Dunkard Creek

Hydrologic Unit Plan

Greene County, Pennsylvania

Developed by:

Pennsylvania Department of Environmental Protection
Bureau of Abandoned Mine Reclamation
Cambria Office

May 16, 2003

I. INDENTIFICATION OF THE HYDROLOGIC UNIT

NAME: Dunkard Creek (lower)

TRIBUTARY TO: Monongahela River

LOCATION: Eastern Greene County

DRAINAGE AREA: 234.65 square miles (150,177 acres)

The following was excerpted from the Dunkard Creek Rivers Conservation Plan, which was funded through the Keystone Recreation, Park and Conservation Fund Act, Act 50 of July 2, 1993, P.L. 359, authorized by the Department of Environmental Protection (DEP). The purpose of the study was to evaluate issues and concerns raised by the public and to recommend policies and action to be undertaken to conserve, restore and/or enhance the river resources and values (Dunkark Creek Rivers Conservation Plan):

"Dunkard Creek is formed by the confluence of the Pennsylvania and West Virginia Forks of Dunkard Creek at the village of Shamrock on the Pennsylvania-West Virginia border. From there it flows from west-to-east, crossing the Mason-Dixon Survey Line several times to the town of Mount Morris, then continuing in an easterly direction to its mouth on the Monongahela River at River Mile (RM) 87.20, near the village of Poland Mines."

"Dunkard Creek is part of the Monongahela River sub basin that drains into the Ohio River. It is identified as Hydrologic Unit Code 05020005010. The creek flows for 36 miles and drains 150,177 acres. 78,827 acres of the watershed drains 9 townships in Greene County, Pennsylvania while 71,350 acres drains 3 districts in Monongalia County, West Virginia.

Steep ridges form the western, southern, and eastern boundaries. The northern boundary of the watershed follows along the Warrior Trail. The hydrologic boundary to the west runs along the boundary line between Monongalia County, WV and Wetzel County, WV and on the south with the Marion County, WV boundary. The elevations along these ridge tops range from around 1500 ft. to over 1600 ft. above mean sea level. The highest recorded elevation in the watershed is 1686 ft., which is the U.S.G.S. Jackson Triangulation Station located on Bake Oven Knob (on the Monongalia-Marion County line in West Virginia) near the headwaters of Miracle Run. Dunkard Ridge forms the eastern boundary of the watershed.

Flows are augmented by numerous tributaries that drain the short hollows that characterize the terrain of the watershed. The largest of these found in Pennsylvania are Pennsylvania Fork, 24,098 acres; Toms Run, 11,258.55 acres; Roberts Run near Blacksville, 7,766.17 acres; Hoovers Run at Brave, 7213.76 acres; Rudolph Run, 6,453.42 acres, Shannon Run near Mt. Morris, 6,258.55 acres and Meadow Run near

Davistown, 4,895.85 acres. The major tributaries found in West Virginia are West Virginia Fork, 16,232.57 acres; Miracle Run, 14,854.24 acres; Days Run, 9,237.49 acres; Jakes Run, 8,203.83 acres and Dolls Run, 6,966.92 acres."

The lower 6.2 miles of Dunkard Creek has been severely impacted by AMD and is the focus of this Hydrologic Unit Plan. Attachment A shows the watershed, including its major tributaries.

II. EFFECTS OF MINE DRAINAGE

Historical information indicates that Dunkard Creek has suffered the effects of AMD for the last 75 years. The following is excerpted from the Dunkard Creek Rivers Conservation Plan.

"In 1931 the Pennsylvania Department of Health surveyed Dunkard Creek and described it as a stream mildly polluted by acid mine drainage. It contained fishable populations of bluegills, yellow perch, catfish, and bass (Anon. 1931). In 1938 J.H. Banning found the stream to contain smallmouth bass, rock bass, crappies, bluegill and other sunfish, carp, bullheads, suckers, and minnows.

In 1941 a West Virginia Mine located along Dolls Run discharged acid mine drainage into Dolls Run, a tributary to Dunkard Creek. No legal action was taken against the mining company because "the pollution laws of Pennsylvania exempt mine drainage pollution" (French 1941). As a result a fish kill was suffered on Dolls Run. The Shannopin Mine located near Bobtown, PA had some adverse affects on Dunkard Creek downstream of Mount Morris, PA during low flow periods. A chemical sampling in 1951 showed Dunkard Creek at Mount Morris had a pH of 7.5 and an alkalinity of 15 mg/l, but a pH of 2.9 and a total acidity of 282 mg/l at a point 12.8 km (8.0 miles) downstream from Mount Morris."

"A second survey was done in August 1972 to determine the effects of pollution from the Shannopin Mine on Glade Run and Dunkard Creek (Hesser et al. 1972b). A heavy precipitate covering the stream bottom was noted at the confluence with Glade Run and downstream along the left bank for approximately 300 feet. The stream bottom of Glade Run downstream from the discharge, besides being stained, contained masses of algae characteristic of mine acid drainage discharges. The survey determined that acid mine drainage from Glade Run substantially reduced the invertebrate populations immediately downstream. Because of the high buffering capacity of this stream, the invertebrate population approximately 3 miles downstream at the L.R. 30074 bridge appeared to have been unaffected by the discharge.

A survey done in June of 1977 reported that Dunkard Creek appears to sustain good water quality for most of its length (Proch 1978). Proch determined that mine drainage accounted for the loss of water quality in the lower reaches of the creek. Two point

sources accounted for only a small portion. Most resulted from barrier breeching along the valley wall starting at Bobtown and continuing for almost a kilometer."

"The Department of Environmental Protection (DEP) conducted a Priority Water Body Survey in 1984 (Rider 1985). The report investigated the Chapter 93 Water Use Designation of Warm Water Fishes. The survey data indicated this use was attained from Mount Morris to Taylortown and could be attained from Taylortown to the mouth in the absence of acid mine drainage. The recommendation was to retain the Warm Water Fishes Use Designation (Lorson, Shervinskie and Eisel 1995).

In September of 1998, The Pennsylvania Fish and Boat Commission reported a large fish kill at the Taylortown bridge. Approximately 1,752 fish were found dead on a 2 mile stretch starting at the Taylortown bridge. It is suspected that a large acid mine drainage discharge located above this area is to blame."

The DEP, Bureau of Water Quality Management completed a biological survey of Dunkard Creek in 1998 (Dunkard Creek Watershed Assessment, DEP Bureau of Water Quality Management, Southwest Regional Office, 1998). This survey sampled 7 stations and found Dunkard Creek to be relatively unimpaired at the upper 5 stations. Station 6 was located at the Taylortown Bridge, just downstream of the first significant AMD discharge and the location of the 1998 fish kill. Macroinvertebrate sampling indicated impairment here. Intolerant mayfly genera had disappeared and more pollution tolerant genera were found. According to the report, "This is the first site on Dunkard where we began to see a significant change in the structure of the aquatic community". Their station 7, which was located midway between Poland Mines and Bobtown, was found to be "…completely impaired by mine drainage". The survey found no living aquatic invertebrates or fish, primarily due to heavy iron precipitate that had coated the substrate. Another fish kill occurred downstream of the Taylortown Bridge in 2002, and was determined by the DEP to be AMD related.

The lower 6.2 miles of Dunkard Creek, starting near Taylortown, is severely impacted by abandoned mine discharges associated with Pittsburgh Coal seam underground mines. The acidity produced by these discharges is assimilated and neutralized by the highly alkaline water in Dunkard Creek. However, as neutralization occurs, severe iron and aluminum precipitation and deposition occurs in-stream along the entire lower section. In-stream iron concentrations frequently approach and occasionally exceed 25 PA Code Chapter 93 standards. Figure 1 provides a graphical summary of water quality changes that occur as the result of AMD inflows in the Lower 6.2 miles of Dunkard Creek. Sample points DC5 and DC6 are located upstream of the hydrologic unit while DC7 and DC8 are within the unit. DC7 is located near the USGS gauging station at Bobtown and represents the influence of AMD discharges 2 and 4. DC8 is located near the mouth of Dunkard Creek and represents the additional impact of AMD discharges 6, 7 and 8 (see the attached water quality spreadsheet for additional stream data)

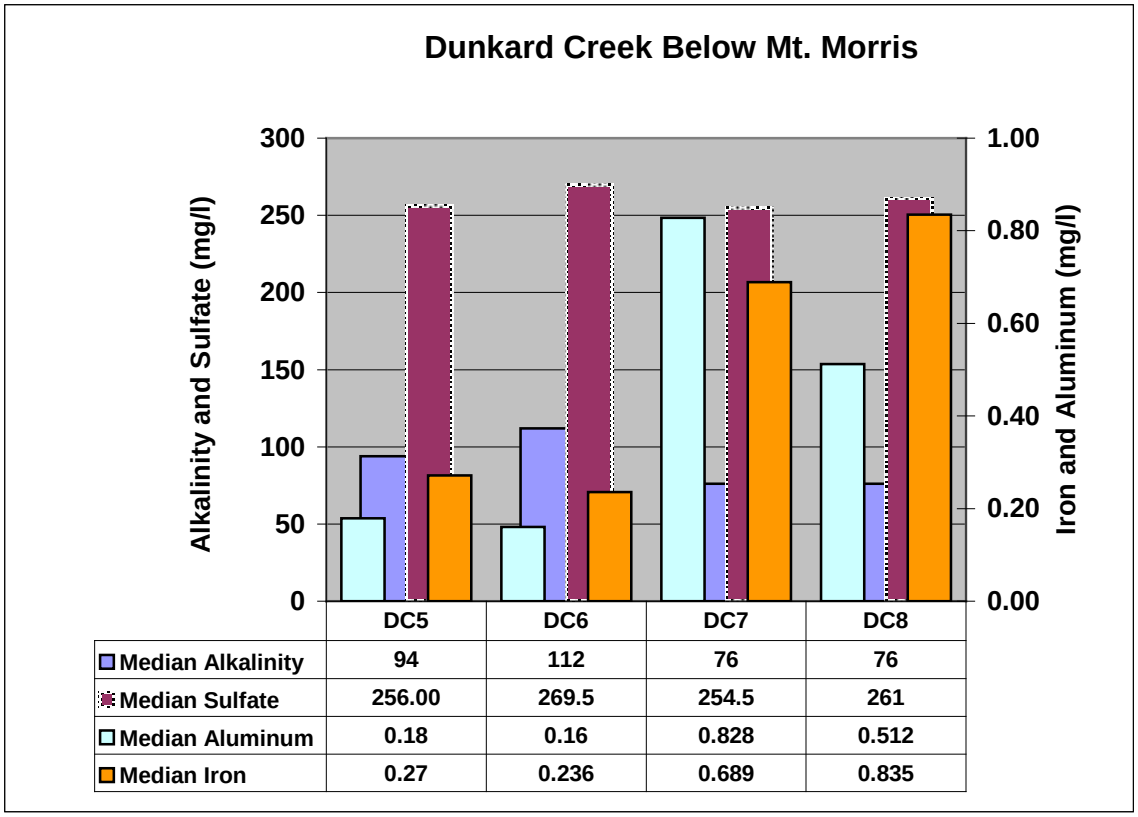


Figure 1 Dunkard Creek Water Quality Summary

In addition to the adverse effects of existing pollutional discharges, the lower section of Dunkard Creek is threatened by a potential discharge from the abandoned Shannopin deep mine complex. The abandoned Shannopin deep mine complex is slowly flooding and is filling to the point where it will discharge from abandoned portals in Bobtown, approximately 3.6 miles upstream from the mouth of Dunkard Creek. This mine was abandoned in 1992 and, at the current rate of flooding, it is expected to discharge by late 2004 or early 2005. If the abandoned mine is allowed to discharge, water quality and biological resources will be severely affected in the lower portion of Dunkard Creek, with further impairment expected in the Monongahela River, downstream of the mouth of Dunkard Creek. This discharge is expected to adversely impact biological life and water supplies, possibly for a distance as great as 15 miles downstream (MEPCO Power Point Presentation, 2003).

II. SOURCES OF MINE DRAINAGE:

Dunkard Creek water quality has been characterized as good, meeting its 25 PA Code Chapter 93 designated uses above the hydrologic unit. Upstream of Taylortown, previous PA DEP and Pennsylvania Fish and Boat Commission reports have documented stream impact resulting from sewage, agricultural and other abandoned mine drainage sources. However, these contributions do not impact the stream to the point of impairment. Permitted mine sites have approved NPDES discharge points in the upstream segments of the watershed (there are no permitted mining facilities within the hydrologic unit). No

stream impairment has been noted from these facilities as documented by facility monitoring and inspection reports and by the above referenced PADEP and PAFBC studies. (Also see the Dunkard Creek Rivers Conservation Plan and Attachment B water quality spreadsheets for additional information).

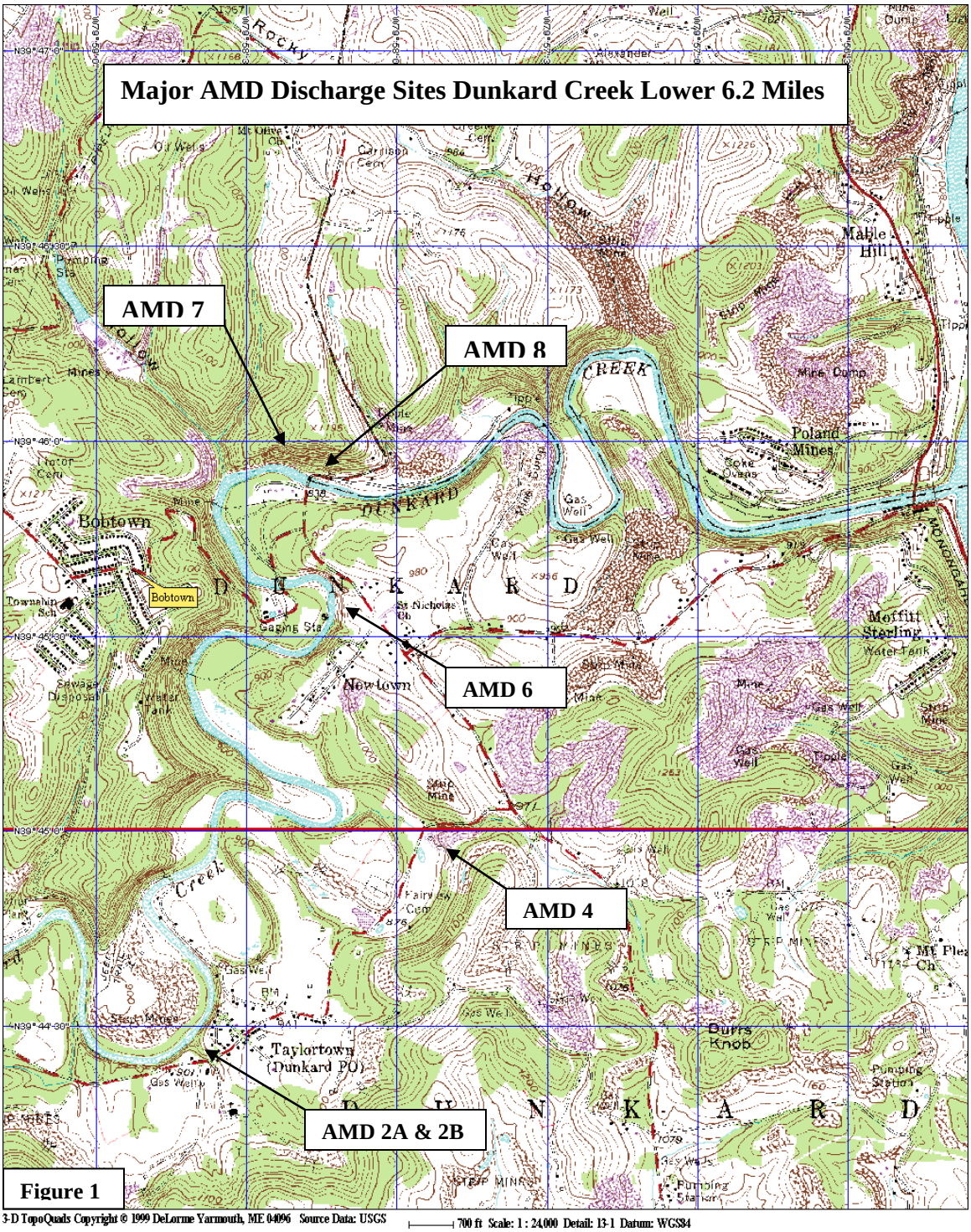


Figure 2 Sources of Abandoned Mine Drainage

The lower 6.2 miles of Dunkard Creek is severely impacted by abandoned mine discharges associated with Pittsburgh Coal seam underground mines. Figure 2 above shows the location of the five most significant AMD discharges within the hydrologic unit. These five discharges were determined to be the most significant during the development of the Rivers Conservation Plan and a subsequent, ongoing watershed assessment that is focusing on AMD impacts. Table 1 below summarizes the characteristics of these discharges, additional data in the attached water quality spreadsheets. Three other discharges that were monitored were determined not to be of significance and were dropped from the monitoring program.

Dunkard Creek AMD Discharges - Lower Section

Table 1 Dunkard Creek Mine Drainage Pollution Loading Lower 6.2 miles (Taylortown to Mouth)

Site		Flow (gpm)	pH	Acidity (mg/l)	Acid Load (tons/year)	Iron (mg/l)	Iron Load (tons/year)	Al (mg/l)	Al Load (tons/year)
2A	min.	13.5	3.1	60.0	5.0	11.1	0.9	12.0	0.7
	median	26.9	3.6	168.6	7.6	23.4	1.4	21.1	1.1
	max	53.9	4.6	492.0	14.5	50.8	1.5	37.8	1.7
2B	min.	179.5	2.9	268	187.1	30.9	20.9	28.3	14.5
	median	359.0	3.1	384.7	293.6	39.4	35.6	33.2	25.9
	max	695.6	3.2	474.8	568.1	55.3	49.0	36.8	45.5
4	min.	98.7	2.8	388.0	95.3	53.0	13.2	1.7	0.4
	median	215.4	2.9	439.6	227.0	58.4	27.6	24.1	10.1
	max	350.1	3.1	528.0	319.7	89.7	58.6	28.7	22.1
6	median	147	3.0	134.9	134.9	26.2	8.5	40.2	13.0
7	min.	246.8	6.1	-66.0	-74.8	160.0	94.6	0.2	0.1
	median	291.7	6.1	-19.2	1.2	171.0	114.5	0.5	0.3
	max	516.1	6.2	107.0	40.1	213.0	193.7	0.5	0.6
8	median	97	3.4	326	69.4	123.0	26.2	4.8	1.0
Totals	**min.**	**782.6**		**416.9**		**164.3**			**29.7**
	median	**990.1**		**598.8**		**205.3**			**38.4**
	max	**1859.7**		**1146.7**		**337.6**			**83.8**

Potential Impacts of the Shannopin Mine Pool Discharge:

DEP and OSM staff have closely monitored mine pool elevations since abandonment of the Shannopin Mine in 1992. At its projected rate of rise, the pool will discharge into Dunkard Creek at the mine openings near Bobtown during late 2004 or early 2005. The mine openings are approximately 3.6 miles upstream of the mouth of Dunkard Creek. Current information on the quality and quantity of the Shannopin mine pool water

indicate that the discharges from the Bobtown mine openings will severely impact lower Dunkard Creek and portions of the Monongahela River. Predicted water quality indicates acidity concentrations will range between 3,000 to 4,000 mg/l, iron concentrations will range between 500 and 1,500 mg/l, and aluminum concentrations will range between 100 and 200 mg/l. Flow rates are estimated to range between 2,000 and 3,500 gpm. Loading rates predicted for the discharge are: Acidity, 13,000 to 30,000 tons/year, Iron, 2,200 to 11,500 tons/year, and Aluminum, 500 to 1,500 tons/year.

Comparing these values to the summary load values in table 1 above discloses the potential impact of this new discharge if no corrective action is taken. Pollution load rates will increase an order of magnitude or more within the hyrologic unit. Adverse impacts will extend beyond Dunkard Creek downstream into the Monongahela River. There are four municipal water intakes within 15 miles downstream on the Monongahela River. These facilities supply potable water to over 42,000 customers. Two industrial intakes are also located within these distances. Increased treatment costs will be substantial. Biological and recreational impacts upon the river will also likely be very substantial.

III. IDENTIFICATION OF PROJECTS AND MEASURES PROPOSED

The Dunkard Creek Rivers Conservation Plan developed a Management Option that determined treatment methodologies and cost estimates for the 5 significant existing discharges. Table 2, below, which provides this information, was derived from Table 16 of that Plan. It has been modified and updated to provide recent revisions.

Discharge	Management Option	Cost Est.	Funding Sourc	Timeframe
Site 2A & 2B	Pipe discharges across Dunkard Creek to an area where a passive treatment system can be constructed	$870,500	EPA 319 or Growing Greener or 10% S.A.	As funding becomes available
Site 4	Construct Passive Treatment system on approximately 10 acre contiguous property	$1,102,316	87% Growing Greener 13% Local Match	Growing Greener agreement in place. Completion date June 30, 2004
Site 6	Pipe discharge along Dunkard Creek and across SR 2012 to area suitable for passive treatment construction.	$294,000	EPA 319 or Growing Greener or 10% S.A.	As funding becomes available
Sites 7&8	Pipe discharge along Dunkard Creek and across SR 2011 to area suitable for passive treatment construction.	$491,000	EPA 319 or Growing Greener or 10% S.A..	As funding becomes available
Total Cost		**$2,757,816**		

Table 2 Management Plan

At this time, the Site 4 proposed project has been funded. The Commonwealth's Growing Greener program is providing the majority of the funds for this project. While future projects are likely to occur, there is no funding in place for them at this time. The Commonwealth's Ten Percent Set Aside Program may be used for future funding, but no development work has been done at this time to determine the feasibility of treating these discharges. If a decision is made in the future to provide additional Set Aside funding at one of these sites, this Hydrologic Unit Plan and related Environmental Assessment will be amended to address this activity.

Shannopin Treatment Plan

This hyrologic unit plan was developed to initiate activities under the Pennsylvania Ten-Percent Set-Aside Program to prevent the adverse effects that would occur with a discharge from the Shannopin complex. The proposed project involves pumping the mine pool from an existing airshaft (Steele Shaft) in the abandoned Shannopin Mine and treating at a chemical treatment plant to be constructed for this purpose. The plant will provide pre-aeration in an 18' diameter tank to remove CO_2 from the mine water, neutralization with lime in two 35' diameter aeration tanks and solids removal in a 105' diameter thickener tank. Sludge will be injected into mined out portions of the Sewickley coal seam and treated effluent will be discharged to Dunkard Creek. The detailed project funding breakdown is shown in Table 3.

Annual operating costs are projected to be $2 million. Initially, AMD Reclamation Inc. and Dana Mining will provide all operation and maintenance of the facility (Dana is mining a seam above the flooded Shannopin mine; their operation is being hindered by the rising mine pool and they are willing to operate treatment facilities in order to be able to access their coal reserves). Long term operation will be provided either by a company called GenPower, who may take the treated effluent to use at a power plant that may be constructed just over the state line in West Virginia, or the Commonwealth of Pennsylvania.

The project partners for the Shannopin project include: Dana Mining Company, AMD Reclamation Inc., Genpower, and the Commonwealth of Pennsylvania.

The project partners in the Dunkard Creek restoration effort include: The Greene County Conservation District, Dunkard Creek Watershed Association, PA Department of Environmental Protection's Bureau of Abandoned Mine Reclamation and Bureau of District Mining Operations, USDA Natural Resources Conservation Service, PA Fish and Boat Commission, PA Game Commission, California University, Stream Restoration Inc., local municipalities and local landowners.

Item	Cost	DEP 10% Set-Aside	DCED OG	DCED ISR	PENNVEST
AMD Pump & Installation	$305,000	$305,000			
Site Prep. (inc. Electrical, phone, roads, fencing, etc.	$311,000	$311,000			
Discharge Pipeline	$1,074,900	$1,074,900			
AMD Treatment Facility Const.	$3,850,000	$109,100		$6,500	$3,734,400
Contingency @ 5%	$277,045				$277,045
Total Capital Costs	**$5,817,945**	**$1,800,000**		**$6,500**	**$4,011,445**
Development Cost – Dana & Genpower	$300,000		$100,000	$200,000	
Development Cost – 3rd party	$283,500			283,500	
Total Development	**$583,500**		**$100,000**	**$483,500**	
Costruction Management	$210,000			$210,000	
Mobilization & Commissioning	$300,000				$300,000
Insurance	$200,000			$200,000	
Total Non Capital	**$710,000**			**$410,000**	**$300,000**
Total all Costs	**$7,111,445**	**$1,800,000**	**$100,000**	**$900,000**	**$4,311,445**

Table 3 Shannopin Detailed Cost Summary

V. COST OF PROPOSED TREATMENT MEASURES

See section IV Tables 2 and 3

VI. EXISTING AND PROPOSED FUNDING

See section IV Tables 2 and 3

VII. ANALYSIS OF COST EFFECTIVENESS AND ENVIRONMENTAL BENEFITS

The proposed expenditures from the Ten Percent Set Aside fund represent partial capital costs to implement the abatement and treatment measures. These funds, at the amount of $1.8 million, will be matched against $5.3 million from other Commonwealth sources for the Shannopin project and Commonwealth and local funding of $1.1 million for the project at Site 4. All operation and maintenance costs for the proposed facilities will be the responsibility of Dana Mining. Upon completion of operations by Dana Mining, operation and maintenance will become the responsibility of either GenPower or the Commonwealth.

The environmental benefits of the planned projects at Shannopin and Site 4 include the prevention of the mine breakout at Bobtown and its impact on Dunkard Creek and the Monongahela River. This includes the prevention of biological and recreational impacts, as well as impacts to public and industrial water supply users. In addition, Dunkard Creek will benefit from the 2,000 to 3,500 gpm of treated water that will be discharged upstream of the impaired section. This influx of water meeting NPDES permit limits will improve the assimilative capacity of Dunkard Creek to handle the pollutional discharges identified in this plan. This, along with the removal of pollutants at Site 4, will result in habitat and water quality improvement and therefore improvement in the aquatic life in the lower 6.2 miles. This additional assimilative capacity should also prevent the sporadic fish kills that have occurred in lower Dunkard Creek.

REFERENCES

1. Greene County, Pennsylvania Conservation District,1999; Rivers Conservation Plan for the Dunkard Creek Watershed

2. PA DEP Bureau of Water Quality Management, 1998; Aquatic Survey of Dunkard Creek

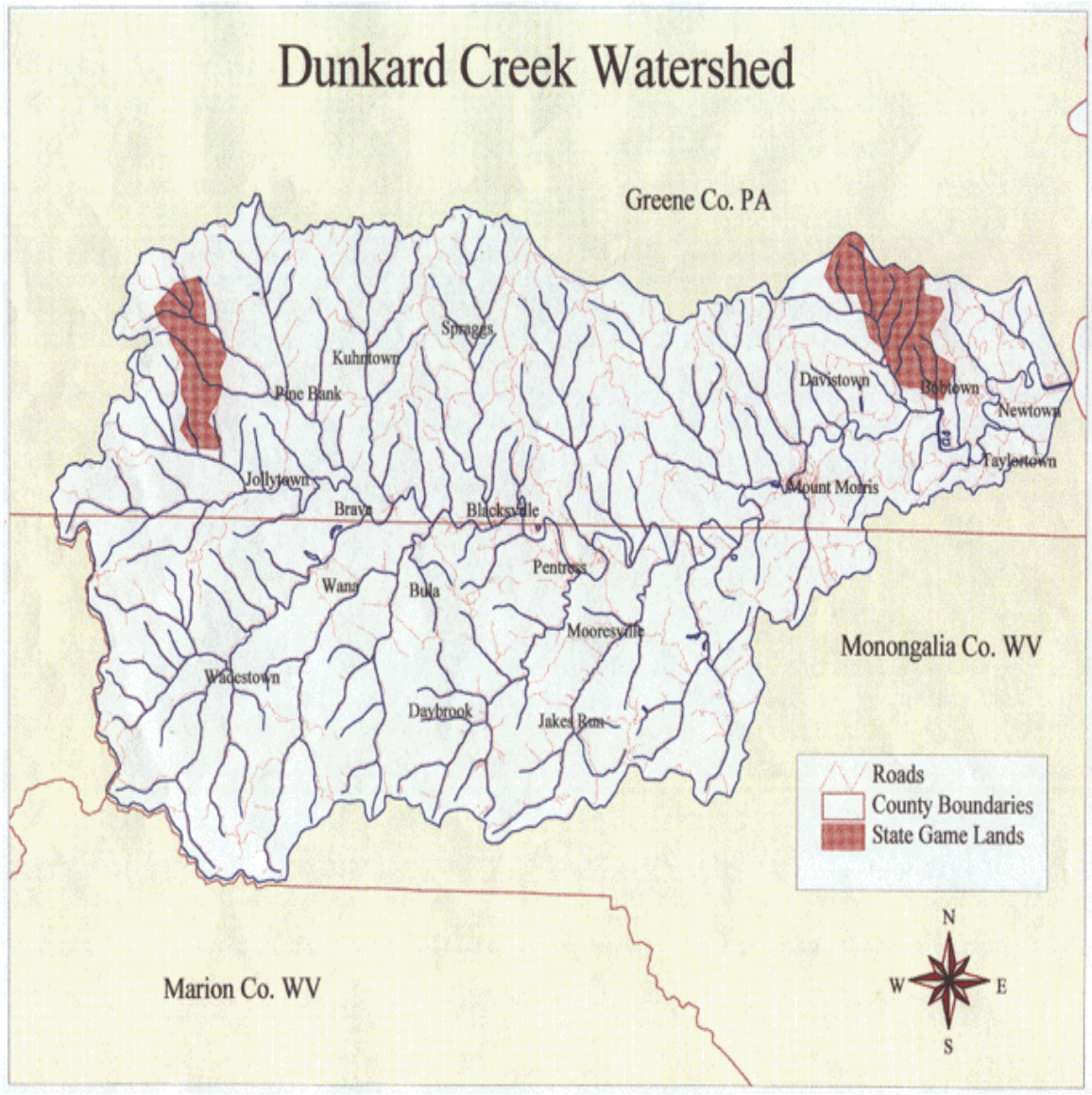
3. Dunn, Margaret H., Stream Restoration Inc, 2002, Mathews Restoration Area (AMD Site 4) Proposal; PA DEP Growing Greener Grants Program

4. Leavitt Bruce R. PE, PG, 2003, Personal Communication, Draft Restoration Plan – Dunkard Creek; PA DEP Growing Greener Grants Program

5. MEPCO, 2003, Power Point Proposal for solving the Shannopin AMD Problem

6. PA DCNR, Topographic & Geologic Survey, 1984; Coal Resources of Greene County Pennsylvania; Mineral Resources Report 86

ATTACHMENT A



ATTACHMENT B

Water Quality Spreadsheets:

Dunkard Creek DC 5, DC 6, DC 7 & DC 8

AMD Discharges AMD 2A &2B, AMD 4, AMD 6, AMD 7, & AMD 8