

# Selected Effects of Glacial Till on the Physical Characteristics and Existing Land Use of Indiana's Strip Mined Lands

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## *Abstract*

The paper is a case study of the texture and acidity of glacial till spoil banks as compared to nonglaciaded spoil banks. It also measures land use changes in reclaiming glaciaded and nonglaciaded strip mine areas. Finally, an appeal is made for reclamation plans to better correlate physical capabilities and existing land use of the strip mined lands in Indiana.

## **Introduction**

Surface mining has affected an estimated 3.2 million acres of land in the United States prior to January 1, 1965. Approximately 125,300 acres, or about four percent of the nation's land which has been surface mined, are located in Indiana. Currently thirty-seven coal mining companies are strip mining coal in southwestern Indiana, and in 1966 they disturbed 3,100 acres of land (5). Hoosier coal companies have disturbed about 100,000 acres since 1917 (see Figure 1).

In 1964, only thirty-one percent of the total area disturbed by all surface mining activities in the United States was even partially reclaimed. This is true despite the fact that a myriad of physical and land use changes are caused by surface mining. Unreclaimed surface mining adversely affects virtually all of our major natural resources such as land, water, fish, wildlife, and natural beauty. Therefore, it is necessary to take proper measures to limit the effects of surface mining that have harmful impacts upon the environment.

To help eliminate the effects of surface-mining operations that have harmful impacts, fundamental research should be conducted to provide a better understanding of needed reclamation practices. The last session of the Indiana General Assembly passed an act which requires that a reclamation plan shall be filed and approved by the Natural Resources Commission of the State of Indiana before surface mining can be conducted. The reclamation plan must include land-use objectives, specifications for grading, and the manner and type of revegetation. The law was amended last March in an attempt to improve the aesthetic value of the landscape, and to increase the economic productiveness of Indiana's strip mined areas (1).

## **A Case Study**

This paper is a study of three physical factors which were measured in strip coal mining areas of southwestern Indiana. More specifically, it is a case study of the texture and acidity of twenty-two samples taken on glacial till spoil banks as compared to samples of nonglaciaded spoil banks in twenty-two selected areas of Indiana. Comparisons were also made between existing land use and whether or

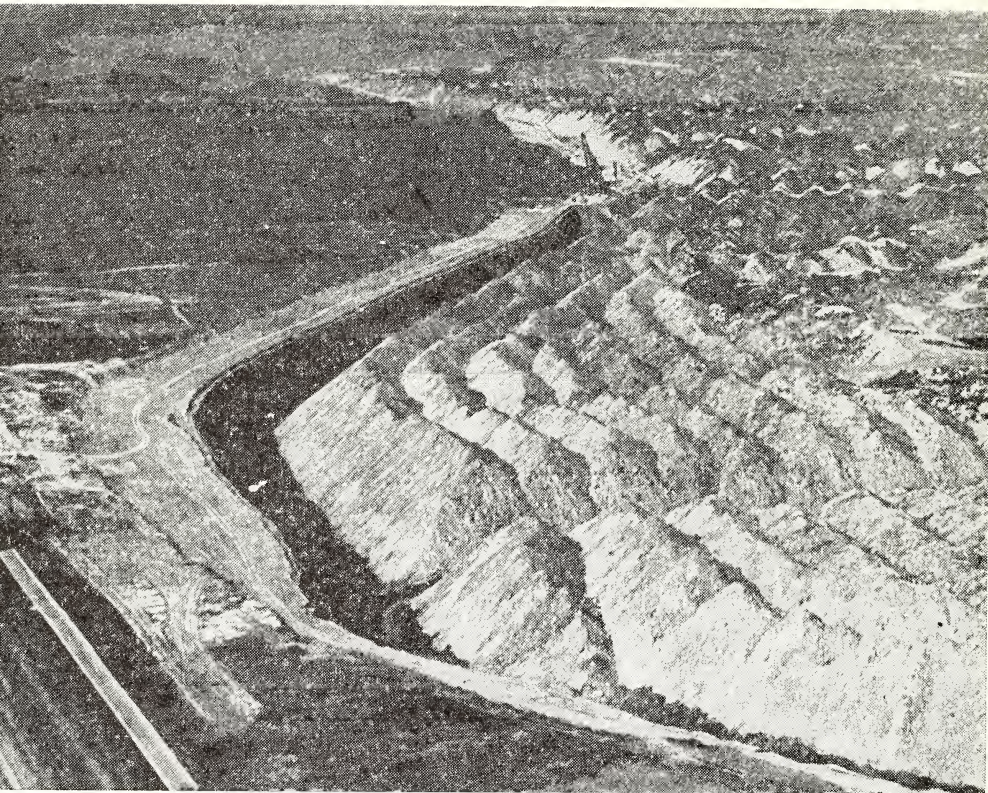


Figure 1.

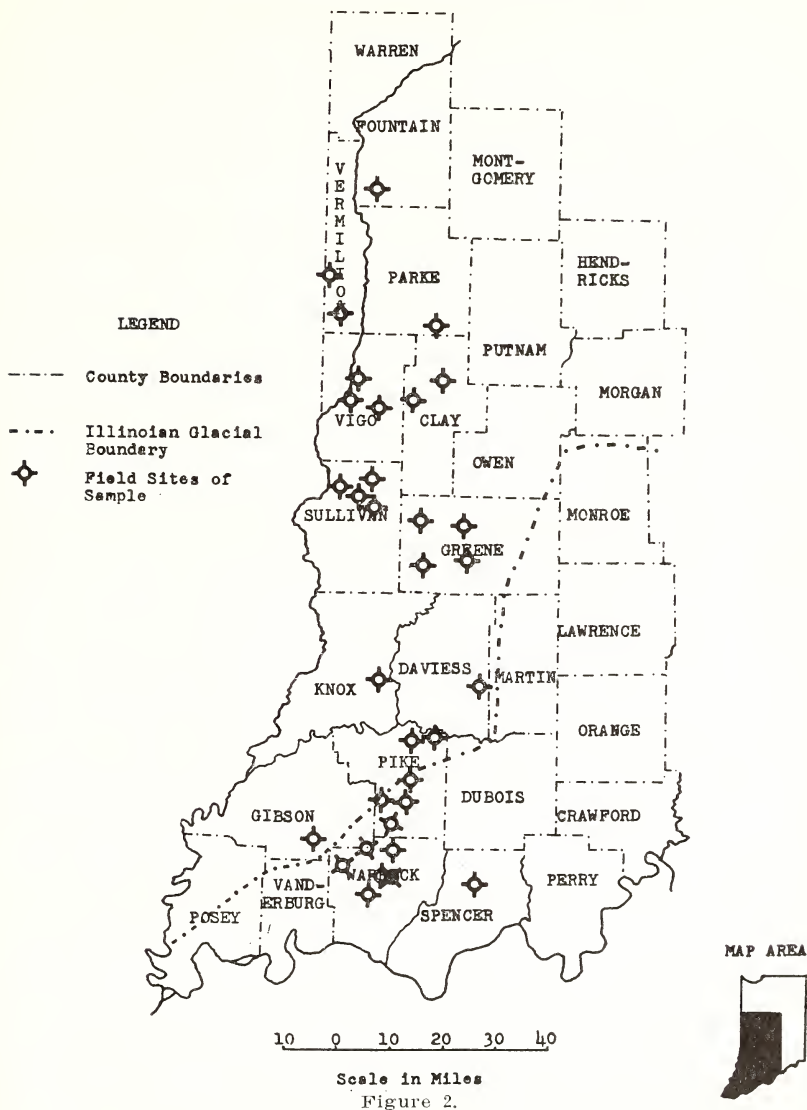
not the overburden and spoil banks contain glacial till deposits (Figure 2).

The tests were all made during early June of 1965 and 1966 in reasonably accessible areas. One half of the samples were collected from areas with overburden containing glacial till and the other half of the samples were from areas located south of the Illinoian glacial boundary.

There are great variations in the procedures used for analyzing spoil materials. Based upon practical time limitations in the field and a mosaic of physical contrasts that exist within the strip-mined areas, a random sampling survey was adopted for this study without regard to age, drainage, slope, or other variables. The tests were conducted as on-site examinations using a balance scales, a two mm screen, and a pH meter.

It was assumed that glacial till in the overburden improves both the texture and pH of the spoil banks, but the study was an attempt to correlate more exactly the relationships among those factors. The two physical variables of texture and pH were selected because of their overriding importance in reclaiming Indiana's strip mined lands.

## SITE OF SAMPLE AREAS



The texture of the spoil is the major factor in affecting the degree of aeration and permeability of the spoil material, and the amount of moisture that spoil material will make available to revegetated plants. The percentage of fine-textured materials (e.g., the percentage of soil-sized particles of less than two millimeters in diameter) was used as a variable for it is generally accepted that most plant nutrients and

humus can be rebuilt more readily in spoil banks which are high in fine-textured materials.

There was a seventy percent positive relationship between the percentage of fine-textured materials in the spoil and the percentage of glacial till in the overburden. These twenty-two samples showed that deposits of glacial till are highly beneficial in the revegetation of Indiana's strip mined lands since increased quantities of fine-textured materials will increase the survival rate and plant growth. In contrast, where excessive stoniness exists, the possibility of obtaining a ground cover is hampered by the rapid run-off and lack of soil.

The acidity of spoils is also of major importance in affecting the survival and growth of plants. Strip mined lands which have a pH of 4.0 or less are lethal to most plants. Acid-tolerant plants can grow in pH areas of 4.0 to 5.5 and most plants can grow in spoils with a pH between 5.5 and 8.0. The twenty-two samples taken during the survey indicated that the spoil material had a pH between 4.5 and 6.7 with a mean value of 5.6 for the glacial till. The mean value for the non-glaciated samples was 4.7 with the range from 3.0 to 6.1. The correlations showed an eighty-four percent positive relationship between the pH of the spoil and the percentage of glacial till in the overburden (Tables 1 and 2).

About thirty percent of the land which has been strip mined for coal was located in areas which have not been glaciated. However, sixty-five percent of the 1965 strip mine coal tonnage was produced in non-glaciated areas of Indiana (4). It is projected that the counties which will have the greatest increase in coal production will be Daviess, Gibson, Knox, Pike, Spencer and Warrick (2). The problems of reclaiming acidic spoil banks with small quantities of soil-sized particles will, therefore, become more widespread. But, on the other hand, only about one-third (17,491 acres) of these counties were in cropland before strip mining occurred. The detrimental impacts of the strip mining process are less severe than in the areas of glacial till even though about 18,000 acres of idle spoil banks are still unreclaimed in Indiana's nonglaciated counties (3).

Surface mining has created opportunities to develop recreational areas. This is because water collects in about 15 percent of the strip mined area in the form of small ponds between ridges with crests fifty or more feet high that are located from fifty to one hundred feet apart. In addition, the last box cut lake is normally several acres in size and has water depths which vary from thirty to sixty or more feet. About 70 percent or 14,000 acres of the approximate 18,000 acres of strip mined lands used primarily as water-oriented outdoor recreation facilities are located in the areas of glacial till and only about thirty percent of the recreation land is south of the glacial boundary.

### Conclusions

This case study has shown (1) a high positive relationship to exist between the pH of spoil banks and the percentage of glacial till in the overburden; (2) a high positive relationship also exists between the

TABLE 1. Glacial Till Samples

| Sample No.              | Percent of Glacial Till | pH  | Percent Fines |
|-------------------------|-------------------------|-----|---------------|
| 1                       | 67.6                    | 7.3 | 60.0          |
| 2                       | 55.0                    | 6.9 | 64.3          |
| 3                       | 62.7                    | 7.1 | 62.8          |
| 4                       | 63.0                    | 7.3 | 71.0          |
| 5                       | 13.0                    | 4.5 | 40.0          |
| 6                       | 17.0                    | 3.8 | 38.0          |
| 7                       | 9.0                     | 5.7 | 35.0          |
| 8                       | 5.0                     | 4.0 | 25.0          |
| 9                       | 16.0                    | 4.9 | 31.0          |
| 10                      | 5.0                     | 4.4 | 32.0          |
| 11                      | 15.5                    | 5.1 | 35.0          |
| 12                      | 16.0                    | 5.0 | 36.0          |
| 13                      | 6.2                     | 4.3 | 50.0          |
| 14                      | 4.0                     | 5.0 | 35.0          |
| 15                      | 6.0                     | 5.0 | 33.0          |
| 16                      | 18.0                    | 5.1 | 36.0          |
| 17                      | 16.0                    | 5.0 | 31.0          |
| 18                      | 7.7                     | 6.3 | 43.0          |
| 19                      | 36.5                    | 6.7 | 60.0          |
| 20                      | 8.0                     | 6.3 | 41.0          |
| 21                      | 36.0                    | 6.7 | 49.0          |
| 22                      | 15.5                    | 6.0 | 39.0          |
| Average or glacial area | 22.7                    | 5.6 | 43.05         |

percentage of fine-textured materials and glacial till; and (3) a definite improvement in the quality and intensity in the land use of reclaimed strip mined lands with the presence of glacial till in the overburden.

On the other hand, it must be remembered that the detrimental effects of strip coal mining are more severe in areas of glacial deposition since most of the area disturbed was in cropland prior to strip mining. In addition, the percentages of fine-textured materials in the glaciated areas are often strikingly reduced by mining methods which deeply bury the glacial till below the bedrock. Often acidic materials are left on the surface from the bedrock which originally lie directly above the coal seam.

Reclamation should be considered by the mining companies as an integral part of strip coal mining. It has been demonstrated that when reclamation of strip mined lands is integrated into both pre-planning and operation stages, it can be done more effectively and at a lower cost than as a separate operation. This is true because machinery used

TABLE 2. Nonglaciati ed Area Samples

| Sample No.                  | Percent of Glacial Till | pH  | Percent Fines |
|-----------------------------|-------------------------|-----|---------------|
| 1                           | 0.0                     | 3.0 | 31.0          |
| 2                           | 0.0                     | 3.6 | 22.0          |
| 3                           | 0.0                     | 3.6 | 22.0          |
| 4                           | 0.0                     | 4.1 | 30.0          |
| 5                           | 0.0                     | 4.9 | 23.0          |
| 6                           | 0.0                     | 5.0 | 22.0          |
| 7                           | 0.0                     | 5.4 | 28.0          |
| 8                           | 0.0                     | 4.2 | 50.0          |
| 9                           | 0.0                     | 5.0 | 48.5          |
| 10                          | 0.0                     | 5.4 | 2.1           |
| 11                          | 0.0                     | 4.2 | 23.0          |
| 12                          | 0.0                     | 5.0 | 43.7          |
| 13                          | 0.0                     | 4.5 | 35.0          |
| 14                          | 0.0                     | 5.6 | 34.0          |
| 15                          | 0.0                     | 6.1 | 31.0          |
| 16                          | 0.0                     | 4.9 | 17.0          |
| 17                          | 0.0                     | 5.6 | 35.0          |
| 18                          | 0.0                     | 5.1 | 20.0          |
| 19                          | 0.0                     | 4.7 | 20.0          |
| 20                          | 0.0                     | 5.0 | 22.0          |
| 21                          | 0.0                     | 5.1 | 22.0          |
| 22                          | 0.0                     | 4.7 | 27.0          |
| Average for nonglacial area | 0.0                     | 4.7 | 27.7          |

in mining can also be used in striking off the peaks, segregating toxic materials, and establishing proper drainage.

Currently, most strip mined lands are reclaimed without an overall understanding of the physical characteristics of the glacial surface features. A detailed regional reclamation plan as now required before strip coal mining can take place in Indiana should be helpful in obtaining a better correlation between physical capabilities and existing use of the strip mined lands. Whether or not a more conforming relationship will be followed by Indiana strip coal mining companies only time will tell. At any rate, it is important that accurate data are made available on the physical characteristics of the spoil material to comply with the intent of the amended law for strip mine reclamation. These data should be included before the reclamation plan is approved by the Indiana Department of Natural Resources. Since the welfare of the people of Indiana is at stake, it is up to us to see that an accurate

reclamation plan improves the aesthetic value of the landscape and increases the economic productivity of the reclaimed strip mined lands.

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