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STRIP MINING STUDY COMMITTEE

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STRIP MINING STUDY COMMITTEE DRAFT REPORT

A C K N O W L E D G E M E N T S

Much of this information gathered for and used by the Strip Mining Study Committee, and presented in this report, is necessarily of a rather technical nature. Considerable assistance in gathering and interpreting technical information relating to techniques and effects of surface mining has been received from Dr. John Lemish, Professor of Geology at Iowa State University in Ames and Chairman of the State Mining Board; Dr. H. Garland Hershey, State Geologist; and Dr. Gordon L. Gatherum, Professor of Forestry at Iowa State University. Other persons who provided valuable assistance in gathering information needed by the Strip Mining Study Committee included State Mine Inspector W. Dean Aubrey and many of Iowa's county assessors, nearly fifty of whom completed questionnaires at the Committee's request. Nine other assessors were interviewed personally. To each of these individuals, as well as to others too numerous to mention who provided assistance with the Strip Mining Study on one or more occasions, the Legislative Research Bureau staff expresses sincere appreciation.

SUMMARY OF RECOMMENDATIONS

The Strip Mining Study Committee, pursuant to Senate Concurrent Resolution 32 of the Sixty-first General Assembly, has conducted "a study of all aspects of present abandoned pit mines and rock quarries in the state in regard to the possibility of using such areas for recreation, conservation, agriculture, and such other purposes as the Committee may determine." The members of the Study Committee have concluded that it would be illogical to undertake any major effort to rehabilitate existing mined out land without requiring that areas mined out in the future be systematically rehabilitated as mining operations are completed. Therefore the Strip Mining Study Committee has submitted two sets of recommendations, both in the form of suggested legislation, for consideration by the Legislative Research Committee and the Sixty-second General Assembly.

Regulation of Future Surface Mining

One of the bills recommended by the Strip Mining Study Committee is entitled "An Act to require licensing of mining operators, to regulate surface mining, and relating to rehabilitation of land affected by surface mining." The bill's major provisions are as follows:

1. Licensing of all Surface and Underground Mine Operators - To enable the Department of Mines and Minerals to more effectively regulate mining activities in Iowa, every person or firm operating one or more surface or underground mines in the state would be required to obtain

a license from the Department. The initial license fee would be fifty dollars, with a ten dollar annual renewal fee. It would not be necessary for a person or firm to obtain more than one license regardless of the number of mines the license operates. A license would have to be issued to any person or firm submitting a properly completed application, but if the licensee repeatedly or willfully violated state mining laws and regulations the Department could--subject to prescribed appeal procedures--suspend, revoke, or refuse to renew the license.

2. Registration of all Surface Mining Sites - Each site on which surface mining operations are commenced after January 1, 1968 would have to be registered with the Department of Mines and Minerals by the operator within fifteen days after beginning surface mining on the site. All sites where surface mining operations were in progress prior to January 1, 1968 would have to be registered within sixty days thereafter. Registration would involve informing the Department of the location and size of the site, and posting a bond equal to the estimated cost of rehabilitating the site after mining operations are completed. A registration fee would be charged, but could not exceed the cost of administering the registration requirements of the proposed act. (The present requirement in sections 82.22 and 82.23 of the Code that a permit be obtained before opening of any new mine would be amended to apply only to underground mines.)

3. Rehabilitation of all Surface Mining Sites - Each site

on which surface mining operations are conducted after January 1, 1968 would have to be rehabilitated by the operator, by reducing spoil banks to grades or configurations specified by the bill, damming unfilled pits where necessary to control drainage, and burying acid mineral seams exposed by mining operations. The required rehabilitation work would have to be performed within two years after completion of mining operations on the site, unless the Department of Mines and Minerals granted additional time for rehabilitation of the site. When the operator's rehabilitation work had been accepted by the Department, the bond he had posted on the site would be released. Failure to rehabilitate a surface mining site as required by the bill would result in forfeiture of the operator's bond, with the proceeds of the forfeiture used by the state to rehabilitate the site on which the bond had been posted.

4. Creation of Land Rehabilitation Advisory Board - A part-time, non-salaried, eight-member "Land Rehabilitation Advisory Board would be created to advise the State Mining Board (administrative body of the Department of Mines and Minerals) on administration and enforcement of the proposed surface mining regulatory statute. The Advisory Board would include an agronomist, a forester, a geologist, representatives of the State Conservation Commission, Natural Resources Council, and State Soil Conservation Committee, and two representatives of Iowa surface mining operators, appointed by the governor for staggered three-year terms.

Land Rehabilitation Demonstration Projects

The second bill recommended by the Strip Mining Study Committee is entitled "An Act to authorize at least one and not more than three projects for the demonstration of methods of rehabilitating land affected by surface mining, and to make an appropriation therefor." The bill would empower the Department of Mines and Minerals to conduct, or arrange by contract or otherwise for the conducting of, from one to three surface mined land rehabilitation projects. First priority would be given to a project for reduction or elimination of surface acidity of a worked out strip coal mine. If it is possible to conduct two or three projects, rehabilitation of worked out surface mine sites for agricultural use and for recreational use would receive second and third priority respectively. The State Mining Board, with advice of the Land Rehabilitation Advisory Board, would select and acquire sites for the projects and would dispose of the sites upon completion of the projects. An appropriation of $30,000 for the projects is proposed, with the State Mining Board authorized to enter into agreements for cost sharing or for the purpose of obtaining matching funds when such agreements would not conflict with the provisions of the proposed bill.

The surface mining regulatory bill proposed by the Strip Mining Study Committee would not require the rehabilitation of land where surface mining operations ended prior to January 1, 1968. The purpose of the surface mined land rehabilitation projects would be to demonstrate to owners of existing worked out surface mine sites the possibility and desirability of restoring some degree of usefulness and attractiveness to the sites, and to encourage the owners to undertake the needed rehabilitation work.

I - INTRODUCTION

For thousands of years men have dug in the earth to obtain minerals for use as fuel and as raw material for roads, buildings, and a wide variety of manufactured products. There is no practical alterantive to continued extraction from the earth of minerals necessary to supply the demands of industrialized societies.[1] The necessity of obtaining minerals from within the earth must therefore be reconciled with the necessity of preserving the economic and esthetic value of the surface of the earth.

There has been concern on the part of some Iowans about what can be done to insure that extraction of minerals from surface excavations does not unnecessarily damage the fertility, usefulness, and beauty of Iowa land. This concern has been demonstrated, in part, by introduction of proposed legislation to regulate strip mining of coal in Iowa during six sessions of the General Assembly over the past twenty years.[2] None of the bills were passed by either house, however the 61st General Assembly adopted a resolution requesting that a committee be established by the Legislative Research Committee to study "all aspects of present abandoned pit mines and rock quarries in the state in regard to the possibility of using such areas for recreation, conservation, agriculture,

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[1] James R. Dunn and John G. Broughton, "A Mineral Conservation Ethic for New York State," State Government, XXXVIII (Summer, 1965), p. 191-2.

[2] House File 154, 52nd G.A. (1947); Senate File 440, 53rd G.A. (1949); Senate File 158, 54th G.A. (1951); Senate File 282, 55th G.A. (1953); Senate File 270, 59th G.A. (1961); Senate File 372 and House File 439, 61st G.A. (1965).

and 'such' other purposes as the committee may determine."[1] The resolution referred specifically to open pit mining of gypsum, limestone, and gravel, as well as to strip coal mining.

In accordance with SCR 32 the Legislative Research Committee established a committee composed of eight legislators and designated the Strip Mining Study Committee, which held its organizational meeting on October 27, 1965. At that time the members of a previously established group composed of one representative of each of the Iowa industries which engage in surface mining (coal, gypsum, limestone, portland cement, sand and gravel, and structural clay products) agreed to serve as an official advisory members of the Strip Mining Study Committee.[2]

Committee Procedure

The Study Committee, assised by the Legislative Research Bureau, began its work by gathering as much useful information as possible about surface mining in general and surface mining in Iowa in particular. The information-gathering phase of the study was largely completed by midsummer of 1966, and the Study Committee begon formulation of its recommendations and suggested legislation.

In gathering information about surface mining, it was found that most published information available relates primarily or entirely to strip mining of coal. Although some publications

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[1] Senate Concurrent Resolution 32, 61st General Assembly, Senate Journal, p. 1432; House Journal, p. 1671.

[2] Strip Mining Study Committee, Minutes of the Meeting of October 27, 1965, pp. 4, 9.

relating to rehabilitation of sand and gravel sites were obtained from the National Sand and Gravel Association, much of the information in this report relating to surface mining of products other than coal is based on personal interviews and on observation of a number of Iowa surface mining sites. Members of the Strip Mining Study Committee visited a number of strip coal mines and limestone quarries, a shale and clay quarry, and a sand and gravel pit in central Iowa on November 17, 1965. In addition, the Legislative Research Bureau staff member assigned to the strip mining study visited the open pit gypsum mines near Fort Dodge, and viewed a number of strip coal mines, limestone quarries, shale and clay quarries, and sand and gravel pits in various parts of the state.

Surface Mined Land Questionnaires

At the outset of the strip mining study it was suggested that the Legislative Research Bureau determine the amount and location of land in Iowa affected by surface mining and what use, if any, is being made of Iowa land where surface mining operations have been completed.[1] However, it was found that little previously compiled information was available as to the amount, location, or condition of Iowa land affected by surface mining. Therefore the Research Bureau late in 1965 mailed questionnaires to county assessors in 82 counties, requesting the following information:

1. Location of each operating or abandoned surface mining site in the county.
2. Whether the site is being used as a mine or mining operations have been completed or abandoned.

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[1] Ibid., p. 8.

3. Number of acres of land at each site which have been affected by excavation including both area excavated and land affected by dumping of overburden.
4. Taxable value per acre of land affected by excavation for removal of mineral products from the site.
5. What use is presently being made of the site, if mining operations have been completed or abandoned.

Questionnaires were not mailed to twelve northeastern Iowa counties--Allamakee, Buchanan, Chickasaw, Clayton, Delaware, Dubuque, Fayette, Floyd, Howard, Linn, Mitchell, and Winneshiek--where it was believed that large numbers of operating and abandoned pits and quarries exist. Also, questionnaires were not mailed to five counties--Mahaska, Marion, Van Buren, Wapello, and Webster--where many operating and abandoned strip mines are located. It was concluded that it would not be reasonable to ask the assessors in these counties to undertake the task of listing and providing information about every surface mining site in each of these counties.

Replies were received from the 52 counties listed below.

Adair	Greene	Page
Adams	Grundy	Palo Alto
Appanoose	Harrison	Plymouth
Audubon	Ida	Pocahontas
Benton	Iowa	Pottawattamie
Bremer	Jackson	Poweshiek
Buena Vista	Jasper	Ringgold
Calhoun	Jefferson	Sac
Cass	Johnson	Shelby
Cedar	Jones	Sioux
Cerro Gordo	Lee	Story
Clarke	Lucas	Tama
Clay	Madison	Taylor
Clinton	Mills	Union
Dallas	Montgomery	Washington
Davis	O'Brien	Winnebago
Decatur	Osceola	Woodbury
Franklin		

Seven of the questionnaires were returned with no information. Two of the seven questionnaires which contained no infor-

mation were accompanied by statements indicating that the county assessors involved had not found it possible to supply the requested information from their files. The other five assessors who returned questionnaires without information wrote notes to the effect there are no surface mining sites in their counties or that the amount of land occupied by such sites is negligible. A number of assessors who returned questionnaires listing some surface mining sites also stated that they had not listed all of the smaller sites in their counties. Much of the information derived from the questionnaires is summarized in Chapters II and III of this report.

Terms Used In This Report

Brief comments about some of the terms used in this report may be helpful. The term "surface mining" is meant to include strip mining of coal and gypsum, quarrying of limestone and shale, and removal of sand and gravel from open or flooded pits. "Overburden" refers to earth removed to expose a mineral deposit for surface mining.

Work needed to make exhausted or abandoned surface mining sites useable for some purpose is referred to in this report as "rehabilitation" rather than as "reclamation," the term used in a number of surface mining regulatory statutes in effect in other states. It has been suggested that reclamation implies restoring surface mined land to its original condition, while rehabilitation implies improvement of surface mined land so as to restore some degree of usefulness without necessarily returning the land to its original condition.[1]

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[1]Letter from Dr. John Lemish, Professor of Geology, Iowa State University and Chairman, State Mining Board, February 9, 1966.

Reasons For Surface Mining

Where mineral deposits which are to be mined lie at or very near the surface of the earth, there may be no practical alternative to use of surface mining methods. However the development of large and powerful motorized earth moving equipment has made it possible to surface mine relatively deep deposits which could also be, and in some cases originally were, mined by underground methods. Some underground gypsum mines in Webster County, Iowa, have been converted to strip mines.[1] An underground limestone mine in far western Iowa was converted to an open pit mine a few years ago after the roof of the underground mine collapsed, fortunately at night while no one was in the mine.[2]

Most published discussions of the economic advantages of surface mining as opposed to underground mining relate specifically to strip mining of coal. The factors which are said to make strip mining of coal more economically advantageous than underground coal mining are:

1. The interval between initial investment in land and equipment and production of coal by strip mines is comparatively short.[3]
2. Strip mines use larger units of machinery which, although they may require a somewhat greater initial investment than underground mining machinery, can be

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[1] Interview with Mr. Harold Zelms, Plant Manager, Bestwall Gypsum Co., Fort Dodge, March 11, 1966.

[2] Interview with Mr. Ted Welp, Materials Geologist, Iowa State Highway Commission, February 10, 1966.

[3] Kenneth K. Lau, Mineral Rights and Mining Laws (Honolulu: University of Hawaii Legislative Reference Bureau, 1957), p. 22.

operated by fewer skilled employees and have considerably greater salvage value than underground mining equipment.[1]

3. The average output of coal per man-day in strip mines is more than double that of underground mines in the United States.[2]

4. From 95 to 100 percent of the coal contained in a seam being worked by strip mining can be recovered while recovery of coal contained in a seam being worked by underground mining rarely exceeds 50 percent, because columns of coal must be left in place to support the ceiling of the mine.[3]

5. Such hazards of underground mining as rockfalls, gas or dust explosions, and poor ventilation are eliminated by strip mining.[4]

The advantages of strip coal mining are offset to some extent by the fact that strip mined coal is frequently lower in quality than coal mined at deeper levels underground. However, many modern steam plants are able to efficiently burn low quality coal and such plants consume most of the nation's output of strip mined coal.[5]

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[1] Ibid.; Robert Montgomery, Strip Mining in Kentucky (Frankfort: Kentucky Department of Natural Resrouces, 1965), p. 23; Guy-Harold Smith (ed.) Conservation of Natural Resources (2d ed. rev.; New York: John Wiley & Sons, Inc., 1958), p. 316 .

[2] Ohio Legislative Service Commission, Comparative State Strip Mining and Reclamation Laws, Staff Research Report No. 67. (Columbus: Ohio Legislative Service Commission, 1965), p. 5.

[3] Montgomery, loc. cit., Comparative State Strip Mines and Reclamation Laws, loc. cit.

[4] Montgomery, loc. cit.

[5] Comparative State Strip Mining and Reclamation Laws, loc. cit.

Summary

There is no practical alternative source from which to obtain the raw minerals obtained by mining. The desire of some Iowans to insure that surface mining--strip mining of coal and gypsum, quarrying of limestone, shale and clay, and production of sand and gravel from dry or flooded pits--does not unnecessarily damage Iowa land has led to a number of proposals for regulatory legislation over the past several years. The Strip Mining Study Committee was established to consider need for regulation of surface mining in Iowa.

Much of the information appearing in this report was obtained by personal interviews with knowledgable individuals and on replies to a questionnaire prepared on behalf of the Study Committee. It was found that much of the published material relating to surface mining is concerned primarily or entirely with strip mining of coal. It was also found that little information had previously been compiled on the number, location, size, and condition of surface mining sites in Iowa, and therefore a questionnaire was sent to 82 of Iowa's county assessors seeking the needed information. Replies were received 52 county assessors, and interviews were obtained with assessors in nine of the 17 counties to which questionnaires were not mailed because of the large number of surface mining sites in the counties.

Where a given mineral deposit could conceivably be worked either by surface or underground mining methods, the advantages claimed for surface mining include greater output per man-day, greater safety for miners, and nearly 100 percent recovery of the mineral deposit as compared to a practical maximum of about fifty percent recovery of deposits worked by underground mining.

II - GENERAL INFORMATION ON SURFACE MINING IN IOWA

Iowa mineral industries produced, processed and sold $106.6 million worth of mineral products in the calendar year 1964.[1] The principal raw materials involved were coal, gypsum, limestone, sand and gravel, and shale and clay.[2] Sales of portland and masonry cements, processed products of which limestone is a principle ingredient, accounted for over $48.2 million of the total value of Iowa's 1964 mineral production.[3] Only part of the total value of Iowa cement production represents the cost of raw minerals obtained in Iowa; an unknown proportion of the $48.2 million figure represents the cost of other ingredients used in cement and processing costs.

Most of the raw minerals produced in Iowa are obtained by surface mining of one sort or another. Twelve underground coal mines, a single underground gypsum mine,[4] and a few underground limestone mines[5] were operated in Iowa in 1964. Mineral production was reported in 1964 in every county in Iowa except Davis, Ringgold, and Wayne.[6]

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[1] James H. Aase, The Mineral Industry of Iowa, preprint from U.S. Bureau of Mines 1964 Minerals Yearbook (Washington: U.S. Government Printing Office, 1965), p. 1.

[2] Ibid. Other minerals produced in Iowa in 1964 were peat and "other nonmetals" which together had a total value of $1,279,000.

[3] Ibid.

[4] Iowa. Report of the State Mine Inspector for the Biennial Period ending December 31, 1965, (Des Moines: State of Iowa, 1966), p. 15.

[5] Materials Source Map of Possible High Quality Aggregates, prepared by Iowa State Highway Commission, 1965.

[6] Aase, op. cit., pp. 8-9. Strip Mining Study Committee questionnaires were sent to all three counties: the return from Davis county listed no operating surface mining sites in 1965, the return from Ringgold County listed one producing limestone site in 1965, and no reply has been received from Wayne County.

. . All types of surface mining involve considerable excavation of the earth's surface. The five major types of surface mining carried on in Iowa--coal, gypsum, limestone, sand and gravel, and shale and clay--differ in the manner in which the necessary excavation is carried out, the amount of land disturbed, and the nature of the effect produced on the land which is disturbed.

A. - Strip Mining of Coal in Iowa

Coal deposits are believed to lie beneath about 20,000 square miles of Iowa land lying south of a line beginning near Onawa on the Missouri River and swinging in a great arc across western, central, and southeastern Iowa to near the State's southeastern tip.[1] Coal mining in Iowa dates back to 1840 but strip coal mining by means of motorized earth moving equipment did not begin in Iowa until after 1930.[2] All coal produced in Iowa in 1964 was used within the state, 74 percent being consumed in the generation of electricity.[3]

Iowa produced in 1965 a total of 1,045,607 tons of coal. Strip mining accounted for 849,739 of coal, over 81 percent of the State's total 1965 production.[4] Only a little over 3 percent of the more than 4,000,000 tons of coal mined in Iowa in 1932 was strip mined.[5] Table I indicates that while total Iowa coal production

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[1] Strip Mining Study Committee, Minutes of December 15, 1965 Meeting, p. 16; Mineral Resources of Iowa, map prepared in 1947 by Dr. H. Garland Hershey, now State Geologist.

[2] Dr. Hubert L. Olin, Coal Mining in Iowa (Des Moines: State of Iowa, 1965), pp. 80, 87.

[3] Aase, op. cit., p. 6.

[4] Ibid., p. 7.

[5] Iowa. Report of the State Mine INspector for the Biennial Period Ending December 31, 1933 (Des Moines: State of Iowa, 1934), p. 14. This report, covering the years 1932 and 1933, is the earliest such report in which separate figures are given for strip and underground coal mine production.

TABLE I - PROPORTION OF TOTAL ANNUAL IOWA COAL PRODUCTION ATTRIBUTABLE TO STRIP MINING, 1932-1965

Year	Total Iowa Coal Output	Total Iowa Strip Coal Mine Output	Percentage of Iowa Coal Output Strip Mined
1932	4,002,955	130,031	3.25%
1933	3,351,130	260,996	7.79%
1934	3,581,280	244,779	6.83%
1935	3,787,605	237,688	6.28%
1936	3,962,085	272,622	6.88%
1937	3,683,316	419,459	11.39%
1938	3,182,638	497,006	15.62%
1939	3,010,905	568,203	18.87%
1940	3,302,869	733,641	22.21%
1941	3,027,058	707,476	23.37%
1942	3,041,479	706,270	23.22%
1943	2,782,249	679,023	24.41%
1944	2,240,000	523,078	23.35%
1945	2,071,648	531,327	25.65%
1946	1,751,140	633,774	36.19%
1947	1,687,590	747,240	44.28%
1948	1,666,774	790,140	47.41%
1949	1,749,861	983,571	56.21%
1950	1,931,022	1,298,053	67.22%
1951	1,600,443	1,093,161	68.30%
1952	1,410,259	971,776	68.91%
1953	1,354,587	940,539	69.43%
1954	1,097,651	841,760	76.69%
1955	1,266,678	933,059	73.66%
1956	1,049,072	1,310,489	80.05%
1957	1,006,505	1,277,002	78.82%
1958	1,178,388	898,716	76.27%
1959	1,176,047	945,722	80.42%
1960	1,057,425	855,937	80.95%
1961	930,491	780,178	83.85%
1962	1,133,586	966,314	85.24%
1963	1,212,614	1,057,763	87.30%
1964	971,977	803,067	82.62%
1965	1,045,607	849,739	81.27%

SOURCE: Reports of Iowa State Mine Inspector, 1933-1965

declined fairly steadily, the proportion of the State's coal output produced by strip mining rose in nearly every year from 1934 to 1963. The proportion of Iowa coal production attributable to strip mining dropped slightly in 1964, and again in 1965.

Coal production figures for 1965 show that Marion County produced 51.3 percent and Mahaska County 39.9 of all coal strip mined in Iowa that year. The balance of Iowa's 1965 strip coal mine production occurred in Appanoose, Keokuk, Monroe, Van Buren, and Wapello Counties.[1]

Strip Coal Mining Techniques

An opening in the earth's surface made by removal of overburden to expose a mineral deposit for surface mining is called a cut. Operators of Iowa's larger strip coal mines remove overburden by digging over a period of time a series of successive parallel cuts each of which exposes a portion of the coal deposit being mined. A new cut is opened only after all or most of the coal exposed by the preceding cut has been removed. Smaller strip mines frequently involve only one cut. The length of a cut may vary considerably from one strip mine to another and is determined by land contour, amount of land purchased or leased for stripping, and the extent of the coal deposit being mined. The width of each cut may be from twenty to as much as eighty feet.

Each cut is made by removing overburden, which usually has been loosened by explosives, and depositing the removed overburden as a spoil bank at one side of the cut. The spoil bank created by opening of a strip mine's first cut must usually be deposited on undisturbed earth. The second cut is later opened at the side of the first cut opposite the spoil bank, with the over-

[1] Iowa. Report of the State Mine Inspector . . . 1965 (Des Moines: State of Iowa, 1966), p. 14.

burden from the second cut being dumped into the mined out first cut. This procedure is repeated with each succeeding cut until the mine reaches the limit of the recoverable coal deposit or of land purchased or leased for stripping. Unless the mine is re-graded after removal of coal is completed, the mined out final cut usually remains unfilled and may become flooded.[1]

The booklet Coal Mining in Iowa, published in 1965, states that

> "The dragline is the principal machine in use in Iowa for removing the overburden from the coal although the bulldozer is used quite extensively for pushing off some of the topsoil. Carry-all scrapers are used at some strip mines in conjunction with the dragline and bulldozer."[2]

Although bulldozers and carry-all scrapers (large diesel-powered, rubber-tired machines often seen in use on major road-building projects) can sometimes be used to remove topsoil and subsurface clay, draglines are needed to remove the heavier shale material which overlies coal deposits.[3]

In addition to draglines, strip mine operators in other states use power shovels and the more recently developed wheel-type excavators to remove overburden from coal which is to be strip mined.[4] (A wheel-type excavator removes earth by scooping it up in buckets mounted around the outer edge of a large wheel and

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[1] Interview with Mr. Aubrey, March 18, 1966.

[2] Olin, op. cit., p. 87.

[3] Interview with Mr. Aubrey, March 18, 1966.

[4] Soil Conservation Society of America, A Digest: Strip-Mine Reclamation, prepared in cooperation with the Eastern Region, Forest Service, U.S. Department of Agriculture (1964), pp. 25-26.

arranged to dump onto a system of conveyor belts which carry the earth away from the point of excavation and deposit it in a single continuous operation.) There are no stripping shovels or wheel-type excavators in use in Iowa at the present time, largely for economic reasons which will be discussed in succeeding paragraphs. A number of relatively small power shovels are used in Iowa to load strip mined coal after the overburden has been removed and the coal has been loosened by blasting.[1]

Limited Scale of Iowa
Strip Coal Mine Operations

The area in Iowa where coal deposits are believed or known to exist is part of the northern end of the Western Interior Coal Field which extends through several states. Because Iowa coal deposits are near the edge of this field, many of the State's deposits are in the form of relatively small and shallow discontinuous beds. Such beds are sometimes described as "lenticular," thick at the center and thinning toward the outer edges of the deposit.[2] Coal deposits strip mined in Iowa in 1964 ranged from 22 to 66 inches in thickness, and overburden which had to be removed to reach the coal deposits ranged from 18 to 60 feet deep.[3]

Most strip coal mines operated in Iowa up to the present time have worked fairly small deposits. As a result, individual Iowa strip coal mines generally have a shorter productive life and

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1. Interview with Mr. Aubrey, March 10, 1966.

2. Interview with Dr. H. Garland Hershey, State Geologist, and Mr. Fred H. Dorheim, Iowa Geological Survey, Iowa City, March 15, 1966.

3. Aase, op. cit., pp. 6-7.

a lower rate of production than many strip coal mines in other states.[1] The most productive strip coal mine in Iowa in recent years, located near Knoxville, was opened in 1950 and was worked for about 13 years.[2] The mine reached its highest annual rate of production in 1956, when 323,642 tons of coal were mined there.[3] The State Mine Inspector's biennial reports show that annual coal production at this mine was considerably greater than at most Iowa strip coal mines.

By contrast, eight strip coal mines being operated at locations in Illinois, Indiana, and Kentucky by a single large coal mining firm reported individual 1962 production totals ranging from 420,000 tons to a maximum of 2,222,000 tons. One of these mines, which produced 980,000 tons of coal in 1962, was then in its twenty-first year of continuous production and three of the other mines had been in production for twelve years or more.[4]

The relatively small size of the coal deposits which have been strip mined in Iowa in the past have made it necessary for Iowa strip mine operators to employ equipment which can be moved from a worked out mine to a new mining site at intervals of only a few years without excessive cost.[5] The State Mine Inspector believes that a 12 cubic yard dragline is the largest piece of equipment which has been used in strip coal mining in Iowa.[6]

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[1] Interview with Dr. Hershey, March 15, 1966.

[2] Interview with Mr. Aubrey, March 18, 1966; Report of the State Mine Inspector . . . 1963, p. 13.

[3] Report of the State Mine Inspector . . . 1957, p. 11.

[4] "Ayrshire Producers Today," Coal Age, October, 1963, p. 69.

[5] Interview with Dr. Hershey, March 15, 1966.

[6] Interview with Mr. Aubrey, February 18, 1966.

Many of the large strip coal mines in states to the east and southeast of Iowa are worked by mammoth pieces of equipment, ranging up to a 180 cubic yard stripping shovel which was assembled at an Illinois mine in 1965.[1] Such pieces of equipment can be disassembled and moved to different sites only at great cost, although the equipment is mobile in the sense of being able to move at the mining site as stripping operations proceed.

Geologists believe that Iowa has coal deposits accessible to strip mining which are far larger than the deposits strip mined in the State in the past. Development of such deposits might justify the use in Iowa of very large strip mining equipment.[2]

Amount of Land Affected by Strip Coal Mining in Iowa

No conclusive statistics relating to the amount of Iowa land affected by past and present strip coal mining were found by the Legislative Research Bureau. Dr. John Lemish, Iowa State University professor of geology who is Chairman of the State Mining Board, estimated that pits and spoil banks left by strip coal mines which are now abandoned cover a total of about 4,000 acres of land in the State.[3] However, officials in Marion County state that over 5,500 acres of land in that county alone has been affected by strip coal mining.[4]

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[1] Montgomery, loc. cit., p. 11.

[2] Interview with Dr. Hershey, March 15, 1966.

[3] Strip Mining Study Committee, Minutes of December 15, 1965 Meeting, p. 10.

[4] Interview with Mr. Merle Maddy, Marion County Assessor, Knoxville, Iowa, June 23, 1966. Mr. Maddy's figures are based on information provided by Mr. M. O. Hanson, Marion County Engineer.

A 1962 Iowa State University publication states that "approximately 12 square miles (7,680 acres) of land area have been stripped, and each year an additional 400 to 500 acres are worked for coal."[1] The estimate is based on research carried out from 1952 to 1955.[2] The State Mine Inspector believes the amount of Iowa land annually stripped for coal has totaled only 100 to 150 acres in the past few years.[3]

Strip Coal Mine Permits - It is believed that an indication of the number and location of past and present Iowa strip coal mining operations can be derived from records of application which, under Iowa law, must be obtained from the State Mine Inspector before a coal or gypsum mine may be opened.[4] Information required by law to be shown on the application for such permits does not include the amount of land which the applicant anticipates will be strip mined, nor is there any requirement that periodic reports be made on the amount of land actually stripped.[5]

Information prepared for the Strip Mining Study Committee by the State Mine Inspector's office indicates that from the inspection of strip mining in Iowa to approximately the end of the calendar year 1965, 259 permits for the operation of strip coal mines in eighteen Iowa counties had been issued. The number of strip coal mining pits which have been opened does not correspond

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[1] N. J. Hansen, et. al., Reclaiming Coal Spoilbanks in Southeastern Iowa (Ames: Iowa State University Cooperative Extension Service, 1962), p. 1.

[2] Letter from Dr. Gordon E. Gatherum, Professor of Forestry, Iowa State University, March 14, 1966.

[3] Interview with State Mine Inspector W. Dean Aubrey, April 15, 1966.

[4] Code of Iowa (1966), secs. 82.22, 23.

[5] Ibid., sec. 23.

exactly to the number of permits issued because some operators have opened more than one pit on adjacent tracts of land under a single permit, while in other cases more than one permit has been issued for the same pit because of changes in ownership.[1] It is believed however that some idea of the number and location of abandoned strip coal mines in Iowa may be obtained by comparing the total number of permits issued for strip mines in each county from 1930 to the end of 1965, and the number of strip coal mines operating in each county at the end of 1965. Such a comparison appears in Table II.

TABLE II

1. County	2. Total Strip Coal Mine Permits Issued Since 1930	3. Number Strip Coal Mines In Operation At End of 1965
Marion	78	7
Mahaska	64	5
Wapello	28	2
Van Buren	21	1
Monroe	17	2
Davis	13	-
Jasper	6	-
Keokuk	6	1
Webster	5	-
Warren	4	-
Greene	3	-
Jefferson	3	-
Appanoose	2	1
Boone	2	-
Hamilton	2	-
Polk	2	-
Washington	2	-
Lucas	1	-

SOURCES: Information prepared by State Mine Inspector's Office; James H. Aase, The Mineral Industry of Iowa, preprint from U.S. Bureau of Mines 1964 Minerals Yearbook (Washington: U.S. Government Printing Office, 1965), p. 7.

[1] Information prepared by State Mine Inspector's office.

Strip Mining Study Committee questionnaires have been returned from seven of the 18 counties where strip coal mining has occurred; Appanoose, Davis, Greene, Jasper, Jefferson, Lucas, and Washington. The assessors in four of these counties listed one or more abandoned strip coal mine sites, as follows:

Davis County - 12 sites totaling 472 acres

Greene County - 3 sites totaling 39 acres

Jasper County - 1 site totaling 40 acres

Jefferson County - 1 site totaling 2 acres and other small sites, "none worthy of mention."

The questionnaire returned from Appanoose County contained no information and those returned from Lucas and Washington Counties mentioned no strip coal mine sites. The Lucas county assessor commented that a small firm planned to begin surface mining in that county about two years ago "but went broke before they got anywhere." The Lucas County assessor did not state whether the proposed surface mining operation was to be strip coal mining or some other type of surface mining.

Future Strip Coal Mining Prospects - It is estimated that recoverable coal reserves totaling 3,262,000,000 tons lie beneath some 4,000 square miles of land in 37 Iowa counties.[1] The estimate is based on the assumption that an average of fifty percent of any given coal deposit can be recovered when the deposit is mined,[2] however the recovery of deposits which are strip mined usually approaches 100 percent.[3] The proportion of

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[1] E. R. Landis and Orville J. Van Eck, Coal Resources of Iowa (Des Moines: State of Iowa, 1965), p. 1.

[2] Ibid.

[3] Montgomery, loc. cit.; Comparitive State Strip Mining and Reclamation Laws, loc. cit.

Iowa's estimated recoverable coal reserves which is accessible to strip mining is not known.

Although Iowa coal production has not exceeded two million tons per year for the past twenty years,[1] there have been reports during 1965 and 1966 of some interest in greatly increased strip mining of coal in Iowa. The State Mine Inspector reported in October, 1965 that at least two large out-of-state mining firms had for several months been prospecting in Iowa for coal mining for strip mining. One of these companies indicated to the mine inspector that before beginning stripping operations in Iowa, it would want to be assured of reserves at a single location sufficient to allow removal of one million tons of coal per year for a period of at least 10 years. The State Mine Inspector estimates that strip mining of coal on the scale proposed by the firm would affect at least 100 acres of land per year.[2]

Little information is available concerning anticipated future demand for Iowa strip mined coal. In recent years three of the State's major public utility firms have been burning a total of about 900,000 tons of coal per year.[3] Since a high proportion of Iowa mined coal is used to generate electricity, announcements during 1966 by some of the electric utility companies serving Iowa of plans to construct or participate in construction of nuclear-powered generating plants probably lessened the liklihood of any dramatic increase in Iowa coal production in the near future.[4]

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[1] Report of the State Mine Inspector . . . 1963, p. 26.

[2] Interview with Mr. Aubrey, October 22, 1965.

[3] Strip Mining Study Committee, Minutes of the November 16-17, 1965 Meeting, p. 10.

[4] _____, Minutes of the August 3, 1966 Meeting, p. 9.

B. - Strip Mining of Gypsum in Iowa

Iowa was in 1964--the most recent year for which Federal figures are available--the nation's third-ranking state in raw gypsum production.[1] Gypsum, presently being mined only in Webster and Des Moines counties, was formerly mined in Appanoose County also and is believed to exist in large subsurface deposits at other points in Iowa.[2] Commercial utilization of Iowa gypsum began about 1872 with subsurface quarrying of deposits in Webster County.[3] Gypsum is the basic raw material for a variety of building materials including several types of plaster, wallboard, lath, and tile.[4]

Total 1964 gypsum production in Iowa is listed by the U.S. Bureau of Mines as 1,287,000 tons.[5] According to the most recent figures published by the State Mine Inspector, strip mines in Webster County--where all production of gypsum in recent years has been by strip mining--accounted for over 81 percent of the total 1965 Iowa gypsum production.[6] All gypsum produced in Des Moines County comes from a single underground mine where a deposit 600 feet below the surface is being worked.[7]

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[1] Aase, op. cit., p. 4.

[2] Ibid.; Report of the State Mine Inspector . . . 1963, pp. 32-33; Interview with Dr. H. Garland Hershey, State Geologist, and Mr. Fred H. Dorheim, Iowa Geological Survey, Iowa City, March 15, 1966. Marion County Engineer M. O. Hanson reported that a gypsum deposit was encountered some distance below the earth's surface in a limestone slope mine opened by the Durham Mining Company in eastern Marion County in the summer of 1966.

[3] Report of the State Mine Inspector . . . 1963, pp. 32-33.

[4] Aase, op. cit., p. 4.

[5] Ibid., p. 1.

[6] Report of the State Mine Inspector . . . 1965, pp. 15, 19.

[7] Ibid., p. 33. The gypsum mine formerly operated in Appanoose County was also deep underground.

Strip Gypsum Mining Techniques

All strip mining of gypsum in Iowa occurs in an area of a few square miles near Fort Dodge in Webster County. Gypsum deposits in the area lie from 35 to 70 feet beneath the surface of the earth and range from 14 to 24 feet in thickness, tapering down to eight feet or less at the edges of individual deposits.[1] No other gypsum deposits accessible to strip mining are known to exist in the State.[2]

The gypsum deposits being strip mined in Webster County are sufficiently extensive and localized to permit operations at the same mining site to continue many years. The four gypsum strip mines presently being worked have been open for varying periods of time ranging up to nearly forty years.[3]

Gypsum strip mining, like strip mining of coal, is carried on by operning successive cuts in the earth's surface, each of which exposes a portion of the gypsum deposit being worked. The overburden removed from the gypsum is deposited as a spoil bank, either on land adjacent to the cut or in an earlier cut where all or most of the gypsum has been removed. Virtually all removal of overburden from gypsum deposits in Webster County is now performed by carry-all scrapers, although draglines have been used by some gypsum mining firms in the past. The scrapers permit much more flexibility in spoil placement than is possible with draglines.[4]

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[1] Interview with Mr. Harold Zelms, Plant Manager, Bestwall Gypsum Co., Fort Dodge, March 11, 1966.

[2] Interview with Dr. Hershey and Mr. Dorheim, March 15, 1966.

[3] Interviewswith plant managers of gypsum firms now operating at Fort Dodge, Iowa, March 11, 1966.

[4] Ibid.

Amount of Land Affected by
Strip Gypsum Mining in Iowa

Records in the State Mine Inspector's office indicate that strip mining of gypsum in Iowa has always been confined to Webster County. Strip mining permits have in the past been issued to six gypsum firms, four of which remain in business at the present time.[1] The two gypsum firms which in the past obtained strip mining permits and which subsequently went out of business left strip mined areas, but only one of these areas is of any appreciable size.[2] Information as to the exact extent in acres of the abandoned gypsum strip mines in Webster County is not available.

Four open pit gypsum mines were operating in Webster County early in 1966, and a new pit was brought into production during the year. The four older pits are believed to total between 600 and 650 acres in extent.[3]

It is estimated that Webster County gypsum reserves accessible to strip mining are sufficient to permit continued production at the present rate for many years, but no other gypsum deposits sufficiently near the surface to permit strip mining are believed to exist in Iowa.[4] The underground gypsum mine presently operated in Des Moines County and an underground gypsum mine formerly in operation in Appanoose County were both opened to work desposits lying 550 to 600 feet below the surface.[5]

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[1] Information prepared by State Mine Inspector's office.

[2] Interview with Mr. Zelms, March 11, 1966.

[3] Interviews with Mr. Zelms; Mr. Maynard Mielitz, Plant Manager, Celotex Corporation; Mr. Joseph Carter, Plant Manager, National Gypsum Co.; Mr. M. E. Davidson, Works Manager, U.S. Gypsum Co., Fort Dodge, March 11, 1966.

[4] Interview with Dr. Hershey and Mr. Dorheim, March 15, 1966.

[5] Report of the State Mine Inspector . . . 1963, p. 33.

C. - Quarrying of Limestone in Iowa

Limestone deposits are believed to underlie virtually all of Iowa, although the deposits in much of the northwestern quarter of the State are not considered accessible to any type of mining because they are very deeply buried and some of the strata above the deposits carry large amounts of water.[1]

It is not known when commercial utilization of Iowa's limestone resources began. The State's total 1964 production of limestone was 23,935,000 tons with a total value of $33,038,000.[2] In 1964, 74 percent of Iowa's total limestone production was used as concrete aggregate and roadstone, fifteen percent was consumed in the manufacture of portland cement, nine percent was spread as agricultural limestone, and the remaining two percent was used as riprap, railroad ballast, structural building stone, and for other purposes.[3]

Most of the limestone sources in Iowa are surface mining operations generally referred to as pits or quarries, although a few underground limestone mines are in operation in the State.[4] No breakdown of the amounts of limestone produced by pits and quarries and by underground mines is available.

Recoverable limestone deposits in Iowa vary considerably both as to depth below the earth's surface and thickness of the deposit itself. Limestone usually lies at or fairly near the

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[1] Interview with Dr. Hershey, March 15, 1966.

[2] Aase, op. cit., p. 6.

[3] Ibid.

[4] Materials Source Map . . ., prepared by State Highway Commission.

surface and in rather thick deposits, ranging up to a thickness of 100 feet or more in some cases, in northeastern Iowa. Recoverable deposits are found at increasing depths beneath the surface and become progressively shallower across the State toward the south and west. Some isolated limestone deposits which once existed at or near the surface in southwestern Iowa now are believed exhausted.[1]

Limestone Quarrying Techniques

There are significant differences in the surface configuration and depth of the overburden which must be removed to permit quarrying of limestone in Iowa. In most parts of the State where limestone is produced, the land lies in a relatively level plane so that stripping of overburden and quarrying of limestone creates a pit. However in far northeastern Iowa, where the topography is quite rough and hilly and limestone is found at or near the earth's surface at most points, there are a considerable number of hillside quarries which do not creat pits.[2]

In the operation of limestone quarries situated on more or less level land, overburden is stripped in successive cuts as necessary to expose the limestone for removal. Limestone deposits in eastern and northeastern Iowa in many cases are considerably thicker than the overburden lying above them, while in central, southern and southwestern Iowa the overburden which must be removed is usually two or more times as deep as the thickness of the limestone deposit being quarried.[3]

Quarries where thick limestone deposits can be reached by removal of only a few feet of overburden tend to increase in land

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[1] Interview with Dr. Hershey, March 15, 1966.

[2] Ibid.

[3] Interview with Mr. J. C. Griffin, Superintendent, Marquette Cement Manufacturing Co., Des MOines, April 4, 1966.

area rather slowly and to produce little spoil. Quarries where limestone deposits are shallower must work more land in a given period of time to obtain the same volume of stone. Sizeable spoil banks are created by removal of the deeper overburden found at many quarries working relatively shallow limestone deposits.[1]

It is believed that all limestone producers in areas of Iowa where large amounts of overburden must be removed are now stripping with carry-all scrapers which deposit spoil banks having a rolling configuration.[2]

Hillside Quarries - Hillside limestone quarries are opened by stripping away whatever dirt is present on the sides of fairly steep hills where there are limestone outcroppings or limestone is present very near the surface. Quarrying is carried on by removing successive vertical layers of the exposed rock.[3] As quarrying proceeds the slope of the hillside being quarried becomes more nearly vertical and recedes toward the original center of the hill.[4] The extent to which a given hillside is quarried is determined by the quality of the limestone contained in the hill, the limits of land at the site owned or leased by the quarry operator, and the relative cost of quarrying more deeply into the hill as opposed to opening a new hillside quarry elsewhere.[5]

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[1] Interview with Dr. Hershey, March 15, 1966.

[2] Interview with Mr. Griffin, April 4, 1966.

[3] Interview with Dr. Hershey, March 15, 1966.

[4] Ibid.

[5] Interviews with Mr. Alfred L. Hansmeier, Allamakee County Assessor, Waukon, March 16, 1966, and Mr. Melvin O. Sattre, Winneshiek County Assessor, Decorah, March 17, 1966.

Amount of Land Affected by
Limestone Quarrying in Iowa

No specific information on the extent and effect of limestone quarrying in Iowa could be obtained by the Legislative Research Bureau except the information contained in Strip Mining Study Committee questionnaires completed by county assessors. It should be kept in mind that only 52 of 82 questionnaires mailed by the Bureau were returned, and that no questionnaires were sent to twelve northeastern Iowa counties in several of which there are numerous limestone quarries.

Table III lists the thirty counties from which questionnaires were returned reporting one or more limestone quarries. The use presently being made of land affected by past limestone quarring operations which have been discontinued is also shown on Table III. Rehabilitation of worked out or abandoned surface mine sites is discussed in Chapter III of this report.

TABLE III - LOCATION OF OPERATING AND ABANDONED LIMESTONE QUARRIES

County	Acres Operating	Acres Abanoned[a]							
		Total	Idle[b]	Pond	Dump & Junkyard	Recreational	Pasture	Cultivated	Other
Adair	53	52	47				5		
Adams	186								
Benton	60	10	10						
Bremer	33	34	34						
Cass	70	42	35	7					
Cedar		21	21						
Cerro Gordo	249	444	444						
Clarke	340								
Clinton	33								
Dallas	20								
Decatur	210	20	10				10		
Franklin	69	15	15						
Harrison	87	92	44						28[c]
Jackson	16								
Jefferson	60	3	3						
Johnson	80	87	56	31					
Jones	38	10					10		
Lee	38	10	10						
Madison	683	1,096	698				398		
Mills	79								
Montgomery	41	121	81		35		6		
Pocahontas	272								
Pottawattamie	104	14	?				7		
Poweshiek	130								
Ringgold	30								
Story	130								
Tama	45	35	33				2		
Taylor	15	60	40	20					
Union	38	25	22				3		
Washington	159	49	44			5			
TOTALS	3368	2240	1673	58	35	5	441		28

[a]Division of total abandoned limestone pit acreage among various categories of present use is somewhat arbitrary because several questionnaires contained entries such as "pond and waste" or "pasture and water" for a single site. In such cases the total acreage of the site was divided equally between the two categories.

[b]Includes all sites described as timber, brush, or waste.

[c]Includes 20 acres of former quarry land now used as an airport, and eight acres being used for storage of quarried rock.

SOURCE: Strip Mining Study Committee Questionnaires completed and returned by county assessors.

Abandoned limestone quarries totaling 2,240 acres in twenty counties scattered over the eastern and southern three-quarters of the State are listed on Strip Mining Study Committee questionnaires which were returned to the Research Bureau. Nearly half of this total, 1,096 acres, is located in Madison County. The next largest amounts of land affected by abandoned limestone quarries in single counties are 444 acres in Cerro Gordo County and 121 acres in Montgomery County.

Strip Mining Study Committee questionnaires returned from 29 counties list a total of 3,368 acres of land occupied by operating limestone quarries. Counties reporting relatively large amounts of land occupied by operating limestone quarries include Madison, 683 acres; Clarke, 340 acres; Pocahontas, 272 acres; Cerro Gordo, 249 acres; and Decatur, 210 acres.

Federal Bureau of Mines statistics indicate that limestone was produced in 65 Iowa counties during 1964, although specific amounts of limestone produced in each county in 1964 are not available.[1] In 1963; Madison County led all Iowa counties in production of limestone followed in order by Scott, Cerro Gordo, Linn, and Johnson Counties.[2]

The counties where no limestone production was reported during 1964 are Audubon, Boone, Buena Vista, Calhoun, Carroll, Cherokee, Clay, Crawford, Davis, Dickinson, Emmet, Greene, Guthrie, Ida, Iowa, Kossuth, Lucas, Lyon, Monona, Monroe, O'Brien, Osceola, Palo Alto, Plymouth, Polk, Ringgold, Sac, Shelby, Sioux, Warren,

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[1] Aase, op. cit., pp. 8-9.

[2] John W. Sweeney, "The Mineral Industry of Iowa," Minerals Yearbook, 1963, U.S. Bureau of Mines, vol. III (Washington: U.S. Government Printing Office, 1964), p. 418.

Wayne, Winnebago, Woodbury, and Wright.[1] Twenty-five of the 34 counties lie in an area bounded roughly by lines extending straight north and straight west from Des Moines to the respective borders of the State, although the area described also contains a few counties which did produce limestone in 1964.

D. - Production of Sand and Gravel in Iowa

Iowa is part of an area composed of most of the north-central and northeastern states where sand and gravel deposits are more abundant than in most other partsof the United States.[2] Sand and gravel occur both as glacial deposits and fluvial deposits (created by action of rivers and streams) in most of Iowa.[3]

Sand and gravel produced in Iowa are utilized primarily as road and building construction materials, with relatively small amounts used as blast sand, filter sand, engine sand, molding sand, railroad ballast, and for other industrial and construction purposes.[4] Iowa produced 13,890,000 tons of sand and gravel with a total value of $13,546,000 in 1964.[5] So far as is known all production of sand and gravel in Iowa is by surface mining operations.

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[1] Aase, op. cit., pp. 8-9.

[2] Anthony M. Bauer, Simultaneous Excavation and Rehabilitation of Sand and Gravel Sites (Silver Spring, Maryland: National Sand and Gravel Association, 1965), pp. 5-6.

[3] Mineral Resources of Iowa (map).

[4] Aase, op. cit., p. 5.

[5] Ibid.

Techniques of Sand & Gravel Production

Sand and gravel are produced from two general types of excavations; those on upland sites where pits remain dry and those on lower level sites where pits usually become flooded. Operations at a particular site may involve both wet and dry areas simultaneously. Also, a site which has been dry for a number of years may become wet if the bottom of the pit is excavated to a point below the ground water line.[1]

Most sand and gravel production in Iowa at the present time is believed to occur on bottom land or on natural "benches" (level areas) on the rise from rivers and streams to higher land. Locations in Iowa where sand and gravel may be obtained from upland deposits are becoming relatively scarce.[2]

It is urually necessary to remove from five to ten feet of overburden to expose sand and gravel deposits for mining, although much deeper overburden is occasionally encountered.[3] On low-lying land, where many Iowa sand and gravel pits are located, ground water often begins to fill the excavation almost as soon as removal of the overburden from the first cut has been completed.[4]

Removal of overburden and excavation of sand and gravel may be carried on by any one or a combination of several different types of machinery. The type of machinery chosen is governed by a number of factors including depths of overburden and of sand-gravel deposits, ground water level, and how and where any spoil resulting from stripping is to be deposited.[5]

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[1] Bauer, op. cit., p. 16.

[2] Interview with Dr. Hershey, March 15, 1966.

[3] Bauer, op. cit., p. 34.

[4] Interview with Mr. Welp, February 10, 1966.

[5] Bauer, op. cit., p. 10.

In Iowa, many flooded sand and gravel pits are worked by hydraulic mining, a method which often creates little or no spoil.[1] In hydraulic mining, a pumping device mounted on a barge sucks sand and gravel from the bottom of the pit and forces the material through which is not more than a few feet deep can be undermined by sucking sand and gravel from beneath it, causing the overburden to fall into the water at the edge of the pit. Any overburden sucked up with the sand and gravel is later separated from the sand and gravel along with other waste material removed by processing equipment.

The rate at which a sand and gravel pit expands over additional area is determined largely by the composition and depth of the deposit and by market demand in the area where the pit is located. In general, the higher the sand content of a particular deposit, the more rapidly a pit working that deposit will increase in size. Assuming identical sand-gravel composition, a pit working a shallow deposit may be expected to increase in size more rapidly than a pit working a deeper deposit.[2] It is not usually economical to haul sand and gravel more than 30 miles from the point of production to a market area because transportation costs are rather high relative to the cost of the material at the point of production.[3]

Amount of Land Affected by Sand and Gravel Production in Iowa

Strip Mining Study Committee questionnaires returned by county assessors are virtually the only source of specific information about the amount of Iowa land affected by sand and gravel production available to the Legislative Research Bureau. Of 82 questionnaires mailed to county assessors, 52 were returned and 29 of these listed one or more operating or abandoned sand and gravel pits. The 29 counties are shown on Table IV.

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[1] Interview with Dr. Hershey, March 15, 1966.

[2] Bauer, op. cit., p. 19.

[3] Interview with Dr. Hershey, March 15, 1966.

TABLE IV - LOCATION OF OPERATING AND ABANDONED SAND AND GRAVEL PITS

County	Acres Operating	Acres Abandoned[a]							
		Total	Idle[b]	Pond	Dump & Junkyear	Recreational[c]	Pasture	Cultivated	Other
Audubon	58	31	31						
Bremer	16	3	3						
Buena Vista	107	122	56	14			52		
Cedar	23	13	13						
Cerro Gordo	117	303	94		209				
Clay	137	24	14	7		3			
Clinton	17								
Dallas	480	100	60	15			25		
Franklin	315	60		60					
Greene	50								
Harrison	33								
Ida	2	37	29	3		5			
Jackson	21								
Johnson	15								
Jones	18	3					3		
Mills	10								
Montgomery	43	12					12		
Page	145								
Palo Alto	186	70	50	5	2	5	8		
Plymouth	70	151	146			5			
Pocahontas	81	306	60		35	17	67	30	97[d]
Sac	789	49	25				24		
Shelby	40								
Sioux	357	225	128	66		10	7	14	
Story	181								
Tama	56								
Union	10	20	20						
Winnebago		12				12			
Woodbury	200	420	60			360			
TOTALS	3577	1961	788	170	246	417	198	44	97

[a]Division of total abandoned sand and gravel pit acreage among various categories of present use is somewhat arbitrary because several questionnaires contained entries such as "pond and waste" or "pasture and water" for a single site. In such cases the total acreage of the site was divided equally between the two categories.

[b]Includes all sites described as timber, brush, or waste.

[c]Specific recreation purposes mentioned include private game refuges, private fishing spots, present or proposed county conservation board parks, swimming pools, a golf course and a private zoo.

[d]A number of small abandoned sand and gravel sites totaling 97 acres were reported by the county assessor who entered a question mark in the space provided for designation of the present use of the sites.

SOURCE: Strip Mining Study Committee Questionnaires completed and returned by county assessors.

Questionnaires returned from 19 counties scattered over the entire State list a total of 1,961 acres of abandoned sand and gravel pits. The Woodbury County assessor listed 420 acres of land occupied by abandoned sand and gravel pits. Cerro Gordo and Pocahontas Counties each reported slightly over 300 acres of abandoned sand and gravel pits, and Sioux County reported 225 acres of such land.

Assessors in 28 counties returned Strip Mining Study Committee questionnaires oisting operating sand and gravel pits occupying a total of 3,577 acres of Iowa land. Operating sand and gravel pits are reported to occupy 789 acres of Sac County land, 480 acres in Dallas County, 357 acres in Sioux County, and 200 acres in Woodbury County.

The U.S.Bureau of Mines reported that sand and gravel was produced in 79 Iowa counties in 1964. The twenty counties which did not report production of any sand or gravel in 1964 are, with the exception of one county, located in the southern half of Iowa. The counties are Adair, Cedar, Clarke, Davis, Decatur, Keokuk, Lee, Louisa, Lucas, Madison, Mills, Monroe, Montgomery, Pocahontas, Poweshiek, Ringgold, Taylor, Union, Washington, and Wayne.[1]

E. - Quarrying of Shale and Clay in Iowa

No estimate of the extent of shale and clay deposits in Iowa is available. The Iowa Geological Survey stated nearly 20 years ago that "many potential (shale and clay) deposits, at or near the surface, are still undeveloped."[2] This statement is still considered valid.[3]

[1] Aase, op. cit., pp. 8-9.

[2] Mineral Resources of Iowa (map).

[3] Interview with Dr. Hershey, March 15, 1966.

Iowa's total 1964 production of shale and clay was 1,008,000 tons and was valued at $1,254,000.[1] Fifty-three percent of the shale and clay produced in Iowa in 1964 was used in manufacturing cement, forty percent went into heavy clay products, and the remainder was used primarily as lightweight aggregate, in mortar mix, and for floor and wall tile.[2] It is believed that all shale and clay production in Iowa is by surface mining.

Techniques of Quarrying Shale and Clay

Most of Iowa's shale and clay quarries are located on hilly land which has little agricultural value.[3] A few quarries in north central Iowa are working clay deposits on level land of good agricultural quality.[4] Shale and clay deposits being quarried in Iowa are generally considerably thicker than the depth of the overburden covering the deposits.[5] In hilly areas, overburden tends to be deepest at the crown of a hill and becomes thinner as the hill slopes downward. Shale outcroppings occur on some hillsides.[6]

It is believed that all Iowa shale and clay quarry operators are presently using scrapers to strip overburden from shale deposits. Overburden stripped from Iowa shale and clay quarries is used to fill nearby gullies or to level the floor of the pit area, and does not create a spoil bank.[7] Because shale and clay deposits tend to

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[1] Aase, op. cit., p. 1.

[2] Ibid., p. 4.

[3] Interview with Dr. Hershey, March 15, 1966.

[4] Interview with Mr. Dale Gilbert, Manager, Redfield Brick and Tile Company, April 6, 1966.

[5] Interview with Dr. Hershey, March 15, 1966.

[6] Interview with Mr. Gilbert, April 6, 1966.

[7] Statement submitted to Advisory Members of the Strip Mining Study Committee by Charles T. Bridgman, advisory member of the Committee representing structural clay products industry, February 10, 1966.

be quite thick and to lie beneath relatively light overburden, quarries opened to work the deposits generally expand in area very slowly and produce little spoil.[1]

The twenty clay products plants in Iowa are reported to have producted 584,100 tons of finished products in 1965, stripping a total of thirteen areas of land to obtain the necessary raw material.[2] One central Iowa clay products firm has operated the same quarry for seventy years, stripping an average of 3,000 square feet of land per year while maintaining an average annual production of 27,000 tons of clay products.[3]

Amount of Land Affected by Quarrying of Shale and Clay in Iowa

Shale and clay production was reported in 1964 from 18 counties, all but one of which lie in the eastern two-thirds of Iowa. The counties are Appanoose, Benton, Boone, Cerro Gordo, Dallas, Floyd, Franklin, Keokuk, Madison, Mahaska, Marion, Polk, Scott, Story, Wapello, Warren, Webster, and Woodbury.[4] However, the Strip Mining Study Committee questionnaire returned from Franklin County was the only completed questionnaire which listed a shale or clay quarry. The quarry reported by Franklin County totals eighty acres in area.

Summary

Coal, gypsum, limestone, sand and gravel, and shale and clay are the principal raw minerals produced by surface mining in

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[1] Interview with Dr. Hershey, March 15, 1966.

[2] Statement submitted by Mr. Bridgman, February 10, 1966.

[3] Interview with Mr. Gilbert, April 6, 1966.

[4] Aase, op. cit., pp. 8-9.

Iowa. Some underground mining of coal, gypsum, and limestone also occurs in the state but most of Iowa's mineral production is by surface mining.

Gypsum is strip mined only in Webster County. Coal strip mining in 1965 was confined to seven southeastern Iowa counties. Shale and clay were quarried in 1964 in eighteen counties scattered through the eastern two-thirds of Iowa. Limestone was quarried in 65 counties in 1964; most of the counties not reporting limestone production in 1964 are in northwestern Iowa. Sand and gravel was produced in 79 counties in 1964; counties which did not report production of sand and gravel in 1964 are, with one exception, in southern Iowa. Davis, Ringgold, and Wayne Counties reported no mineral production of any kind in 1964, according to Federal statistics.

The techniques of surrace mining and the permanent effect of surface mining on land vary according to the mineral involved. Coal and gypsum deposits are relatively shallow and considerable overburden must be removed to expose the deposits, therefore surface mining of these minerals produces sizeable spoil banks. Shale and clay deposits are generally quite deep and lie beneath rather shallow overburden, so that surface mining produces little spoil but leaves a large excavated area. The relative depth of limestone deposits and of overburden covering the deposits varies greatly within the state, and the effects of surface mining of limestone in various areas accordingly. Overburden covering sand and gravel deposits is usually relatively shallow and the depth of the deposits vary considerably; many ꝛ of the deposits are partially xꝛ or entirely below ground water line and pits opened for excavation of such deposits become flooded.

There is presently no source of comprehensive statistics

on the extent and effect of surface mining in Iowa, nor on the degree to which surface mined land has been rehabilitated for other uses after completion of mining operations.