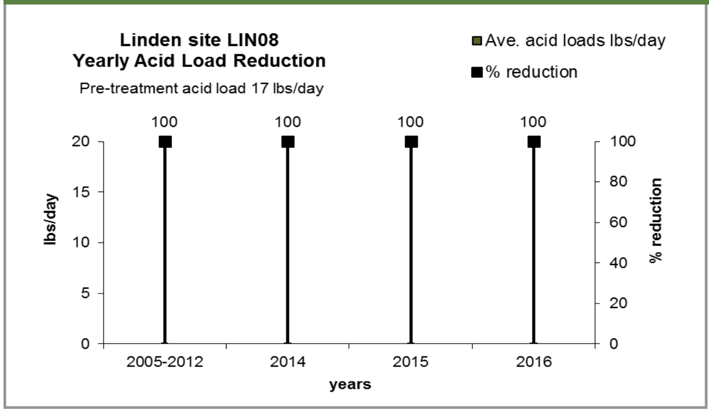
Italicized indicates projects are not actively monitored for acid and metal load reduction purposes

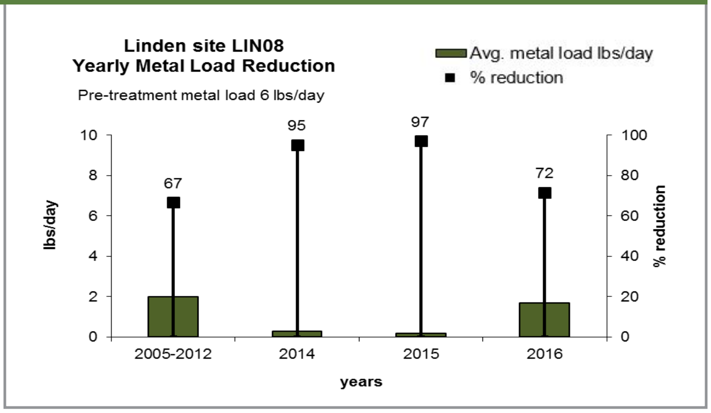
**Indicates no yearly trend graphs due to lack of pre or post data*

Yearly acid and metal load reduction trends per project

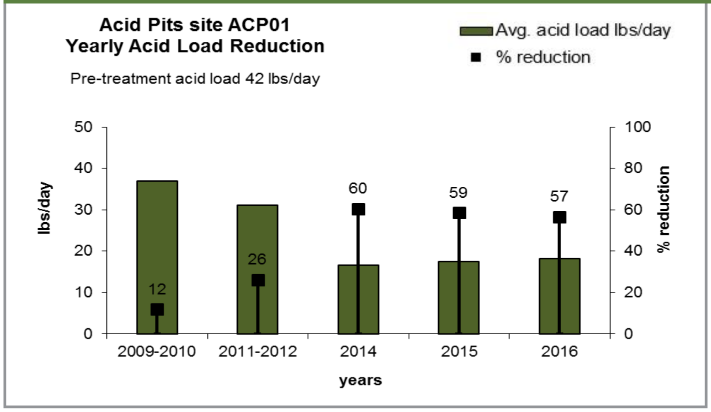
Similar to other environmental best management practices (BMPs), performance of passive acid mine drainage reclamation projects are also expected to decline with time. Active treatment systems are not expected to decline with time but sometimes need to be maintained to perform adequately. Currently, operation and maintenance plans are being designed for each existing system and are planned for future projects. The graphs below show the mean annual acid and metal load reduction using the Stoertz Water Quality Evaluation Method (Kruse et al., 2014) 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 is implied. Knowing the rate of decline will aid in the implementation of operation and maintenance plans.

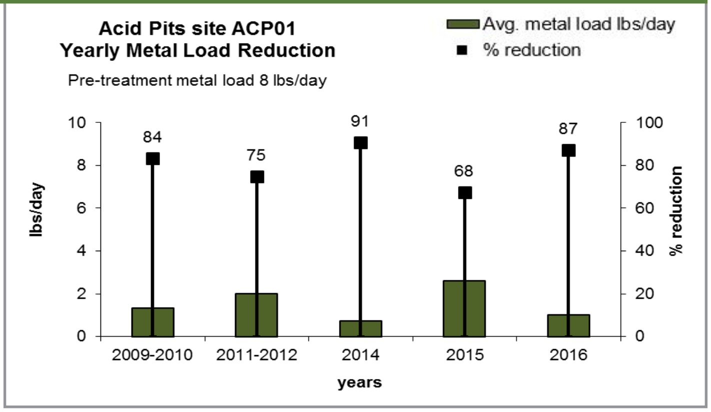
Linden site LIN08



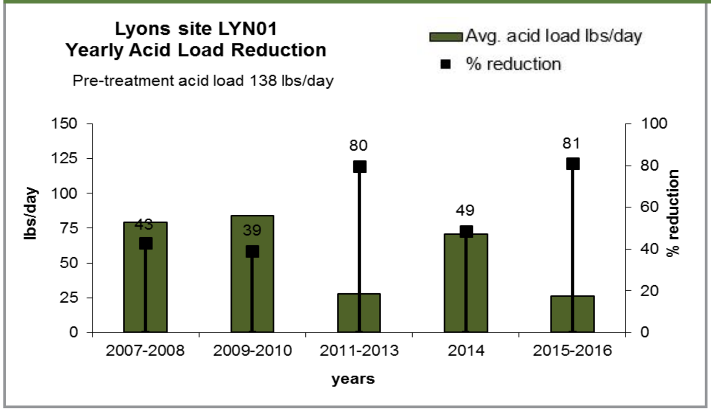


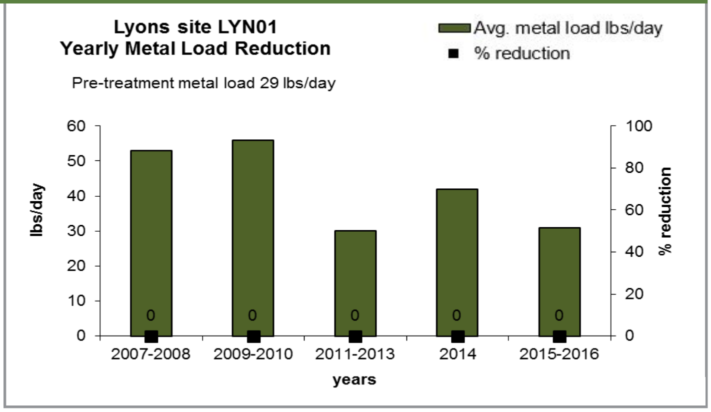
Acid Pits site ACP01





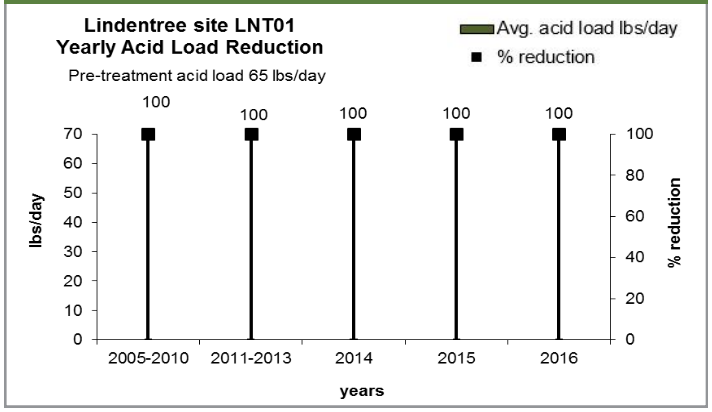
Lyons site LYN01



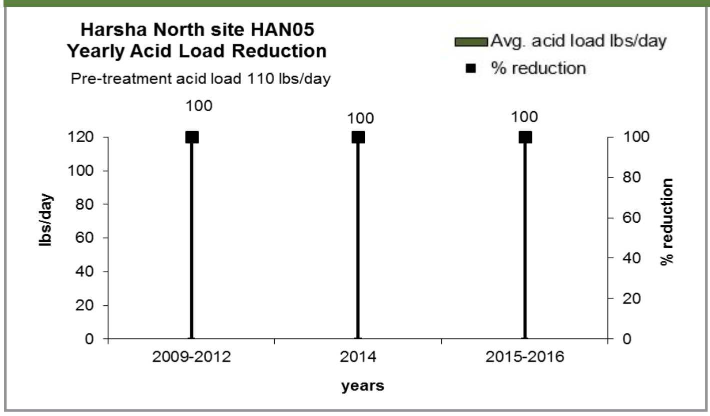


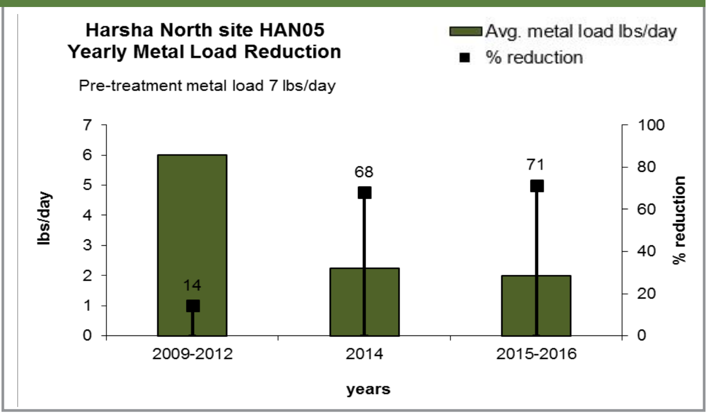
Yearly acid and metal load reduction trends per project

Lindentree site LNT01

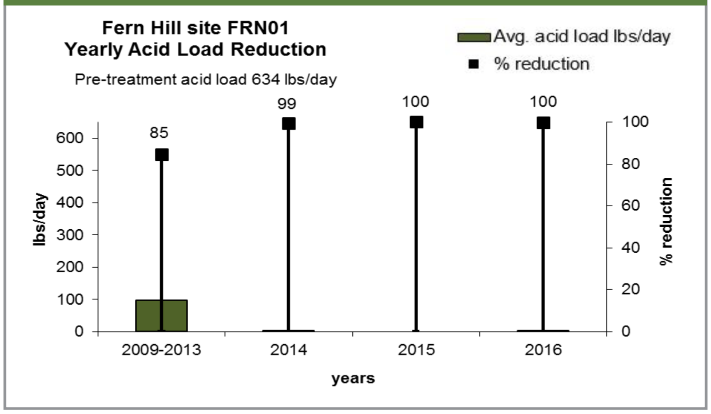


Harsha North site HAN05





Fern Hill site FRN01

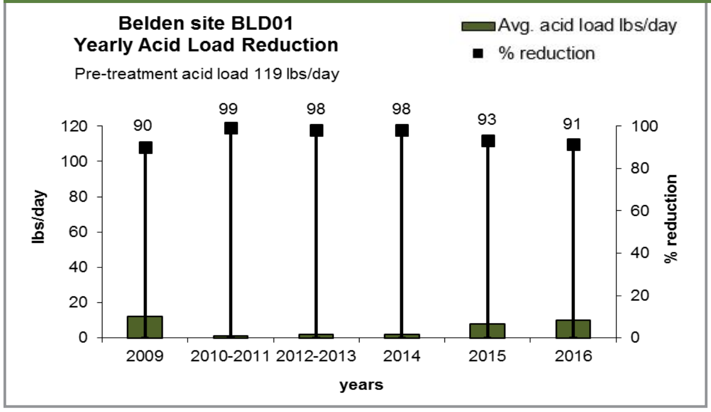


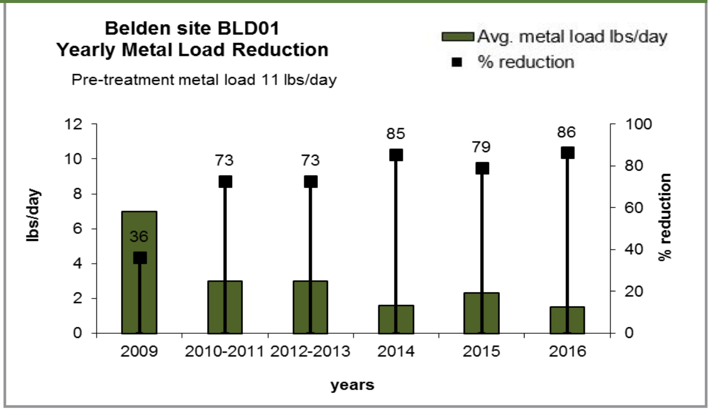
2016 NPS Report - Huff Run Watershed

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

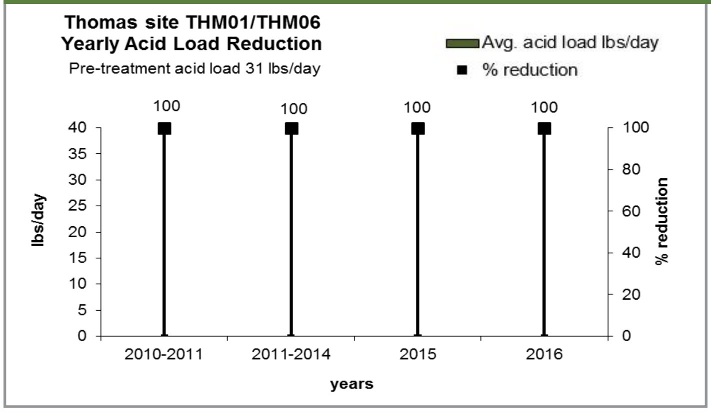
Yearly acid and metal load reduction trends per project

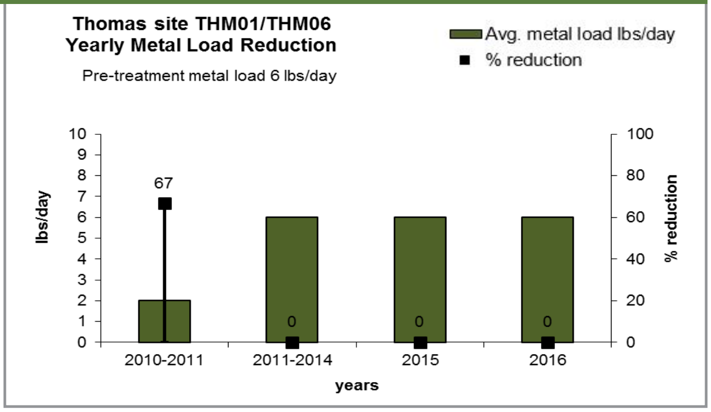
Belden site BLD01



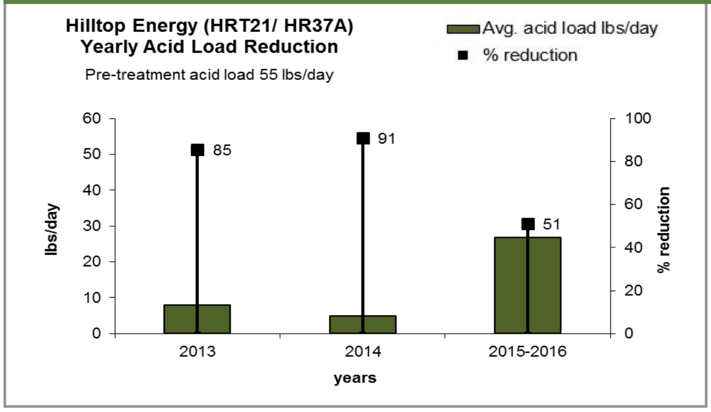


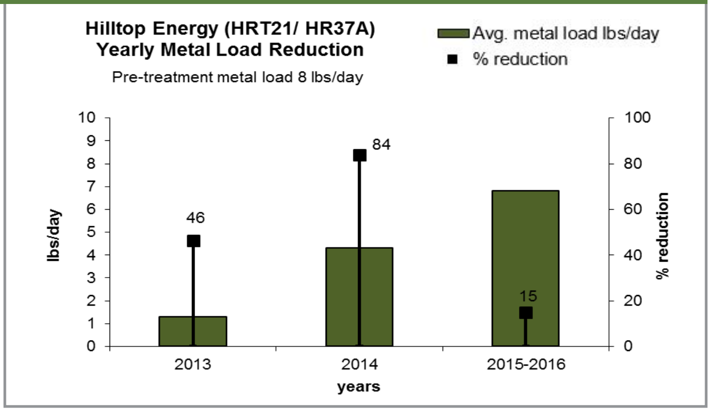
Thomas site THM01/THM06



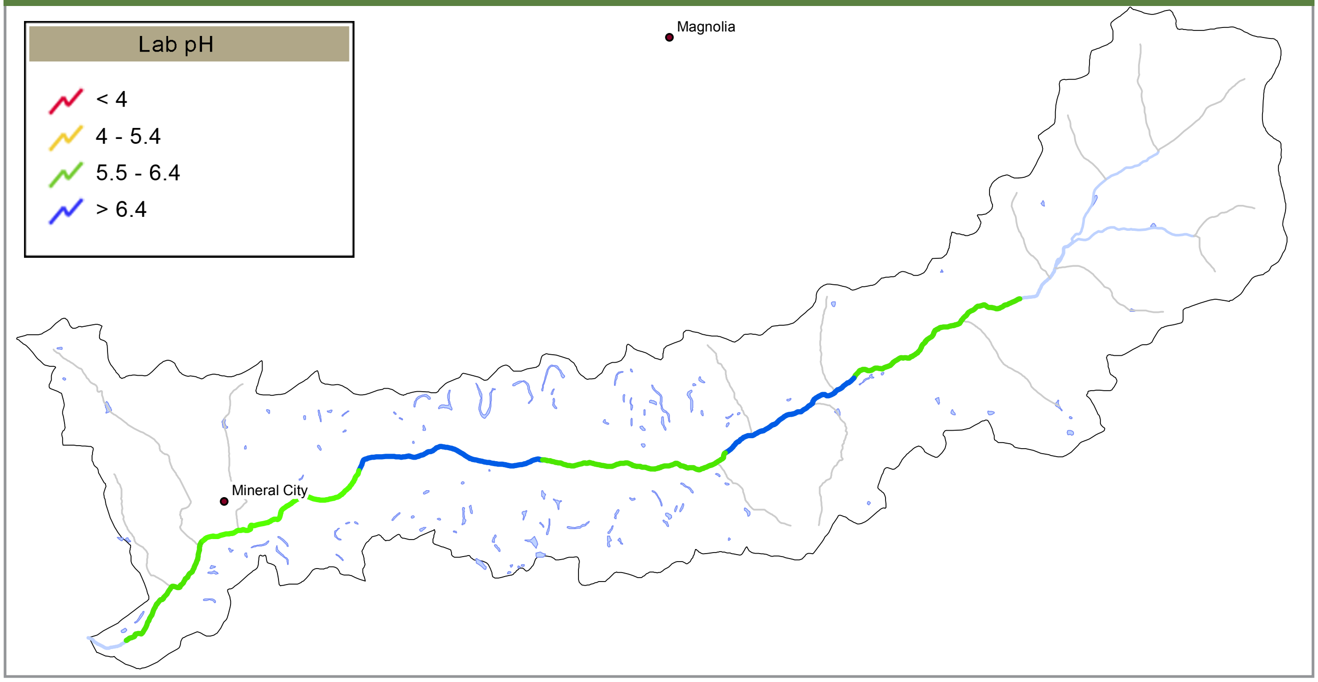


Hilltop Energy (HRT21/HR37A)

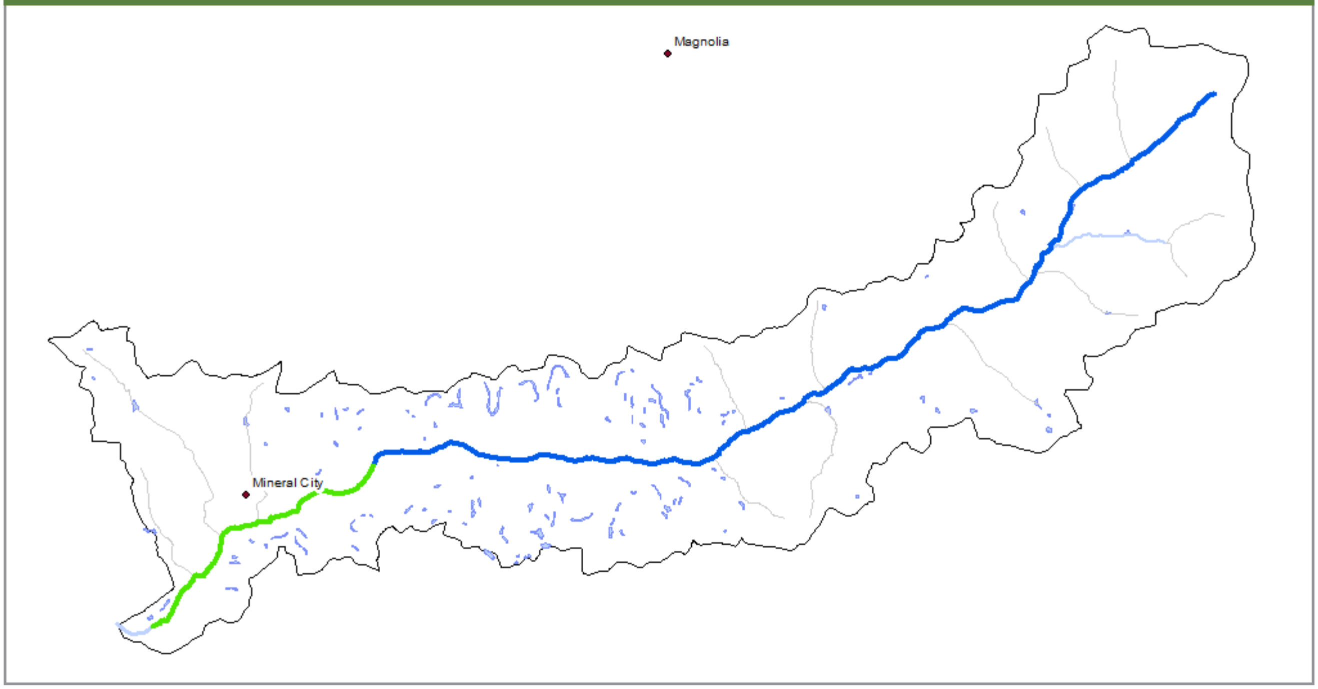




Huff Run baseline pH



Huff Run 2016 pH

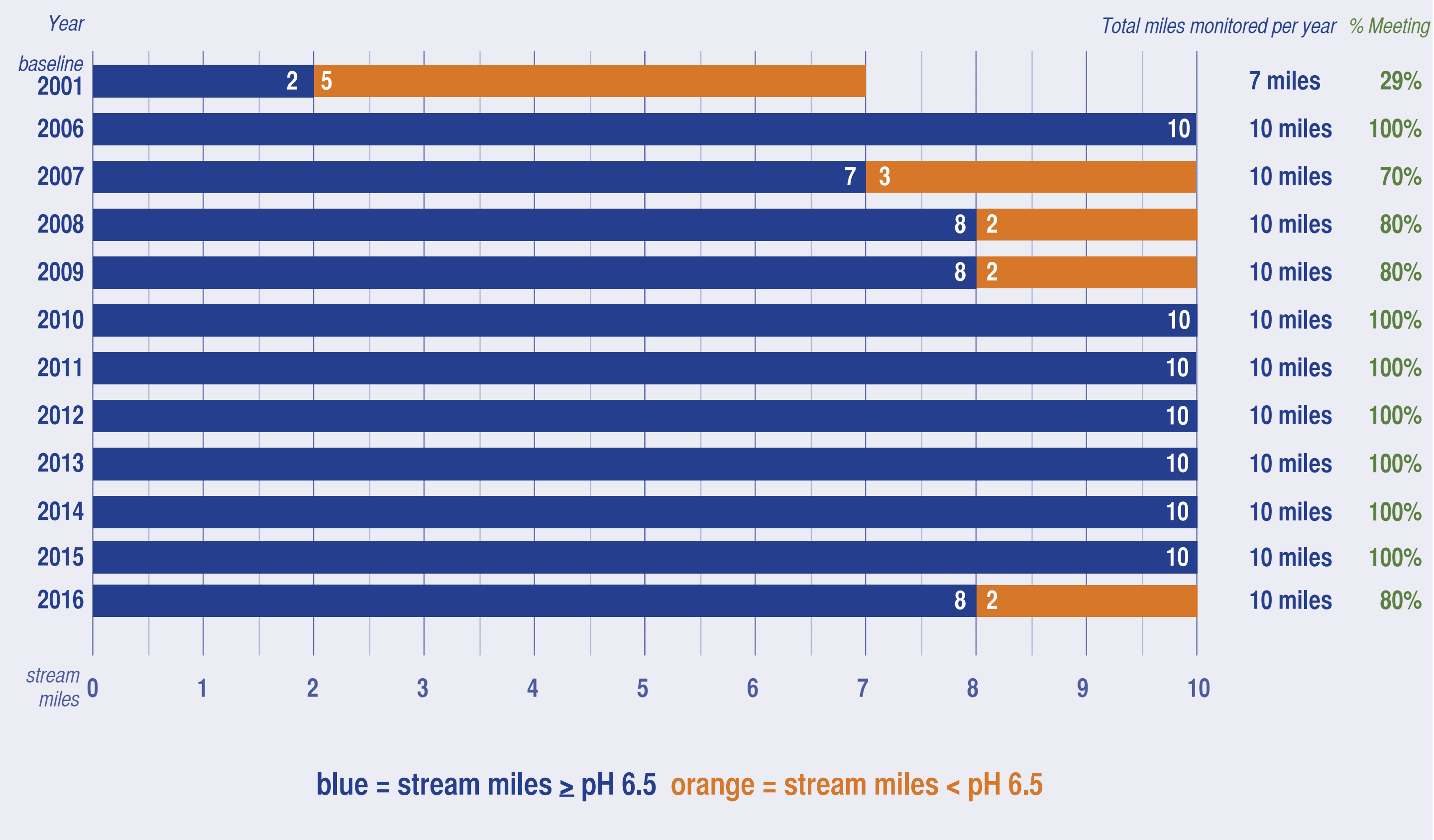


Huff Run pH values have improved from baseline conditions (1985-1998) to 2016. The mouth of Huff Run fell just below the pH target in 2016, leaving 7.8 miles of the upper part of Huff Run meeting the pH target of the 10 miles monitored.

Chemical Water Quality

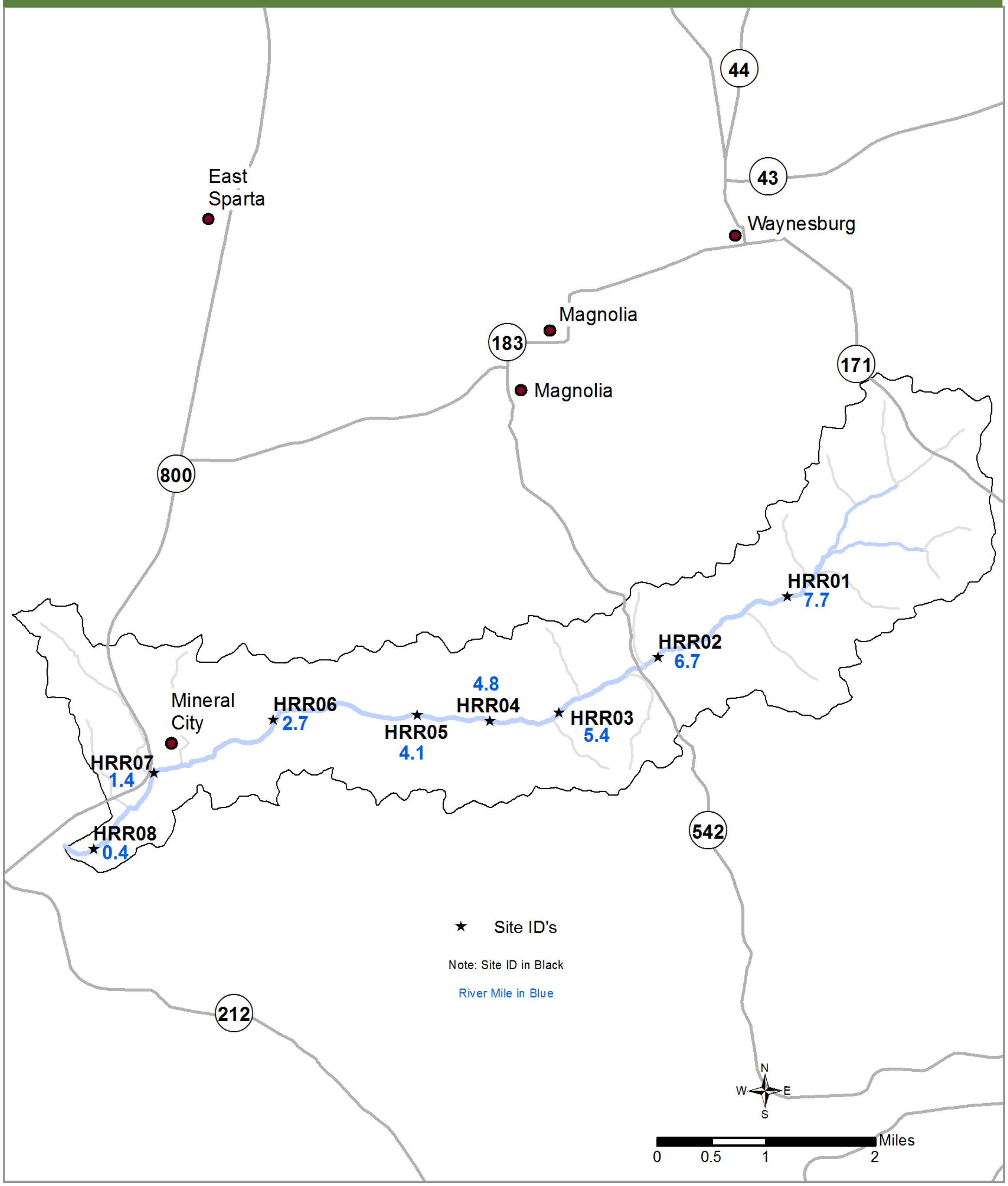
The mainstem of Huff Run is approximately 10 miles in length with monitoring occurring year round. In 2009, 8 miles met the pH target of 6.5 while the two downstream stream reaches (HRR08 and HRR07) fell slightly below the target with an average pH of 6.4. From 2010 to 2015, all 10 miles met the pH target. 2016 is similar to the 2008 and 2009 stream conditions where the mouth of Huff Run fell just below meeting the pH target leaving approximately 8 miles meeting and 2 miles slightly less than pH 6.5.

Huff Run pH



Chemical water quality analysis per stream reach

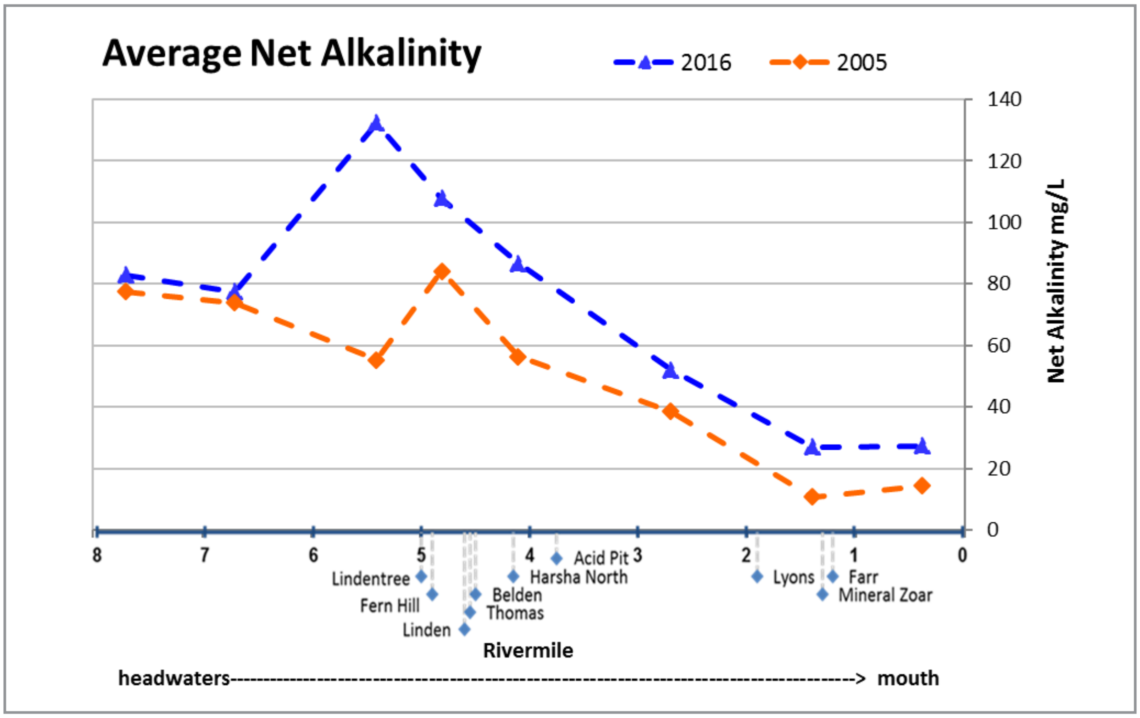
Huff Run

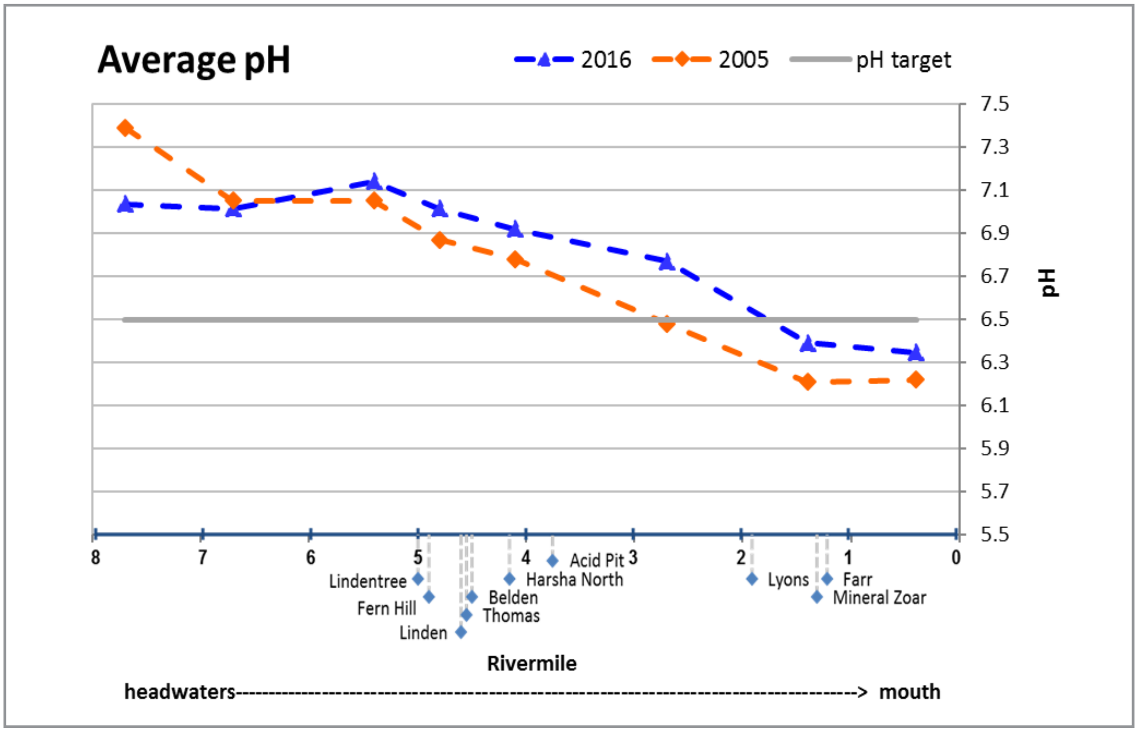


Chemical water quality analysis per stream reach

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





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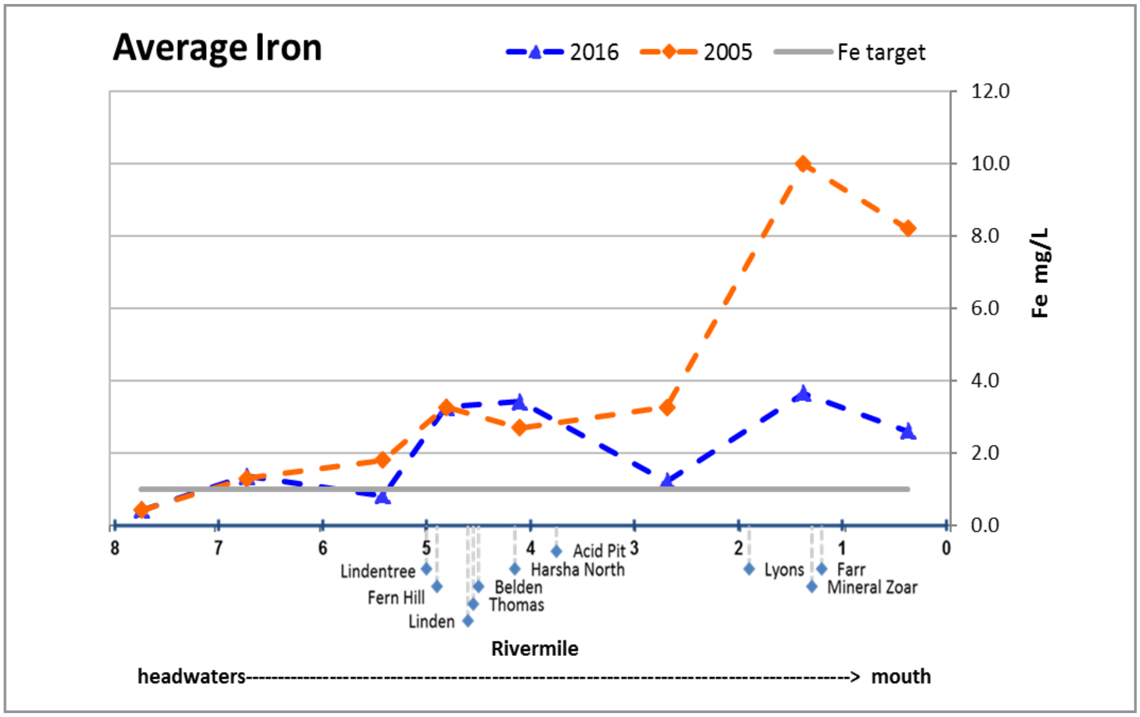
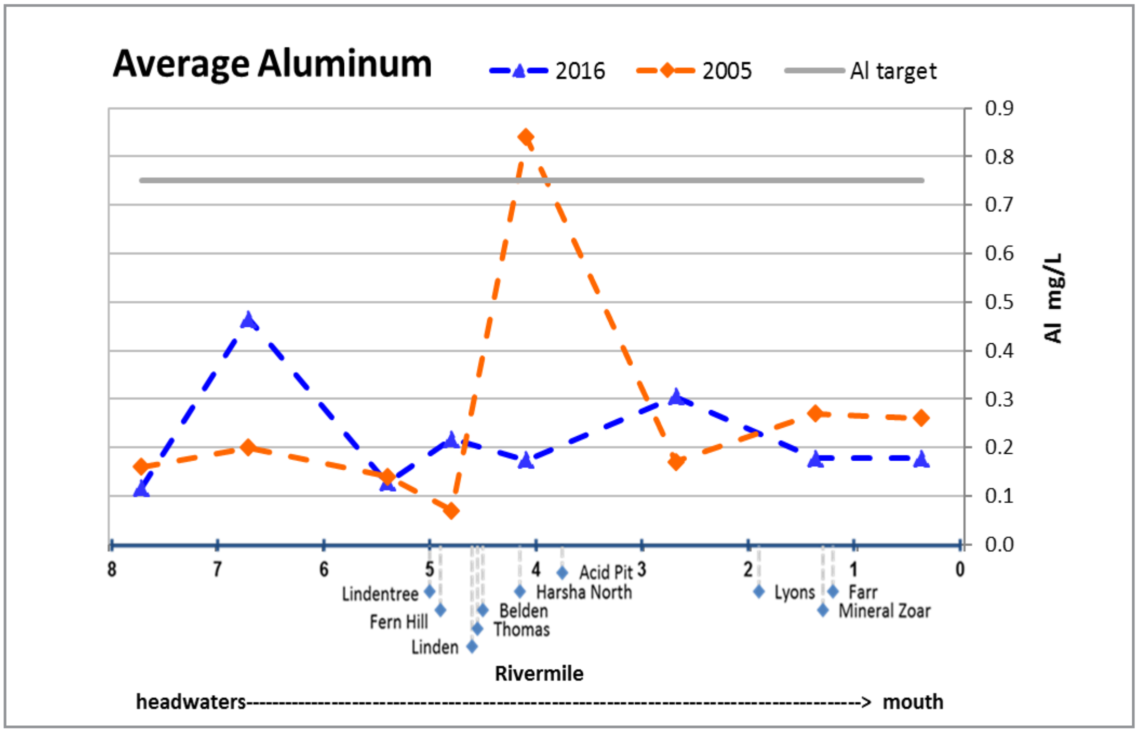
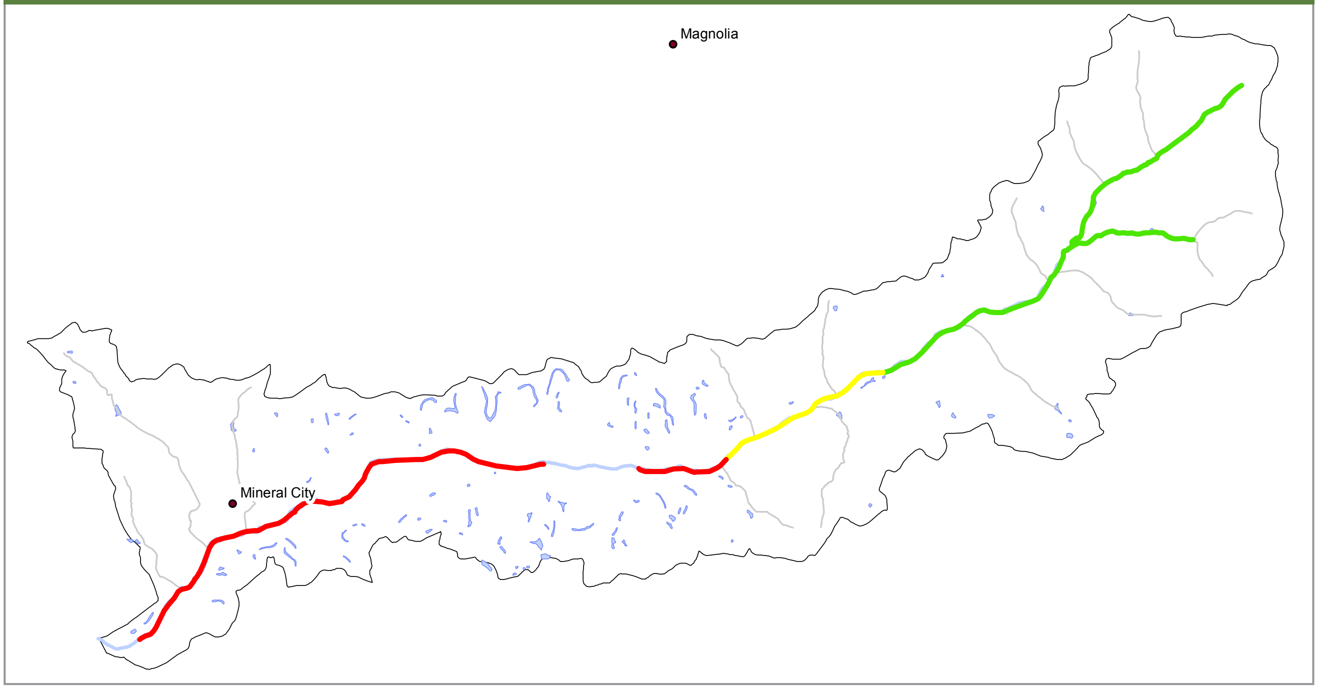


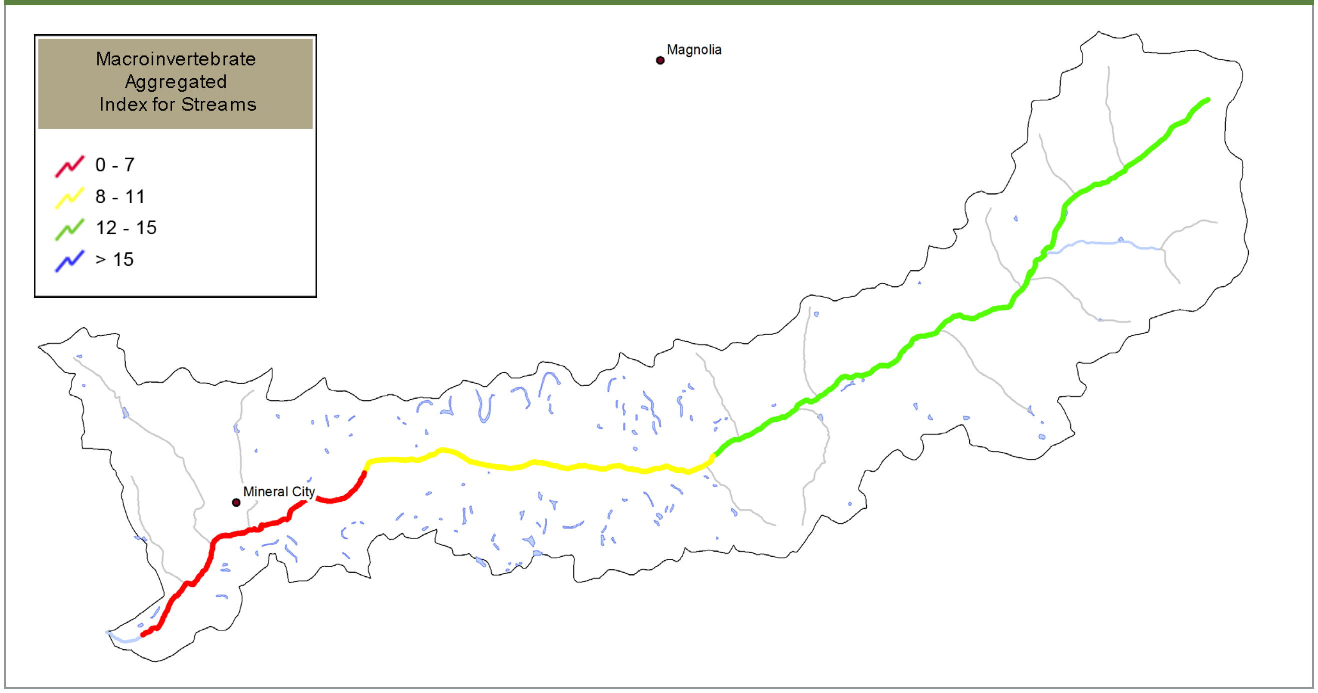


Biological Water Quality

Huff Run baseline MAIS



Huff Run 2016 MAIS

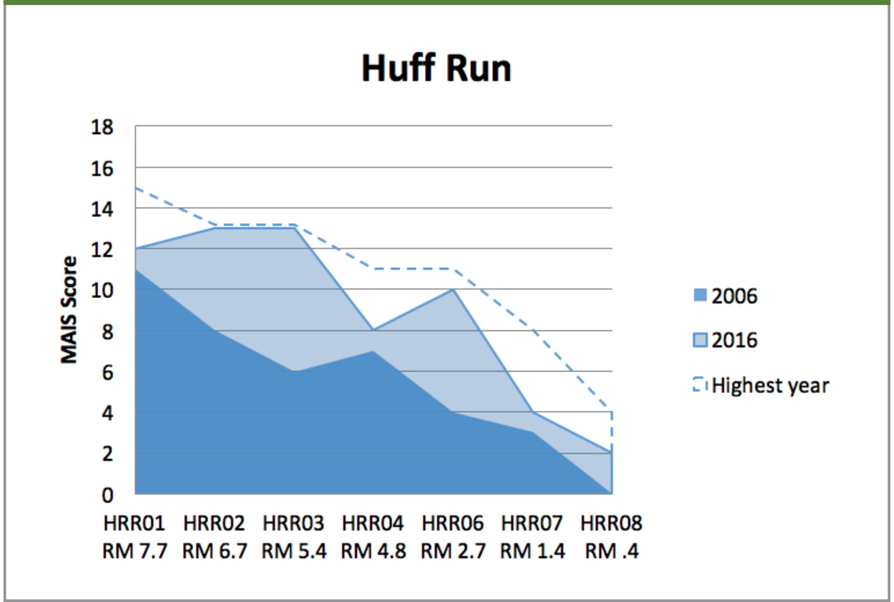


Biological quality in Huff Run decreases from headwaters to the mouth.

Biological Water Quality

Biological quality in Huff Run (based on macroinvertebrate data) improved modestly along the length of the mainstem. In 2014 for the first time since monitoring began in 2005 one of the eight monitoring sites (RM 5.4), improved enough to be categorized as sustained and statistically significant and four sites (RM 7.7, 5.4, 4.8 and 2.7) achieved new high scores that year. In 2015, RM 5.4 became the first site to reach its biological restoration target, earning a MAIS score “13”. RM 2.7 also earned a new high score of “11” and became the second site along the mainstem to show sustained biological recovery. These improvements, however, do not extend further downstream; biological quality at the two lowermost sites continues to be relatively poor. Scores at the upper two sites were also unusually low this year.

Area of Degradation 2006-2015



Huff Run MAIS Regressions

	RM	‘05	‘06	‘07	‘08	‘09	‘10	‘11	‘12	‘13	‘14	‘15	‘16	Linear trends	R square	P-value	Years
HRR01	7.7	14	11	12	12	13	9	13	6	10	15	9	12	no change	0.054	0.468	12
HRR02	6.7	12	8	8	8	9	11	11	11	10	9	7	13	no change	0.029	0.599	12
HRR03	5.4	8	6	7	6	8	9	7	9	10	11	13	**13**	improved	0.751	0.0003	12
HRR04	4.8	6	7	9	8	9	9	6	7	9	11	9	8	no change	0.185	0.163	12
HRR06	2.7	5	4	5	3	4	5	3	4	5.5	7	11	**10**	improved	0.488	0.011	12
HRR07	1.4	2	3	3	2	8	2	2	3	5	7	2	4	no change	0.063	0.436	12
HRR08	0.4	3	0	4	3	4	3	3	3	3	4	4	2	no change	0.060	0.441	12