Lambert run: Watershed scale approach to remediation

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Extended Abstract

Lambert Run (West Virginia stream code: WVMW-16, HUC-12: 050200020602) is a small tributary located in between the towns Fairmont and Clarksburg, WV that drains directly into the West Fork River. The Lambert Run watershed is an 8 mi² (20.7 km²) drainage area located near the smaller town of Spelter in Harrison County, West Virginia. It is part of the larger Limestone Run Watershed and ultimately West Fork River Watershed (HUC 05020002). The West Fork River and Tygart River converge in Fairmont, West Virginia to form the Monongahela. The Lambert Run Watershed is a rural watershed that is mostly forested with some agriculture occurring within its reaches. Additionally, Marcellus Shale development has occurred within the watershed since 2008. Deep mining has taken place in the watershed since the 1950s. The greater part of the mining performed in the watershed was to extract the Pittsburgh coal seam; this seam is often known to produce deleterious Acid Mine Drainage (AMD) as sulfide minerals in and around the seam are exposed to oxidizing conditions (Edinger et al. 2003).

The first TMDL (Total Maximum Daily Load) report approved by the USEPA in 2002 provided the impetus for the creation of the first Lambert Run Watershed-Based Plan (WBP). The Guardians of the West Fork (GWF), the local watershed group with interest in Lambert Run, spearheaded this effort and in 2003 they submitted a watershed-based plan to the USEPA which was approved later that year. The plan permitted the watershed group to pursue funding for passive treatment remediation of the mine discharges in the watershed. Research for the WBP found that improper reclamation and/or abandoned mine lands led to the identification of ten (10) sources of harmful mine drainage in the Lambert Run watershed with water chemistries of the mine discharge sources varying from net acidic to net alkaline mine drainage (Fig. 1). Research for the WBP confirmed the impairments listed in the TMDL (pH, iron, and aluminum) (U.S. Environmental Protection Agency, 2002).

In 2004, an initiative between the West Virginia Department of Environmental Protection, the U.S. Office of Surface Mining Reclamation and Enforcement, West Virginia University – National Mine Land Reclamation Center (NMLRC), and the GWF started working towards the restoration of multiple mine drainage sources by installing passive treatment systems within the watershed. Since 2006, there have been six passive systems installed in the Lambert Run watershed. Sites 1, 2, and 10 (indicated in Fig. 1) do not have landowner agreements for treatment as of this submission date; therefore, they are not mentioned in great detail. The ultimate goal of this venture is to remove Lambert Run from the state's 303(d) list of impaired streams and restore watershed health to pre-mining conditions. The NMLRC and GWF reassessed the watershed-based plan in 2017 and 2018 to quantify the efficacy of the treatment systems and recommend future improvements in the interest of the health of the watershed.

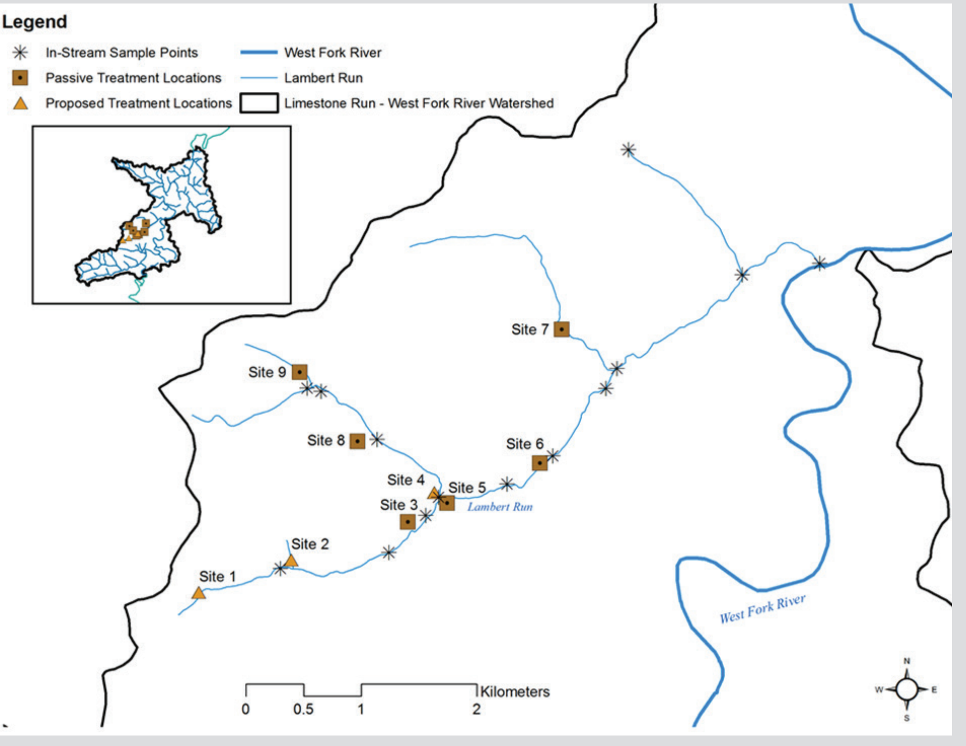


Figure 1 *Map of Lambert Run treatment sites and AMD source locations*

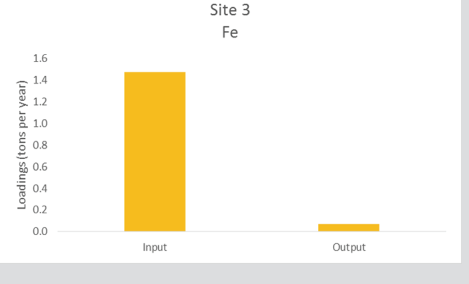
Systems and Performance

Project #1 – Site 3, Muzzleloader Club, completed in 2006.

The Site 3 treatment consists of a steel slag leach bed used to add alkalinity and increase pH and two large, baffled wetlands that use biological processes to treat the drainage. 2017/2018 analytical results showed a 93% reduction in total iron and a 95% reduction in total aluminum, while pH increased from 6.4 to 7.1. Load reductions for total Fe are offered in Fig. 2. Average flow (Q) = 96 gpm (363 L/min).

Project #2 – Site 8, Oldaker, completed in 2007.

Site 8 treatment consists of settling ponds and two large, baffled wetlands with water level control structures. 2017/2018 analytical results confirmed an 80% reduction in total iron while pH increased from 6.4 to 7.2. Load reductions for total Fe are offered in Fig. 3. Average Q = 225 gpm (852 L/min).



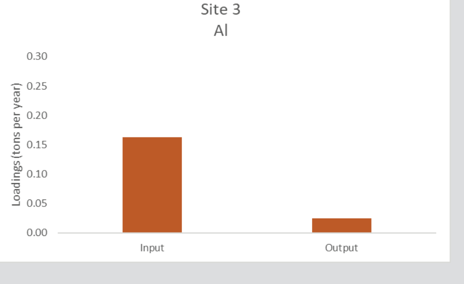


Figure 2 *Total iron and aluminum load reductions at Site 3*

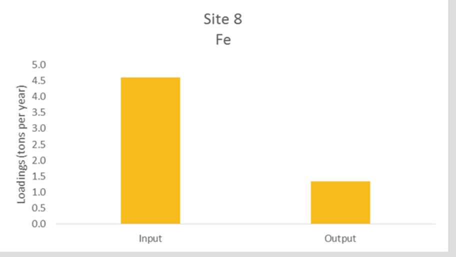


Figure 3 *Total iron load reductions at Site 8*

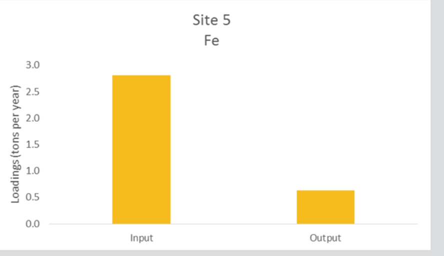


Figure 4 *Total iron load reductions at Site 5*

Project #3 – Site 5, Meadows, completed in 2008.

Site 5 treatment consists of a grouted limestone channel, settling ponds, and two large, baffled wetlands with water level control structures. 2017/2018 analytical results confirmed an 80% reduction in total iron while pH increased from 6.7 to 7.0. Load reductions for total Fe are offered in Fig. 4. Average Q = 510 gpm (1,931 L/min).

Project #4 – Site 9, White Oaks, completed in 2008.

Site 9 treatment consists of a large settling pond, a vertical flow pond, and a three-acre wetland for final polishing. 2017/2018 analytical results confirmed an 81% reduction in total iron and an 80% reduction in total aluminum, while pH increased from 5.8 to 7.3. Load reductions for total Fe are offered in Fig. 5. Average Q. = 235 gpm (890 L/min).

Project #5 – Site 6, Guinn Portals, completed in 2012.

Site 6 treatment consists of a grouted limestone channel and two baffled wetlands. 2015 analytical results confirmed a 90% reduction in total iron and a slight reduction in total aluminum, while pH increased from 5.7 to 6.6. Average Q = 85 gpm (322 L/min). Site 6 was unable to be analyzed in 2017/2018 due to landowner matters.

Project #6 – Site 7, Barnhart, completed in 2015.

Site 7 treatment consists of five aerobic wetland cells. The total wetland area is approximately four acres. 2017/2018 analytical results confirmed a 70% reduction in total iron and a slight reduction in total aluminum (22% reduction from 0.046 mg/L to 0.036 mg/L), while pH increased from 6.6 to 7.2. Load reductions for total Fe are offered in Fig. 6. Average Q = 990 gpm (3,748 L/min). Total Fe loadings in correlation to seasonality are in line graph form via Fig. 7.

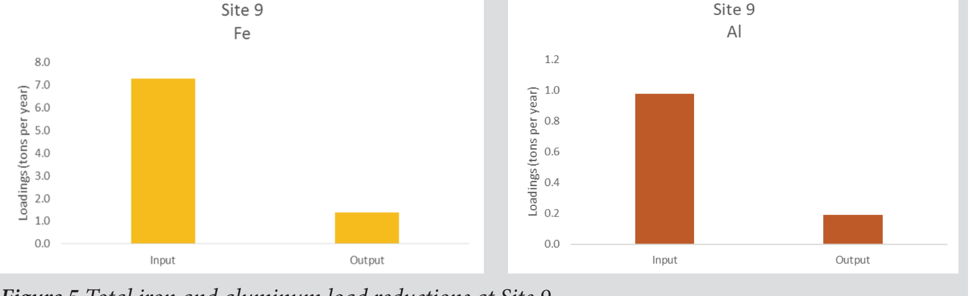


Figure 5 *Total iron and aluminum load reductions at Site 9*

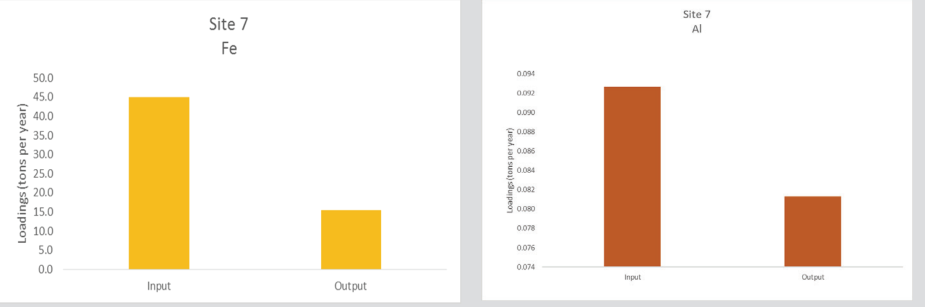


Figure 6 *Total iron and aluminum load reductions at Site 7*

Future Projects

Project #7 – Site 4, Allen Property, to be completed in 2024.

Site 4 treatment will consist of two large settling ponds and two baffled wetland cells. The NMLRC anticipates an 80% reduction in metals and a slight increase in pH. Q = 85 gpm (322 L/min).

Project #8 – Site 7 Phase II, Barnhart, to be completed in 2025.

Site 7, the most substantial AMD contributor to Lambert Run, will undergo renovations and upgrades to improve overall treatment and function. Recent data from sampling conducted in 2021 and 2022 shows that the large wetland system is functioning at an 80% plus metal (total iron and aluminum) removal rate; however, high flow and metal concentrations correlate to an abundance of AMD constituent loadings still entering the Lambert Run mainstem. For instance, the total Fe load entering the receiving stream remains consistent at 10-14 tons per year. BioMost performed an engineering evaluation in 2020 and recommends sludge removal, baffles, level spreaders, and other appurtenances to reduce preferential flow pathways and increase metal removal performance.

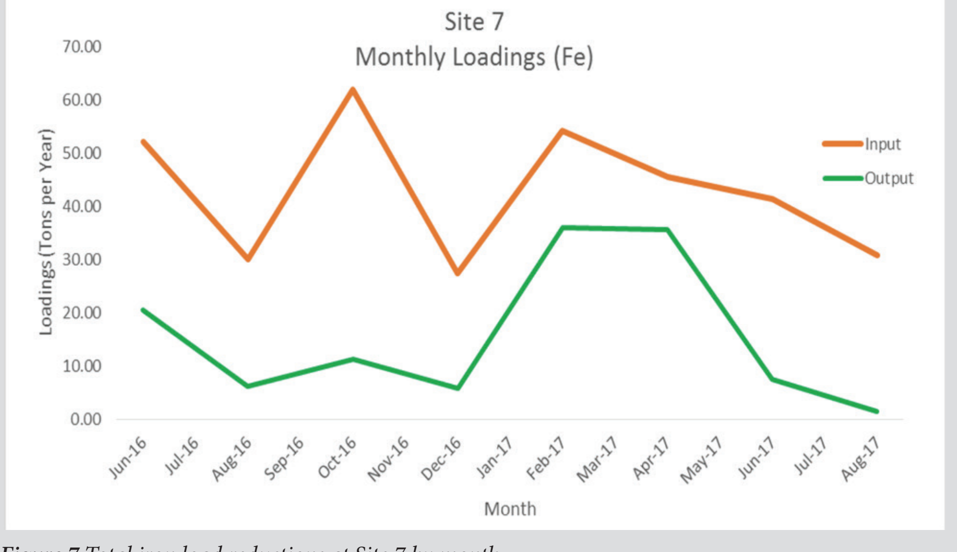


Figure 7 *Total iron load reductions at Site 7 by month*

Project #9 – Site 8 Phase II, Oldaker, to be completed in 2026.

Site 8, if left untreated, would contribute the third highest amount of AMD pollutants to Lambert Run from the Abandoned Mine Lands's located in the watershed. The original treatment system constructed in 2007 has undergone some slight renovations and operation and maintenance (O&M) to maintain functionality; however, recent analytical results indicate that sludge buildup, increased flow, and general degradation have led to reduced system performance. A complete renovation, including enlarging the wetlands and replacing flow barriers, will expectantly return the system to the desired performance levels.

Keywords: Acid mine drainage, mine water remediation, passive treatment, watershed restoration

Summary and Conclusions

Six passive treatment systems have been installed in an 8 mi² (20.7 km²) drainage area that encompasses the Lambert Run watershed. System installation began in 2006 following USEPA approval of the Lambert Run Watershed-Based Plan; to date, over $2,500,000 has been spent on AMD remediation to improve the stream and watershed. Since 2006, several of the major contributors of mine drainage to the watershed have been remediated and the mainstem of Lambert Run is showing improved water quality as metal loads have been reduced and pH has been increased. As an indicator of success, the 2014 Integrated Water Quality Monitoring and Assessment Report removed pH as an impairment to Lambert Run (West Virginia Department of Environmental Protection, 2014). A 2017/2018 watershed study indicated that many of the passive treatment systems were performing well with high metal removal rates and overall increases in pH. However, as many of these systems reach their intended lifespan of 20 years, upgrades will be necessary to maintain performance. The NMLRC and GWF will continue to monitor the watershed water quality and health and will continue to seek funding for system improvements when necessary.

Acknowledgments

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