

## What Lies Beneath: Treatment of Canvas-backed Pennsylvania Coal Mining Maps for Digitization

### ABSTRACT

An ongoing program to preserve approximately seven hundred oversized, canvas-backed, coal mining maps from the CONSOL Energy Mining Map Collection was initiated by the University of Pittsburgh (Pitt) in 2007, supported by funding from the United States Department of the Interior Office of Surface Mining and Reclamation (OSM) and the Pennsylvania Department of Environmental Protection (PA-DEP). The main goal of this project is to stabilize and clean the mining maps for digitization at the OSM National Mine Map Repository (NMMR) located in Pittsburgh, Pennsylvania. The digitized data of the underground mines will be incorporated into Geographical Information Systems relative to mine safety, land reclamation, current mining operations, and new development.

### INTRODUCTION

#### *The collection*

CONSOL Energy Inc. first donated mining-related materials to the Archive Service Center at the University of Pittsburgh in 1991. The collection has grown with additional

deposits of material including maps, survey books, photographs, and published works. Mining maps represent the largest component of the collection, with over eight thousand individual map sheets of various formats. The bulk of the collection dates from the 1890s through the first half of the twentieth century. The CONSOL Energy Mining Archives includes significant historical materials that document Pittsburgh's national industrial heritage. They include, for example, the records relating to Henry C. Frick Coal and Coke Company and materials that document the coal and coke mining industry in general.

This project focuses on approximately seven hundred oversized maps, the majority dating between 1850 and 1950, known as "hardbacks." The term "hardback," coined by the coal mining industry, refers to the map's construction of heavy-weight paper backed with canvas. The hardback maps were first drafted in graphite and later colored by hand using different media including inks, colored pastels, and watercolors (fig. 1). The large dimensions of the maps present challenges in use and preservation, as the average map is five feet in height, and varies from two to thirty feet in length (fig. 2). The hardbacks contain the most complete, if not only, diagram of underground mines owned and/or



LEFT TO RIGHT

Fig. 1. Detail of hardback mine map completed with watercolor and ink. The different colors and letters are date codes corresponding to the years that coal was mined out of the area

Fig. 2. A hardback map unrolled measuring five by fifteen feet (1.5 by 4.5 m)

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operated by Consolidated Coal Company and its constituents in the Pennsylvania counties of Allegheny, Westmoreland, Washington, Greene, Fayette, and Somerset.

#### *Significance and use*

The CONSOL Energy Mining Map Collection provides a wealth of information about the changing environment in Western Pennsylvania during much of its mining history. Increased access to this collection will allow fuller exploration by disciplines such as environmental studies, geology, and engineering, in addition to the mining industry. Beyond the typical use by researchers, the hardbacks are currently being consulted by the PA-DEP and OSM for the following projects:

- Access to the PA-DEP in support of the Pennsylvania Coal and Clay Mine Subsidence Insurance (MSI) program. These maps contain crucial data necessary to create better mapping and accurate information for the public to determine their risk of mine subsidence.
- Access and use by the California District Office of District Mining Operations to map mined area extents and determine approximate areas and extents of mine pools.

The maps are also an important source of information for municipal, economic, and transportation planners as they seek to develop new housing, commercial facilities, and highways, as well as deal with such issues as subsidence and mine water runoff. In recent years, these hardbacks have been consulted by a variety of people, including: a private citizens group undertaking a land reclamation project dealing with the underlying mines and mine drainage issues to convert 452 acres in the southwestern corner of Settler's Cabin Park in North Fayette and Collier Townships into the Botanic Garden of Western Pennsylvania; engineers planning the route of the Mon-Fayette Expressway, a key to future economic development in the Monongahela and Youghiogheny

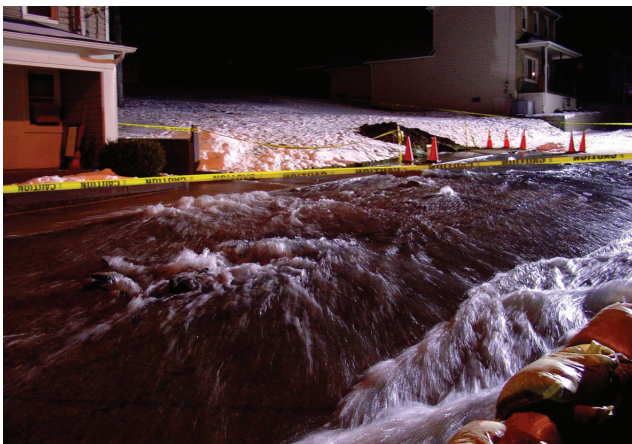


Fig. 3. Mine water breakout in McDonald, Pennsylvania, in 2005

River valleys; and federal, state, and municipal officials dealing with the mine water breakthrough incident in McDonald, Pennsylvania, in 2005 (fig. 3). In these cases and others, the hardback maps held by the Archives Service Center provided vital information not available elsewhere and will continue to have a role in any new development or reclamation project.

The large size and deterioration of the hardback maps render them cumbersome to handle and use. Stabilization and digitization of the maps will facilitate cataloging efforts and increase access. The Archives Service Center and the PA-DEP are collaborating to catalog the hardback maps and incorporate the inventory into the Pennsylvania Historical Mine Maps Inventory System (PHUMMIS). The PHUMMIS and the Pennsylvania Spatial Data Access (PASDA) system will provide for enhanced access to the data contained on the hardback maps. This project is one initiative fostering partnerships between the mining industry and educational institutions, but additional collaborations are needed to preserve these oversized materials and set cataloging agendas for underground mining maps to ensure that underground mining data is accessible for research, development, and safety in the future.

#### MAP PRESERVATION PROJECT

##### *Workflow*

The primary goals established by the Project Team were to design a treatment strategy and complete treatment on one hundred maps by June 2008. Conservation treatment is completed by the project conservator and student assistants at the University of Pittsburgh's Preservation Department. Once a month, a mining specialist from the PA-DEP transports a batch of treated maps from the preservation lab to the NMMR for scanning. The PA-DEP retains the digital files and returns the original maps to the University of Pittsburgh for archival storage (fig. 4).

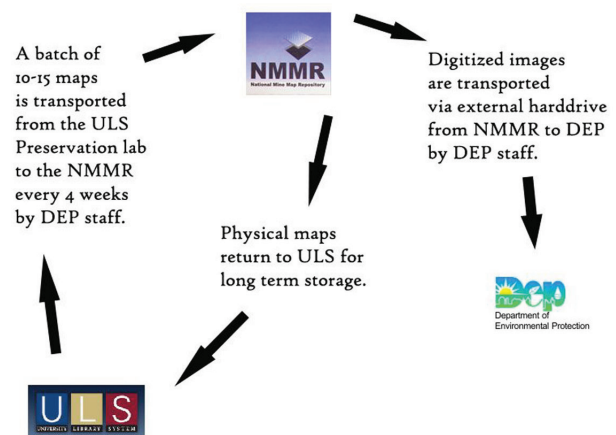


Fig. 4. Diagram showing the transportation of physical maps and digital images between the preservation lab, PA-DEP, and NMMR

### Staffing

The conservation staff for this project consists of one full-time conservator working in the preservation lab, two paper conservators who serve as consultants, one student assistant who works for ten hours per week, and the head of preservation who provides overall supervision and guidance to the project. The consultants were required to work one hundred twenty hours, conduct training sessions relating to map preservation, submit detailed reports outlining their recommendations in achieving the project goals, and assist the project conservator in making decisions about materials, methods and treatments (fig. 5).

### Database

In order to propose conservation treatment for the maps, an efficient tool was needed to conduct a detailed condition survey. The staff also required a system for recording treatment documentation, cataloging, and tracking maps. The project conservator designed a database building upon the Pennsylvania Historical Mine Maps Inventory System (PHUMMIS) template provided by the PA-DEP. The template contained fields relative to mining institutions, such as mine name and geographic location of a mine. Additional fields relating to condition, conservation treatment, and tracking were added to the template and this collaborative database was nicknamed “CONcat” (fig. 6).

## CONSERVATION TREATMENT

### Condition

In 2006 two interns from the School of Information Sciences at the University of Pittsburgh conducted an initial condition survey of one hundred hardback maps from the CONSOL collection. The survey revealed that forty-one percent of the maps assessed were in “good” condition, nineteen percent in “fair” condition, and forty percent in “poor” condition. Throughout the survey process, the interns also amended an item-level inventory provided by CONSOL Energy that accounted for just over six-hundred hardback maps. They discovered that multiple maps were rolled inside of other maps, increasing the original inventory. The staff continues to find additional hardbacks rolled together and the inventory has grown to 680 maps as of June 2008.

A detailed survey of the maps’ condition also required identifying the types of damage that were common among the maps. It was found the main factors of deterioration were threefold: inherent vices in the materials used to construct the maps; the environment of the coal mines in which the maps were used; and the manner in which the maps were utilized, repaired, and stored. The combination of rolled storage and brittle paper resulted in a fragile map that users had to “crack” open in order to read, causing tears, regular patterns of creasing, and areas of loss (fig. 7). These damages were often



Fig. 5. The consultants and project conservator examine a map in the humidity chamber

A screenshot of a web-based database interface. At the top, there are input fields for 'Local\_Sheet\_ID' (27-A-10), 'Sheet\_Name' (Eureka Waverly), and 'xsl #' (104). Below these are dropdown menus for 'Map\_Type' (Underground Mi), 'Shelf Location' (10-1), and 'Current Location' (Pres felts). A series of tabs (General, Scanning, Geography, Geology, Physical, Mine, Condition, Treatment, H K Sheet) are visible, with 'Condition' currently selected. The 'Condition' tab contains a form with fields for 'Local\_Sheet\_ID' (27-A-10), 'Survey\_date' (2/5/2008), and a table for recording damage: 'Able to unroll without damage?' (checkbox), 'Losses' (0), 'Surface Dirt' (1), 'Tears' (2), 'Stains' (0), 'Brittle' (1), 'Creases' (2), and 'Tape' (0). There is also a 'Treatment proposed' dropdown set to 'Humidify and Flatten' and a 'Condition comments' text area. At the bottom, a record navigation bar shows 'Record: 1 of 1'.

Fig. 6. Detail of the condition tab in the CONcat database



Fig. 7. A hardback map showing tears, losses, and a regular pattern of creases

repaired with pressure-sensitive tapes or patches of canvas. Because the maps were heavily used inside working mines, a considerable amount of coal dust has accumulated on the



maps. The most concentrated coal dust is usually found at the edges where the inner core of the rolled map was exposed to the storage environment.

The hardbacks depict different types of information relative to mining such as underground mine workings, property divisions, and coal town street plans. The archivist, PA-DEP, and project conservator determined that underground mine maps take treatment priority over other types of maps. After the maps are surveyed, depending on their priority and condition, they either return to the original shelf or enter the preservation lab for treatment. Treatments include dry cleaning, humidification and flattening, tape removal, and mending. For the first year of this project, maps requiring repair beyond the aforementioned treatments are returned to the original shelf for future assessment. As of June 2008 less than two percent of the 178 maps surveyed were returned to the original shelf for this reason.

#### *Dry cleaning*

The project conservator and consultants tested methods for dry cleaning including Absorbene putty, dust cloths, eraser crumbs, soot sponges, Wishab sponges, and Magic Rub erasers. Soot sponges and Wishab sponges removed the most soot and cleaned the largest areas on the front of the maps (fig. 8). The smaller 3 x 6 x 3/4" soot sponges that are available in many archival products catalogs were originally used, but they proved difficult to grasp and the staff often had to fold these in half to get a better grip. It took two of these sponges to clean one map on average. Switching to larger 3 x 9 x 1 1/4" soot sponges and ordering them directly from the manufacturer made cleaning more efficient and reduced cost by ninety-five percent. The larger sponges are easier to hold and can be reused by trimming dirty areas with scissors. On average one large sponge will effectively surface clean up to three maps. Student assistants perform much of the dry cleaning

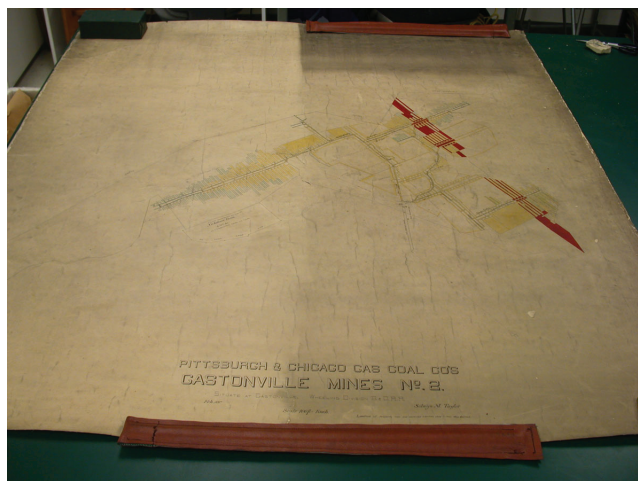


Fig. 8. The left side of this map was cleaned with soot sponges. The right half of the map shows the original amount of coal dust present

on the maps; however, before any treatment begins the project conservator and students study the map together to identify areas that require extra attention, such as areas drawn in graphite that were never inked-in.

The staff cleans the canvas backing of maps using a Nilfisk back vacuum with hypo-allergenic dust brush attachment (fig. 9). A clothes brush attachment with short stiff bristles was tested for cleaning, but this attachment was not as effective at cleaning deep into the canvas weave as the soft long bristles of the dust brush. The vacuum is not used on the front of maps as the paper is too fragile to withstand even gentle suction and there is also friable media present on every map. A fellow conservator suggested holding the vacuum cone slightly above the paper, but this only removed a small amount of soot. The sponges are more effective at cleaning the front of the maps.



Fig. 9. A student assistant vacuums the back of a map with the Nilfisk back vacuum using the dust brush attachment

#### *Tape removal*

Approximately twenty-five percent of the maps surveyed were previously repaired with various kinds of pressure-sensitive tapes. The preservation lab at the University of Pittsburgh cannot accommodate the use of solvents for tape removal. Luckily, most adhesive softens with the application of a tacking iron through silicone-release paper or by humidification. The carrier can then be peeled away with a microspatula. In general, the plastic tapes are more difficult to remove than the cloth or paper tapes. After the carrier is removed, any remaining adhesive residue is left to dry, then reduced with a rubber cement pick-up eraser.

#### *Humidification and flattening*

Maps that cannot be unrolled without cracking are humidified in a dome constructed by Museum Services Corporation that measures five-by-eight feet. The dry-rolled map is placed

on top of mesh screening and blotter paper in the dome. A 1.7 gallon ultrasonic humidifier is connected to the dome with a black hose. Moisture build-up inside the hose tends to drip down the hose and leak out at the connection point to the dome. To catch the drip, a paper towel is placed between the black hose and the connection tube (fig. 10). Also, water builds up in the elbow-shaped plastic tube where humidity enters the dome. Every twenty minutes as someone regularly checks the map's progress in the dome, they also clean out the water build-up in the tube, and replace the paper towel. On average, maps take five hours to humidify this way. Larger maps take longer, and un-backed paper maps take a shorter amount of time.

Immediately following humidification the map is placed between polyester webbing and  $\frac{1}{4}$ " thick wool felts (fig. 11). Three-by-nine foot acrylic sheets are positioned on top of the felts, weighted with bricks, and the maps are left to dry in this stack a minimum of two days.

### *Mending*

The treatment objective for mending maps is safe handling, making the technique more structural than aesthetic. Large tears are mended with Japanese tissue bridge mends and areas of loss are filled with muslin patches (figs. 12–13). The mends are adhered with Beva D-8, an ethylene vinyl acetate adhesive. The length of time to complete the mending process may vary from fifteen minutes to over twenty hours per map.

### *Housing*

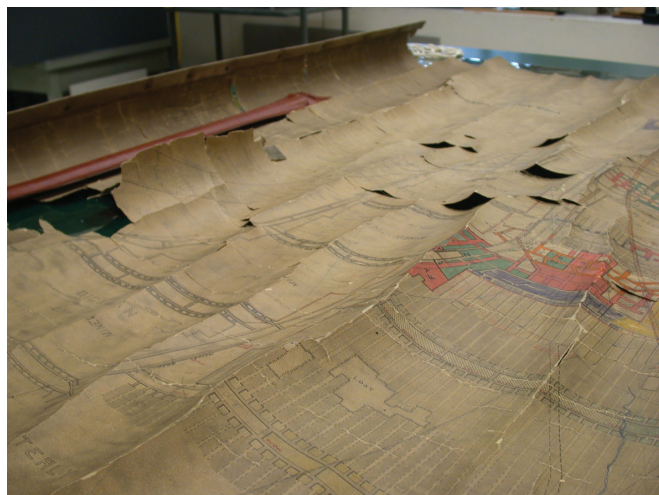
The project staff creates cores made of blotter as a temporary support to transport the maps around the lab. In order to protect the treated maps when they are sent to the scanning facility each month they are wrapped in a "raincoat" of four-millimeter polyester tubing. The tubing is cut down to the



Fig. 10. Map during humidification



Fig. 11. Map between polyester webbing and felt after humidification and flattening



Figs. 12–13. Front of map before mending (left). Front of map after mending showing white muslin patches (right)



length of the map, tucked in at both ends, and secured with Velcro. The proposal for long-term storage of the maps at the University of Pittsburgh is to wrap the maps in muslin and fasten with cotton ties.

#### IMAGE CAPTURE AND GEO-REFERENCING

The project staff determined that the maps had to be transported rolled to the scanning facility, but then be able to lay flat on the scanner bed. Maps that could not lay flat on their own had to be able to withstand the suction generated from the scanning bed in order to keep them even and level. A mining specialist from PA-DEP picks up an average of ten to fifteen maps each month to transport them to the NMMR for scanning and returns the original maps to the University of Pittsburgh for long-term storage. The various physical locations of the maps are tracked through the CONCat database.



Fig. 14. From left to right: map wrapped in poly tubing, secured with Velcro for transportation to the scanning facility; map wrapped in muslin with cloth ties for final storage; and map wrapped on blotter core and secured with cloth ties for temporary support

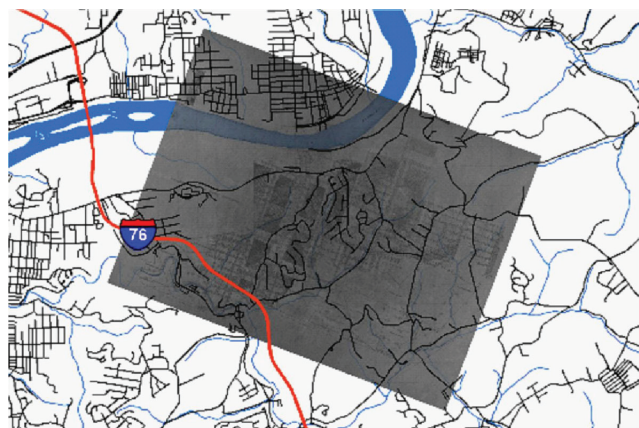


Fig. 15. Detail of a digitized hardback map geo-referenced to a road map also showing physical rivers and creeks

At the NMMR the maps are cataloged into their own database. The maps are digitized on a Cruse Table Scanner CS 285/1100 ST/FA. The scanner is equipped with a 58" x 90" vacuum table. The maps are scanned in 24-bit true color at 200–250 dots per inch, captured with an optical lens camera. The images are stored as uncompressed, tagged image file format (TIFF) files and the average size is 1.1 gigabytes per image. After the physical maps have been scanned the TIFF images are saved to an external hard drive and transported to the PA-DEP where the digital data is cataloged and geo-referenced by mining specialists.

#### CONCLUSION

The project goal of executing conservation treatment on one hundred maps within the first year has been exceeded. Figure 16 outlines the accomplishments as of June 2008.

CONSOL Mine Map Preservation Project Statistics	
# of maps	Activity completed
178	Surveyed
116	Dry cleaned
21	Humidified & flattened
15	Mended
89	Digitized

Fig. 16. Project statistics as of June 2008

The University of Pittsburgh has promoted this project in several ways. Jean Ann Croft, head of preservation, and Debbie Rougeux, archivist, collaborated on a short article that was published in *Archival Product News*. Colleagues from the PA-DEP, IUP, and the University of Pittsburgh collaborated on a presentation for the Mid Atlantic Regional Archives Conference held in Scranton, Pennsylvania, in April 2007. This session addressed the collaborative efforts in Pennsylvania to build an Internet-accessible database for the maps of underground coal mines in the state, to digitize vital maps, and to preserve the original maps.

Pitt is expecting additional funding from OSM and PA-DEP for the next year to continue this project. The cooperative preservation and scanning efforts of this project have increased the availability of mine mapping resources by providing mapping detail that was not previously accessible. The cataloging efforts and increased communication offer the coal mining industry the necessary tools to determine whether a desired map resides in the Pitt collection and a process by which to request and borrow the map

relatively quickly. This relationship benefits all parties concerned, especially the PA-DEP Mine Subsidence Insurance and Mine Safety Programs.

#### ACKNOWLEDGMENTS

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California Technology Park  
Coal Center, PA 15423  
724-769-1100  
<http://www.depweb.state.pa.us/dep/site/default.asp>

National Mine Map Repository  
Office of Surface Mining, Reclamation & Enforcement  
3 Parkway Center  
Pittsburgh, PA  
412-937-3001  
[http://arcc.osmre.gov/MMR\\_Intro.asp](http://arcc.osmre.gov/MMR_Intro.asp)

University Library System  
Preservation Department  
7500 Thomas Boulevard  
Pittsburgh, PA  
412-244-7523  
<http://www.library.pitt.edu/>

#### PROJECT WEBSITE

CONSOL Energy Mine Map Preservation Project Website  
<http://www.pitt.edu/~acb59/index.html>

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