Big Run Subwatershed Assessment

Big Run is a major tributary and a major contributor of AMD to Blacklegs Creek. Immediately downstream of its confluence with Big Run, Blacklegs Creek is devoid of life. Four major AMDs exist within the Big Run watershed (Figure 2). Funds have been allocated to address BR4 and BR7. The BR4 Treatment System (named Big Run # 2) has been completed, and the BR7 is currently under construction. The following section describes the discharges that have been identified within the Big Run subwatershed, including location maps and conceptual treatment considerations for the high-priority discharges.

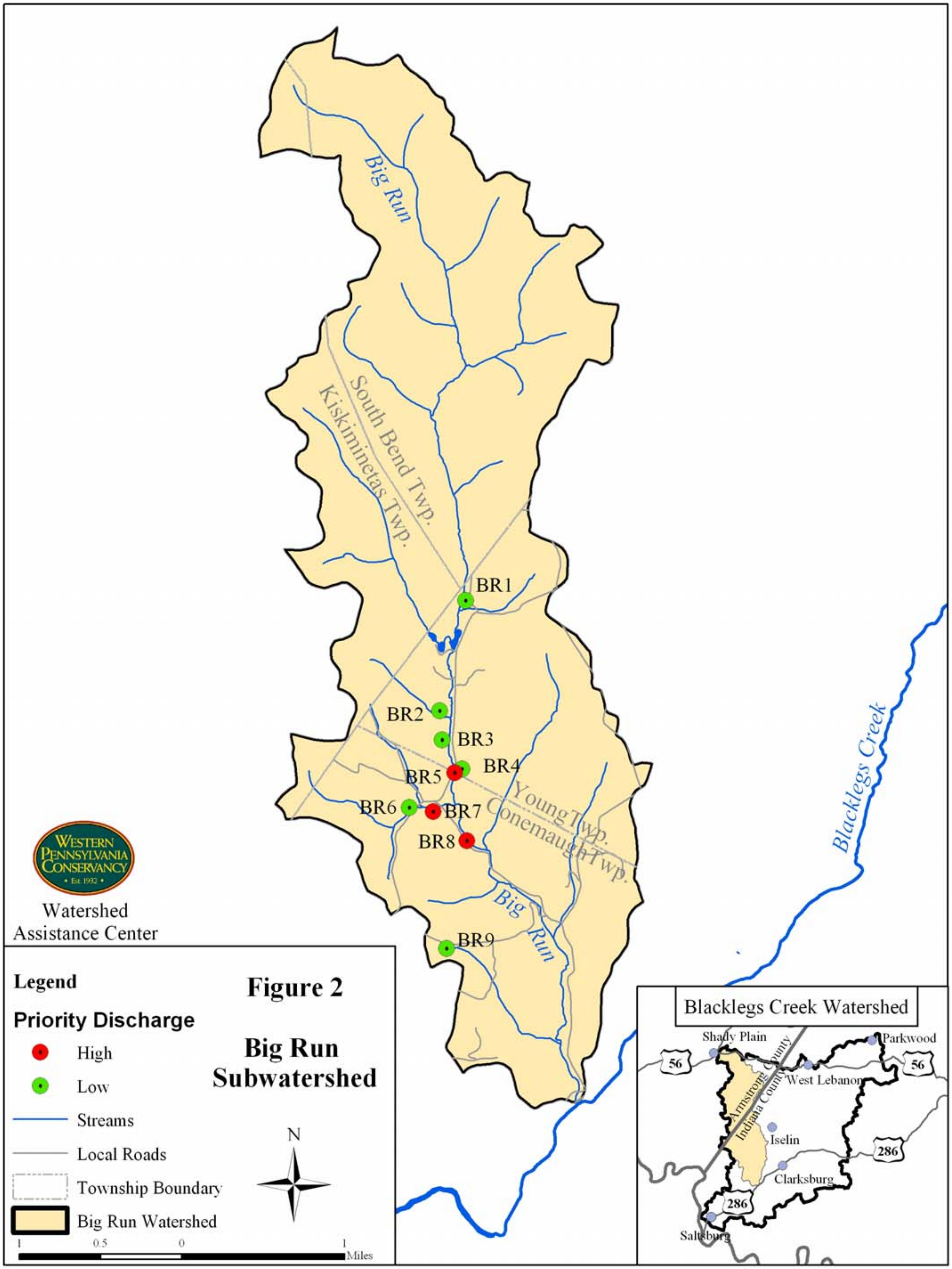
BR1

This discharge originates at the outflow of a constructed treatment system, which incorporates the use of soda ash and settling ponds for treatment, and then discharges through a pipe exiting to an existing wetland adjacent to Big Run. The discharge has a moderate flow of 4-10 gpm. The iron levels of the discharge are ~ 1 ppm. This discharge is already being treated and by a mining company, therefore, is considered a low priority at this time.

BR1 Prior to Treatment

BR1 Treatment Pond

BR1 Discharge after Treatment System


Big Run
South Bend Twp.
Kiskiminetas Twp.
BR1
BR2
BR3
BR4
BR5
BR6
BR7
BR8
BR9
Young Twp.
Conemaugh Twp.
Big Run
Blacklegs Creek
Watershed
Assistance Center
Legend
Priority Discharge
High
Low
Streams
Local Roads
Township Boundary
Big Run Watershed
Figure 2
Big Run
Subwatershed
N
1 0.5 0 1
Miles
Blacklegs Creek Watershed
Shady Plain
Parkwood
56
West Lebanon
Armstrong County
Indiana County
Iselin
286
Clarksburg
Saltsburg

BR2

This discharge, located above the home of a private landowner, originates at a small abandoned mine opening. The flow is estimated to be ~3-5 gpm. Iron levels are estimated at ~4 ppm. Coal was found to be present in the streambed during investigations. The discharge is considered a low priority due to its low flow and minimal impact to Big Run.

BR3

The channel of the discharge is often dry, as well as most of the small intermittent tributary to Big Run. It appears that the discharge may have originated at an old mine opening. The pH above and below the discharge is ~5.9. There is minimal potential for treatment at the site, although some room may be available in a neighboring field. As a result of the minimum impact to Big Run, this discharge is considered a low priority.

BR4

This discharge emanates from a deep mine opening on Big Run. Though the chemistry of BR4 does not indicate a severe impact, the high average flow rate of 1,250 gpm, contributing 245 tons of acidity and 8.5 tons of aluminum per year, is a significant source of pollution to Big Run. A treatment system, Big Run #2 AMD Treatment Project, was constructed for this high-priority discharge in 2004. The design for the system was based on years of flow and chemistry and relies on contacting the acidic discharge with limestone to increase the pH of the water. The Department of Environmental Protection (DEP) Growing Greener Program and the Office of Surface Mining provided funding for the project. Because the treatment system eliminates a significant number of metals from this discharge, it has been downgraded to a low priority.

Conceptual Treatment Consideration

The BR4 discharge represented the first major impact to Big Run, even though a few smaller discharges are located upstream. The treatment system consists mainly of a large limestone treatment pond and a polishing wetland. Skelly and Loy, Inc. completed the engineering design for the project and Grguric Excavating constructed the system.

Big Run #2 Treatment System

Table 6. Big Run #2 Treatment System Average Performance		
Parameter	**Influent**	**Effluent**
Flow (gpm)	1,666	1,666
pH	5.0	6.1
Acidity (mg/L)	28.2	0.0
Alkalinity (mg/L CaCO3)	11.0	50.2
Aluminum (mg/L)	4.3	3.1
Manganese (mg/L)	1.8	1.9

Since its construction, the treatment system has received sustained flows greater than the design flow rate of 1,250 gpm. As a result, the effluent is a significant improvement over the influent water quality, but not to the level that was originally intended. The increased flow of the discharge can likely be attributed to the well-above average rainfalls experienced in the region in 2003 and 2004. During high flows, metals that have precipitated out during the treatment process are expelled from the system into the stream, rather than retained in the treatment pond. Filtered effluent has a significantly lower concentration of iron and aluminum than water coming into the system, but unfiltered effluent does not. Manganese does not differ between filtered and unfiltered samples because it is still dissolved at the pH measure exiting the treatment system.

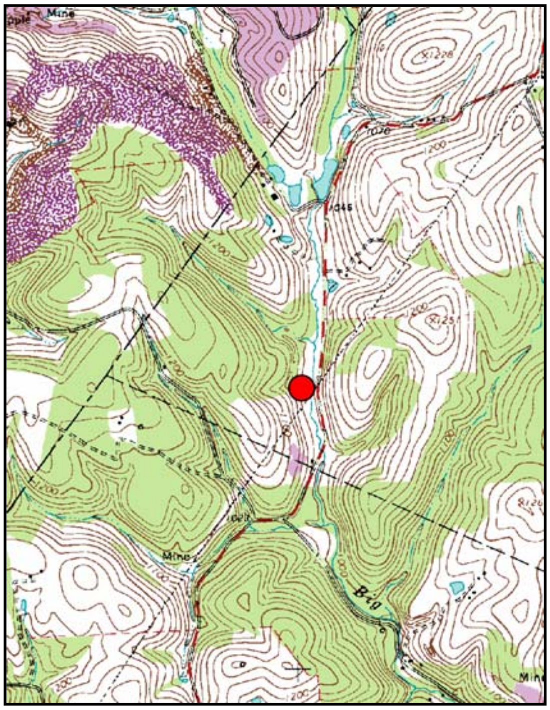
Table 7. Big Run # 2 Treatment System Comparison of Filtered and Unfiltered Samples			
Influent	Aluminum mg/L	Iron mg/L	Manganese mg/L
Unfiltered (10/24/04)	4.0	0.4	1.8
Filtered (10/28/04)	2.6	0.7	1.6
Effluent	Aluminum mg/L	Iron mg/L	Manganese mg/L
Unfiltered (10/24/04)	3.6	0.4	1.8
Filtered (10/28/04)	0.8	0.03	1.3

Conclusion

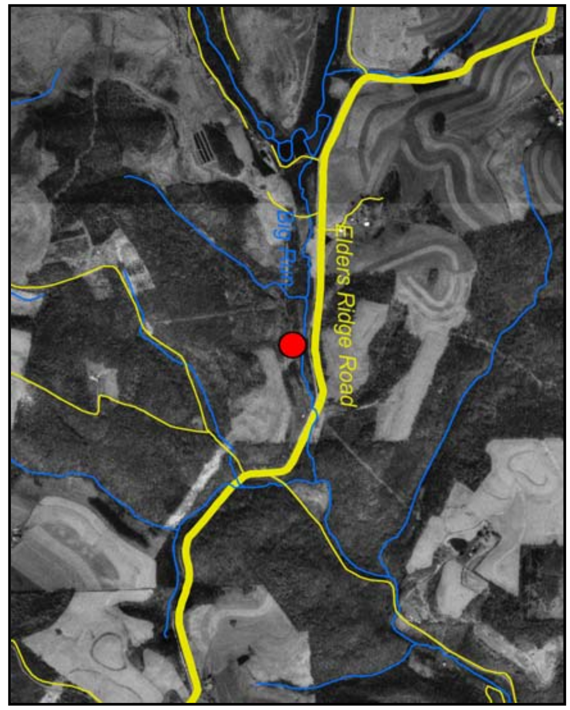
In spite of high flows, the system has continued to produce alkalinity at the rate of 144 tons/year. The BCWA has applied for a DEP Growing Greener Operation, Maintenance, and Replacement grant for additional limestone to raise the design flow rate from 1,250 gpm to 1,750 gpm. This would contribute an additional 230 tons of alkalinity per year.

BR5

This large AMD enters Big Run at stream level, directly across from a private residence. It confluences approximately 25 feet downstream of BR4, but on the opposite side of the stream. It appears to come from under a ground pipe that was routed below a small storage shed on the private residence. Acid-thriving bacteria is visible at the mouth of the AMD.



BR5 (Avonmore DRG)



BR5 (Avonmore NE and SE)

Table 8. Discharge BR5 Chemistry	
Parameter	**Average**
Flow	324.7 (n=6)
PH	3.2 (n=21)
Calculated Acidity	208.8 mg/L
Alkalinity	0 (n=19)
Iron	3.3 mg/L (n=18)
Aluminum	29.1 mg/L (n=11)
Manganese	4.5 mg/L (n=11)

Conceptual Treatment Consideration

A passive treatment, limestone pond-based approach is proposed to treat the BR5 discharge. One limestone pond will accept the BR5 discharge, contact the water with limestone, and direct the net-alkaline water to a settling pond.

A conceptual design was prepared for a limestone pond for treatment of the BR5 discharge. Only one sample showed iron concentrations greater than 5 mg/L. After weighing the risk of reduced system efficiency due to iron coating against the potential permeability problems associated with designing a vertical flow wetland for a discharge with flow rates above 300gpm, it was determined that simplified maintenance through easier access afforded by a limestone pond made it the preferable alternative.

A network of perforated pipes will be incorporated into the design to allow for the flushing of accumulated metals from the void space of the limestone pond. This flushing network will likely be separate from the primary flow outlet to minimize short-circuiting. If adequate space and hydraulic head are available, dosing siphons will be considered to passively flush the metals from the limestone pore spaces.

The limestone pond is proposed to discharge to a settling pond that will provide retention time for the oxidation, precipitation, and retention of metals. If site conditions permit, the settling pond will be sized to accommodate 2.5 times the volume of water released during a flushing operation plus 25 years of estimated sludge production.

BR6

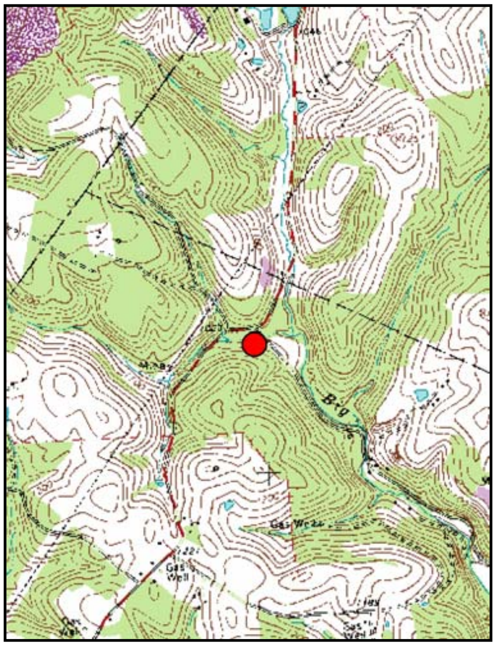
This discharge consists of two small AMD's that meet to form one discharge, which enters BR7 before being conveyed through a culvert under Sportsmen's Road. Originally, these two AMD's were considered separately by PASEC as BR5 and BR6. Because of their small size and close proximity, the discharges were combined into the BR6 discharge for the purposes of this assessment. Chemical information indicates that BR6 is not contributing a significant amount of pollution to Blacklegs Creek compared to the other discharges, and therefore it is considered a low priority.

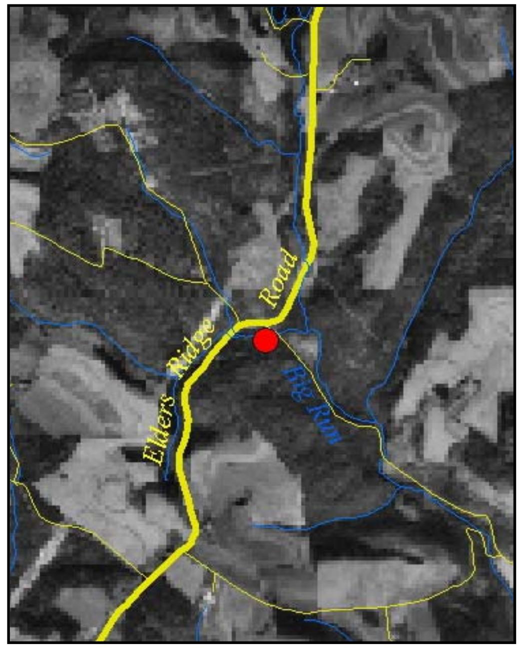
BR7

This discharge is considered a high priority due to high aluminum content, but it has low iron and low pH.

As of August 2005, a treatment system is being constructed for this discharge. The discharge initially was considered a moderate seep. After a year's worth of flow data, it was found that the flow fluctuated greatly and the average flow of this discharge is actually ~800 gpm. The flow of water capable of exiting the mine, were excavation done, was not known until tests were performed at the site prior to the building of a treatment system.

Photo of BR7





BR7 (Avonmore DRG) ***Avonmore SE and NE***

Conceptual Treatment Consideration

The conceptual design for treatment of this discharge includes a limestone pond. There is no specific data available to estimate the amount of alkalinity to be generated by this treatment system, although data collected for the BR4 discharge (Big Run #2 treatment system) suggests that, at average flow rates, approximately 350 tons of limestone would be dissolved. Using the design limestone volume of 5.738 tons, the contact time after 5 years would be 3 hours at the maximum flow of 1,826 gpm and 6hours at the average flow of 790 gpm.

Because only minor amounts of iron have been detected, there is a reduced threat of iron coating the limestone. Therefore, no compost is needed to lower oxygen levels prior to contact with the limestone (as in the treatment design for BR8, which includes a vertical flow wetland).

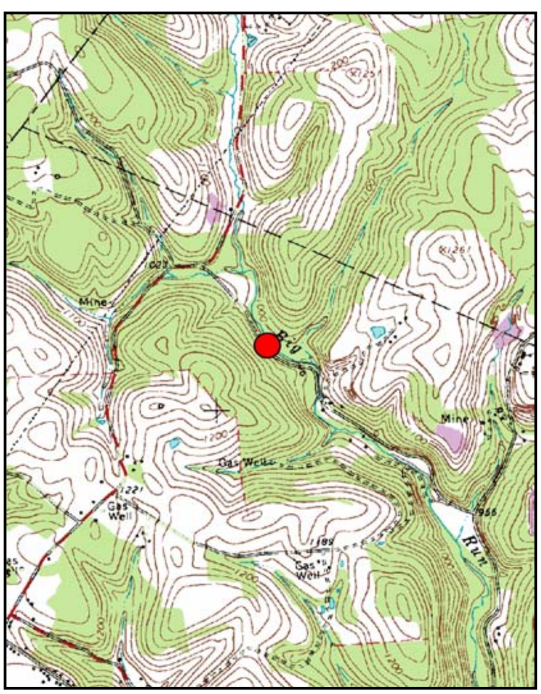
The limestone pond and initial settling pond is currently being installed near the BR7 location. A new road culvert will be installed to direct BR7 under the road, where it will be captured and transported approximately 1,000 feet to a polishing wetland using a limestone channel. Limestone in the pond will be installed to a depth of four feet. One in-line control structure will be placed in the limestone pond while another will be placed in the settling basin so that aluminum can be passively flushed through the voids in the limestone. Removing the boards in the limestone will flush the system. Prior to flushing, the settling basin will be drained and the boards replaced.

The polishing wetland on the other side of the road may also be used for parts of systems built in the future to treat BR5 and BR8.

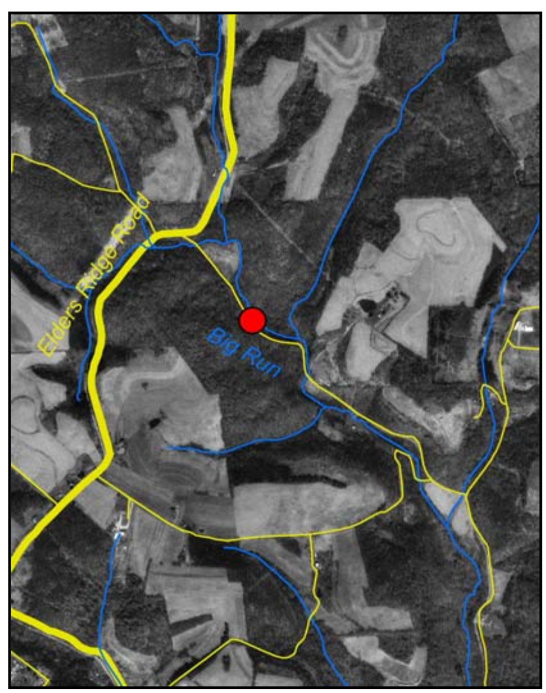
<u>BR8</u>

One of the three major AMD contributors to Big Run, this major discharge originates above the streambank on Sportsman's Road. This discharge contains a high level of both aluminum and iron. Because of the location of the discharge, which is extremely close to the stream, treatment options will involve transporting the discharge to an alternative treatment location.

Photo of BR8



B*R8 (Avonmore DRG)*



BR8 (Avonmore SE and NE)

Table 9. Discharge BR8 Chemistry	
Parameter	**Average**
Flow	898.1 (n=6)
pH	3.2 (n=27)
Calculated Acidity	231.8 mg/L
Alkalinity	0 (n=25)
Iron	20.4 mg/L (n=23)
Aluminum	26.9 mg/L (n=18)
Manganese	2.9 mg/L (n=2.9)

Conceptual Treatment Consideration

The most essential aspect of the design lies in delivering the discharge water to a suitable treatment location. Presently, the discharge emanates from a drainage heading constructed approximately 1,040 feet through bedrock from near the stream elevation to a low point in the underground mine. In order to direct the water to the proposed treatment area, a mine seal is proposed to raise the discharge elevation and allow the water to be directed to the available treatment location. To minimize the likelihood of a catastrophic blowout of the mine pool, the water elevation in all of the treatment system ponds will be lower than the coal outcrop elevation.

Geotechnical and exploratory drilling have been conducted on the proposed construction site. The drainage heading was located during the drilling and its location and orientation have been defined. In spite of the information obtained by the drilling program, the construction of a discharge capture structure in the existing drainage heading will be a significant challenge.

An upflow limestone pond-based approach is proposed for the passive treatment system to treat this discharge. One large limestone pond is proposed due to site restrictions. This limestone pond will be located adjacent to the limestone pond next to BR7. If adequate space existed, an additional pond would also be proposed. The proposed large limestone upflow pond will accept the discharge, contact the water with limestone, and direct the discharge water to a settling pond.

Coating of the limestone was considered and is a concern based on the measured concentrations of iron in BR8. By configuring the limestone pond so that the water enters from the bottom of the pond, it is believed that the limestone dissolution process may take place under anoxic or near anoxic conditions. In this anoxic state, the iron precipitation would be minimized. Furthermore, a subsurface capture of the discharge would result in minimizing ferric iron concentrations. After weighing the risk of reduced system efficiency due to iron coating against the potential permeability problems associated with designing a vertical flow wetland for a discharge with this magnitude of flow, it was determined that the easy maintenance access afforded by an upflow limestone pond made it the preferable alternative.

The upflow limestone pond will include a network of perforated pipes to flush accumulated metals from the void space of the limestone pond. This flushing network has a proposed separation from the primary flow outlet to minimize short-circuiting. The proposed limestone pond will discharge to a settling pond that will provide retention time for the oxidation, precipitation, and retention of metals. Because of this restriction, sludge removal activities will be required more frequently than the common design interval of 25 years. The settling pond will be sized based on space available at the site and may be a combined settling pond to include outflow from limestone ponds to treat BR5 and BR7. If additional treatment space can be made available, it would be advantageous to pass the discharge water through an additional limestone pond and a polishing wetland to ensure consistent system performance.

General Treatment Considerations for the Big Run subwatershed

This plan includes general conceptual treatment designs for the Big Run subwatershed. However, actual designs may change as a result of new geological and hydrological information. Due to the close proximity of BR5, BR7, and BR8 discharges and the general similarity of the treatment designs, there is the potential to direct these discharges into shared limestone ponds and/or settling ponds. This may also save money, time, and increase the ability of BCWA to maintain the systems. To date, the BCWA has met with representatives from Skelly and Loy, DEP, the Indiana Conservation District, and other vested parties to discuss these options but plans have not been finalized.