RECLAMATION OF POST-MINED LANDSCAPES

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1 ABSTRACT

The Anthracite Coal Region is only a small part of the large scale energy extraction landscape in Pennsylvania. While hydraulic fracturing operations are the most recent extraction process, in the past, it was anthracite coal mining that caused environmental, ecological, and economic concerns. After many years of prosperous extraction of our earth's "black diamonds", the coal mining process has resulted in scarring the area's cultural and natural ecosystems. Degraded, barren and devastated landscapes became the norm in the region. The anthracite coal region is now stamped with abandoned coal mines, new landforms of mining waste and a contaminated landscape of sulfur and iron polluted watersheds. This acid mine drainage is visible in most of the region's streams, but there are resolutions to these hydrological and environmental problems. The purpose of this paper is to define the planning processes that must be enacted in order to successfully reclaim the mining sites, their individual ecologies, and communities in the coal region. This method of research begins with precedent studies of a successfully remediated bituminous coal mine in eastern Pennsylvania, and the planning methods of International Bauausstelling (IBA) Fürst-Pückler-Land for mining sites in Germany. This paper will review the successful remediation work of landscape architects, scientists, and engineers specifically due to community involvement. Innovative designs and planning measures are seen to help rebuild post-mined landscapes into healthy, productive, and reusable land that will economically strengthen and re-energize the community.

1.1 Keywords

anthracite mining, reclamation, biotopes, remediation, community

2 OBJECTIVES

This paper will review the precedent built reclamation project, the AMD&ART Project. This project proves success with a defined planning process including the involvement of the community, landscape architects, scientists, and engineers. Further study of the planning efforts of the German organization, International Bauausstellung (IBA) Fürst-Pückler-Land, provides vivid and innovative design efforts that have rebuilt post-mined landscapes into healthy, productive and reusable land that has economically strengthened and re-energized communities.

3 INTRODUCTION

The Anthracite Coal Region in Northeastern Pennsylvania was first defined in the late eighteenth century. As mining of this economic resource began, mining corporations were formed and employed a great number of miners. Communities and small towns were established around the mining source and the communities grew as the mines developed. Mining communities were built in what was termed "patches" or villages where typically, everyone's home was owned by the coal companies. The coal mine was the hub of activity (Poliniak, 1993). Over time and after extensive mining, the anthracite coal would become depleted and the mining production would come to an end. The mine would shut down and the scarred landscape would become abandoned. Coal miners and their families would often have to relocate or find a new economic resource or industry that would sustain the strength of community.

When mining of this economic resource began, the Appalachian landscape was altered. The geologic processes of the region have formed the layers of rock and coal veins into deep threads that run hundreds of feet into the earth. Access to the anthracite coal started with deep coal mining extraction. Miners would dig based on their mapping a series of tunnels underground that cut the landscape both vertically and horizontally. The mined landscape had been mapped in plan-view but, most importantly, sectionally, so men could tunnel through the landscape and extract the anthracite coal, or earth's diamond (Figure 1).

Figure 1. Deep Coal Mining, Ashland, Pennsylvania (2012); Strip Mining at Blaschak Coal Corporation, Mahanoy City, Pennsylvania (2012). Photos by Author

Traversing through the series of underground mazes was the most prevalent way that coal miners could extract the coal. When it came to mining safety, strip coal or surface mining was the safer and more economical procedure. Mountainsides were ripped with explosives, revealing the shallow layers of coal veins amongst the rock. The strip mining procedures and techniques quickly removed and carved out large landforms and mountains, leaving barren open pits which posed hazards to individuals walking in the mountains (Figure 1). This method was safer for the mine workers; however, the strip mining left a larger visual scar on the earth's surface than the deep coal mining. In both deep coal mining and strip coal mining, a waste product, culm, is the end result once all of the usable coal is filtered out. An astonishingly massive quantity of culm results from each mining site. New landscapes and culm mounds are formed, altering the site's topography dramatically (Montrie, 2003).

Most often, deep mining and strip mining both have negative impacts visually and environmentally. The underground mines and their supports often fail over time resulting in the earth shifting and evidence of this is seen on the surface by the presence of dangerous sink holes. In 1962, an underground fire ignited from a trash dump in Centralia, PA (Devine, 1991). This fire, which still burns today, has resulted in deadly gases and unstable soils that have made the town of Centralia too dangerous for human habitation. In 1984, the U.S. Congress allocated more than $42 million for relocation efforts. In 1992, Pennsylvania Governor Bob Casey invoked eminent domain on all properties in the borough, condemning all buildings within the borough. The pressing questions are: Is there ever a chance of Centralia being safe and livable again? Is there any hope for reclamation of either the landscape or the community (DeKok, 2000).

4 ENVIRONMENTAL IMPACTS OF MINING

In 1977, the Surface Mining Control Act was approved and states that "this Act establishes a program for the regulation of surface mining activities and the reclamation of coal-mined lands, under the administration of the Office of Surface Mining, Reclamation and Enforcement, in the Department of the Interior. The law sets forth minimum requirements for all coal surface mining on Federal and State lands, including exploration activities and effects of underground mining. Mine operators are required to minimize disturbances and adverse impact on fish, wildlife and related environmental values and achieve enhancement of such resources where practicable. Restoration of land and water resources is ranked as a priority in reclamation planning" (Green, 1977). The requirement to reclaim land takes time and money but restoration is needed on the sites that were abandoned and scarred before this law was enacted.

The major visual artifacts of mining, culm banks have become the new landscape in the coal region. These resulting black landforms cannot support abundant plant life and, consequently the runoff contaminates the local watersheds, resulting in Acid Mine Drainage (AMD). The culm banks are toxic to plants and the unplanted large black landforms are highly erodible. Rainwater seeps through these contaminated banks draining onto the watershed surfaces and into local streams (Squillace, 2009).

Early coal mining companies did not have the knowledge to realize the long term affects their mining practices had on the environment. Thousands of miles of streams were contaminated when pyrite (an iron sulfide) was exposed and reacted with air and water, forming sulfuric acid and dissolved iron. Some or all of this iron can precipitate to form red, orange or yellow sediments along the streams (Figure 3).The acid runoff further dissolves heavy metals such as copper, lead and mercury into the ground or surface water. AMD disrupts growth and reproduction of the aquatic plants and animals that are necessary for the environment to be healthy.

Figure 2. The Vinton Colliery Site (1997). Permission by T. Allan Comp, PhD; Culm bank at Blaschak Coal Corporation, Mahanoy City, Pennsylvania (2012). Photo by Author

Figure 3. Acid Mine Drainage Reclamation, Nesquehoning, Pennsylvania (2012); Local stream contaminated with AMD, Ashland, Pennsylvania (2012); Acid Mine Drainage Reclamation, Nesquehoning, Pennsylvania (2012). Photos by Author

This AMD also diminishes valued recreational fish species which devalues and degrades outdoor recreation and tourism, negatively affecting the economy. Most importantly, AMD contaminates surface and groundwater drinking supplies, and causes acid corrosion of the wastewater pipe infrastructure. More than 3,000 miles of streams and associated ground waters are affected by these mines, affecting four major river basins in Pennsylvania (www.arippa.org).

5 CASE STUDY

In order to analyze and study precedent mining reclamation projects, one built project will first be presented. This project was selected because it has been remediated for nine years and has been proven successful by the scientists, hydrologists, ecologists, and community members involved. The second precedent study is based on the design and planning strategies of remediated mining sites of the successful organization, International Bauausstellung (IBA) Fürst-Pückler-Land in Germany.

5.1 AMD&ART, Vintondale, PA

Location: Vintondale, Pennsylvania
Site: The Vinton Colliery
Size: 35 Acres
The core Design Team: T. Allan Comp, Historian and Project Director; Bob Deason, Hydrologist; Stacy Levy, Sculptor; Julie Bargmann, Landscape Architect

AMD&ART is a remediation project that was conducted from 1994-2005, on the past Vinton Colliery site in Vintondale, Pennsylvania. The post-mined landscape was contaminated from AMD and the strategy was to utilize historians, scientists, hydrologists, artists, and landscape architects to remediate and rebuild the site. This local abandoned community was experiencing the derelict, scarred landscape and contaminated watershed. The site was redesigned with a series of cleaning ponds, gardens, and wetlands that would be used in part as an educational tool for the public and additionally as a cleaning system for the watershed. The AMD Treatment System would function both aesthetically and scientifically as the vegetation, soils, and aeration techniques help to extract the contaminating metals from the water. The water treatment begins in a holding pattern where the contaminated water resides and is a clear visual marker of the localized AMD (Figure 4). This pond references the beginning visual educational indicators, starting with the orange pond. From the first orange acidic pond, water will next drain into the following three ponds that utilize vegetation and soil compost to increase the pH of the water (Figure 5). Pond 5 uses a thick layer of organic material under the top two feet of water (Figure 6). Four feet of limestone and a drainage system below is situated under this organic material layer. Each of these layers takes on the additional role to deoxygenate and continue to clean the flow of water. The water passes through an aerator to empty into the sixth remediating pond that is now free of the orange color. Testing has proven that the pH increases and the water that empties in the design Litmus Garden is metal-free. It is here that native trees and shrubs are shown in a carpet of color that enhances the appealing visual experience of a fall landscape. The fall display is also an occasion for celebration among community members who now indulge in the beauty of a clean watershed (Comp, AMD&ART, Inc., 2003-2007).

The clean water that traveled through the series of treatment ponds empties into a designed wetland conceived by the Wildlife Habitat Council. This area was once the site of all of the major Vinton Colliery buildings (Figure 7). Remnants or footprints of the torn-down structures that were left in the wetland area are evident as structures that are found among the wetland vegetation.

Figure 4. Site Signage for the Acid Pool and Litmus Garden (2005). Permission by T. Allan Comp

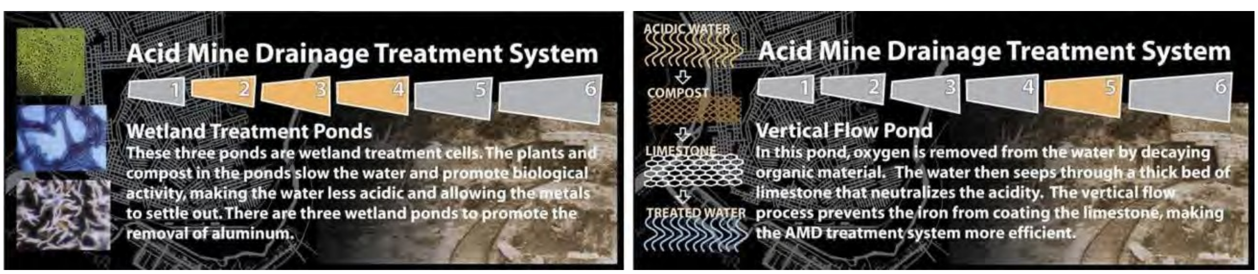

Figure 5. Site Signage for the Wetland Treatment Ponds and the Vertical Flow Pond (2005). Permission by T. Allan Comp

Figure 6. Site Signage for the Final Settling Pond and the Wetlands Habitat (2005). Permission by T. Allan Comp

Figure 7. Vinton Colliery Washery and Power House in 1906, Collage of the old building on the reclaimed land, and the AMD&ART Park today (2005). Permission by T. Allan Comp

This historic mining area now shows biotope success in this new wetland environment that attracts birds and wildlife. Thousands of native wetland plants were planted that now attract local bird and insect species, local wildlife and even native bats (Comp, AMD&ART, Inc., 2003-2007).

Artists were also part of the planning process and there are currently three art installations on site that indicate the mining history and those who worked in the mines. One installation visualizes the past history of the site map that once was on the mining site and what the reclamation site has mapped out. The before – after overlay provides the viewer with a clear visual history ranging from what was historically located there to what the ponds and wetlands function as now (Comp, AMD&ART, Inc., 2003-2007).

The success of this remediated biotope first relied on the removal of the four-to-eight feet of mining waste that covered this area of the site. A Government Financed Construction Contract Permit had to be issued by the Office of Surface Mining and the state mining office that allowed a coal hauler to remove 70,000 tons of waste material at no cost. One of the first steps or issues that many remediation sites begin with is the mountainous culm banks. The fundamental questions are: Is there funding possible for removal? Are there new energy resources for recycling this material (Comp, AMD&ART, Inc., 2003-2007)?

The scientists and design team worked closely with the community to give form to community aspirations. Public art spotted around the site provides historical perspective and an artful celebration for sustainable community development. Artists were also part of the planning process and there are currently three art installations on the site that indicates mining history and those who worked in the mines. One installation visualizes the past history of the site map of what was once on the mining site and what the reclamation site has mapped out. The before – after overlay provides the viewer of a clear visual history of what was once there to what the ponds and wetlands function as now. The community was now able to participate in an educational learning experience from the six "cleaning" ponds and enjoy the wetland biotope, public art, and recreation area (Comp, Science, Art, and Environmental Reclamation: three projects and a few thoughts, 2008).

AMD&ARTS formed a successful team of designers that worked closely with the community to build a successful remediated post-mining site that is educational, aesthetic, and that has functionally remediated the AMD from the mining process landscape.

5.2 International Bauausstellung (IBA) Fürst-Pückler-Land

International Bauausstellung (IBA) Fürst-Pückler-Land is a German organization that has led design competitions, workshops and planning efforts in the mining regions of Germany. IBA has given economical, creative and ecological impulses for restructuring past industrial sites as they did with Peter Latz's Emscher Park in Duisburg. From 2000-2010, IBA Fürst-Pückler-Land refocused their efforts in reshaping the mining landscapes in Brandenburg. Within these ten years, IBA was engaged in thirty projects that comprised a "Workshop of New Landscapes". IBA hosts workshops that enable and guarantee a high-quality standard of landscape architecture and leads to innovative designs. My personal experience was to participate in the 2001 work in Cottbus, Germany that connected multiple universities from 14 different countries to study and propose designs for the city of Cottbus. IBA is an incremental planning instrument for these mining communities. The philosophy of IBA was to facilitate these mining communities into finding and developing new economical and innovative visions for the region through seven main topics: Industrial heritage, Waterscapes, Energy Landscapes, New Land, Border Landscapes, Cityscapes, and Transitional Landscapes (Hunger, 2005)

IBA intends to preserve the industrial heritage, culture, and history of the site. However, the hope is also to design new alterations for the site that increases tourism and possibly renames and add uses for previous structures. At Emscher

Park, the historic buildings are reused for housing, workplaces and leisure activities. Old structures have been turned into climbing walls, and the gasometer is now a diving tank. As designers, it is crucial to retain elements of the past, but restructure, reprogram, and reuse the structures and spaces.

Waterscapes will be the product of a resulting landscape of new surface water. The strip mining pits will be flooded and will become lakes within the region. In Lusatia, there will be a chain of ten lakes over 35 kilometers long, linked by navigable canals. Increased recreational tourism in the area is the emphasis on creating sporting recreation, including sailing, surfing, cycling, skating, riding and golfing. In part development of the Lusatian Lakeland is aimed toward reintroducing a new mobile waterfront/waterscape of floating houses. As the water levels rise over time, the floating homes will move with the water's edge, keeping the shorelines free from construction and still active during the years of filling (Scholz, 2010).

Energy Landscapes, consisting of wind, sun, and biomass can be ideally located in these expansive pre-mined landscapes. "IBA has been examining concepts for energy landscapes to combine different energy sources for a new, variably usable and ecologically enduring cultural landscape." Brandenburg University of Technology has a project entitled "Energy Landscape Welzow", which investigates how mining companies may cooperate with possible agricultural and forestry systems in rotation with plantations of wood for energy use. The wood is a revenue source for the community that was relocated for mining (Scholz, 2010).

New Land is the result of the mine scarred land that enables the creation of new topography, slopes, and uses. Landscape architects have an infinite vision for iconic, innovative and artistic sculptural landscapes that have a new purpose without forgetting the mining history. One IBA project dreamt up having both the desert-barren landscape that is the result of mining, adjacent to the oasis of a natural protected area. The unfortunate nature of citizen unpopularity and possible technical difficulties did not allow this proposal to progress. However, additional landform projects like "Art-Landscape" helped influence the new landscape designs (Scholz, 2010).

Border Landscapes are designs that have been drawn across the border to Poland. Following the Second World War, the new border between the countries had separated cultural landscapes and towns that were once one community. IBA's goal was to reconnect these communities across borders and reconnect them. The International Geopark Muskau Coal Crescent is one example that now offers potential tourism (Scholz, 2010).

Cityscapes are the power or influence to reshape and rebuild these previous mining communities that have hope of repopulating after deindustrialization in their region. IBA has focused on the re-valuing of space and reprogramming remnant architectural structures into new usable pieces of architecture. Additional IBA projects focused urban development in these disappearing cities (Scholz, 2010).

Transitional Landscapes, in theory, is meant to give new vision to this mined landscape and provide an educational background of this scarred landscape before and during reclamation. Through mining tours, IBA envisioned the possibility of visitors to experience these landscapes and reinterpret the idea on which mining altered the vision and function of the landscape. This new educational form of tourism would be introduced for visioning of the built remediation process (Scholz, 2010).

6 DISCUSSION

As the Environmental Protection Agency has set rules, standards, and laws to protect human health and the environment, The Surface Mining Control and Reclamation Act of 1977 establishes regulations of surface mining activities and the reclamation of coal-mined lands. This Act emphasizes pre-planning of potential mining sites with continued land-use planning, development, and reclamation as part of the mining process. Landscape Architects enact in this planning process that is multi-jurisdictional and involves private industry, the general public, and many State and Federal Agencies (USGS, BLM, Forest Service, State Land Department, Fish and Game, etc.) Landscape Architects have the potential to harmoniously incorporate mined lands into something that is visually appealing, successfully follows proper land-use plans, and reclaims the land from any pollutants from mining (American Society of Landscape Architects, 1978).

It is essential to first identify the key issues, gather the data to help answer the appropriate questions, and organize the potential project implementation while still understanding the underlying core team involved. Surface mining in Pennsylvania has a variety of methods used to reform the land during the mining process. The integration of new landform allow for endless opportunities including agricultural uses, wildlife refuges, parks and gardens (American Society of Landscape Architects, 1978). As suggested by

International Bauausstellung (IBA) Fürst-Pückler-Land, there is great potential in reprogramming the post-mined lands as new transitional landscapes, waterscapes and energy landscapes (Scholz, 2010). The critical factor is the slope of the land and its potential for re-grading based on the planned program of the site (American Society of Landscape Architects, 1978). It is most economical to involve landscape architects at the beginning of the planning process where they may use part of the mining-related landforms for potential land-uses that follow the "mined" slopes. It is most effective to have the decision makers and public to be part of this process. Communities play a vital role in the success of localized reclaimed land. Within the coal region, the mine workers and their families had built or created the small towns and communities. When mines closed, the region's economy suffered as a by-product. The mineworkers' struggles represented a response to the national Depression as well as the decline of anthracite coal. As the nation and region recovered from the Depression, the anthracite crisis still remained (Light, 2005). Manufacturing and industrial employment were on the rise but not all communities were able to make that employment transition a success. Those that experienced successful transition were now the community members who lived in the midst of a mine-scarred landscape. AMD&ART is an apparent built example where economic, ecological, and preserved cultural success is the result of a powerfully-driven community teaming with scientists, hydrologists, historians, artists, and landscape architects. Success of remediation sites will not happen unless the public is involved. As designers, we need to be certain to address the underlying culture of each site as much as the ecology and hydrology of the project location. Successful projects not only have the scientific parts worked out, but there also must be cultural reclamation where the community and its economy continue with a healing process as well (Comp, Science, Art, and Environmental Reclamation: three projects and a few thoughts, 2008).

With input from civil and mining engineers, geologists, surface water and ground water hydrologists, ecologists, sociologists and economists, Landscape architects can utilize their site planning skills to determine the land use plan, reuse of existing infrastructure, and designate the reclaimed ecological systems that will help clean the "wasted" landscapes of culm banks and the cleansing of the local watersheds (Research Committee on Coal Mine Spoil Revegetation in Pennsylvania, 1971). The mined landscape does not necessarily have to be completely forgotten or completely reshaped, but rather integrated within innovative designed landscapes with reuse of remaining infrastructure. Allowing the public to access these reclaimed sites encourages them to experience the past, and become connected to and knowledgeable of the site's history and its effect on that landscape (Burley, 2001).

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