COMPLETED AND FUTURE PROJECTS ON THE CHEAT RIVER AND USE OF TMDL TRADING

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ABSTRACT

The NMLRC works with federal and state agencies and watershed groups, to implement passive treatment methods to remediate watersheds damaged by AMD. In the Cheat Watershed the NMLRC works with the River of Promise, a volunteer group dedicated to restoring the ecological health of the Cheat River. To date, NMLRC has been involved in the construction of 4 passive treatment systems in the Cheat River watershed and, in cooperation with the Friends of the Cheat (FOC), has proposed the installation of 7 additional systems in the watershed before September 2004. These systems, along with large scale AMD treatment systems proposed by WV DEP Office of Abandoned Mine Lands and US Corps of Engineers for Pringle Run and Lick Run, will remove hundreds on tons of acid from the Cheat River every year.

CHEAT RIVER WATERSHED

In 1995 the National Mine Land Reclamation Center joined together with Friends of the Cheat, West Virginia Division of Environmental Protection, US Office of Surface Mining, West Virginia Division of Natural Resources and several other public and private organizations to form the River of Promise. The River of Promise is a collaborated effort by academia, industries, government agencies and citizens groups to address acid mine drainage problems in the Cheat River Watershed. Some state agencies estimate that approximately 200 miles of streams in the Cheat River Watershed have been impacted by acid mine drainage. Most of those miles are within the Preston County portion of the watershed. The largest contributors of acid load to the Cheat River are the streams within the Big Sandy Creek, Greens Run, Pringle Run, Lick Run, Heather Run, Muddy Creek watersheds.

Several passive treatment systems have been installed in the Big Sandy, Sovern Run and Greens Run watersheds since the formation of the River of Promise in 1995. Passive systems at Big Bear Lake and McCarty Highwall in the Beaver Creek, a sub watershed of Big Sandy Creek, have significantly influenced water quality in the mainstem of Beaver Creek to the point that many native fish species are thriving. In addition, large-scale AMD treatment systems are being proposed by WV DEP Office of Abandoned Mine Lands and US Corps of Engineers for Pringle Run and Lick Run.

COMPLETED PROJECTS

Big Bear Lake

Big Bear Lake is a 35-acre recreational lake located near Hazelton in Northeastern Preston County, West Virginia. Although the area was never mined, the lake receives acid water from natural bogs and local, acid forming rock. This increases acidity and reduces pH of nearby streams, which serve as the headwaters for Big Bear Lake and, subsequently, Beaver Creek. Prior to construction, the pH of the lake was about 4, however it was only moderately acidic (20 mg/L) and contained little to no metals.

In spring of 1999 a 100-ft open limestone channel (OLC) was constructed between the two ponds above the main lake. In addition, a limestone leach bed (LS Bed) was constructed downstream of the swimming pond. The leach bed was constructed using 1500 tons of limestone and receives water from the swimming pond through a pipe. During high flow periods water also

exits the swimming pond through two large culverts, which run underneath the dam road. In September 2000 a second OLC was constructed parallel to the LS Bed to treat this overflow water. A second, smaller limestone leach bed was also constructed in September 2000 above the Top Pond to boast the alkalinity of water entering subsequent systems.

Although, there have been some seasonal variations in the data due to high flows associated with winter and spring snow melt, on average the site has continued to discharge net alkaline water into the headwaters of Beaver Creek. Currently the pH of water discharging the lake is 4.6 and contains 2.2 mg/L of alkalinity. By the time this discharge reaches Mt Dale Church Rd, approximately 1 mile downstream, the pH has increased to 5.6 and remains net alkaline.

McCarty Highwall

The McCarty Highwall is an abandoned surface mine site located about 10 miles Southeast of Bruceton Mills in Preston County, West Virginia. Prior to construction at McCarty, water seeping out along an old spoil pile was flowing into a channel and mixing with a second spoil seep approximately 500 ft downstream. These two seeps form a small stream that flows south into Beaver Creek and eventually into the Cheat River. Along the way the stream picks up several other small AMD seeps. A 1997 reconnaissance study by the Corps of Engineers showed the first seep was moderately acidic with a pH of 4.1 and a net acidity of 27.5 mg/L. The second seep was similar with a pH of 3.9 and 24.5 mg/L acidity.

In October 2000, a series of open limestone channels (OLCs) and steel slag leach beds were installed downstream of seeps 1 and 2. The leach beds consisted of a settling basin and steel slag check dam. Both check dams were formed from approximately 150 tons of steel slag and rip rapped along the downstream side with 6-8 ” limestone rocks. A 200 ft open limestone channel (OLC #1) was constructed from the upper spoil seep to the edge of the first settling basin. A secondary OLC (OLC #1b) was constructed to the left of OLC #1 to carry AMD from an intermittent spoil seep to the first basin. Water leaches from the basin through the center of a steel slag check dam and enters a 300 ft open limestone channel (OLC #2). OLC #2 exits into the second settlement basin, along with water from a 100 ft open limestone channel (OLC #3) constructed at the seep 2 site. Water enters into settling basin #2 from OLCs #2 and #3 and exits the system through a second steel slag check dam and forms the headwaters of an unnamed tributary of Beaver Creek.

Initial water samples collected from the leach beds contained extremely high concentrations of alkalinity (1479-1513 mg/L) and high pH values (11.6). However, by the fourth month, alkalinity had fallen to about 30 mg/L (pH 9.0). Since that time both pH values and alkalinity concentrations have appeared to stabilize between 20-30 mg/L. However, samples taken during the month of December show that SLB #2 was discharging net acid water (11 mg/L acidity) at a pH of 6.2. It is difficult to predict if this trend is due to the exhaustion of alkalinity from the slag or to high flow situations caused by snowmelt.

Middle Fork of Greens Run

The Greens Run watershed, in Central Preston, County, West Virginia is severely impacted by acid mine drainage (AMD). One of the primary acid sources to Greens Run occurs in the headwaters of the Middle Fork of Greens Run. Mining in this area has significantly altered surface topography and downstream water quality. An acidic pit lake and down slope spoil seep transport an average of 164.1 tons of acid per year to the Middle Fork of Greens Run.

High alkaline steel slag and limestone were used to increase pH and alkalinity and decrease iron, aluminum and manganese concentrations of AMD discharging into the Middle Fork of Greens Run. Treatment was accomplished through the construction of:

- a steel slag check dam and a freshwater leach bed within the pit lake,
- steel slag and limestone lined channels from the pit lake to the sump,

- a slag infiltration bed above the spoil seep,
- a kisch slag basin at the spoil seep,
- a settling pond, which receives treated water from the open limestone channel and kisch basin, and
  a limestone check dam downstream of the settling pond.

Construction of the Middle Fork site was completed on 10/7/02. The initial post-construction sampling event was conducted on November 14, 2002. At this time, water downstream of the pit lake slag check dam was pH 10.5 and contained 41.3 mg/L of alkalinity. However, the pit lake had not yet begun discharging into the top of the OLC. Additionally, the kisch basin did not appear to be sufficiently neutralizing the acidity of the spoil seep discharge. In December, when the lake was sufficiently filled and discharging, it was discovered that, during construction, the top of the OLC was set above the top of the slag check dam. Therefore, the seep water was flooding the dam and flowing across the top of the lake and not through the slag check dam as originally designed. During this sampling event, water discharging the lake had a pH of 4.1 and was only slightly alkaline (0.6 mg/L). Therefore, since the kisch basin is not sufficiently neutralizing the acid seep downstream, the site continues to discharge net acid water. However, once the top of the channel is lowered to below the top of the slag check dam, water exiting the lake should have a higher alkaline load and be able to neutralize much of the acid entering the system downstream.

PROPOSED PROJECTS

Sovern Run # 62 Upgrade

During the winter of 1997/98 a passive AMD treatment system was installed at the #62 site to treat acidic water discharging from an abandoned Freeport underground mine. Water was discharging from the mine through a collapsed portal approximately 100 ft above Sovern Run. This discharge had a pH of 3.2 and added nearly 748 mg/L of acid, 76.8 mg/L Fe, 98.1 mg/L Al and 11.1 mg/L of Mn into the mainstem of Sovern Run. During construction, gravel sized limestone was pneumatically injected into the mine portal and a dam was constructed its base to collect treated water exiting the portal. A 650 ft open limestone channel was then constructed below the pond to provide additional acid neutralization to the pond effluent.

During the first year following construction the portal drain treated an average of 705 mg/L of acid and the OLC treated an additional 1.1 mg/L of acid for a total acid reduction of 94%. However, after the first 15 months of treatment, the system began to show reduced acid neutralization and is currently treating only 38% of the acid discharging the mine. In addition, 95% of this acid treatment is occurring within the portal drain with little to no additional treatment occurring in the OLC. This is due to the presence of 2-6 inches of metal hydroxide sludge on the surface of the OLC. This sludge greatly reduces the limestone's exposure to acid water and its ability to neutralize acidity. However, inspection of individual limestone rocks under the metal sludge showed that the limestone surfaces are not significantly coated with metal hydroxides and should still neutralize acidity if uncovered.

To increase acid neutralization in the pond, steel slag fines will be placed along the inside of the dam. The slag will increase alkalinity in the pond and provide an area for precipitated metals to settle out. In addition, by lining the downstream edge of the pond with slag we will be adding alkalinity to any acid water that may be leaching through the dam and resurfacing lower in the limestone channel. To accomplish this, one foot of steel slag fines will be placed to an approximate depth of 6 ft into the pond and along the entire length of the dam. The existing limestone channel will also be upgraded by removing the metal sludge from the channel surface and placing 1 ft of limestone riprap on top of the channel.

North Fork of Sovern Run Headwaters (Tichenell site)

The north fork of Sovern Run headwaters originates in a wetland area at the base of an old landowner operated surface mine, located on the Tichenell family property near Valley Point, in Northern Preston County, WV. There are three main sources of AMD at this site. The first flows from a collapsed borehole in the middle of an access road at the head of the wetland. This water is mildly acidic (approximately 35 mg/L) and contains very little Fe, Al or Mn. The second is an extremely acidic seep along the upstream bank of the west side of the wetland. This water has acid concentrations greater than 500 mg/ L and high concentrations of Fe, AL and Mn. The third acid source is a pond on the east side of the valley, approximately mid-way down the wetland. The pond discharges nearly metal free, moderately acidic water into the wetland, approximately ½ mile downstream of the other two sources. All together this site adds approximately 200 tons of acid per year to the mainstem of Sovern Run.

The presence of a fairly well developed wetland impedes the installation of treatment structures along the center of the valley. However, several structures are proposed that can be installed either outside of the wetland area or along the perimeter. These structures include an open limestone channel (OLC) to treat the mildly acidic borehole water and transport it along the existing access road and into a limestone leach bed at the head of the right fork of the wetland. Water leaving the limestone leach bed will then enter a steel slag leach bed before discharging into the right fork of the wetland channel. This slag bed will increase alkalinity of the right fork water, so that it can then be used to indirectly treat the highly acidic discharge in the left fork of the wetland channel, downstream where the two channels meet.

A similar limestone/slag system will also be installed at the third acid source, a small pond on the east side of the valley. The pond will be filled with limestone and will act as a limestone leach bed. Water exiting this leach bed will flow through a culvert under the existing access road and into a steel slag leach bed. This alkaline water can then neutralize any residual acidity coming down the valley from above.

South Fork of Sovern Run Headwaters AMD Treatment Site (Clark site)

The south fork of the Sovern Run headwaters drains several underground portals located along the Hudson Rd, near Valley Point, WV. Wet seals were installed in these portals in the late 1990's by the WVDEP Abandoned Mine Land Program as part of a larger reclamation project in the area. However, reclamation at this site did not address water quality and large volumes of acid water still discharge from the portals and into the south fork of the Sovern Run headwaters. With this project, FOC and NMLRC proposed to construct an AMD treatment system at this site to neutralize these discharges and reduce their impact on the mainstem of Sovern Run.

Proposed treatment at this site consists of a large open limestone channel constructed within the existing channel. The OLC is designed to be 2000 ft long and contain 2028 tons of limestone riprap. An OLC of this size should reduce the acidity leaving the site by 97% and will eliminate nearly 60 tons of acid from the south fork of the headwaters of Sovern Run.

Pringle Run (Pase site)

Pringle Run, an 8-mile acid-impacted stream entering the Cheat approximately 12 miles upstream of Albright, WV, adds over 700 tons of acid per year to the Cheat River. Several acid seeps have been identified within the Pringle Run Watershed. However, until recently reclamation projects in this watershed have only addressed surface restoration and safety issues and have virtually ignored water quality issues. The first discharge to be addressed by NMLRC and ROP in this watershed is located on the property of Mr. Charlie Pase, located near Jessop, in central Preston County, WV. This site forms the headwaters of an unnamed tributary of Pringle Run and will be the first of many AMD treatment systems to be installed in the Pringle Run Watershed.

Two limestone leach beds will be constructed at the head of two seeps located on the property. Leach Bed 1 will be installed at the site of Seep 1. This is a small seep, flowing less than 1 gpm and accounts for only 1% of the acid leaving the site. An 800 ft^3 leach bed will treat all the acid at this seep and will require only 34 tons of limestone. Leach bed 2, however, will be treating Seep 2 and 99% of the acid load leaving the site. This leach bed will be 9600 ft3 and will require 406 tons of limestone to treat the 38 tpy of acid discharging from the seep.

Water exiting the leach beds will flow into a central open limestone channel (OLC). The OLC will be constructed of riprap-sized limestone and will flow along the existing flow channel. Both the vertical drop of the channel and the tortuous path around the riprap will encourage oxidation and the precipitation of metals into the channel.

Auman Rd

The source of acidity at this site is a pit lake located along Preston Co. Rd 11/1 (Auman Rd). This lake collects acidic discharges from two seeps along a reclaimed highwall. The pit lake discharges through a culvert under Auman Rd and into an unnamed tributary of Beaver Creek, approximately 1-1/4 miles above its confluence with Beaver Creek. The pit lake adds nearly 75 tons of acid per year to its receiving stream, which in turns adds over 63 tpy of acid to Beaver Creek. Analysis of the discharge water also shows that the pit lake contributes relatively large concentrations of aluminum and manganese to the receiving stream, 21.59 mg/L and 6.34 mg/L, respectively.

Neutralization of the acid in the pit lake will occur through the installation of a large limestone check dam across the lake. The check dam will be constructed of riprap-sized limestone and will perform as a vertical leach bed to intercept the flow of acid water through the pit lake. The design calls for a 1369 ton LS check dam to be constructed across the pit lake. A leach bed of this size should neutralize 98% of the acid load leaving the pit lake and will have a service life yrs 18 yrs. In addition, the residence time in the lake will promote the settling of precipitated metals in the lake itself and reduce metal flock downstream. To further promote precipitation and settling of metals, a limestone channel will be constructed downstream of the lake discharge.

Upper Muddy Creek

Although severely degraded by acid mine drainage near its mouth, the headwaters of Muddy Creek remain a high quality trout fishery. A pristine Muddy Creek flows nearly 9 miles from its source near Afton, WV in Eastern Preston county to the point where its crosses under the Brandonville Pike south of Centenary, WV. Just before crossing under the Brandonville Pike the stream encounters a large acidic discharge from an abandoned mine site on its north bank. The site consists of three abandoned benches and their associated spoil piles. The majority of AMD from this site comes from four discharging collapsed portals located on the top 2 benches. Water from each portal flows over the top benches and onto the lower bench, which is approximately 5 ft above the surface of Muddy Creek. The acid water flows down the lower bench and into a wetland before discharging into the stream. The seeps have similar pHs (3.5), acidities (150-200 mg/L) and metal concentrations. However, seeps 1 and 2 occur at lower elevations along the bench and have greater flows and, consequently, higher acid loads.

The proposed passive treatment system at the Muddy Creek site involves the construction of limestone leach bed at each of the four acid seeps. Discharges from the top (higher in elevation) seeps will then be directed through an OLC to the lower leach beds. This design will form a single treatment system consisting of four consecutive limestone beds joined by open limestone channels. A final limestone channel will transport discharge from the last leach bed into an existing wetland on the bench below. Treated water will run through this wetland before discharging into Muddy Creek as it passes under the Brandonville Pike.

North Fork Greens Run WMD Treatment Site

The North Fork of Greens Run AMD treatment site is located along Dinkenberger Rd, approximately 4 miles west of Kingwood, in Central Preston County, WV. Historic mining of the Freeport seam in this area has produced some of the worst AMD in the state. At this site, extremely acid (1760 mg/L), iron-laden water flows from an open portal along a narrow bench approximately 20 ft above Dinkenberger Rd. Water from the portal collects in a small pool on the bench before discharging over the bank and into a ditch that runs along Dinkenberger Rd. This ditch runs approximately 20 ft along Dinkenberger Rd before passing under the road through a 8" culvert and towards flows under the road and through the woods toward a second culvert under Dinkenberger Rd, where it flows into an unnamed tributary of the North Fork of Greens Run. The seep did not flow directly into the small stream but paralleled the stream and joined it just above the culvert sampling point. Since that time, the portal discharge has been sampled monthly by the National Mine Land Reclamation Center.

AMD from the mine opening will be collected into a small pool at the mouth of the portal (this pool is pre-existing, but will be updated by adding a small dike to the downstream side). Water in the pool will discharge into a 10'x50' limestone leach bed along a bench approximately 20 feet above Dinkenberger Rd. Discharge from the leach bed will flow through a non-limestone riprapped channel and through a culvert under Dinkenberger Rd. A small limestone slash basin will be constructed at the culvert exit to diffuse the erosive force of the flow and to redirect the water into an 860 ft open limestone channel. The channel will run parallel to Dinkenberger Rd and will discharge into a small stream, approximately ¼ mile from the confluence with the North Fork of Greens Run.

USE OF TMDL TRADING- USEPA WATERSHED INITIATIVE: THE LOWER CHEAT RESTORATION PROGRAM

Introduction

The Lower Cheat Restoration Program proposes to "jumpstart' the implementation of the Cheat Watershed TMDL by addressing the pollutant loading identified in the TMDL in the Cheat River mainstem. This will be accomplished by active acid mine drainage (AMD) treatment on impaired tributaries, funded by USEPA with Office of Surface Mining (OSM) Watershed Cooperative Agreement Grants (WCAPs), with operation and maintenance support from local industry and West Virginia Department of Environmental Protection/Abandoned Mine Lands & Reclamation (WVDEP/AML&R). It is projected that this will result in meeting established TMDLs in the river and establishing a fishery on the entire lower Cheat mainstem while continuing to address AMD sources with longer term passive system installations.

The Remediation Strategy

In order to provide long-term treatment for the entire Lower Cheat River, the proposed strategy will address four key elements:

1. Treat 10,000 tons per year (tpy) of acid load from the seven polluted tributaries by establishing and maintaining lime-dosing stations in the seven acid tributaries.
2. Development of a pollution-trading framework.
3. Consistent with the pollution-trading framework, attract private sector and State investment in dosing station operation and maintenance.
4. Implement the Lower Cheat Restoration Program.
5. Partner with state and federal funding sources to maximize watershed restoration.

Treatment of Acid Mine Drainage in the Lower Cheat River:

The Cheat River is healthy upstream of Rowlesburg WV. Downstream of Rowlesburg, however, AMD from seven tributaries severely degrades the value of the fishery to Cheat Lake, 20 miles away. The acid tributaries: Pringle Run, Lick Run, Heather Run, Morgan Run, Muddy Creek, Greens Run and Bull Run contribute about 10,000 tons per year of acid to the lower Cheat River. The watershed plan and the Cheat River TMDL recognize that AMD, specifically, low pH and metals are the primary limiting factors in reestablishing the full ecological value to the river. This plan will put into place a mechanism for long term treatment of the major sources of AMD in the lower Cheat River and will establish a management structure that will acquire financing for and provide the maintenance and operations of the AMD treatment system. The plan will employ market-based incentives toward maintenance of the treatment system.

Friends of the Cheat has applied to USEPA, under the Watershed Initiative, for a $1.3m grant to purchase and install eight to ten dosers in the lower Cheat Basin. Matching funds for procurement and installation will come from Office of Surface Mining Watershed Cooperative Agreement Program grants.

Development of a pollution-trading framework:

The West Virginia Department of Environmental Protection has convened a stakeholder committee to determine if water quality trading is appropriate for West Virginia, and if so, to develop a trading framework. Locally, a stakeholder group has been developing a Cheat Watershed Trading Framework. If and when these frameworks are complete, a trade may be allowed that will provide annual operation and maintenance funds for this project.

Attract private sector and State investment in dosing station operation and maintenance:

One objective of this project will be to find investment partners and strategies that can generate funds adequate to treat this acid load. Significant capital investments, plus annual operation and maintenance expenses, will be required. If the USEPA Watershed Initiative and OSM WCAP's can fund these capital investments, the West Virginia Abandoned Mine Lands Set-aside Fund may be able to fund the annual expenses. Or, subject to the approval of a new state water quality trading program, funds may be available through a cross-pollutant trade in which a local power station makes investments in return for continuing its thermal discharges.

Thermal Pollution. The Albright Power Station currently discharges cooling water directly to the Cheat River, creating occasional distress periods for fish in the immediate vicinity of the station. A conventional remedy to the thermal discharge would be extremely expensive, threaten the viability of the Station, its surrounding coal suppliers while, arguably, making only minor improvements to the Cheat.

Proposed Trade. We propose that, in exchange for relieving the Albright Power Station from the burden of addressing thermal water pollution, that its owner: Allegheny Power Systems, Inc. makes annual contributions in the amount of $215,000 to a Cheat River Restoration Fund. The fund would be established by the Preston County Commission and be administered by a panel appointed by the Commission to oversee its disbursement. The panel would be responsible for ensuring that the dosers are supplied with treatment material and maintained in working order. The panel would issue regular reports including system performance, needs and audited disbursement/income reports. The fund would also pay for upkeep and repair of the dosers. Other trading partners would be sought: coal companies with active NPDES permits and WVDEP. Nevertheless, it is expected that Allegheny Power would be the primary trading partner.

Implement the Lower Cheat Restoration Program:

Acid mine drainage (AMD) is, by far, the most significant stressor on the Cheat fishery. AMD originates in numerous abandoned mine discharges in the upper reaches of eight tributaries reaching from Pringle Run to Bull Run. Roughly 10,000 tons of acid will need to be removed annually in order to eliminate the impacts of AMD. Until now only construction grants have been available for treating AMD in the Cheat. These have no allowance for operations and maintenance costs and are limited by cost, effectiveness of existing technologies and uncertainties about long-term performance. Pollution credit trading will require a firm appreciation of the ecosystem value of the trades. In this case we need a reliable estimation of how much acid load will be removed by each dollar invested. Only chemical dosing can give the required level of certainty. Chemical dosing, however, requires regular maintenance. Fortunately, the nature of the trading program allows generation of O&M funds from operating cash flows. Operating and maintenance costs for the dosing system is based on the Maryland Department of Environment's dosing program in the North Branch of the Potomac River. Treatment on the Potomac has resulted in development of stocked trout streams downstream from dosers and significant improvement in the fishery in a downstream lake. This program uses a number of reagents but has increasingly favored cement kiln dust (CKD) applied by Aquafix or EDS dosers. Operating and maintenance costs are currently running about $20/ton of CKD. This amount includes purchase and transportation of CKD, supply to the dosers and regular inspection. A ton of CKD is required to treat a ton of acid load. Thus, it is estimated that treating the Cheat's 10,650 tons per year of acid will cost about $215,000 per year.

Project Description

The project will rely on a system of in-stream dosers to eliminate acidity and precipitate metals in seven acid tributaries within the Lower Cheat River watershed. Two types of dosers will be evaluated for individual sites: the Aquafix and EDS Dosers. Both are used by Maryland Department of Environment in their North Branch, Potomac AMD dosing program and both are water powered, requiring no electricity. Both have been found to be reliable under local climatic conditions. The Aquafix is most suitable under steady flow conditions while the EDS unit performs best in settings where flows are variable. Both units cost about $100k each, which includes a 100-ton bin, footers and installation. We will select sites that have all weather road access suitable for 23-ton bulk pneumatic haulers, suitable space for the doser and pneumatic haul truck. The trucks are self-unloading and will feed directly into a pipe feeder so that the loading process is completely sealed and will generate minimal dust.