

The Dents Run AML/AMD Ecosystem Restoration Project

LOCATION

Problem Areas (PAs) 1934, 3888, 3890, 3893, 3894, 3895, 3896, 3897, 3898
Benzette Township, Elk County, Pennsylvania

SUBMITTED BY

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PROJECT START DATE

October 2002

PROJECT COMPLETION DATE

March 2012

CONSTRUCTION COST

AML Funds: \$6,274,295

State Funds: \$2,610,342

Other Funds: \$5,314,551

PRIMARY PROJECT PARTNERS

PA DEP, Bureau of Abandoned Mine
Reclamation
Bennett Branch Watershed Association
Pennsylvania Game Commission
U.S. Army Corps of Engineers –
Baltimore District

PA DCNR, Bureau of Forestry
Rocky Mountain Elk Foundation
Western Pennsylvania Conservancy
P&N Coal Company, Inc.

CONTRACTORS

P&N Coal Company, Inc.
Punxsutawney, PA

Stream Restoration, Inc.
Pittsburgh, PA

Berner Construction, Inc.
Lancaster, PA

DATE SUBMITTED

March 30, 2012

Executive Summary

The Dents Run Restoration Project is one of the most comprehensive Abandoned Mine Land (AML) and Watershed Restoration Projects undertaken by the Pennsylvania AML program to date. It involved multiple partners, employed innovative technologies and resulted in significant water quality benefits. The project addressed numerous Priority 2 health and safety hazards including significant highwalls, dangerous water impoundments, mine openings and hundreds of acres of barren, unstable acid mine spoil. Dents Run is a 25 square mile watershed located in north central Pennsylvania in Benezette Township, Elk County. It is located in the center of the habitat range for Pennsylvania's elk herd. The upper portions of the watershed are a Class A wild trout stream. The lower 4.5 miles of the stream were severely degraded by pre-Surface Mining Control and Reclamation Act (SMCRA) acid discharges from both surface and underground mines. A sub-drainage basin, called Porcupine Run, contributed over 90 percent of the pollution load to Dents Run and approximately 35 percent of the pollution load to the Bennett Branch of Sinnemahoning Creek. The Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation (PA DEP BAMR) worked with various partners to develop and implement a comprehensive watershed restoration plan. Partners included federal, state and local government agencies, private foundations, the coal industry and local grassroots organizations. The partnership embraced for the project provided important benefits, including additional technical capacities and financing for 55.8 percent of the total project cost by non-Title IV funding sources.

The project encompassed many pollutional discharges that were extremely acidic with highly elevated metals concentrations. Passive or active treatment alone would be costly and technically difficult to achieve. A combined reclamation and treatment/abatement effort afforded the greatest chance of successful remediation. The rehabilitation plan included alkaline materials addition, materials handling technologies and surface and groundwater best management practices (BMPs). The project provided an opportunity to examine mine drainage (AMD) improvement using alkaline addition and water handling techniques on AML sites. One of the targeted AML problem areas, PA 1934, contained both marketable coal reserves and a large volume of high quality limestone (1,500,000 tons). Limestone was used for alkaline materials addition on the site and in the other reclamation projects as well. A demonstration remaining permit facilitated the mining and reclamation of the site containing the limestone and provided an opportunity to develop a partnership with the mining industry that lowered the overall project cost. Project benefits are substantial and extend beyond the Dents Run Watershed.

Three hundred twenty (320) acres of scarred landscape was regraded and revegetated with grasses and other ground cover suitable to the local wildlife, including the growing elk herd. Ten (10) highwalls, totaling approximately 30,850 linear feet, were reclaimed. Project activity included the mining of 543,000 tons of limestone from the PA 1934 site which was used as alkaline addition material to the backfill on the additional reclamation sites. The limestone was mixed with 1,450 acre-feet, or approximately 6 million tons of spoil material. A total of 5,500 cubic yards of abandoned coal refuse material was removed from PA 1934, PA 3895 and PA 3896/97 and was used in a cogeneration facility. Twenty-three (23) mine openings were reclaimed and five (5) wet seals were installed at selected openings to direct drainage to treatment systems. Fourteen (14) different point-source discharges, or in some cases diffuse seepage areas, were addressed through the construction of passive treatment systems.

Two larger discharge areas are being treated actively by lime dosers. For the first time in a century, the downstream sections of Dents Run are net alkaline. In addition to providing limestone, the remaining effort on PA 1934 and the ensuing partnerships allowed for the establishment of a treatment trust fund for the long-term operation and maintenance of the facilities.

Project Background

Project Location

The Dents Run Watershed is located in Benazette Township, Elk County, Pennsylvania. The watershed encompasses approximately 25 square miles of mountainous, sparsely populated and wooded terrain in the north central part of the state. The watershed lies within the Allegheny Plateau and consists of deeply cut valleys with very steep side slopes.

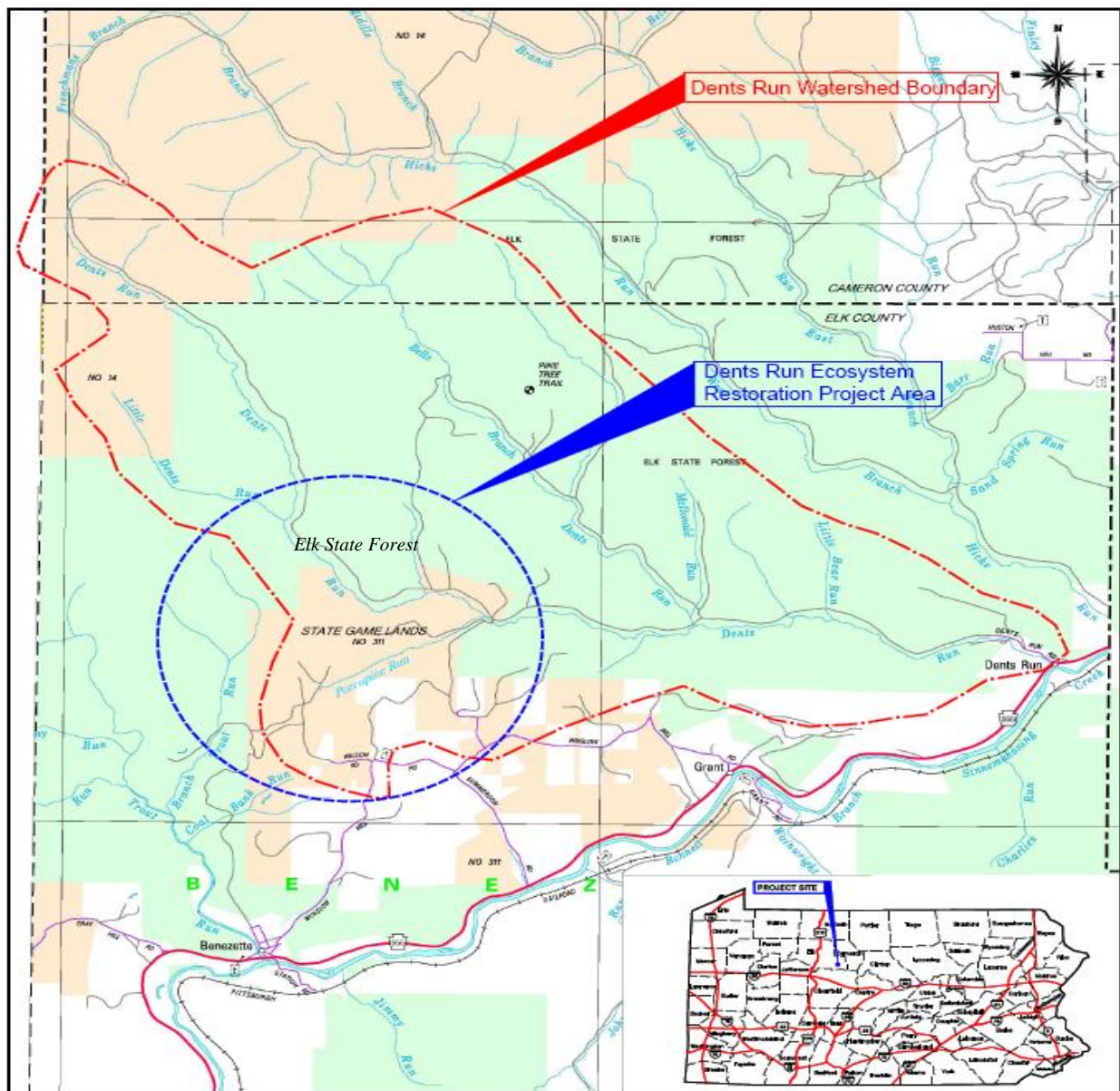


Figure 1 – Project Location Map

The small villages of Benezette and Dents Run are located along the southern perimeter of the watershed. The watershed is located approximately 12 miles south of the City of St. Marys, 35 miles northeast of the City of DuBois and 23 miles north of the Borough of Clearfield. Dents Run is a tributary to the Bennett Branch Sinnemahoning Creek. Sinnemahoning Creek is a tributary to the West Branch of the Susquehanna River, which ultimately empties into the Chesapeake Bay in northern Maryland. The location and boundary of the Dents Run Watershed is shown on Figure 1. Dents Run is also located on the southwestern edge of the rangeland for Pennsylvania's growing elk herd which now totals over 850 elk. Figure 2 shows elk grazing on the reclaimed PA 3896 and 3897 sites in the upper Dents Run Watershed.



Figure 2 – Elk on reclaimed AML sites in the Dents Run Watershed

Mining History

Coal mining began in the Dents Run area in the late 1800s and consisted of excavating small pits and driving short drift entries into the coal seams. In the early 1900s, underground mines were developed using the 'room-and-pillar' method to extract the coal. This method of coal mining continued in the watershed until the 1940s when surface or 'strip' mining became the predominant technique for mining the remaining coal reserves. The surface mining was conducted primarily on the Lower Kittanning (B-Coal) and the Clarion (A-Coal) Seams. Much of this mining activity took place in the Porcupine Hollow Subwatershed.



Figure 3 – Dents Run Watershed (circa 1920s) Wilmer No. 1 Mine (left), downtown Benezette (right)

Description of AML Problems

Figure 4, a portion of an AML Inventory Map for the project area, shows abandoned and unreclaimed mine features within various problem areas (identified by the letters “PA” followed by a four-digit number) located in the Dents Run Watershed. Figure 5 shows an unreclaimed, dangerous highwall located in PA 3898 in the upper Dents Run Watershed and Figure 6 shows a deep mine discharge from an abandoned underground mine located in PA 1934. These represent typical examples of the AML conditions that were present within the Dents Run Watershed.

The Elk County Conservation District submitted a request to PA DEP BAMR to restore the water quality in the Dents Run Watershed. The Pennsylvania Game Commission (PGC), the Pennsylvania Fish and Boat Commission (PFBC) and the Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry (PA DCNR BOF) also supported the request.

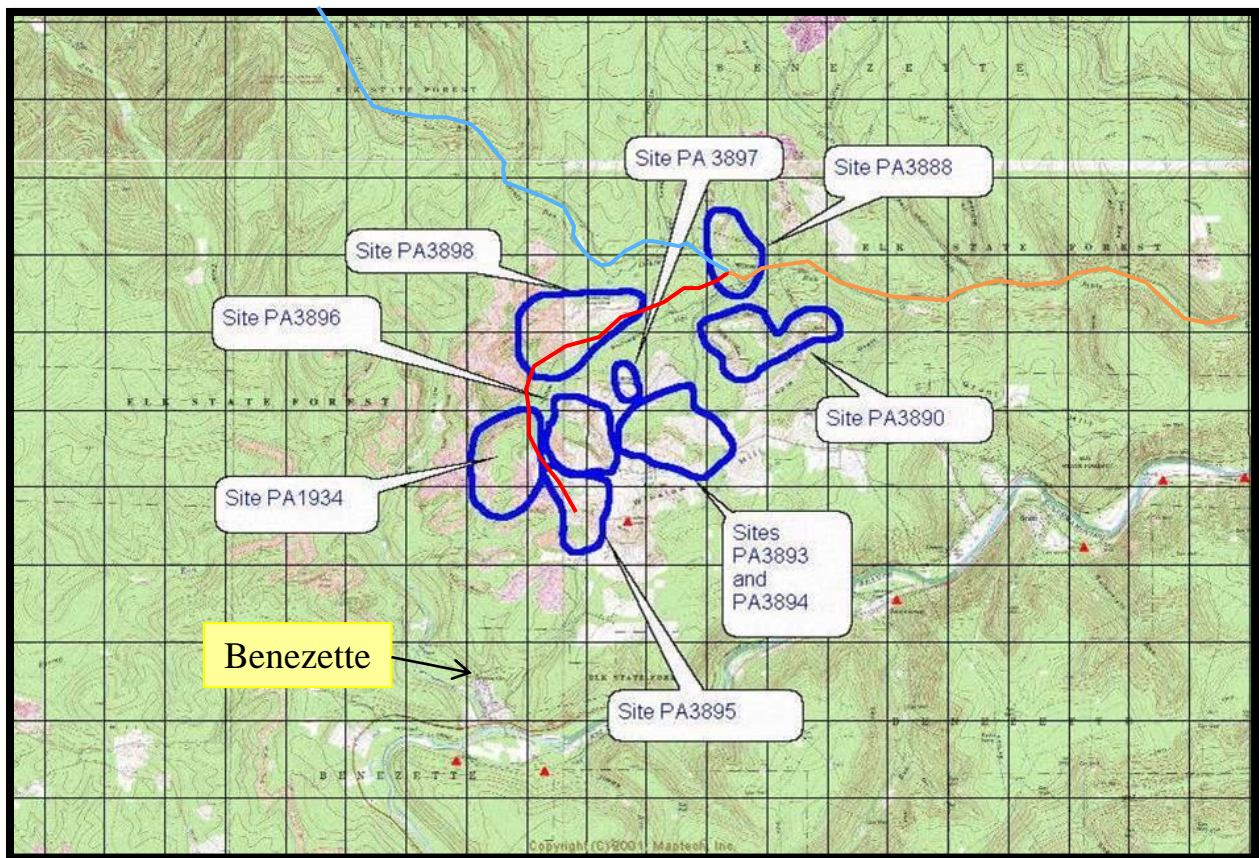


Figure 4 – AML inventory map showing problem areas included in the Dents Run Project

Difficulty of Achieving Reclamation under Existing Conditions

Specific and Unique Considerations

BAMR began working with the various partners to develop a comprehensive watershed restoration plan. A preliminary evaluation of the work required to restore the watershed revealed an estimated cost of approximately \$7,200,000 for the surface mine reclamation and alkaline addition. It was anticipated that following the surface mine reclamation work, passive treatment

systems, estimated to cost several million dollars more, would be required for the ultimate restoration of the watershed. Due to insufficient funds to fully fund this effort, BAMR began looking for other partners to assist with the funding and implementation of the project. Support grew from other local and national groups/organizations, including the Rocky Mountain Elk Foundation and the Western Pennsylvania Conservancy. The Bennett Branch Watershed Association (BBWA) began to take the lead, at the grass roots level, in implementing the project.

On-Site Difficulty of the Project

BAMR evaluated the problems in the watershed and established a water quality and quantity monitoring program. Abandoned mine sites were evaluated to determine restoration needs. Data analysis indicated that many of the pollutional discharges were extremely acidic with highly elevated metals concentrations. Consequently, they would be costly and technically difficult to effectively treat with passive systems alone. It was decided that a combined reclamation and treatment effort afforded the greatest chance to improve water quality. Six project areas were identified in the watershed for remediation. These areas either contained, or contributed to, the most significant discharges in the watershed. Alkaline materials addition, other materials handling technologies and surface and groundwater BMPs were deemed necessary and were included in the initial watershed rehabilitation cost estimates. Due to the remote location of the sites, supply of the required alkaline material from established sources would be very costly.

BAMR evaluated the geology of the area and identified the availability of limestone (alkaline material) in an unmined area, contiguous to one of the proposed reclamation projects (PA 1934).



Figure 5 – Abandoned surface mine highwall and water-filled pit located in the Porcupine Hollow sub-basin of Dents Run

An exploratory drilling project was developed to determine the extent and quality of the limestone and to gather additional overburden analysis data. A local mining company, Original Fuels, Inc., offered to provide the core drilling services at no cost if the overburden analysis and limestone quality data were shared. The results of the drilling project indicated a substantial reserve of high quality limestone (1.5 million tons) and also mineable quantities of both Upper Kittanning and Middle Kittanning coal (approximately 400,000 tons) on PGC property. The limestone reserve was sufficient to provide all of the necessary alkaline material for the required alkaline addition in the watershed.



Figure 6 – Abandoned underground mine (Lower Kittanning Coal Seam) discharge located in the Porcupine Hollow sub-basin of Dents Run

Reclamation Techniques

BAMR made a request to the U.S. Army Corps of Engineers (COE) to evaluate the proposed project for funding via one of their authorizations. The COE – Baltimore District, began evaluating the watershed for rehabilitation under their Section 206 program. The Section 206 program allows the COE to complete and implement a comprehensive watershed rehabilitation plan in cooperation with a local sponsor. An ecosystem approach, developed by the COE, was used to evaluate cost-effective measures that would restore the biological, chemical and physical integrity and habitat suitability of significant species to the restoration area. Brook trout were used as the indicator species for the aquatic community structure desired since brook trout and other species currently exist in the healthy, upper reaches of Dents Run and in Little Dents Run. Since the majority of the degradation is due to AMD, the project alternatives focused on those measures that treat and control AMD from abandoned mine lands. An array of AMD treatment alternatives that could restore the Dents Run ecosystem was identified. The COE developed an

Environmental Impact Statement (EIS) to analyze and disclose the significant environmental benefits of this project.

The recommended plan included a combination of reclamation and treatment technologies at six of the eight PAs identified as being the major AMD contributors (~97 percent of the total acid load) within the watershed. In addition to treatment systems, nearly one million cubic yards of “mine spoil” were regraded (with limestone added in the backfill) and revegetated. Surface drainage was redirected to promote runoff and reduce infiltration into the mine spoil, reducing future AMD generation. Wet seals were constructed at the portals of former underground mining operations to raise the water level within the mine, thereby reducing oxygen levels and consequently, future AMD generation. A total of five wet seals were constructed. In addition, 543,000 tons of an estimated 1.5 million tons of limestone within the watershed was mined to provide the source of neutralization and alkaline addition for the backfilling/reclamation efforts. The majority of the remainder or approximately 1.0 million tons of limestone was mined and used by P&N Coal Company, Inc. for the alkaline addition requirement on the active mine site (PA 1934). The remainder of the limestone was used to address other AMD or dirt and gravel road runoff problems within the Bennett Branch of the Sinnemahoning Creek Watershed.

Project Start and Completion Dates and Construction Costs

Construction on the project began with a groundbreaking ceremony in October 2002, Figure 7. The COE began reclamation work at PA 3888 with construction of mine seals and a passive treatment system in the spring of 2003. Mining operations also began at this time at PA 1934. As of January 2012 all work with the exception of reclamation activities by BAMR on PA 3888-3 has been completed. Table 1 contains specific cost information and identifies funding sources, as well as lead partner(s) for each reclamation area.



Figure 7 – October 2002 Dents Run Project partners’ groundbreaking ceremony

Name of the Organizations Responsible for the Reclamation

One unique aspect of the Dents Run Ecosystem Restoration Project is the number of partners involved. Partners included federal, state and local government agencies, private foundations, the coal industry and local grassroots organizations. The organizations are: the Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation; the Bennett Branch Watershed Association; the Pennsylvania Game Commission; the U.S. Army Corps of Engineers – Baltimore District; the U.S. Department of Interior, Office of Surface Mining (OSM); the Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry; the Western Pennsylvania Conservancy; the Pennsylvania Department of Environmental Protection, Bureau of District Mining Operations; the Elk County Conservation District; the Rocky Mountain Elk Foundation; the Elk County Commissioners; the U.S. Environmental Protection Agency and local mining companies: P&N Coal Company, Inc. and Original Fuels, Inc. Tables 1 through 4 provide summaries of accomplishments and identify the lead organization for the individual reclamation efforts.

On-Site Effectiveness

BAMR established water monitoring stations within the watershed in 1993. The stations included both strategic stream monitoring points and major AMD discharges identified within the watershed. The stations have been continuously monitored for flow and quality. Table 2 provides a summary of the data collected and illustrates the significant improvement in water quality observed to date. Trends in the data indicate/suggest that additional improvement in water quality is likely as the benefits of reclamation and addition of alkaline materials continue to positively impact surface and groundwater within the project area. At present the downstream sections of Dents Run are net alkaline for the first time in over a century. The improved water quality in the lower reaches of Dents Run has enabled the re-establishment of a fishery in the formerly impaired portions of the watershed. An initial goal of the restoration plan, reconnecting unimpaired upstream segments of the watershed, has been achieved.

Effective/Innovative Use of Technology

Addition of alkaline materials has been employed on a number of active mine sites in Pennsylvania since the early 1980s. Prior to the Dents Run Project, alkaline addition to abate AMD had not been employed on this scale at any abandoned mine site in Pennsylvania. Initial application rates on sites mined or approved prior to 1986 were based upon research conducted by the West Virginia Surface Mine Drainage Task Force and an AMD remediation project associated with the construction of Interstate 80. Both studies suggested that a realistic lime application rate was probably a third of the calculated deficiency. Applications at these levels were not successful in abating or significantly ameliorating AMD at the majority of these sites. Adjustments to alkaline addition rates that more closely approximated the calculated deficiency (1:1 addition) at sites also resulted in only limited success. More recent alkaline addition research has indicated a strong correlation between a site's net neutralization potential (NNP), expressed in tons of calcium carbonate per 1,000 tons of overburden and the post-mining water quality, in terms of net alkalinity. These studies evaluated over 120 mine sites with both overburden analysis data and post-mining water quality.

Their findings indicated that sites having NNP greater than 10 to 30 tons per 1,000 tons of overburden (T/TT) produced net alkaline drainage, whereas sites with a NNP less than 10 T/TT frequently exhibited net acidic water. Based on this research and the conditions documented at

the Dents Run Project site, alkaline addition requirements of 3,600 tons per acre were calculated to insure an NNP of greater than 12 tons per 1,000 tons of overburden. BMPs were developed for incorporating the alkaline material into the backfill in the most efficient and effective manner.

Landscape Conforms to the Natural Environment

Over 320 acres of enhanced rangeland for Pennsylvania’s growing elk herd were established through reclamation and remining efforts of this project. The project partner’s in-house experts, including wildlife biologists and foresters, worked supportively with BAMR and the COE staff to design and enhance the reclamation plan to achieve multiple goals. The post reclamation landscape not only enhanced habitat for elk and other wildlife, but also complimented the scenic grandeur of the surrounding forested countryside.

Table 1 – Dents Run Funding and Restoration Summary

Problem Area	Description	Lead Partner(s)	Fund Source(s)	Cost	
				Individual	By Fund Source
3888-1	Passive Treatment	U.S. COE	ACOE Section 206 Funding	\$295,543	\$1,688,140
3888-2	Passive Treatment Upgrade			\$158,133	
3893-1	8 acres AML Reclamation			\$311,000	
3893-2a	Passive Treatment			\$515,987	
3895-2a	Passive Treatment			\$407,477	
1934	Remining Including Limestone Mining for Alkaline Addition	P&N Coal Company, Inc.	Coal Industry	\$2,634,860	\$3,234,860
1934	Operation and Maintenance Trust Fund for the Lime Dosers	P&N Coal Company, Inc.		\$600,000	
1934	Limestone for Alkaline Addition and Installation of Lime Dosers	BBWA	State Funds	\$1,300,000	\$2,610,342
3890	54.9 acres AML with Alkaline Addition	DEP BAMR		\$535,342	
3898	52 acres AML with Alkaline Addition	DEP BAMR		\$775,000	
1934	Limestone for Alkaline Addition	BBWA	Title IV	\$3,027,926	\$6,274,295
3888-3	32 acres AML with Alkaline Addition	DEP BAMR		\$396,089	
3890	54.9 acres AML with Alkaline Addition	DEP BAMR		\$294,583	
3894	49.7 acres AML with Alkaline Addition	DEP BAMR		\$560,684	
3895	28.8 acres AML with Alkaline Addition	DEP BAMR		\$391,297	
3896	Relocation of Lime Doser	DEP BAMR		\$47,000	
3896/97	40 acres AML with Alkaline Addition	DEP BAMR		\$1,193,919	
3898	52 acres AML with Alkaline Addition	DEP BAMR		\$362,797	
Various	In-Kind Services for the Project	Various	In-Kind	\$391,551	\$391,551
Total Funding					\$14,199,188

Table 2 – Water Quality Summary (Median Values)

Point Description	pH		Alkalinity (mg/l)		Hot Acidity (mg/l)	
	Pre 2010	Post 2010	Pre 2010	Post 2010	Pre 2010	Post 2010
Dents Run upstream of Porcupine Run adjacent to site PA 3888	6.3	6.6	9.6	12.4	10	-1.8
Dents Run 500 feet downstream of Porcupine Run	3.6	5.6	0	10.4	66.6	14.4
Porcupine Run at mouth	3.4	4.8	0	12.2	142.2	52.8
Tributary to Porcupine Run downstream of PA 3890 and 3893	3.9	5.85	0	16.3	46	4.5
Porcupine Run midstream section	3.3	4.75	0	12.7	283.4	87.8
Porcupine Run Headwaters downstream of PA 3895	2.9	6.55	0	37.4	654	-17.1
Dents Run at mouth	4.7	6.19	7.2	9.3	21.2	11.4
Discharge No. 13 on PA 3898	3.7	4.4	0	7.9	210	88
Discharge No. 14 on PA 3898	2.8	4.3	0	8.4	615	165
Discharge No. 15 on PA 3898	3.4	4.25	0	6.4	228	85
Discharge No. 17 on PA 1934	2.8	2.9	0	0	1433	857
Discharge No. 19 on PA 1934	3.1	3.4	0	0	369	206
Discharge on PA 3888	3.1	7.1	0	36.2	60	-23.2

Elimination of Significant Health and Safety Problems

The abandoned highwalls, water impoundments, steep unstable spoil areas and mine openings were considerable health and safety concerns, given their existence on public land frequently visited by a large number and wide variety of outdoor aficionados. Sportsmen, hikers, horseback riders and an ever-expanding number of visitors observing Pennsylvania’s elk herd frequent this area throughout the year. It was recognized that site hazards would become more problematic as a result of these recreational opportunities. In addition, establishing new habitat, rangeland and food plots on the newly reclaimed AML lands for the elk and other wildlife is helping to keep the animals away from developed residential and agricultural areas. This helps reduce the potential for undesirable elk and human encounters, as well as damages occurring on private property and along major public highways. Figure 8 shows two examples of such situations.



Figure 8 - A close and somewhat undesirable encounter with elk along State Route 555, as experienced by BAMR design engineering staff (left), live lawn ornaments (right)

Funding

Effective Use of Funds

As shown in Table 3, 55.8 percent of the total project cost was shared by non-Title IV funds. Clearly, the partnership and comprehensive approach yielded significant savings. The addition of other entities including federal, state, local and industry partners has resulted in conveying not only additional funding, but more importantly, additional technical capacities to the project. Tables 1 and 3 summarize the funding contributions of the various project partners.

Table 3 – Project Cost Summary

Funding Source	Amount	Percentage	
Coal Industry	\$3,234,860	22.78%	55.81%
U.S. Army Corps of Engineers	\$1,688,140	11.89%	
DEP BAMR State Funds	\$2,610,342	18.38%	
Local/In Kind	\$391,551	2.76%	
Title IV Funds	\$6,274,295		44.19%
Total	\$14,199,188		100.00%

Table 4 – Summary of AML Features Addressed

Problem Type	Quantity
Dangerous Highwalls (Linear Feet)	30,850
Hazardous Water Bodies	10
Spoil Areas	260
Mine Openings	23
Passive Treatment Systems	4
AML Sites Remined (Acres)	60
Active Treatment Systems (Lime Dosers)	2
Total AML Acres Reclaimed (Acres)	280

Leveraging – Use of Partners for Funding or Technology

The project included a demonstration permit (Project XL permit) that facilitated the mining and reclamation of the site containing the limestone (PA 1934). This provided an opportunity to develop a partnership with the mining industry and lowered overall project cost. Project XL is a cooperative program developed by the U.S. Environmental Protection Agency (EPA), OSM, the Interstate Mining Compact Commission (IMCC) and the Pennsylvania Department of Environmental Protection's Bureau of Mining and Reclamation (BMR). The permitting approach was developed to encourage remining and is based on compliance with in-stream pollutant concentration limits and implementation of BMPs instead of National Pollutant Discharge Elimination System (NPDES) numeric effluent limits measured at individual discharge points. Under a Project XL permit, the mining operator is required to meet or improve water quality at an in-stream monitoring point located downstream of the mining operation rather than at each individual discharge to the stream. These provisions will result in statewide interest extending reclamation opportunities beyond current permitting and AML funding limitations.

The PGC, through a partnership with Domtar Papermill located in nearby Johnsonburg, PA, is conducting additional research aimed at improving the quality and sustainability of vegetation on these reclaimed AML sites. Domtar produces a highly alkaline paper waste sludge product that has a PA DEP general permit approval for land application as a soil amendment. Wildlife biologists and soil scientists with PGC are conducting on-going studies, utilizing this material in amending food plots on the reclaimed projects. Figure 2 shows approximately 170 elk grazing on one of these application areas.

Benefits to the Community

Community Support for the Project

Significant community interest and support exists for this project. In 1998 the BBWA formed to begin the restoration work needed on the Bennett Branch to restore it to its pre-mining condition. Local government officials strongly supported the project. The PGC's Facebook Page, www.facebook.com/PennsylvaniaGameCommission, established in October 2011, contains two articles highlighting the reclamation project. Both have received numerous positive replies from followers throughout the nation.

Long-Term Benefits to the Community

Approximately 75,000 people travel annually to Dents Run to view the elk herd. Recreational activities, including fishing, hunting, hiking and camping, have been improved within the general vicinity of the watershed as a result of the project. The local economy has also benefited as well. New or expanded businesses include rental cabins, bed and breakfast hotels, sport shops and stores.

Surface Mining Control and Reclamation Act (SMCRA)

Exceeds the Spirit and Intent of SMCRA

The Dents Run Restoration project addressed a number of high-priority AML problems in accordance with the spirit and intent of Title IV of SMCRA. The project's location on publicly-owned land that is frequently visited by sportsmen, outdoor enthusiasts and an ever-expanding number of individuals observing Pennsylvania's elk herd, reinforces both the

need for and the tremendous benefits of a national AML reclamation program. The addition of other entities including federal, state, local and industry partners has resulted in conveying not only additional funding, but more importantly, additional technical capacities to the project. This resulted in a reclamation effort that clearly has exceeded the resources available to any individual organization.

Increased Public Awareness of SMCRA

Prior to and during construction of the Dents Run Project, the site served as a field site for a number of tours for state and federal legislators and others interested in AML problems and the impacts of AML and AMD in the Appalachian Region. It can now serve as a model of the great reclamation work that is accomplished throughout the country through the SMCRA, Title IV AML Program.

Transferability to Other AML Projects

The project exemplifies a comprehensive reclamation approach. Site specific AML hazards were targeted and addressed while taking into account methods which would provide a positive impact on the watershed. It also helped the members of a grassroots organization, BBWA, to develop and meet their goals in restoring their watershed. The partnership approach that was used here resulted in substantial savings in both time and overall cost. There are many similar sites in the coalfields where this approach can be duplicated.

Summary/Conclusion

The Dents Run Restoration Project addressed a variety of AML problems, posing both a threat to public health and safety as well as causing significant environmental degradation. Partnerships with local grassroots organizations, government agencies and the coal industry facilitated the completion of the project. The positive health, safety and environmental impacts were magnified since the project was located on high visitation public land. The project also directly improved and expanded habitat for the elk, helping to more firmly establish the reintroduced species in Pennsylvania. The holistic approach and partnerships resulted in more reclamation and a greater regional impact than was possible under Title IV alone. The resultant reclamation provides an outstanding example of what can and is being accomplished through the AML program here in Pennsylvania and throughout the country.



June 2005



August 2009



April 2010

Figure 9 – Dents Run confluence with Bennett Branch 2005 (upper left), Dents Run mouth 2005 (upper right), Dents Run mouth 2009 (lower left), trout fisherman enjoying a restored section of Dents Run approximately 2 miles upstream of mouth (lower right)



Figure 10 - PA 3898 prior to reclamation (upper left), dangerous highwall and highly acidic water impoundment (upper right), reclaimed site spring of 2007 (lower left) and aerial view of reclaimed site PA 3898 late summer of 2007 (lower right)



Figure 11 – Mine discharge near the headwaters of Porcupine Run PA 3895 (upper left), coal refuse in stream channel PA 3895 (upper right), mine spoil and coal refuse PA 3895 (lower left) and PA 3895 showing reclaimed area and passive treatment system (lower right)



Figure 12 – 1920s era shovel on PA 3896/3897 (upper left), coal refuse and mine discharge area (upper right), site just prior to seeding in summer 2010 (lower left) and site in fall 2010 showing revegetation, white-tail deer and tipping bucket lime doser in operation (lower right)



Figure 13 – Fall 2007 aerial view of remining operation on PA 1934 (above) and stockpile of limestone available for alkaline addition on PA 1934 site (below)

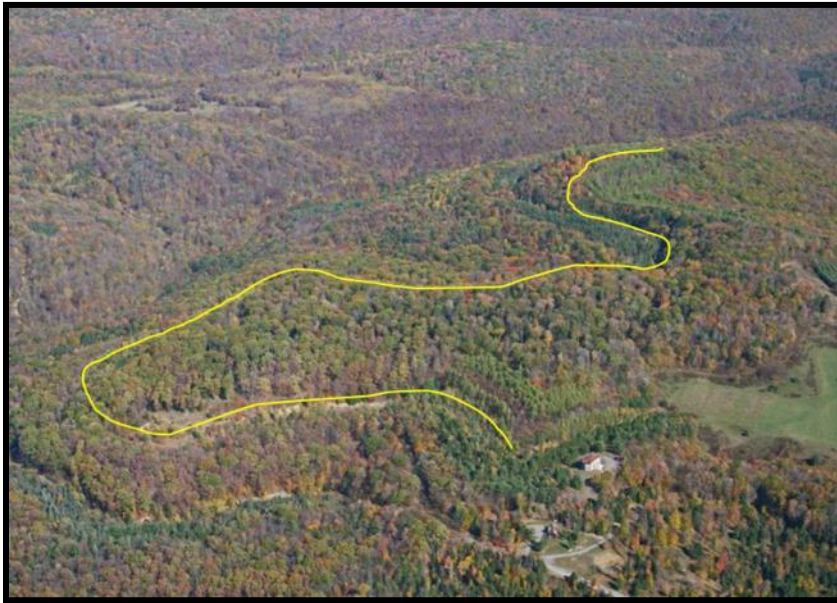


Figure 14 – Abandoned highwall on PA 3890 (upper left), aerial view of reclaimed PA 3890 site (upper right), U.S. COE highwall reclamation area and passive treatment system (under construction) on PA 3893 (lower left) and U.S. COE passive system on PA 3888 (lower right)



Figure 15 – Elk cooling off in COE passive treatment system PA 3888 (above), tipping bucket lime doser treating AMD Discharge No. 17 PA 1934 (below) photos from PGC website