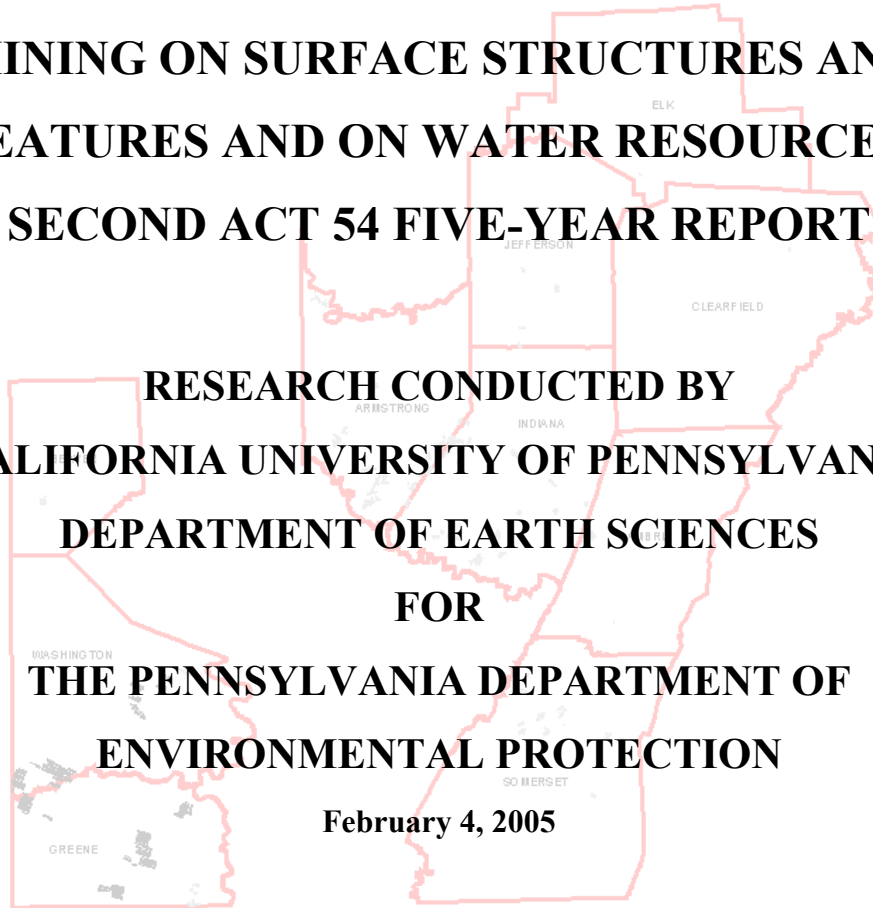


**THE EFFECTS OF SUBSIDENCE RESULTING
FROM UNDERGROUND BITUMINOUS COAL
MINING ON SURFACE STRUCTURES AND
FEATURES AND ON WATER RESOURCES:
SECOND ACT 54 FIVE-YEAR REPORT**

**RESEARCH CONDUCTED BY
CALIFORNIA UNIVERSITY OF PENNSYLVANIA
DEPARTMENT OF EARTH SCIENCES
FOR
THE PENNSYLVANIA DEPARTMENT OF
ENVIRONMENTAL PROTECTION**

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CONTENTS

Section III LIMITATIONS OF THE STUDY

III.A. Overview

III.B. Time

III.C. Data on Water Sources

III.D. Data on Structures

III.E. Fieldwork

III.F. Anecdotal Information

III.G. Nonjudgmental Reviews of Commissioned Reports

III.H. Section 18.1 and the “Five-Year Period”

III.I. No Base Level Studies of Affected Sites

III.J. Record-Keeping

III.K. Intensity and Extent of Mining Methods and Their Effects

III.L. Scale

Section III: LIMITATIONS OF THE STUDY

III.A. Overview

This section reveals constraints to the study. It enumerates some of the difficulties encountered in the attempt to fulfill all requirements of the MOU.

This report was not chiefly the product of “primary field research,” though such research was conducted during the course of the study. Time and distance, access to sources of data and to sites, and even poor weather conditions limited the breadth and depth of primary field research. Much of this study was dependent upon paper files contained in the California District Mining Office and on records obtained from BUMIS. It was also dependent upon responses by local and state agencies, utility companies, and transportation companies to inquiries about the extent to which underground mining affected their respective facilities and operations.

III.B. Time

This report is the result of a 160-day study, including start-up time. Start-up involved gaining access to the dataset contained in the integrated electronic data file known as the Bituminous Underground Mining Information System (BUMIS) stored and maintained by the Department (see IV.A, below). Use of BUMIS required password clearance for researchers and instruction in its use. After an introduction to the system, the University’s researchers commenced querying the database for reports of information germane to the study at hand. After a start-up period of ten days, the researchers waited an additional four days for the initial reports to be extracted from BUMIS. During the study an interruption in access to BUMIS slowed the progress of the “paper chase” component of the research.

Time was the primary constraint on the study, particularly on the fieldwork. A perusal of any plate in this report that shows the locations of wetlands and streams will give one a sense of the travel time required to visit any one of numerous sites (see III.E, below).

III.C. Data on Water Sources

The University could find no data on the depths of individual wells affected or allegedly affected by mine subsidence. Thus, the University had to assume the “average” depth of wells for southwestern Pennsylvania. Also, owners of wells keep no public records of the water supply, so exact yields were not available to use for assessing the percent of diminution. Public water suppliers did not release any information on water lines.

III.D. Data on Structures

Although the original intention of the PA DEP and the University was an analysis that includes “distance to mining” as a parameter of research on structures, no such analysis could be accomplished because of incomplete data for many of the structures. Structures that were directly over a mine were assigned a distance of zero feet in most of the records. Structures that suffered supposed impacts from subsidence but were later found to be unaffected by mining (“no liability” for the mining operator) did have their distances to mining recorded. Some structures that lay at distance from mining and that suffered damage by mining also had distances to mining recorded. Still other structures had no distances to mining recorded.

The report was originally designed to include an analysis of the time between the report of a problem, the filing of a claim, and the resolution of the problem, and the first draft included such an analysis. However, in the interim between the first and second drafts of this report, the University’s researchers learned that the date recorded as the date of a subsidence-related problem—the date relied upon for the first attempt at an analysis and a date contained in both BUMIS and the paper files—was not necessarily the date that the actual problem occurred. Rather, the date of the problem was often the date of a message faxed to the California District Mining Office, a message required of a mine operator after a property or structure owner files a complaint with the operator. Also, some purported structure problems were not, during the assessment period, discovered contemporaneously with their initial occurrence for various reasons, including, but not limited to, the owner’s not being at home at the time of the occurrence and the slow

exacerbation of some problems, such as cracks in basement walls whose discovery could not be related to their initial occurrence.

III.E. Fieldwork

Field studies were limited by the short period of the study, weather, accessibility to properties, the high number of stream and wetland sites, and distances to stream and wetland sites. Work on streams was aided by the California District Mining Office's biologist who set aside time to guide the University's stream specialist to sites where either subsidence-induced impacts were occurring or restoration was working. Without the biologist's help, the University would literally have to have "reinvented the wheel" on stream assessments, taking up even more of the limited time committed to the study.

The wheel does have to be reinvented with respect to stream geomorphology, however. No comprehensive prior base level study had established a geomorphologic categorization of streams over mines to use as a comparison. Even if there had been base level studies available for the University's reference, re-examining streams in 100-foot increments would require more time than was available to observe the more than 100 miles of undermined stream segments. In light of the improbability of completing the task, the PA DEP and the University decided to forego an initially planned Rosgen (or alternative) classification of undermined streams.

III.F. Anecdotal Information

Because mining operators are required to report "problems" to the PA DEP through the California District Mining Office as those problems arise and because property owners who report problems also may register complaints with the PA DEP through the California District Mining Office, the researchers did not include a survey of property owners to ascertain problems already registered in BUMIS. A review of the "Supplement to the June 1999 Report" (*The Effects of Subsidence Resulting from Underground Bituminous coal Mining on Surface Structures and Features and Water Resources*) revealed that such a survey was ineffective because of "no response from property owner" in a number of survey categories. The University's researchers used anecdotes in

the report only to emphasize circumstances in which qualitative judgments substitute for quantitative analyses in determinations of liability for or magnitude of surface subsidence impacts. This limitation is not an indication that property owners do not have something of value to say on the matter of subsidence. What they have said on record is included in the comments contained in the BUMIS files and in correspondence with investigators from the California District Mining Office.

III.G. Nonjudgmental Reviews of Commissioned Reports

The University was required by the MOU to review commissioned studies mentioned above (section II.J) for the current report. *The University's researchers had no control over the methods, findings, or conclusions of those reports, and they do not pass judgment on or critique any of them.* The reviews of 1) "Remote Sensing of Forestland above Longwall Mines," 2) "Study of the Effects of Longwall Mining on Streams, Wetlands, and Riparian Areas," 3) "Effects of Longwall mining on Real Property Values and the Tax Base of Greene and Washington Counties," and 4) "Effects of Undermining Interstate Route 70 South Strabane Township, Washington County," can be found in section XI.

III.H. Section 18.1 and the "Five-Year Period"

This report was generated in compliance with 1994 amendments to ACT 54, Section 18.1, of the Commonwealth of Pennsylvania's mine subsidence control law. It is intended to be a review of the effects of surface subsidence caused by underground bituminous coal mining in western Pennsylvania between August 21, 1998, and August 20, 2003. Because of the nature of such effects, some "problems" that arose during the first five-year ACT 54 period lingered into, and even beyond, the second five-year ACT 54 period (the period of this study). Similarly, at the close of the second five-year ACT 54 period, some subsidence-related problems lingered as "unresolved." Relevant data from the unresolved problems, such as information on location and type of problem are included in the current report.

III.I. No Base Level Studies of Affected Sites

The ideal circumstances under which this research might have been conducted would have a substantial base level of data on sites scheduled for undermining. Such information would include thorough, pre-mining studies of streams, wetlands, and groundwater made by individuals, groups, organizations, or agencies unaffiliated with coal operators. The magnitude and rapidity of modern longwall coal-mining methods and the apparent, limited financial and human resources available to fund and carry on complex studies on multiple surface features and multiple variables has constrained the amount of data available to the University's researchers, as mentioned in III.E.

III.J. Record-keeping

During the course of the five-year period that is the focus of this study, the PA DEP shifted its data storage from several Microsoft ACCESS databases to BUMIS. The move meant the merging of data from independent sources. In the process numerous claims were recorded more than once. Data entry on subsidence incidents reported from mines with name-changes and from properties with multiple features exacerbated the problem of determining the exact number of surface features directly impacted by underground mining. Ferreting out the duplicate filings was a major task of the research team, and, because of the nature of the data storage system, presented problems throughout the research period. As of the publication of this report, the University's researchers believe they have eliminated duplicate data entries to provide an accurate accounting of subsidence impacts.

III.K. Intensity and Extent of Mining Methods and Their Effects

The "universe" of this study included Pennsylvania surface properties undermined by longwall, room-and-pillar, and room-and-pillar-full-retreat, mining processes. The different mining methods, the geology and extent of the coal mined, and the boundaries of permitted mining properties determined the amount of property undermined (and the amount of coal extracted). Because longwall mining removes the greatest quantity of coal in the shortest time, Washington and Greene counties, the sites of the longwall mines, had the greatest proportion of surface area undermined during the study period.

Although the University’s researchers examined effects of subsidence by collecting data on all underground mines, they did not treat each mine as an equal entity. Feature density (usually determined by population density) plus mining type, intensity, depth, and area determine the number of impacts at the surface. Where only one or two water loss reports were associated with a mine—in all cases, room-and-pillar mines—the data were insufficient for drawing conclusions about the regional ground water. Thus, the researchers limited their analysis of the effects of underground bituminous coal mining on regional ground water to the longwall mines (and, therefore, to Washington and Greene counties) because those extensive mining operations had most of the reported water problems during the assessment period.

III.L. Scale of the Study

The University’s researchers recognize that the global picture does not emphasize the problems of an individual property owner for whom property is a personal “universe.” Although in making this report the researchers included available data on all such individual universes, they did not rely on any anecdotal evidence short of that already recorded in the BUMIS files, in the paper files, or in interviews with California District Mining Office investigators who, from personal experience, could provide property descriptions and updates on resolutions.