LAND-USE PROBLEMS IN ILLINOIS

Papers from a Symposium at the 137th Meeting of the American Association for the Advancement of Science, Chicago, December 26-31, 1970.

Arranged by Robert E. Bergstrom
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A sixth paper, "Waste Disposal and the Use of Land," by John R. Sheaffer, University of Chicago, was presented at the Symposium but was not available for publication at the time Environmental Geology Note 46 went to press.
LAND-USE PROBLEMS IN ILLINOIS—AN INTRODUCTION*

Robert E. Bergstrom

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I am pleased to welcome you to our Symposium this afternoon and to note that we have a significant number of ladies in our audience. We are fortunate in having a panel of speakers, well known in their fields, who are eminently qualified to discuss their subjects.

We shall use Illinois to illustrate several of our more pressing land-use problems and their relation to the environment. The problems are not unique to Illinois, nor are they new. Indeed, some of them have a long history.

Land-use problems have had a strong impact on our cultural heritage. Consider how literature, movies, and television have made use of the land-use conflict. They depict the traditional strife between cattle rancher and sheep herder, between rancher and homestead-farmer, and between Indians and advancing settlers and railroads. Modern land-use conflicts no longer provoke a rattle of gunfire, as a rule, but they create sociological, economic, technological, and emotional problems that are some of our thorniest concerns today.

Concern about the degradation of our environment heightens land-use conflict. In some cases a particular land use does not merely annoy a neighborhood but alarms large segments of the public.

Many of the present land-use problems are focused in and around the city, where concentrations of people increase the need for services, goods, energy, fuel, and more land, and where wastes are created at an astonishing rate. Aside from these demands, urban dwellers want adequate places for recreation, and, because they are highly mobile, they can penetrate to the farthest reaches of our open lands.

The open land areas away from the cities, where land is used for farming, forestry, and mining, are not immune from the problem. The expanding population needs more food, but environmentalists want less chemical fertilizer and pesticide used in growing foodstuffs. The population wants more fuels and energy, but environmentalists oppose disruption of the land by mining and proliferation of power generating stations.

* Includes excerpts from article by author that appeared in September 4, 1970, issue of "Science."
Illinois provides an appropriate setting for illustrating these problems. It is an agricultural as well as a manufacturing state; it has a substantial mining industry; its downstate prairies create some special problems in the development of water resources; and it contains the metropolitan giant of Chicago situated beside one of our greatest fresh water resources, Lake Michigan. Furthermore, there has been widespread public dissatisfaction with the condition of its environment, with the result that, this year, the functions of several previously existing state agencies were combined and a new Environmental Protection Agency and a full-time Pollution Control Board were created.

Our speakers today will examine agriculture and its relation to the environment, the expanding city, a multiple-purpose reservoir conflict, solid wastes in relation to pollution and the use of land, and reclamation of land that has been surface mined. I trust you will leave here today with a clearer understanding of the ramifications of these problems and also with an inkling of what progress we are making in their solution.
IMPLICATIONS OF CROP-PRODUCTION TECHNOLOGY FOR ENVIRONMENTAL QUALITY

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Ecologists and agronomists have totally different perceptions of the impact of agricultural technology on the environment. This is unfortunate because scientists in both disciplines are equally dedicated to the welfare of society. They simply have not been listening to each other.

It appears that ecologists commonly perceive agriculture, including agricultural scientists, as being interested mainly in high yields and efficient production but having little understanding of, or concern for, the effects of technology on the ecosystem.

Agricultural scientists generally perceive themselves to be deeply concerned with environmental effects but feel that ecologists are not familiar with either agricultural practices or with the impractical nature and potentially disastrous effects of some solutions that nonagriculturists suggest.

Agriculture has had a tremendous impact on the environment. The basic purpose of agriculture is to manage part of the environment in order to produce the food and fiber needs of mankind. Agriculture in the United States has been eminently successful in meeting these needs of society. But society is now asking all segments, including agriculture, to reassess their roles in environmental quality.

In this paper Illinois is used as a model to examine some effects of technology on the environment, but the principles will apply to all parts of the United States.

ECOLOGICAL MILESTONES RELATED TO FARMING

About 60 percent of the land surface of Illinois is in harvested cropland. Except for small areas cultivated by the Indians, the nearly 21 million acres that are now producing crops were native, tall-grass prairie or forest at the time the early settlers arrived (Fehrenbacher et al., 1967). Soil

* Member of Illinois Pollution Control Board.
building and soil depleting processes were proceeding simultaneously. Soil building processes included the slow accumulation of organic matter, nitrogen, and phosphorus, and improvement in structure of the surface soil. Leaching of base elements—potassium, calcium, and magnesium—accompanied by an increase in acidity, was soil depleting with respect to the growth of higher plants.

The major intrusion of man into a slowly evolving but relatively stable ecosystem began with the cutting of forests about 1800 in Illinois, though hunting, fishing, and trapping began much earlier. The early settlers first cleared and farmed the forested land, which generally occupied the steeper slopes, because they needed the forest products and because they did not have plows suited to turning the prairie sod. Furthermore, the prairie was too wet to farm in some areas.

Pioneer farming undoubtedly resulted in greatly accelerated erosion, stream siltation, and enrichment of streams with both plant nutrients and organic matter, which for decomposition had a substantial oxygen requirement.

The second major change caused by agriculture was the plowing of the prairies. Plowing caused three gross effects on the environment: 1) consumptive use of native soil fertility; 2) accelerated erosion and sediment pollution because soils were unprotected for considerable periods; 3) reduction in the runoff of soluble organic phosphates, especially during the winter when soils were frozen and in early spring when rainfall greatly exceeded infiltration capacity. Less phosphate ran off because plant residues were incorporated into the soil rather than left on the surface as they were in the virgin condition.

Tillage of both forest and prairie soils greatly accelerated the oxidation of humus and fresh plant residues within the plow layer. This released nutrients for utilization by crops and for possible movement into surface and ground water. It also hastened the rate of decline in soil productivity owing to deterioration in soil structure and tilth.

Another milestone in agriculture technology was the great increase in livestock, including both those needed for food and clothing and those for power to do farm work. The total animal units* in the year 1867 was 2.4 million, likely a great increase over the native population of buffalo, deer, and other animals. But because the wastes from domestic livestock were widely scattered over the landscape and because the plant nutrients contained therein were derived solely from crops grown locally, the increase in nutrients contributed to surface water was small. The recent trend toward confinement production of livestock in large units has drastically altered the situation but is not a topic for discussion in this paper.

Between 1890 and 1915 artificial drainage was installed on nearly 15 percent of the Illinois land area. The primary purpose of drainage was to facilitate timely plowing, planting, cultivating, and harvesting. From an environmental point of view, the effect was to accelerate greatly the oxidation of the soil organic matter and humus, thus releasing large amounts of nitrogen and phosphorus. The consequences of this have already been described.

* Cattle, horses, mules—1 animal = 1 unit; sheep—10 animals = 1 unit; hogs—8 animals = 1 unit. Poultry was not tabulated.
The next major change in crop production technology was the shift from horse and mule power to mechanical power. From 1910 to 1960 more than 1 million horses and mules were displaced in Illinois. Undesirable effects on the environment of this change were: a) increases in unburned hydrocarbons, carbon monoxide, and nitrogen oxides emitted into the air from burning fossil fuels; b) consumption of resources and pollution associated with manufacturing the power units and the required fuel, and c) problems of disposing of obsolete machines.

But the shift to mechanical power resulted in less animal wastes, less demand on fertility nutrients to produce feed, and less erosion and sediment pollution associated with feed production. Horse and mule power required feed and generated pollutants 8760 hours per year, whereas the average tractor is operated only 500 hours per year. On balance it seems likely that the shift from animal power to mechanical power reduced the undesirable effects on the environment.

EFFECTS OF SELECTED MODERN CROP PRODUCTION TECHNOLOGIES

All crop production technologies relate directly or indirectly to environmental quality. The main components of crop production technology are cropping systems, varieties, fertilization, tillage, plant residue management, pest control, and harvesting. As an example of technology, some effects of fertilization will be examined here. Tillage and residue management will be discussed briefly in association with fertilizer effects. Pesticides, of course, have important effects, but the authors are not qualified to discuss them.

Nitrogen and phosphorus fertilizers deserve special attention because they have been implicated in eutrophication, and, in addition, nitrogen is a potential source of unwanted nitrates in drinking water.

Nitrogen

A substantial amount of information from research is available on the chemical form of nitrogen and on time and rate of application, and it is now used by farmers as a guide to efficient utilization of applied nitrogen. The cost of nitrogen relative to the value of additional crop produced is such that Mid-west farmers are inclined to apply nitrogen nearly to the top of the yield response curve (fig. 1). The dilemma resulting therefrom is that, although society benefits from low-cost food, the potential for nitrate addition to ground and surface water is increased. Nitrogen from fertilizer or other sources that is not found in the harvested grain may be in several places in the ecosystem:

1) In leaves, stems, or roots of the crop.
2) In the soil as NO₃ (fig. 2) or attached as NH₄ to exchange sites on clay and organic matter.
3) Immobilized in microbial tissue resulting from decay of plant residues.
Fig. 1 - Response of corn to nitrogen in four experiments in central Illinois, 1969.

Fig. 2 - Nitrate distribution in a Missouri soil following seven annual applications of three rates of nitrogen. (From Smith, 1968.)

Fig. 3 - Nitrate concentration in four rivers in or bordering Illinois. (From Harmeson and Larson, 1957, 1969.)
4) Returned to the atmosphere as $\text{N}_2$ or a nitrogen oxide following denitrification and volatilization.
5) In surface or ground water as the result of leaching or surface runoff.

Of these possible fates of nitrogen, only the last one, if excessive, is ecologically undesirable.

The extent to which nitrates in water are increased by well planned fertilizer and crop-production programs is still to be determined.

The potential for nitrate contribution to surface and ground water is greatest near the upper end of the yield response curve (fig. 1). Successive increments of nitrogen are recovered less efficiently in the grain. At the point of maximum yield, the recovery of additional applied nitrogen is nil. Olsen (1969) in Wisconsin and Smith (1968) in Missouri found little buildup of nitrate in the subsoil (fig. 2) from three to seven annual applications of 100 pounds of nitrogen but large accumulations from 300 pounds.

The average annual application of fertilizer nitrogen for corn in Illinois in 1970 was 116 pounds per acre. But since corn occupied only 40 percent of the cropland and relatively small amounts of nitrogen were applied for other crops, the average application per acre per year for all cropland was less than 60 pounds. This was, of course, augmented on some fields by nitrogen derived from animal manure and/or a preceding legume crop. On the average, nitrogen rates are not excessive, though there are exceptions on individual fields. Data collected by Harmeson and Larson (1957, 1969) from several rivers in and around Illinois indicate no close relationship between nitrate concentration and nitrogen fertilizer tonnage (fig. 3).

Except for 1965, nitrate has not increased in the lower Kaskaskia River at New Athens since 1946. Nitrates 100 miles upstream at Shelbyville, on the other hand, not only increased abruptly in 1965 but remained around the 1965 level through 1969, though fertilizer nitrogen in the watershed nearly doubled in this 5-year period. This river was the subject of an unfortunate error which is widely scattered through environmental literature concerning the nitrate status of Illinois rivers. At the AAAS meeting two years ago, Commoner (1968) stated, "It is evident that the nitrate level of the Kaskaskia River has increased threefold between 1946-1950 and 1956-1968." This erroneous conclusion was based upon the use of data from the New Athens location in the first period but from Shelbyville in the latter period.

Nitrate concentrations in the Illinois and Wabash Rivers are highly variable but appear to be increasing somewhat. Nitrate in the Mississippi River increased between 1956 and 1960, when little nitrogen fertilizer was used in the watershed, but showed no trend from 1960 to 1969 when nitrogen fertilizer use increased from 308,000 tons to 2,100,000 tons annually.

The Illinois, Kaskaskia, Mississippi, and Wabash are the only rivers in or around Illinois for which long-term records are available. Five-year records for several smaller rivers reveal some cases of sharp increases and some of decreases. The averages for sixteen streams were: 1962 - 7.7, 1963 - 7.3, 1964 - 8.1, 1965 - 9.4, and 1966 - 9.5 mg/1 $\text{NO}_3$. 
Fertilizer is one of the four most likely sources of increased nitrates in water, the others being urban sewage (modern sewage treatment converts more of the organic nitrogen to nitrate), livestock wastes, and nitrogen oxides from internal combustion engines. The relative contributions of each need to be determined. Commoner's research group at Washington University, St. Louis (personal communication), proposes the use of relative abundance of $^{15}\text{N}$ and $^{14}\text{N}$ in fertilizer, soil humus, and drainage water as a means of identifying the specific source of nitrates. The method is based on the knowledge that the ratio of $^{15}\text{N}$ to $^{14}\text{N}$ is about .3666 in the air but is somewhat more in the soil. On the basis of this knowledge, it may be possible to approximate the relative amounts of nitrates in water that are derived from fertilizer ($^{15}\text{N}/^{14}\text{N} = .3666$) and from mineralization of soil humus ($^{15}\text{N}/^{14}\text{N}$ greater than .3666). This may be a promising research tool, but it does not help to answer the practical question of the effect of fertilizer nitrogen per se as distinguished from the effect associated with yield level but irrespective of source.

There is little if any reason to believe that the amount of nitrate that gets into surface or ground water per unit of crop produced would be less if the nitrogen were supplied by sources other than nitrogen fertilizer. All major food crops except rice use mainly nitrate nitrogen. The total amount of nitrate nitrogen that must be available in the soil during the growing season is, therefore, approximately the same regardless of source.

There is a common misimpression that fertilizer nitrogen affects the environment differently than nitrogen from other sources. Nitrate ions derived from fertilizer are neither more nor less subject to leaching than nitrate ions from other sources. Nitrates (except for a small amount in some fertilizers) result from the nitrification of ammonium (NH$_4$) whether the source is plant residues, animal waste, soil humus, or fertilizer.

Some biologists have suggested that nitrogen from the decay of organic matter is used more efficiently and is thus less subject to leaching than fertilizer nitrogen because the rate of release is somewhat correlated with the rate of need of the growing crop, whereas the nitrogen in fertilizer is all available at one time. This concept is of questionable validity because at least 90 percent of all fertilizer nitrogen is in the ammonium form or soon converts to ammonium following application to the soil and, until it is oxidized, is not leachable because the NH$_4$ ion attaches to the negatively charged clay and organic matter (NO$_3$, being negatively charged, is not held by the cation exchange mechanism). Besides, fertilizer nitrogen can be, and often is, supplied to the crop immediately prior to the period of greatest plant uptake.

No control is possible over the time when nitrate nitrogen is release from decaying residues. It occurs whenever the temperature is suitable. Nitrate resulting from the decay of residues in the early fall is far more likely to reach ground water and tile drains than nitrate from anhydrous ammonia or salts that are applied in the late fall, spring, or as a side dressing to the growing crop.

The impact of fertilizer nitrogen is due not to its chemical makeup but rather to the fact that it increases the total amount that is available for crop production and for redistribution through soil and water.
A compelling reason for using nitrogen fertilizer, from an ecological point of view, is to maintain the productive capacity of the soil for future generations. Nitrogen is the key to maintaining organic matter in intensively farmed soils. This is because there is always an abundance of carbon in plant residues that are returned to the soil, but supplemental nitrogen is needed for a suitable C/N balance and to increase the amount of humus produced upon decomposition.

If the organic matter content of the soil is allowed to continue to decline for lack of adequate supplies of nitrogen, as it has during the past 100 to 200 years (fig. 4), the water infiltration capacity of the soils will decline. Future generations will then have increasing difficulty not only with adequate production of food but also with floods, erosion, and sediment pollution.

There is at the present time no feasible way to reverse the decline in soil organic matter without adequate nitrogen fertilizer. Composting residues is not a solution because the return of most crop residues to the soil is already standard practice.

A small proportion of farmers are applying excessive rates of nitrogen. In the future, nitrogen rates can and should be geared more closely to efficient utilization by crops. Crop yields on many acres can be improved by increases in nitrogen, but the upward trend for the most heavily fertilized fields will slow significantly in the immediate future. It appears highly probable that the amounts of nitrogen applied by the most progressive farmers will be increased only when breakthroughs in technology raise yield potentials so that crops can efficiently utilize the additional nitrogen.

Phosphorus

Phosphorus applications have been raised to unrealistically high levels in many Illinois fields. Extensive research indicates little likelihood of a profitable response when the Bray P-1 soil test is above 50, yet 41 percent of the fields in a representative sampling in Illinois in 1967-1969 (table 1) tested above 50, and 16 percent tested above 100.

<table>
<thead>
<tr>
<th>P-1 test</th>
<th>Rating</th>
<th>Percentage of fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 20</td>
<td>Very low</td>
<td>15</td>
</tr>
<tr>
<td>21 - 50</td>
<td>Low optimum</td>
<td>44</td>
</tr>
<tr>
<td>51 - 100</td>
<td>Optimum to excessive</td>
<td>25</td>
</tr>
<tr>
<td>Above 100</td>
<td>Unrealistically high</td>
<td>16</td>
</tr>
</tbody>
</table>

It appears that many farmers either did not know what their tests were or were unfamiliar with agronomic research showing that they had exceeded the most profitable point.
Phosphorus attached to soil sediment equilibrates with phosphorus in solution in lakes and streams. Phosphorus-rich sediment produces a high phosphorus solution, whereas low-phosphorus sediment may actually extract phosphorus from the water. Phosphorus fertilizer applications in the future can be reduced on many fields, though it should be increased on others (table 1).

Phosphorus is an extremely immobile nutrient in the soil, hence very little leaches out in drainage water (table 2).

Most of the phosphorus that reaches surface waters from cropped field is attached to soil sediment. Hence reducing erosion, especially from phosphorus-rich fields, effectively reduces phosphorus in water.
TABLE 2—SEVEN-YEAR AVERAGE ANNUAL LOSS OF PHOSPHORUS FROM FILLED LYSIMETERS
(Kurtz (1970) from unpublished data from S. W. Melsted)

<table>
<thead>
<tr>
<th>P added in fertilizer (lb/acre)</th>
<th>P lost in drainage water (lb/acre/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cropped</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0.04</td>
</tr>
<tr>
<td>20</td>
<td>0.03</td>
</tr>
<tr>
<td>415</td>
<td>0.04</td>
</tr>
<tr>
<td>Uncropped</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>0.05, 0.06</td>
</tr>
</tbody>
</table>

There are several techniques for reducing phosphorus input to water from erosion. These include strip-cropping, terracing, contour farming, and growing relatively less cultivated crops.

Chiseling, zero-tillage, and other systems that reduce erosion by leaving residues on the surface have been suggested to reduce phosphorus inputs to surface water. Though such systems do indeed reduce soil loss, they may not appreciably reduce phosphorus input to water for two reasons:

1) The fertilizer phosphorus is concentrated in the surface 1 to 2 inches of soil rather than being mixed through 6 to 10 inches, hence the reduction in soil loss may be more than offset by the fact that the sediment is very high in phosphorus.

2) When plant residues decay on the soil surface, the resulting soluble organic phosphorus compounds are readily carried into streams and lakes, especially when the soil is frozen.

Holt et al. (1970), for example, found that soluble phosphorus in run-off from alfalfa was 3.5 times that from continuous corn crops. His research showed the loss of phosphorus in solution combined with loss of phosphorus attached to sediment on a 6 percent slope planted in continuous corn was slightly greater, 0.16 lb P per acre per year, than loss from a corn-oats-meadow system, which lost 0.13 lb per acre. But the amount of phosphorus lost per unit of net energy of feed produced was slightly less in a continuous corn system than in a system of corn-oats-hay because the corn produced a higher yield.

The introduction of large amounts of plant nutrients in commercial fertilizers (fig. 5) had profound effects on agriculture. Most persons who evaluate the impact of fertilizers focus only on the great increases in yield and the potential for nutrient enrichment and consequent accelerated eutrophication.
of surface waters. The most significant effects of fertilizers on the environment have generally been overlooked:

1) The deterioration in soil fertility, which had proceeded inexorably from the first farming attempts of the settlers until about 1940, can now be arrested and in some cases reversed (fig. 4).

2) Abundant nitrogen fertilizer has provided farmers with increased flexibility in cropping patterns. Corn can be grown intensively on level, nonerosive soils. Cropping systems that include more hay and pasture are grown on sloping fields. If legumes were the sole source of nitrogen, similar cropping systems would be required on all soils, resulting in greater erosion on sloping fields. Furthermore, this change in cropping systems would eliminate the production of feed grains for sale to grain-deficit areas in the eastern United States and to foreign countries.

3) Higher acre yields reduce the acres needed for food production; hence agriculture can be concentrated on the soils that are least erosive, thus reducing floods and sediment pollution with its associated burden of phosphorus, nitrogen, organic matter, and absorbed pesticides.

The Morrow Plots on the campus of the University of Illinois are the best long-term tests on the North American continent of the extent to which crop production technology can reduce the acres needed to produce food. Relative changes in land required from 1886 to 1970 under two cropping systems and with different fertility treatments are shown in figures 6 and 7.

The experiments began in 1876, and it can be safely assumed that yields of the untreated plots had already declined considerably by 1886 when records became available. On plots that did not receive fertility treatments, acres required remained high in the corn-oats-clover system throughout the entire period in spite of the utilization of improved varieties and other cultural practices in recent years. The continuous corn plot has shown great improvement (less area required since 1950) as a result of better hybrids, optimum plant population, and early planting, but in the most recent period it still required three times as much land for equivalent yield as the fully treated plot.

Plots that received manure, lime, and phosphorus began to show the impact of improved technology in the late 1930's. Additional lime, nitrogen, phosphorus, and potassium introduced in 1954 dramatically increased yields and reduced the relative area required to produce net energy. The effect of this is to reduce greatly the undesirable effects of food production on the environment.

Continuous corn has been about 30 percent more efficient than a mixed cropping system in producing usable net energy on this deep, dark, level loess soil since 1954 when adequate nitrogen was added to the system.
Aggregate Effects of Crop Production Technology

The undesirable effects of excess plant nutrients in water and the injury to nontarget species by certain insecticides are real problems, but, as they have been widely publicized, they are not re-examined here. The enormous benefits to crop production from the application of science and technology have not been afforded similar acclaim, however.

From 1867, when the Illinois Department of Agriculture began to keep records, until the mid-1930's, improvements in crop production technology were approximately offset by declining soil productivity (fig. 4). Beginning about 1940, the results of research and education triggered changes in crop production that have had pervasive effects on the environment. Corn yields in Illinois reveal the aggregate effect of improved technology (fig. 8). Preoccupation with yield increases per se has obscured these important basic results:

1) Less pollution by sediments, associated phosphorus, organic matter, and pesticides because fewer acres are required. (Previously discussed under fertilizer effects and illustrated in figure 6.)
2) Capability to produce the quantity of food needed by a growing population at a decreasing percentage of the consumer's disposable income.
3) More acres left for wildlife habitat, forest, and recreational uses.

POSSIBLE CHANGES IN USE OF LAND RESOURCES

Recent restrictions on the use of certain production technologies—for example, chlorinated hydrocarbon insecticides and 2,4,5-T herbicides—and attacks on fertilizer use make it appropriate to examine in greater detail the possibilities for and consequences of producing crops with less use of available technology.

The utilization of land in Illinois is shown in table 3. More than two-thirds is in cropland, of which nearly three-fourths is in row crops. Is there land that could be (a) transferred from present nonagricultural use or (b) upgraded from relatively low to more highly productive use?

In order to answer this question, land capability classes and subclasses were used to aggregate land-use data of the 1967 Illinois Conservation Needs Inventory (Illinois Conservation Needs Committee, 1970). Soil mapping units, which are cartographical areas that are delineated on detailed soil maps, were grouped into land capability classes and subclasses.

The land capability classification is a grouping of soils into categories on the basis of potential and limitations for cultivated crops, pasture, and trees. The capability unit, class, and subclass are the categories of the system (Klingebiel and Montgomery, 1966).
Fig. 6 - Relative areas required to produce a constant amount of net energy in continuous corn system with various fertility treatments at the Morrow Plots, Urbana, Illinois. Six-year averages, 1886-1890 = 100.

Fig. 7 - Relative areas required to produce a constant amount of net energy in a corn-oats-clover system with various fertility treatments at the Morrow Plots, Urbana, Illinois. Six-year averages, 1886-1890 = 100.

Fig. 8 - Corn yields in Illinois. (From Illinois Crop Report Service.)
TABLE 3—ILLINOIS ACREAGES (1967) IN VARIOUS LAND-USE CATEGORIES (From 1967 Illinois Soil and Water Conservation Needs Inventory)

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>State total</td>
<td>35,765,625</td>
</tr>
<tr>
<td>Land not in conservation needs inventory (urban areas, highways, small water areas, etc.)</td>
<td>2,951,858</td>
</tr>
<tr>
<td>Land in conservation needs inventory</td>
<td>32,813,767</td>
</tr>
<tr>
<td>A. Cropland</td>
<td></td>
</tr>
<tr>
<td>Row crops</td>
<td>17,587,293</td>
</tr>
<tr>
<td>Close-grown field crops</td>
<td>2,380,002</td>
</tr>
<tr>
<td>Rotation hay and pasture</td>
<td>2,057,880</td>
</tr>
<tr>
<td>Hayland</td>
<td>266,407</td>
</tr>
<tr>
<td>Conservation use only</td>
<td>1,536,757</td>
</tr>
<tr>
<td>Temporarily idle cropland</td>
<td>272,116</td>
</tr>
<tr>
<td>Orchards and vineyards</td>
<td>36,468</td>
</tr>
<tr>
<td>Open land formerly cropped</td>
<td>224,077</td>
</tr>
<tr>
<td>B. Pasture and range</td>
<td>3,345,493</td>
</tr>
<tr>
<td>C. Forest</td>
<td>3,584,772</td>
</tr>
<tr>
<td>D. Other land</td>
<td>1,522,502</td>
</tr>
</tbody>
</table>

The capability unit is a group of individual soil mapping units that have similar potentials, limitations, and hazards for a particular agricultural land use and require similar management. Capability units are not shown in our land-use summaries.

The capability classes are groups of subclasses or capability units that have the same degree of hazard or limitations. Eight capability classes are designated I through VIII. The limitations in use and risks of soil damage increase progressively from Class I (lowest risk and fewest limitations) to Class VIII (greatest risk and most limitations). Land in Classes I through IV is generally suited for intensively farmed cropland, whereas land in Classes V through VIII is regarded as noncropland and suited only for pasture, trees, or wildlife.

The capability subclasses are groups of capability units that have the same major conservation problem or limitation, such as erosion and runoff (e), excess water or wetness (w), shallow, drouthy, or stony (s), or climatic (c) limitations. The subclass is designated by the lower case letter—e, w, s, c—following the class number.

Land use in Illinois according to land capability class or subclass is given in table 4. About 1.9 million acres in conservation use, temporarily idle, and open land (second column from right in item 3 in table 4) is suitable for cropland and could readily be brought into production. That is an increase of less than 10 percent over present harvested cropland.
<table>
<thead>
<tr>
<th>Land use</th>
<th>I-IVe</th>
<th>Ve-VIIe</th>
<th>IIW-IVw</th>
<th>Vw-VIII</th>
<th>IIs-IVs</th>
<th>Vs-VIII</th>
<th>I-IV</th>
<th>V-VIII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not suitable for cropland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Row crops, small grain, rotation hay and pasture, and hayland</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL HARVESTED CROPLAND</td>
<td>13.227</td>
<td>.289</td>
<td>8.068</td>
<td>.053</td>
<td>.646</td>
<td>.046</td>
<td>21.941</td>
<td>.388</td>
</tr>
<tr>
<td>(1 + 2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Orchards, vineyard and bush fruit</td>
<td>.030</td>
<td>.003</td>
<td>.002</td>
<td>0</td>
<td>.001</td>
<td>0</td>
<td>.033</td>
<td>.003</td>
</tr>
<tr>
<td>TOTAL LAND NOT NOW IN CROPLAND BUT SUITABLE FOR CROPLAND (3 + 4 + 5)</td>
<td>4.476</td>
<td>1.699</td>
<td>.209</td>
<td>6.384</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Some increase in food production could be achieved by converting pasture that is suitable for cropland (2.571 million acres, item 4) to cropland. However, much of the pasture classified as suitable for cropland is small areas randomly interspersed with pasture land that is not suitable for cropland and would be difficult, if not impossible, to farm with present-day machinery. The net gain in food production by using this pasture land for cultivated crops, rather than for grazing as at present, is difficult to assess under present farming conditions but is not believed to be large.

There are 1.9 million acres in commercial forest that are classified as suitable for cropland. Cultivation of this land would, in general, be even more difficult than farming the portion of pasture land that is listed as suitable for cropland. Since much of Illinois has a dearth of land in forest for timber production, recreational purposes, and esthetic enjoyment, few would concede that this land should be converted to cropland.

It is also evident from table 4 that some land in Classes V through VIII now producing crops is either steep, very wet, or drouthy and should be converted to noncropland uses. A considerable portion is cultivated only because it is commingled with suitable cropland in the same field.

In summary, land use in Illinois can be shifted and intensified to some extent, but gains in food production from these shifts will be small with present-day farming methods.

Mean corn yield estimates were prepared for land capability classes and subclasses for major land resource areas 108, 110, and 114 in Illinois. The major soils in the state are included in those areas (Austin, 1965). High input levels were assumed for the corn yield estimates (Odell and Oschwald, 1970, p. 9). The corn yield estimates are presented in table 5.

The differences between mean corn yields show in a general way the effect that kind (capability subclass) and degree (capability class) have on corn yields. Wide variations exist within a class or subclass. For example, the soil mapping units included in subclass IIe range in estimated corn yield from 65 to 140 bushels per acre.

The data presented in table 5, along with data on land use by capability subclasses (tables 4 and 6), indicate the influence that land-use adjustments that result in using less suitable land for cropland will have on (a) total crop production in bushels and (b) increased hazards of production. Marked increases in food production by use of land now considered as not suitable for cropland (under machine cultivation) can only be obtained by use of more hand cultivation.

Crop production in Illinois is concentrated on the most productive land and land that is most easily farmed (land capability Classes I and II in table 5). If crop yields on the best land are lowered slightly by placing restrictions on the use of available technology, the needed food can be produced by cropping land now idle or in conservation reserve. But this will soon be inadequate, and at an early future date more land would be required in capability Classes III and IV and in the subclasses with erosion, runoff, and shallow rootzones as severe limiting factors.
TABLE 5—ESTIMATED AVERAGE CORN YIELD FOR LAND CAPABILITY CLASSES AND SUBCLASSES IN ILLINOIS (High Management Level)

<table>
<thead>
<tr>
<th>Land capability class</th>
<th>Aggregate yield of class</th>
<th>Subclass yields with limitations of</th>
<th>Erosion &amp; runoff (e)</th>
<th>Wetness (w)</th>
<th>Shallow rootzone (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>117</td>
<td>117</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>II</td>
<td>105</td>
<td>-</td>
<td>104</td>
<td>112</td>
<td>91</td>
</tr>
<tr>
<td>III</td>
<td>84</td>
<td>-</td>
<td>86</td>
<td>91</td>
<td>72</td>
</tr>
<tr>
<td>IV</td>
<td>75</td>
<td>-</td>
<td>77</td>
<td>65</td>
<td>63</td>
</tr>
<tr>
<td>Average</td>
<td>95</td>
<td>117</td>
<td>96</td>
<td>103</td>
<td>76</td>
</tr>
</tbody>
</table>

* Includes soils that are inherently poorly drained but where tile drainage systems have been installed and, consequently, productivity is high.

From the number of acres of corn in capability Classes I, IIe, IIw, and IIIw and the yields in table 5, one can calculate that a 10 percent reduction in yield could be offset by planting corn on approximately all of the land in capability Classes III and IVe that are now in conservation use, temporarily idle, or in pasture. This would not only increase the total area exposed in row crops by 1.25 million acres but would involve soils that have severe erosion problems.

Data are now available with which to estimate the additional acres that would be needed to compensate for food production lost under various levels of restrictions on production technology. Soil scientists can indicate the approximate sequence in which land areas should be transferred into a more productive usage. Three general levels of increased needs will be discussed.

The first 10 percent of additional food can be produced rather easily by optimizing fertility treatments in land that is presently underfertilized, and by cropping land that is now conservation reserve, idle cropland, or pasture. This shift would have only minor effects on environmental problems. A second 10 percent increment could only be achieved with substantial disruption of the present land-use system and damage to the environment. A third 10 percent increment would likely be impossible even if nearly all land in forest or recreational use were transferred to crop production. This would, of course, require a return to great inputs of human labor necessitated by farming small parcels of land and steep slopes. Intensive application of erosion control techniques at great cost would be essential. Episodes of serious environmental damage would likely occur in periods of unusually heavy rainfall.

SUMMARY

The application of available science and technology in agricultural production causes certain environmental problems. The justification for using
<table>
<thead>
<tr>
<th>Land use</th>
<th>I</th>
<th>IIe</th>
<th>IIIe</th>
<th>IVe</th>
<th>Ve-VIIe</th>
<th>IIw</th>
<th>IIIw</th>
<th>IVw</th>
<th>Vw-VIIIw</th>
<th>IIIs</th>
<th>IIIIs</th>
<th>IVs</th>
<th>Vs-VIIIIs</th>
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<tbody>
<tr>
<td>Row crops</td>
<td>3.870</td>
<td>5.004</td>
<td>.781</td>
<td>.505</td>
<td>.152</td>
<td>5.154</td>
<td>1.505</td>
<td>.057</td>
<td>.046</td>
<td>.233</td>
<td>.181</td>
<td>.078</td>
<td>.022</td>
</tr>
<tr>
<td>Small grain</td>
<td>.390</td>
<td>.708</td>
<td>.155</td>
<td>.131</td>
<td>.042</td>
<td>.540</td>
<td>.296</td>
<td>.014</td>
<td>.004</td>
<td>.032</td>
<td>.032</td>
<td>.023</td>
<td>.012</td>
</tr>
<tr>
<td>Rotation hay and pasture</td>
<td>.317</td>
<td>.814</td>
<td>.193</td>
<td>.137</td>
<td>.060</td>
<td>.329</td>
<td>.132</td>
<td>.005</td>
<td>.003</td>
<td>.022</td>
<td>.026</td>
<td>.010</td>
<td>.009</td>
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<td>Hayland</td>
<td>.011</td>
<td>.081</td>
<td>.044</td>
<td>.055</td>
<td>.032</td>
<td>.022</td>
<td>.012</td>
<td>—</td>
<td>—</td>
<td>.002</td>
<td>.004</td>
<td>.002</td>
<td>.003</td>
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<tr>
<td>Conservation use</td>
<td>.257</td>
<td>.424</td>
<td>.134</td>
<td>.105</td>
<td>.046</td>
<td>.346</td>
<td>.122</td>
<td>.005</td>
<td>.017</td>
<td>.026</td>
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<td>.007</td>
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<tr>
<td>Temporarily idle</td>
<td>.023</td>
<td>.050</td>
<td>.026</td>
<td>.030</td>
<td>.013</td>
<td>.066</td>
<td>.041</td>
<td>.001</td>
<td>.007</td>
<td>.006</td>
<td>.002</td>
<td>.004</td>
<td>.001</td>
</tr>
<tr>
<td>Orchards and fruit</td>
<td>.001</td>
<td>.016</td>
<td>.006</td>
<td>.007</td>
<td>.003</td>
<td>.001</td>
<td>.001</td>
<td>—</td>
<td>—</td>
<td>.001</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Open land</td>
<td>.011</td>
<td>.037</td>
<td>.032</td>
<td>.033</td>
<td>.033</td>
<td>.040</td>
<td>.019</td>
<td>—</td>
<td>—</td>
<td>.002</td>
<td>.001</td>
<td>.005</td>
<td>.008</td>
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<tr>
<td>Cropland</td>
<td>4.880</td>
<td>7.134</td>
<td>1.371</td>
<td>1.003</td>
<td>.381</td>
<td>6.498</td>
<td>2.128</td>
<td>.082</td>
<td>.080</td>
<td>.324</td>
<td>.269</td>
<td>.146</td>
<td>.062</td>
</tr>
<tr>
<td>Pasture</td>
<td>.325</td>
<td>.737</td>
<td>.501</td>
<td>.510</td>
<td>.688</td>
<td>.297</td>
<td>.128</td>
<td>.006</td>
<td>.025</td>
<td>.025</td>
<td>.010</td>
<td>.012</td>
<td>.060</td>
</tr>
<tr>
<td>Forest (commercial)</td>
<td>.246</td>
<td>.378</td>
<td>.273</td>
<td>.323</td>
<td>1.136</td>
<td>.343</td>
<td>.280</td>
<td>.005</td>
<td>.180</td>
<td>.021</td>
<td>.012</td>
<td>.036</td>
<td>.225</td>
</tr>
<tr>
<td>Forest (noncommercial)</td>
<td>.007</td>
<td>.018</td>
<td>.011</td>
<td>.010</td>
<td>.025</td>
<td>.016</td>
<td>.015</td>
<td>—</td>
<td>—</td>
<td>.008</td>
<td>.001</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Forest (total)</td>
<td>.253</td>
<td>.396</td>
<td>.284</td>
<td>.333</td>
<td>1.161</td>
<td>.359</td>
<td>.295</td>
<td>.005</td>
<td>.188</td>
<td>.022</td>
<td>.012</td>
<td>.037</td>
<td>.240</td>
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<tr>
<td>Other land in farms</td>
<td>.150</td>
<td>.311</td>
<td>.064</td>
<td>.044</td>
<td>.044</td>
<td>.128</td>
<td>.060</td>
<td>.003</td>
<td>.021</td>
<td>.009</td>
<td>.012</td>
<td>.012</td>
<td>.008</td>
</tr>
<tr>
<td>Other land not in farms</td>
<td>.074</td>
<td>.123</td>
<td>.046</td>
<td>.022</td>
<td>.031</td>
<td>.084</td>
<td>.043</td>
<td>.004</td>
<td>.004</td>
<td>.012</td>
<td>.015</td>
<td>.007</td>
<td>.153</td>
</tr>
<tr>
<td>Total other land</td>
<td>.224</td>
<td>.434</td>
<td>.110</td>
<td>.066</td>
<td>.075</td>
<td>.212</td>
<td>.103</td>
<td>.007</td>
<td>.065</td>
<td>.021</td>
<td>.027</td>
<td>.019</td>
<td>.161</td>
</tr>
<tr>
<td>Noncropland (pasture, forest, and other land)</td>
<td>.802</td>
<td>1.587</td>
<td>.895</td>
<td>.909</td>
<td>1.924</td>
<td>.868</td>
<td>.526</td>
<td>.018</td>
<td>.278</td>
<td>.068</td>
<td>.049</td>
<td>.068</td>
<td>.461</td>
</tr>
</tbody>
</table>
each practice and subsystem of production must be challenged. Many additional opportunities for reducing undesirable effects on the environment will be found. Research to identify these opportunities is being greatly accelerated.

But it should be clearly understood that the increasing demand for food and fiber is the basic cause of agricultural effects on the environment. Persons who propose a return to more primitive methods with less use of science and technology are generally unfamiliar with agriculture and with land-use capabilities.

The utilization of the best available crop production technology (with minor exceptions) will likely meet the needs of society with the least undesirable impact on the environment.

REFERENCES


THE EXPANDING CITY

Matthew L. Rockwell

Executive Director, Northeastern Illinois Planning Commission,
Chicago, Illinois

It is often observed, since the coming of the industrial and scientific revolutions with their resultant explosions in wealth and population upon the earth, that changes have occurred too fast for this or any society to keep properly abreast of. We have recently become more aware of how our fast-moving urban society has inadvertently polluted and ruined much of its natural environment. We know that neither urban life nor suburban life is satisfying or fulfilling. The revolution has affected our individual personalities, our family structures, and our institutions in such ways that all are suffering from various degrees of disorganization. Change takes place so rapidly that there seems no time to test and evaluate, as we used to, each new way to see whether or not it should be accepted.

Nowhere is this phenomenon of rapid change and consequent disorganization more evident than in the growth of our metropolitan areas. New developments take place with a minimum of knowledge as to ultimate results on ourselves and on our environment. It seems enough to know that the new development is predicated to make a profitable return, or to be eligible for federal funds, or to satisfy the minimum requirements established by an array of somewhat bewildered regulating agencies. Safeguards against wrong decisions lie in the wisdom from an earlier age, which knew nothing of the automobile, or in the little environmental research conducted of late. We can speak directly through our vote or at the public hearing, but we aren't sure what to say.

You might conclude, from these remarks, that I am calling for some sort of speed limit on metropolitan development, but the fact is that I share with many the concern that certain changes have not taken place fast enough—changes in our outdated techniques of city building, changes to correct the many ills we can still identify, whether inherited from the past or brought about by new happenings.

The curious dilemma we face is that by many traditional standards man in his metropolis has never been better situated. The Chicago metropolitan area with its 7 million inhabitants can be compared to the richest nations in the world's history. Our opportunities seem unlimited, yet we continue to exist in an environment that seems to bring little basic satisfaction to anyone,
or, if I am being misled by the news media in this respect, then let us say that many thoughtful people share a sense of profound disquiet with the status quo.

PHYSICAL DEVELOPMENT OF METROPOLITAN AREAS

My special point of view in these matters is that of a regional planner concerned with the physical environment and its interactions with man. I observe the same problems of disorganization in the physical development of metropolitan areas that clergymen see in their congregations or psychologists see in their patients. It seems that we can no more cope with the demands of our physical environment and how to live intelligently with it than today's teenager can cope with his parents.

It is time to turn to examples in order to make my point. In doing so, I shall name but not discuss some of the more widely recognized symptoms that are related only in part to the subject of physical disorganization of the metropolitan environment. These symptoms include race riots and crime, faltering educational systems, and inadequate health services, a multiplicity of largely ineffective government units, gross inequities in the distribution of public and private resources, and air and water pollution.

As if these were not enough to prove that something is wrong, I should like to add this new—really an old—problem that I call the physical disorganization of the metropolitan area. But before I give you these new examples, let me repeat that our metropolitan areas do remarkably well; in fact, they are thriving according to the measures used by your local chamber of commerce, and the final proof of their success may be that they continue to grow.

Recently the Northeastern Illinois Planning Commission was asked to review each of the many applications for federal funding that came from local and state government agencies in our region. We were asked by the U. S. Office of Management and Budget to comment on how each project is related to areawide planning.

Two years ago, we should have had nothing to say because there was nothing in existence that resembled an areawide comprehensive plan. This was, in itself, a symptom of disorganization, for isn't man supposed to be unique in his ability and propensity to do rational planning?

Since our review began, we have had opportunity to comment on a wide range of proposed improvements, though I use that last word cautiously. We have seen literally hundreds of applications, enough so that I can begin to categorize them with respect to what they tell of metropolitan disorganization.

Public Metropolitan Improvements

First are the applications that are seeking Federal assistance to remedy some serious shortcomings in the supply of local services or facilities
whether it be for a neighborhood park, a juvenile court, a municipal sewage treatment system, or a new hospital. In many cases, the existing facilities are grossly inadequate, if they exist at all. One wonders how long the people would have continued to tolerate their overflowing septic tanks, streets used as playgrounds, or a hospital 20 miles away. Why were these same facilities not incorporated into the original building of the community? None of these things are in the nature of new inventions; rather, they have a long history.

The second category speaks of the limited view we have of the future of our growing metropolis. As an expression of farsightedness, many improvements are designed at considerable extra cost for a future "target" year or a time of "ultimate development" as foreseen by the consultant. He, in turn, uses the accepted methods of projecting into the future—he looks at local zoning, he talks to local mayors, and he examines past trends for whatever they might tell him about the future. Limited as this approach may be in preparing for tomorrow's needs, its limits are further compounded when we see another project proposed for the same area but with quite a different expectation of future growth. The classic case was the highway improvement project designed to serve 50 percent more people than could be accommodated by the proposed sewer project in the same area.

Some may say that growth forecasting is, at best, a shot in the dark and shouldn't be taken too seriously. We say that unless we concede that our metropolitan areas are growing totally out of control, we should be able to decide upon a future development pattern and then design our improvements to serve it. This would have two positive effects: (1) the improvements such as highways and sewers would tend to encourage the forecasted growth to occur and (2) a pattern would develop that was intentional and in accord with local and regional objectives.

The third category of projects represents, perhaps, the outstanding symptom of our disorganized metropolis. These are improvements that are proposed in direct contradiction to some other objective of equal or greater worth. An investigation of these projects usually reveals some sort of circumstance that gives plausibility to the application even though a better approach is apparent to everyone. Typical examples include the construction of many small, inefficient wastewater treatment plants where a single, large plant could do the job better at less cost. Also, consider the case of the flood-control project through stream channeling where maintenance of the floodplain as open space with recreation benefits could serve us much better; or the application for a 60-acre park in a remote part of the region, justified because the land is cheap and because the county feels an obligation to award some parks to each of its townships. What a shame that money couldn't be spent on a better piece of land—close to people and having multiple-use potential.

Private Metropolitan Improvements

So far, our experience as metropolitan growth watchers has been limited largely to what are called public improvements. The possibilities for disorganization in the private sector of metropolitan development are
almost unlimited. When the private developer decides to build, it is presumed that he has investigated the profit potential and is aware of whatever public regulations apply. Usually he has to come to terms with local zoning and building regulations, which, as I am sure you know, are currently under indictment as representing special and sometimes illegitimate interests.

Let us examine the problems facing the developer of housing for families of moderate and low income. The legal and political roadblocks set against him would seem to preclude the development of the type of housing needed by the more unfortunate members of our American society. Consider the red-carpet treatment given to the developer of luxury homes and apartments, especially if the apartments promise to exclude any substantial number of children. It is assumed that some other school district is better prepared and more capable of providing public education services than the one in which the builder proposes his housing project.

On occasion our builder may be advised that his project lies on a floodplain, is on unstable soils, will destroy some site of ecological value, or that it will create serious problems in the provision of public services and utilities. If he is aware of these matters, he usually has the option of ignoring them, especially if he intends to sell his product to someone else.

Government Control

You ask, perhaps, whether the county, state, or Federal government has anything to say about metropolitan development. The answer is that each of these levels of government maintains policies that have very strong impacts on metropolitan development, though largely unintentionally. You have all heard the stories of how the FHA policies on mortgage insurance helped seal the doom of many so-called declining or changing neighborhoods. You also know of the very aggressive road-building policies of county, state, and Federal governments. These roads are designed to improve traffic movement and spur economic development. Any other impact was beyond the knowledge or concern of the highway interests until just lately.

You will also realize that counties, states, and the Federal government generally have nothing to say about metropolitan development patterns, not because it isn't a matter of county, state, or national significance, but because these levels of government have shunned a sense of responsibility. And yet, through their spending and regulatory authority, these governmental levels do have an impact for which they must be responsible.

LAND-USE PROBLEMS

What are the land-use problems in Illinois? They are all of the conflicts between one human activity and another, all the assaults of urban and suburban development upon our natural environment, and all the damage we do to ourselves by letting our regions grow as though there were some unseen, benevolent hand guiding us in the direction that will suit our needs and ambitions.
Our land-use problems include the disarrangement of land so that we are crowded together and yet too far apart for convenience and efficiency. We talk about pollution of air, water, and soil! What about pollution of the land surface? Since we are talking about land-use problems in Illinois, let's be specific about what the State of Illinois says about metropolitan development. The comprehensive plan adopted by the Northeastern Illinois Planning Commission calls for a stronger mass transportation system. The State of Illinois continues to build highways and to ignore the financial needs of mass transportation. The NIPC plan calls for substantial quantities of permanent open space. The State of Illinois has historically seen fit to preserve open space almost anywhere except in northeastern Illinois, even though 7 of the state's 11 million population reside in this region. The regional plan calls for housing suitable for all family sizes and income levels to meet consumer demands within each developing sector of the six-county area. The State of Illinois together with the Federal government only nibble at the fringes of this problem. The regional plan urges that industrial development take place where mass transportation and other public services and facilities are conveniently available. The State of Illinois urges industrial development without qualification.

The NIPC plan states as a regional objective that the maximum opportunity for each person to improve his cultural, social, and economic condition be available. Meanwhile, the State of Illinois leaves the financing of public schools largely to the resources of local school districts whose assessed valuation may be all out of proportion to the children they have to educate. The local response to this situation is called "fiscal land-use planning and zoning" and places consideration of taxes above all other things in the making of land-use decisions.

This is not to say that we are at odds with the state on all matters of regional importance. In fact, the state has begun to follow new directions in the areas of environmental preservation and moderate and low-income housing development. Under the present Governor, the state has instituted a high-level planning operation that will cut across the many functional departments. Finally, it is the State of Illinois that gave birth to our regional planning agency and contributes its single largest local share of funds.

To complete my story, I might as well bite the other hand that feeds us—the Federal government. For all of the enlightenment reflected in recent housing and environmental legislation, the Federal establishment has still not faced up to the need of a national land-use policy—excepting its many policies with respect to our vast agricultural lands. We still observe the inadequacy of Federal housing programs, the imbalance between highways and mass transportation priorities, the willingness to subsidize all sorts of public activities without any notion of how they all tie together—if they do.

If, as I said at the beginning, our troubles stem largely from the rapidity of change for which we are all unprepared, let us no longer use this as an excuse for not bringing our governmental policies up to date. Let us no longer pretend that we don't have or don't need public policies with respect to the use of our urban and suburban land but rather consider how to bring them up to date with our current understanding of the metropolitan phenomenon.
RECOMMENDATIONS

My specific recommendations are too numerous to discuss here, but let me suggest them in outline form:

Recommendations for state actions:

1. The creation of an effective state planning agency, preferably in the Governor's office, to be responsible for coordination of all state activities as they relate to urban and regional development.

2. The formation of a comprehensive set of state-wide development policies including those which pertain to land use.

3. The development of new state enabling acts for planning, zoning, subdivision control, and building codes in keeping with state policies for development.

4. The budgeting of state-financed capital improvements in accordance with the comprehensive set of state-wide development policies.

5. The recognition by the state that metropolitan areas are new, different, and deserving of very special treatment in matters of governmental organization, financing, and development standards.

My recommendations to the Federal establishment would be along the same line.

1. The formation of a set of national policies for the development of metropolitan areas.

2. The coordination of Federal programs at the metropolitan level through a more rational set of priorities in public spending or in block grants to states. These grants should be subject to the findings of regional clearing houses, whose job is to see that Federal dollars are being spent in a fashion consistent with regional and local planning.

The final proof of our metropolitan disorganization I have saved for last because it is the most convincing and yet most difficult to cope with satisfactorily. I refer to the government structure—or the lack of it—in our metropolitan areas. The northeastern Illinois area with its more than 1,200 units of local government may well lead the nation in the number of governmental units per capita. Some see this as merely a superabundance of local
democracy. I see it as a symptom of metropolitan disorganization in which democracy hardly has a chance owing to the bewilderment of the local citizen and voter. Perhaps the first order of business in straightening out the disorder in our metropolitan areas is to develop a structure of government that can maintain the desire for local control while giving some opportunity for rational action on matters of metropolitan-wide significance. We have not yet found that structure. I fear that in seeking improvement in government control, we have been intimidated by those who profit from the current lack of structure. The state, which creates local governments, must re-examine what it has bestowed upon us. But in the final analysis, it must be the people who finally provide the impetus and insist upon bringing order out of the chaos I've described today.
THE OAKLEY PROJECT—A CONTROVERSY IN LAND USE

William C. Ackermann


This paper will recount and comment upon the proposed Oakley Dam, around which has developed a classic example of controversy in land use and widely divergent social values. The issues have created two polarized groups of advocates with a bewildered public in the middle.

I will first describe the general location and illustrate the lands that are in contention, then recount the actions of the principal parties to the controversy, interspersing some personal views of this interesting fight.

The broad setting for this drama is the Sangamon River, which flows for about 150 miles westward across the generally flat countryside of central Illinois to its mouth in the Illinois River.

OAKLEY DAM SITE

The Oakley Dam site is in east-central Illinois and is proposed as a flood control structure with added features for water supply and recreation.

Oakley Dam might have remained a relatively obscure engineering work but for its potential impact upon the Robert Allerton Park, which is located along the Sangamon at the headwaters of the proposed Oakley Reservoir. This park is highly prized by conservationists, and it is they who have organized and led opposition to the project.

Although the organized opposition has attacked every facet of the Oakley project, including its purposes and the upstream and downstream effects, their many and unrelenting forays have all been concerned with killing a project which it is feared will injure the park lands. Since that is the case, we should start by taking a look at Allerton Park.

Allerton Park Area

Allerton Park, located a few miles west of Monticello, is a magnificent estate that is owned by the University of Illinois. It was conveyed to
the University in 1946 by the late Robert Allerton along with other farm lands, the income from which would assist in maintaining the property.

The property includes a stately mansion that the University now uses as a conference center. The building is surrounded by formal and informal gardens of great beauty.

Allerton Park contains about 1,500 acres of land, and one of the important points to keep in mind is that this tract is in part upland area on which the mansion, the gardens, and the statuary are located. No variation of reservoir proposals would directly affect this developed part of the park. The bottom land along the Sangamon River, an area of some 600 acres within the park, is directly involved with possible flooding from Oakley reservoir.

The bottom lands contain trees and underbrush of great variety. This bottom floods every year, usually for extended periods, and the existing flora and fauna have adapted to this regimen. It is this land that the conservationists believe to be a unique, natural area of great value as a link with our past and an irreplaceable resource for ecological research. Opposing interests have termed this bottom land a worthless tract, infested by snakes and mosquitoes.

I will not burden you with many statistics, but one of the numbers to bear in mind is the elevation of the floodplain here at the Allerton estate, which is about 630 feet above sea level.

PRINCIPAL PARTIES IN OAKLEY CONTROVERSY

Corps of Engineers

Having looked briefly at the area that principally gives rise to the controversy, we should now begin to introduce the parties to the action. I will start with the Corps of Engineers, which proposes a dam downstream from the park. The basic purpose for this is flood control, to which have been added water supply and recreation, and, for a time, it also was intended to contain storage for low-flow dilution of treated wastes. The conservation pool, containing a reserve for sediment accumulation, was originally set at elevation 621, well below the level of the Allerton bottoms. Flood levels, however, would be deep over the bottom and extend well up on the second banks.

The Oakley project has a long history. It was first conceived in 1939 and was considered feasible for building by the Corps in 1947, but this original version of the project was defeated by farmers whose lands would be inundated or whose agricultural drainage would be affected.

The present project was authorized by Congress in 1962 as part of the Illinois River Basin plan and was to cost about 30 million dollars.
The authorized project accumulated a series of added features and changes, which at one point raised the conservation pool from 621 to 640, and this is what really activated the conservationists. I find it interesting to recount the changes which raised the proposed pool level. First, there was an addition of storage for water supply for the city of Decatur in the amount of 11,000 acre-feet. This is, of course, a perfectly legitimate action under federal law in which the city of Decatur agrees to pay its proportional share of the added cost. Second, an analysis by the Public Health Service, also provided for in the law, found that conditions downstream from Decatur would result in zero dissolved oxygen in the water; so 48,000 acre-feet of reservoir storage was added for low-flow dilution of treated wastes.

Refined topographic maps of the reservoir area revealed less volume than was previously anticipated, so the pool was raised to maintain the equivalent storage. In line with changed federal policy, the economic life of the project was extended from 50 to 100 years, and this required doubling the anticipated sediment pool. The situation was aggravated by adoption of a higher assumed rate of sediment accumulation, so that with both increases the sediment pool grew from 4,500 to 12,000 acre-feet. The assumptions on economic life also resulted in increased storage to guarantee the water supply.

A revised estimate of the historic flood led to increasing flood storage from 132,500 to 168,700 acre-feet to control the flood of record. Finally, the Illinois Sanitary Water Board raised its stream water quality standards from 4 to 5 parts per million of dissolved oxygen, and this required still more storage for added dilution water.

Usually one can count upon changes being somewhat offsetting, but these were all in the direction of requiring a higher pool level. The cost of the project, including rising construction rates, escalated from 30 to 70 million dollars. All of these changes were doubtless a matter of embarrassment to the Corps and to those interested in having the project go forward. To the opponents it was sufficient basis for attacking the credibility of the Corps.

University of Illinois

We have spoken of Allerton Park and have briefly summarized a progression of events related to the proposed Oakley Dam and its sponsor, the Corps of Engineers. We should also speak of the University of Illinois, which owns the park, and may be thought of as the second party in the dispute.

The Allerton estate was conveyed to the university to be used, maintained, preserved, operated, improved, and developed for educational and research purposes, as a forest, wild and plant life reserve, as an example of landscape gardening, and as a public park.

The university seems to have wished to avoid becoming involved as a party in a public controversy and has maintained a low profile. Originally the university reacted to the Oakley proposal by saying that it would not stand in the way of a broader public interest. Later, in 1968, it engaged
the Harza consulting engineering firm to review the project. Their report recommended consideration of a series of alternatives, and this proved useful in bringing about reconsiderations by state, federal, and public interest groups through a widened array of possible compromises and solutions. Although the university, with major interests at stake, has maintained a low key, I am sure they take very seriously their public trust regarding the estate.

City of Decatur

A third party to the Oakley controversy is the city of Decatur, which has consistently been in strong support of the project. To enhance progress in the undertaking, that city has consistently agreed to proposed changes—whether they were for an enlarged or a reduced project.

Decatur is downstream from the proposed Oakley Dam and has an urgent water supply problem. Its Lake Decatur is upstream from the city and just downstream from Oakley. Lake Decatur was created in 1923, was raised in 1956, and is now about 35 percent filled with sediment. Although Decatur has other alternatives for augmenting its water supplies, it has supported the Oakley project, including added water supply storage. I think that Decatur welcomed the prospect of a major recreational facility, which would be a feature of a new lake, and the benefits of area and regional development, as well as the water supply feature. While the controversy has raged, Decatur has watched its water demand rise ever closer to the shrinking capacity of its existing reservoir.

Meanwhile the Corps received a Congressional request to restudy the Oakley project, and in March of 1969 issued a report that included 14 alternate solutions, which were presented in public hearings. In this way the public and agencies were given an opportunity to consider choices. This is a major departure from past procedures, not only with the Corps but other agencies as well, when alternatives were only considered internally and one plan adopted and presented for approval or rejection.

The alternatives studied by the Corps were prompted by suggestions of the Harza report and involved various combinations of measures, including a sub-impoundment on a reservoir tributary named Friend's Creek, which would absorb a part of the main reservoir storage and would also absorb much of the pool fluctuation. They considered levees through the Allerton bottom, land exchange for research, alternative ground-water supplies for Decatur, watershed treatment to reduce sediment, and advanced waste treatment at Decatur to reduce or eliminate the need for dilution water.

Division of Waterways of the Illinois Department of Public Works and Buildings

At this point we introduce the fourth major party to the Oakley controversy, which is the Division of Waterways of the Illinois Department of Public Works and Buildings. That agency had been involved throughout the
saga, but in early 1970 they came forward with a so-called "modified project," which was effective in bringing together the principal parties and also substantially represents the present version of the project. This modified project set the joint-use pool at elevation 623, which you will recall is well below the floodplain level of about 630 at Allerton Park. The modified project incorporated the Friend's Creek sub-impoundment and enlarged the water supply storage. It proposed that the state take over the responsibility of water supply storage, giving Decatur a first option on its use. Flood control storage was reduced. A major innovation was the treatment proposed for the 100 miles of downstream channel. Only a portion of this would be protected from flooding, with other land remaining in a green belt subject to periodic flooding but with recreational value. Reservoir storage was provided so that the downstream reach could be left as a natural flowing stream instead of an efficient but unnatural conveyance channel. The State of Illinois, the university, and the city of Decatur all signed an agreement supporting the plan. The conservationists also seemed to agree, but when the plan was processed through the Corps and emerged with slight changes, the conservationists again erupted.

The Committee on Allerton Park

The fifth and final party to the Allerton controversy is the band of conservationists—ecologists-naturalists—who banded together in 1967 in "The Committee on Allerton Park." They have been extremely vocal and effective in representing the antidam point of view. One of the local newspapers was a powerful ally and maintained a steady barrage of one-sided and often inaccurate arguments. Other allies have been the conservation clubs and various high U. S. officials. For example, Justice Douglas was walked through the park, and Senator Proxmire of Wisconsin was quoted as having said, "The project is a pork barrel boondoggle of the most blatant kind." Other weapons were petitions, of which a third version is now being circulated. One of these petitions gathered 85,000 signatures.

The battle cry "Save Allerton Park" implies that the park would be destroyed, which even in the earlier, high-pool proposal was an exaggeration and is hardly true with respect to the current version. The dogma of the conservationists is that Allerton Park is a unique, natural preserve and an ecological link with the past. That the Allerton bottoms are a wild oasis in the nearly unbroken miles of flat Illinois corn land is a fact, but in my judgment the conservationists, who set themselves up as the scientific high priests of ecology, either deliberately or innocently are promoting a deception or maintaining an illusion. The Allerton bottoms are not natural, virgin land or a living fossil of the past. The Sangamon River has a small channel for a drainage area of about 800 square miles, because 100 years ago, and for thousands of years before that, the upstream drainage area was largely swamp and marsh. This retained a great deal of runoff and released it slowly, so that a small channel was all that was required. Since about 1920 this land has been drained and is now among the most productive agricultural lands in the world, with most of the cultivated area in corn and soybeans. The effect on runoff has been dramatic. Floods are much greater, and the bottoms are covered with
flood water every year—often for long periods. The sediment load from erosion is also great, and the river is using this sediment to attempt to achieve a new equilibrium with the changed watershed environment. With each flood a thin film of silt is deposited on the floodplain, while stream velocities are sufficient to keep the channel scoured. By this means, over some period of years which I have not calculated, the channel is being enlarged by the process of building up the adjacent floodplain. If left to its own devices, the river system will some day create a channel adequate to contain the increased annual floods that result from man's activities. In the meantime, however, and when viewed with some time perspective, the river and overbank are in a highly dynamic state. The vegetation which is there consists of species that can adapt to this harsh environment. But natural, in any historical sense, it is not.

Yet, the conservationists have a right to seek to protect this flooding bottom land, even if it is not what they say it is, and they have been dedicated and ingenious in their cause. When the plan was to build a high dam, which would indeed have permanently flooded the bottom, they emphasized the extent of flooding and implied that the entire park would be under water. They said it was an expensive catch basin for silt, and that the park would be a mudflat. They claimed that multipurpose reservoirs have been proved defective (which is contrary to widely held views), that the benefits of the project were exaggerated, that storage for low-flow dilution was to flush Decatur's raw sewage (which of course isn't true), and that Decatur has other alternative sources for water supply (which is true). They charged that the project is greatly changed from the one which Congress authorized in 1962 and therefore requires re-authorization, but that the Corps has circumvented this because the project will not survive the higher interest rates now being applied (which may be true).

Now that the Committee on Allerton Park has been largely successful in reducing the height of the dam and keeping the permanent pool out of the park, they are still fighting to kill the project, but with a new set of arguments. They say the lake will be too polluted for water-based recreation, that it will be shallow and warm with oozing, stinking mudflats, a tangled mass of water weeds, which will die and create a stench.

SUMMARY

And so the controversy goes on. It has been a fascinating struggle to observe and yet a costly and frustrating way for society to work its will. One might regret the public's dependence upon an advocate system that gives rise to exaggerated and questionable arguments.

The Corps of Engineers has been made a villian for following its established procedures at a time when social values were changing faster than they could adapt to them. We might hope that out of this and similar other contents will come a system of weighing the environmental impacts as projects are being studied, and there is good reason to believe that this will be so in the near future.
As to the final fate of the Oakley project, one set of rumors has it that the Corps has quietly shelved the whole embarrassing business. Another rumor has it that the project has been cleared by the President's Offices of Management and Budget and Council on Environmental Quality. The newspapers say that if the project is in the President's budget, the Committee on Allerton Park will go to court with a lawsuit against the Corps. The end is not yet in sight.
THE DEVELOPMENT AND USE OF COAL SURFACE-MINED LANDS IN ILLINOIS

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Surface mining began centuries ago when man first scratched the earth's surface looking for flint, materials such as salt, or ceramic clay for pottery. The products of such mining have played a major role in the development of our world as we know it today. We need only to look around us to realize how many things result from mining.

Mining for coal is of recent origin. The earliest known reference to coal in the United States was made by Joliet and Marquette in 1673 when they recorded seeing outcrops along the banks of a river, now known as the Illinois, somewhere in La Salle County. Although such outcrops of coal were surely used by early settlers, the first mention of its commercial use was made in Virginia in the early 1700's. In 1809 in Illinois, William Boone (not Daniel in this case) shipped coal by barge from the banks of the Big Muddy River in southern Illinois to New Orleans. For the next 25 years, no record can be found of the production of coal in Illinois, but in 1833 the first tonnage was recorded, marking the beginning of coal production records in Illinois. True surface coal mining, other than the possible digging of outcrop coal, was first recorded in the United States (also in Illinois) near the city of Danville in 1866.

SURFACE COAL MINING

The first use of mechanical stripping equipment, other than horses and scoops, occurred around 1890. A strong impetus was given to this method of mining with the innovation of the revolving shovel in 1911. Also, 1911 was the first year surface-mined coal tonnage was recorded in the state and it is generally accepted as the practical beginning of coal surface mining in Illinois. This method of mining has grown from a rather humble production of 45 thousand tons in 1911 to approximately 35 million tons in 1970 valued at approximately 175 million dollars at the mines. Some 794 million tons of surface-mined coal has been produced in this 60-year period, resulting in approximately 159 thousand acres of surface-mined lands in the state. This acreage, although amounting to less than one-half of one percent of the state's total land, is a subject of concern. In reviewing the development
and use of this land, it is interesting to note that this concern began with coal surface mining's beginnings in Illinois. Studies of land affected by coal strip mining were made by the Botany Department of the University of Illinois as early as 1918 when W. B. McDougall published a paper in which he discussed plant succession on a mined area near Danville. In 1928, a student of Professor McDougall named Croxton presented a paper on the "Ecological Study of Strip Lands," which was an attempt to attack the problem of reclamation through natural revegetation.

RECLAMATION OF SURFACE-MINED LANDS

Natural encroachment of trees, grass, and legumes actually pointed the way for the first reclamation efforts on these lands. The encroachment of light-seeded tree species such as cottonwood and sycamore were of interest to R. B. Miller, the first State Forester, and to W. G. Hartshorn, a pioneer strip miner, who arranged for the first recorded tree planting on mined land in Illinois in 1920 in the Danville area. Some 9,000 trees were planted at that time, including several thousand pines. The records of the State Division of Forestry reveal an interesting follow-up on the first planting. Mr. Miller reported, "I found no trace of the conifers we had planted." Later, a district forester reported he had visited the area and received information that people living in the vicinity had removed and transplanted the pines for home landscaping.

More tangible concern for these mined lands is reflected in the history of legislation pertaining to coal surface mining in the state. As far back as 1929, when less than 5,000 acres had been affected, at least three different bills relating to the reclamation of this land were introduced in the legislature. Since that time, 44 such bills have been introduced, one of which was enacted in 1961 and is now in effect. Several reasons have been given why so many of these bills failed, but in most cases these bills were fatally defective in that they applied to only one product, were overly restrictive, were unrealistic, or were a combination of such defects. The coal industry would be something less than candid not to admit that this concern, as reflected in this vast amount of proposed legislation, had considerable effect on the present development of these mined lands. Of course there have been numerous individuals connected with surface mining whose interests and accomplishments have been of great inspiration in the development and use of this land, but a principal ingredient has been public pressure.

Tree Growth

Early development was primarily through tree growth by natural seeding or planting. Cooperation in this effort with the State Division of Forestry goes back many years. In 1930 the State Division of Forestry and the Illinois Coal Strippers Association entered into a tree planting agreement, and state foresters assisted in supervising the planting of trees on the lands of several coal companies during the period of 1930-1933. With the
inception of the Civilian Conservation Corps program in 1933, the present state tree nurseries at Jonesboro and Topeka were established to supply trees for this early erosion control work. In 1938 when the CCC program began to phase out, strip mine tree planting was increased to make use of the state's increased tree production at its new nurseries. Over eight million trees were planted on Illinois coal surface-mined land during the six-year period of 1938-1943. This planting program declined sharply because of World War II, but it did succeed in reforesting approximately 8,000 acres of mined land and helped the transition period necessary for the state to switch the tree demand from the expiring CCC program to other farm planting.

During this early development period of tree planting, one of those interested individuals previously mentioned, a mine superintendent with a good deal of farmer in his makeup, had observed the natural encroachment and prolific growth of sweet clover on some of these mined lands. So he, against the advice of many (particularly foresters), decided to buck the tree planting tide and try this land for pasture. His success was rather astonishing. This first pasture of approximately 500 acres went into use in 1938, and it is still turning out an average of 200 head of cattle each year with gains around one and one-half pounds per head per day. By 1946 and the end of the war, the momentum had shifted throughout the state from tree planting to pasture seeding, and the present principal use of these lands for forage and livestock production was born. Tree planting, of course, has been continued on some of our mined lands that are not capable of supporting a higher use, and we have a present total of approximately 28,000 acres that can be classified as forest land, with about one-half this acreage established through plantations and another half by natural encroachment.

The year 1946 also witnessed a change from past reclamation methods of trial and error to a more scientific approach. The Central States Forest Experiment Station of the U. S. Department of Agriculture started their study and inventory of "Forest Planting on Illinois Strip Coal Lands," and plans were made for the study by the Illinois Agricultural Experiment Station of "Reclaiming Illinois Strip Coal Land with Legumes and Grasses." Both reports were published by the University of Illinois Agricultural Experiment Station—the first as Bulletin 547 in 1951 and the second as Bulletin 628 in 1958.

Forage Production

In forage production, these mined lands are used for pasture by merely seeding, providing access roads, and fencing; more have been established as pasture by striking off or grading the ridge tops to widths of 10 to 20 feet, then seeding and fencing; and, more frequently in recent years, the mined lands are graded for use by farm machinery or equipment necessary for mowing and hay production. The law now requires either of the last two procedures for pasture land approval. At present some 65,000 acres of these mined lands have been seeded for forage production. Of this forage acreage, 25,000 acres is in the graded land classification, with most of the remainder partially graded by strike-off, as described above. This pasture land, according to recent inventory, was supporting at least 10,500 head of cattle, 1,500 head of
hogs, a few sheep, and over 100 head of horses. This is not a notable rate of use for it is admittedly below potential, but it is worthy of mention and may be surprising to some who have strictly a "wasteland philosophy" for mined lands. It should also be noted that not one pound of fertilizer, nitrogen, phosphate, potash, or limestone has been applied to establish these thousands of acres of legume and grass pastures or hay fields and, as previously mentioned, one pasture has been in use for 33 years. University studies show that on much of this land nutrients were present in amounts in excess of those found on surrounding undisturbed land. When renovation becomes necessary, regrading the ungraded or partially graded pastures is one procedure that has been followed. This opening up produces, in effect, a new supply of nutrients. Because regrading cannot be done on the completely graded land, application is made of whatever is needed or corn or small grain is planted for one or two years, necessary fertilizer is applied, and the land is then reseeded.

Recreation Use

Another major use of land that has been surface mined is for recreational purposes, and these uses are primarily associated with water areas created by the mining operations. There are at present in excess of 10,000 acres of water on surface coal mine areas, most of which is suitable in size and physical characteristics for recreation use. When we speak of water, current environmental consciousness brings the word "pollution" to mind, almost as a synonym. If we hear the word "water" with "coal mining" we immediately think of water pollution. Therefore, this water-oriented development and use that we believe to be such an asset needs more exposure. Today, no one can deny coal mining's contribution to the current problems of pollution, certainly not the coal industry; but to be saddled with a total commitment as sometimes is done is less than fair. There are, of course, polluted waters on mined land and the industry has been, and still is to a lessening degree, responsible for some streams' being affected by pollutants. However, it also is true that good waters have been created, and this is borne out by the actual use of these waters and the surrounding lands. A study completed eight years ago by Southern Illinois University indicated that there were at the time some 47 organized recreation units of various kinds involving as many as 30,000 people using approximately 16,000 acres of Illinois coal strip mine areas. This does not include the thousands of people who annually visit Kickapoo State Park, the Du Quoin Fairgrounds area, or the unauthorized public use of posted land, and especially the unorganized use of other strip-mine lands and waters. Mine land lakes hold the record for the number of various species of fish found in the state, and those who follow the outdoor writers' columns in their daily papers (such as the Peoria Journal Star) recognize the value of nearby mine lakes as recreational and sport fishing areas.

The potential of these areas has not yet been fully recognized, and each year several hundred additional acres of water are created. Under the present law, this new acreage must be approved by the Department of Conservation because these waters have the ability to support desirable aquatic life and must comply with the department's standards for fish stocking. If the total acreage of previously existing waters that have been even temporarily harmed by coal surface mining operations in Illinois is compared with the total
acreage of first-class recreation water that has been created, the reclaimed
recreation areas are by far the larger. An independent study is needed on
this and other uses of surface-mined areas, and such a project was started
this fall by Southern Illinois University, sponsored by the State Department
of Conservation with the full cooperation of the surface coal mining industry.
I am confident that the broad uses of strip mine areas and the data presented
here will be supported by the university's detailed study.

Other Uses

The three uses cited, namely tree growth, forage for livestock, and
recreation, are the principal methods used in the reclamation of the major
portion of Illinois mined land. There are numerous other uses, including
multiple use of the same area and more intensive use of relatively few acres.
These are of significant interest because of their economic importance and
potential for expansion. Multiple use is evidenced in the use of forage areas
for hunting and of the forest areas for camping and other recreational activities.
As a minor, but interesting, multiple use, far more beehives are located on
mined land than are found on larger nonmined areas. This is directly related
to this land's ability to support legume cover, thus providing exceptional
pasture for bees as well as livestock. The surface-mine lakes have on occa-
sion been used as water supply for several towns and villages in central and
southern Illinois, and one such area is now the permanent supply for the
town of Lynnville in southern Indiana.

We think in terms of multiple use for the 700 to 1,000 acres of
hay or pasture land used for corn or small grain production each year. As
previously mentioned, this is one method of renovation of the pasture or hay-
land; also it has been proved through trial and error as well as formal re-
search that corn grown on some of this land after it has been in alfalfa a
few years has yields in the 100-bushel an acre range. Research also has
indicated that on newly mined land without the prior use of a deep rooted
legume, no amount of fertilizer or applied soil conditioner will produce
100-bushel per acre corn. Wheat has consistently been the best producer for
the mined lands, with 40 bushels per acre not unusual, but the use of this
crop has been handicapped by the wheat allotment control on this land. The
no-till method of corn production was tried for the first time this year on
a heavy cover of alfalfa and brome grass. The results were encouraging until
the corn blight reduced yields, but maybe this method can be a partial answer
to more productive utilization for some of this land and still meet the im-
portant environmental factor of erosion control posed by clean-till crops.

Examples of intensive use that can and will be expanded are home-
sites and industrial or business developments. There are at present in excess
of 100 homes in the Wee Ma Tuk Hills mined area in central Illinois, numerous
summer cottages and a few year-round homes in the old Danville mined area,
and a fast growing new home development on mined lands in Grundy County south
and east of Morris, Illinois. There are several other scattered farm and
recreational homes or structures on mined land, one large modern livestock
sales barn complex on mined land in Henry County, a flying-farmer airport
in Knox County, two heavy equipment schools, a fruit packing building and
approximately 150 acres of very productive apple and peach orchards, several storage areas, and more than a dozen bathhouse or clubhouse facilities on the recreational areas.

Finally, the use of strip-mined areas for waste disposal is becoming increasingly important. Solid waste disposal has played a part in surface-mined land use for many years—sometimes not too well controlled. The idea of disposal of sludge from metropolitan sanitary plants on surface-mined land, in Illinois at least, is relatively new, and it is hoped that it may be the means of more intensive development and use of our mined land in relation to its environmental needs and a cure for another important environmental problem. Interest in the use of this land for waste disposal may highlight a basic concept in relation to the development and use of surface-mined lands that needs more recognition—that when a legitimate need arises, coupled with practical environmental and economic consideration rather than motivation by political or emotional consideration, sound results will occur.
ENVIRONMENTAL GEOLOGY NOTES SERIES

2. Data from Controlled Drilling Program in Du Page County, Illinois. 1965.
6. Data from Controlled Drilling Program in Kane, Kendall, and De Kalb Counties, Illinois. 1965.
7. Data from Controlled Drilling Program in McHenry County, Illinois. 1965.
9. Data from Controlled Drilling Program in Lake County and the Northern Part of Cook County, Illinois. 1966.
10. Data from Controlled Drilling Program in Will and Southern Cook Counties, Illinois. 1966.

* Out of print