Soil Information and Urban Planning

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The emphasis in recent years that has been given to the subject of urban growth is indicative of an awakening to the importance of rapid metropolitan expansion on the future of our nation. Some, in fact, have said that the complex problems of urban development constitute the greatest challenge of the twentieth century. Out of this interest and concern has developed town planning, city planning, urban planning, metropolitan area planning. Regardless of which title is used the meaning is the same even though many definitions of the terms can be found in the literature and a precise definition is probably impossible.

Planning is essentially oriented to the future. It is based on the premise that without community action some of the development within a metropolitan area may produce undesirable results. It recognizes that cities will develop and change without planning but that this development and change can be influenced in desired directions by means and costs which are acceptable and desirable. It attempts to conserve and develop the resources of an urban area to build a healthy, happy community.

The size of the urban growth problem and the companion need for wise planning, however, are not widely known or appreciated. Few people realize the magnitude of the current expansion of urban areas due to the large increase in the population of this country and the settlement of virtually all of this net growth in urban areas. One of the significant effects of this metropolitan expansion is the high national consumption of land for residential, industrial, commercial and transportation developments. The current estimated rate of use of land for such purposes is 3,000 acres per day (3). To satisfy this enormous appetite, thousands of acres of good agricultural land, areas essential for water supply, land vital for drainage-ways and floodplains, land containing scarce mineral resources, areas needed for increased recreational requirements, and hundreds of wet lands and woodlands are annually disappearing. It appears certain that huge metropolitan areas, such as the corridor from Boston to Washington, D.C., will soon be a reality.

It is to such growth as well as that in smaller areas and to associated problems that urban planning is directed. The attack on such problems demands a vast amount of information so that wise decisions on guiding metropolitan growth can be made. Because the development of land is a major result of metropolitan expansion, good planning includes land use planning which will result in wise land use development. The goal of such planning is to develop that land use for which each land area is best suited and which is needed by the community.

Such land use planning must recognize that land resources are limited and that misuse will only lead to severe environmental problems for the city. It also requires the collection and analysis of much information about each land resource area so that wise planning policies can

be developed. Information needed includes data on water resources, recreational characteristics of areas, the location of scientific and historical sites, data on woodlands and wetlands, the location of natural fish and wildlife sites and information on soils.

The soils information required for urban planning is that which will assist the planner to determine the best land use to be made of any soil area while also considering the needs and desires of the inhabitants of the community. This includes information on how land areas are currently being used together with an appraisal of the success and value of such use and how they could best be used in an urban area.

Soil data needed for proper planning of land uses has received some study in recent years and one authority (1) has suggested that such information should permit preliminary assessment of:

"1. Engineering properties of soils as an aid in the development and selection of desirable spatial distribution patterns for residential, commercial, industrial, agricultural and recreational land use development.

"2. Agricultural and nonagricultural plant material properties of soils and natural wildlife relationships as an aid in the selection of desirable spatial distribution patterns for permanent agricultural and recreational greenbelts and open spaces.

"3. Suitability of soils for private on-site sewage disposal facilities, agricultural and urban drainage systems, foundations for buildings and structures, and water storage reservoirs and embankments as an aid in the planning and preliminary design of specific development proposals and in the application of such plan implementation devices as zoning, subdivision control, and official mapping.

"4. Engineering properties of soils as an aid in the selection of highway, railway, airport, pipeline, and other transportation facility location.

"5. Location of potential sources of sand, gravel, and other mineral resources."

In such a listing the engineering characteristics of soils receives emphasis as important information needed. This is so because in the development of land for many urban uses—highways, airports, structures, etc.—the soil is the most frequently used material in supporting these structures and is an important influence on the performance of the supported facility. The soil information required for urban planning, as outlined by Bauer (1) is as follows:

"1. Background information on the region, including physiography, geology, climate, cultural characteristics, and generalized soil areas.

"2. Soil formation and classification, including slope data.

"3. Soil descriptions, including typical profiles for each series and relationship of mapping units to series.

"4. Agricultural soil properties, including soil capabilities, crop yield estimates, and crop adaptation.

"5. Wildlife soil relationship properties, including capability to sustain various plant and animal species.

"6. Nonagricultural plant material soil relationships, including suitability for lawns, golf courses, playgrounds, parks and open space reservations.

"7. Water management properties, including identification of areas subject to flood hazard, stream overflow, ponding, and concentrated runoff.

"8. Engineering properties, including depth of major horizons, liquid limit, plastic limit, plasticity index, maximum dry density, optimum moisture content, mechanical analysis, AASHO and Unified classifications, percolation rate, bearing strength, shrink-swell ratio, pH, depth to water table, and estimated depth to bedrock if within approximately 20 feet of the ground surface."

Following the collection of such information, it can be utilized in the preparation of suitability maps for the area for several purposes. One such map might indicate by qualitative ratings the suitability of each area for development or redevelopment as residential, commercial industrial, recreational or open space. Characteristics of the soil, for example, would be important to development of an area for residential purposes with private sewage disposal facilities. Some areas with good internal drainage would be well suited to such development whereas other areas would certainly become troublesome or provide serious sanitary problems. It is not unusual to find large areas unsuitable for such development because of poor on-site sewage disposal characteristics of the soil. Other problems would be found associated with certain soils if they were used to support transportation systems. In both these examples as well as in many others prior knowledge of the engineering characteristics of soils could permit planning which would reduce the problems of development, permit a wise use of the available land, and provide for economical development and maintenance of the urban area.

The soil information desired will also permit an area-wide inventory of available construction materials for highway bases and fills, reservoir embankments and linings and other developments. Of major importance would be the availability of sands and gravels. Such data not only tells the planner where important materials are located but, depending on their availability in the area, provides him with excellent information for formulating policy for their conservation before they can be devoured by urban development.

One growing problem of many urban areas is the availability of usable water that can be supplied to inhabitants at an economical cost. Soil information can indicate suitable watershed areas which can be developed into reservoir areas to minimize this problem. The internal drainage characteristics of the soils, strength under conditions of saturation and susceptibility to erosion would be valuable data for such purposes.

The recreational needs of an urban area are great, especially as the amount of leisure time available to each inhabitant and his ability to move distances by automobile increases. The resulting requirements of each community are more golf courses, playgrounds, parks, and wildlife habitats (hunting and fishing preserves). All of these require soil that is economically capable of maintaining vegetation, thus making information on such characteristics of the soil important to proper urban planning.

Land suitability maps, previously mentioned, might be prepared for each of the important land uses: (1) agricultural, (2) large lot residential with private sewage facilities, (3) residential with public sewage facilities, (4) industrial, (5) recreational and (6) transportation routes. On such maps various symbols are used to indicate suitability of each land area by qualitative ratings, such as very good, fair, poor, and very poor. Such interpretative maps—prepared from an analysis of soil, topographic and other data—provide ready information needed by the planner to properly zone areas for land use development, layout transportation systems, allocate open spaces, plan water reservoirs, and establish recreational areas.

The benefits of having adequate information on the soils of an area, however, consist of more than the major one of conserving land by causing its development in the optimum manner. Other benefits include decreased costs of development and maintenance for the community and the developer. Land improperly used often results in high construction costs to correct for inadequate foundation characteristics, a situation which would have been eliminated by development in areas with better supporting characteristics. Maintenance costs of structures on inadequate foundations, street pavements for example, will also be high and would be minimized if constructed where soil characteristics were more desirable.

It is true, of course, that for many engineering uses of land, the characteristics of the sub-surface as well as the surface soils are required. Availability of data on subsurface soils for planning purposes is often available from geologic knowledge of the region, topography of the area, pedology of the area and from interpretation of aerial photographs. Of real value here would be improved correlation information between the soil information available in the agricultural soil surveys and the resulting pedological maps and the engineering characteristics of these soils. Considerable progress has been made in recent years in including such information with the agricultural soil maps but many of the soil maps of the counties of the state still need to have the engineering characteristics added.

To provide engineering soils information the Joint Highway Research Project at Purdue University initiated several years ago the production of county engineering soil maps. Maps for 35 of the 92 counties have now been completed and in addition numerous portions of other counties have been mapped for special purposes. The completed engineering soil maps at a scale of 1 inch = 1 mile are available to the public at a price of $2 per copy. These maps when used with the agricultural soil maps

and geologic maps of the area can supply much of the information needed for wise land use planning and engineering facility planning.

In recent years an engineering characteristics section has been added to the agricultural soil maps to make them more complete. This has proved most valuable. Unfortunately neither such maps nor other engineering soil information are available for many counties in Indiana. The number of such counties, however, is decreasing each year and hopefully will be entirely reduced to zero within the next several years.

Soil is probably our most important resource. The few inches of soil developed over time supports humanity. Is man capable of conserving it? Experience of the past, as suggested by Walter Havighurst (2), does not particularly assure us of man's efforts. As he tells it:

"In 1823 a little Norwegian wanderer, named Cleng Peerson, walked overland from New York to the western territories. At Chicago he turned north. For six days he printed his steps in the blank sands of Lake Michigan. At evening he boiled his kettle at the lake's edge. He slept under the soothing drones of water. At the site of Milwaukee (three log huts, one of them empty) he found a tall man, naked to the waist, beside a cabin hung with traps and snowshoes.

"What will I find if I continue north from here?" Cleng Peerson asked.

Solomon Juneau was a fur trader. He knew the great twilight of the forests.

"Woods to the world's end," he replied.

"It was literally true. Woods for 600 miles. In that day six-sevenths of Wisconsin was forest. Two-thirds of Minnesota was forest. The upper peninsula of Michigan was all forest. And the forest began beyond Lake Superior, stretching away toward Hudson Bay. A country as big as France and every mile of it mysterious with forest twilight and haunted with the sound of running water . . . cedar, hemlock, tamarack and pine. A forest rich and vast enough for the needs of a nation forever.

"Try to find that forest now. . . .

"The timber cruisers came, walked through the country. . . . Behind them came the lumber kings and the great corporations. They logged off the forest in a furious assault. "Come and get it" was the cry of the lumber camp. . . . "Come and get it" was the slogan of the corporations. . . .

"How did the big corporations get hold of all of the timber? There was the Stone and Timber Act of Congress, designed to safeguard national resources. But the corporations found the loopholes, and they got the timber.

"Following the mining of timber came the fires that swept not only the fallen timber but the seeds as well . . . so there was no second growth. Conservation of this forest preserve came 50 years too late."

Will our soil resource experience the same fate from the demands of urban growth for the development of thousands of acres each day? A real hope exists that waste of this resource will be minimized if we utilize the techniques and philosophy of urban planning to develop

community policies for urban development which uses land for desirable and unfilled urban purposes. Good planning, however, requires a lot of information of many kinds, including information on soils, and its utilization in the planning process. This is where each of us can enter the battle, can assist with urban planning.

Literature Cited

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