

AERIAL IMAGES OF IOWA COAL MINES¹

James F. Ellerhoff²

Abstract.--Iowa has used color infrared, high altitude imagery to monitor coal mining activities since 1978. It has proven to be a cost effective method of supporting inspection and enforcement activities.

In September of 1978 Iowa entered the interim regulatory program of surface coal mining with the U. S. Office of Surface Mining Reclamation and Enforcement (OSMRE). Up to that time both the state and federal government had been independently regulating the coal mines since enactment of the "Surface Mining Control and Reclamation Act" on August 3, 1977.

With only ten licensed coal mine operators and eleven sites with an annual production of 443,324 tons of coal, Iowa had one of the smallest programs in the nation. Iowa had a staff of two professionals and one secretary to watch over and control reclamation on these sites, along with over 1000 mineral mines (limestone, gravel, clay and gypsum).

The state had strengthened its 10 year old law concerning reclaiming coal mine sites with new legislation in 1976. The provisions of the federal law, however, created a new situation which, while embraced by many states and industry apprehensively, did have a national scope and national goals. Thus, Iowa entered a new program understaffed and with the anticipation of a participant at an arranged marriage.

While the Department of Soil Conservation (DSC), the agency which regulated mine reclamation, could only field two people toward the effort before the state, it did have strong ties with other state natural resource agencies. The most notable of these was the Iowa Geological Survey (IGS).

The IGS had for several years been involved in a land-use project which utilized color infrared, high altitude aerial photography. Through the guidance of the people at the IGS and the initial grant funds from OSMRE, the DSC embarked on the ambitious program of systematically flying,

photographing, and interpreting images of the coal mine sites of Iowa.

Iowa was well suited to an aggressive aerial reconnaissance program. With a limited staff and few sites, the state could hire an aerial photography firm to fly the coal mine sites three to four times a year. This photographic effort would create a "cradle to grave" record of each site.

Unlike written reports of inspections or on-the-ground photographs of mining operations, the aerial images serve as point-in-time records that experts in aerial image interpretation can use into the future. It was this aspect that the IGS people impressed upon the DSC staff. This is not to diminish the need for the former, but the aerial images enhance the inspection effort. The aerial photography program was worth two additional field staff for a fraction of the cost.

In 1978 Iowa was faced with a state hiring freeze for new positions and the annual budget for the three staff people and their associated travel costs was \$75,000 per year. As most of us understand, public money to accomplish program goals diminishes with time. Therefore, if one desires to acquire equipment, it is best to identify the items that you need early in the development of a program. Again relying on the guidance from the IGS, the DSC acquired a sophisticated light table made by The Richards Corporation, which employs a Bausch & Lomb stereomicroscope. This cost \$12,750 in December of 1978 and was a pretty hefty outlay of funds at that time as it would be even today. The advantage was that, unlike a staff person, the equipment didn't wander in every two weeks looking for a pay check. Besides, the salary and fringe benefits of a professional staff person in 1978 cost \$21,600 per year and that did not train or put the person in the field. Therefore, the initial one-time cost was a good investment.

Staff from the IGS spent a day training the DSC staff in the use of the stereomicroscope. With the combination of practice in the use of the machine and knowledge of the ground from on-site inspections, information was accumulated from the aerial photographs. We were fortunate

¹Paper presented at the Billings Symposium on Surface Mining and Reclamation in the Great Plains and the Fourth Annual Meeting of the American Society for Surface Mining and Reclamation. March 17-19, 1987. Billings, MT.

²James F. Ellerhoff, Reclamation Officer, Iowa Department of Agriculture and Land Stewardship, Des Moines, IA.

that the IGS had flown several of the active coal mine sites in 1977 and 1978. This allowed the DSC to get positive duplicates of the color infrared, high altitude film for a fraction of the original cost. At the same time, the DSC entered the existing state contract with the Aerial Services, Inc. firm to conduct aerial photography of the active mine sites in 1979. This cost \$700 per flight in 1979 and the DSC had three flights flown. The cost for this service was paid through grant funds that the DSC had sought and received from OSMRE.

Since that time, the DSC has received primacy to administer the Iowa permanent regulatory program and we have developed a comprehensive record of coal mining activities in Iowa. The present cost is \$2440 per flight which covers 26 inspectable units and 6 abandoned mine land sites. The cost of the flight is split between grants for administration & enforcement and abandoned mineland funds, with the cost per frame of film being billed to the respective grant.

Why did we choose color infrared, high altitude imagery over black and white or color photographs? This again was a recommendation from the IGS. Color infrared imagery is that photographic process whereby the portion of the light spectrum just beyond visible red is recorded on film. This produces false colors of most ground features. By doing this, the objects and features on the ground are enhanced and made to be more readily identifiable.

As the state soil conservation agency, soil and water management is the prescribed mission of the agency. In regulating the coal mines the DSC was especially interested in off-site and on-site effects from water. The color infrared enhanced image made erosion features and sedimentation readily identifiable even from 5000 feet above the ground. Another aspect that proved useful is that the density of vegetation can be monitored. Reclaimed mineland is especially susceptible to conditions that stress vegetation. It is possible to identify stressed vegetation so that remedial measures can be taken to rescue the plant community.

By making positive contact prints from the 10 inches by 10 inches film, one has a photographic record of the site and it's relationship to the off-site properties. These are easily carried in the field and can serve as visual aids when working

out problems with landowners and mine operators. Measurements of distance and area can be determined from these photographic images. This has been of great assistance in conducting bond determinations and for bond release purposes.

The DSC has used aerial image photographs in bond forfeiture proceedings as well as contested case hearings on enforcement actions. One limitation in legal proceedings is that hearing officers and judges are not generally knowledgeable of interpretative techniques. This fact means that the presentation of evidence be supported by expert testimony or the evidence be prepared by enlarging the photographic image and using simple legends in order to support the other evidence being presented.

If you are interested in using aerial photography to monitor surface coal mining operations, there is a text and a manual that may assist you. The first is Interpretations of Aerial Photography by T. Eugene Avery. This presents a good overview of aerial photography. I was introduced to it in college in 1970 and it remains a good reference today. The manual, Low Altitude Photointerpretation Manual for Surface Coal Mine Operations is a U. S. Geological Survey publication released in 1983. I had a role in developing this manual and most of the midwestern color infrared images are of Iowa coal mines. This presents a cookbook approach with a national scope for coal mining operations. It is a straight forward presentation that would be a good first book with which to start. In addition, OSMRE has been offering courses in beginning and advanced aerial photography interpretation and my staff person who has attended indicates that they are useful training.

LITERATURE CITED

- Avery, T. Eugene 1985. Interpretations of Aerial Photography, 4th Edition. Macmillan, Inc. New York, NY.
- U.S. Department of the Interior, Geological Survey. 1983. Low Altitude Photointerpretation Manual for Surface Coal Mine Operations.