Engineering and Environmental Geology for Land Use Planning in Hamilton County, Indiana

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Introduction

Many natural aspects of the land must be considered when developing detailed maps for application to land use planning. These include soils, topography, geology, drainage, ground water and present land use. A detailed study of Hamilton County, Indiana provides planners with an overview presented in map, table and text format (4). The materials can be used singly or in combination for various land use evaluations. Reported here is a summary of that study indicating the procedures involved and the primary results obtained.

Hamilton County is located in central Indiana north of Indianapolis, and is bordered by Boone, Clinton, Hancock, Madison, Marion and Tipton Counties. Its population is about 60,000, and the area is undergoing rapid expansionary development. This growth has produced an immediate need for a study such as this on the geology and existing processes likely to be of import to proper land use planning.

Methodology

A review of literature concerned with urban planning, land use and engineering and enivronmental geology was undertaken to determine the most important aspects needed for consideration in land use planning.

Mapped general information topics included generalized topography, bedrock geology and topography, drainage channels and watershed boundaries. Map topics useful for land use planning include surficial geology, seismicity, glacial drift thickness, soils associations and series, ground water characteristics, and present land use. Specialized land use maps were prepared and included septic tank absorption field suitability, sanitary landfill site suitability, and materials resources.

All maps were initially prepared on a 1:63,360 scale base map of Hamilton County to provide for sufficient detail. For presentation, these were reduced to 1:225,000 scale.

Numerous sources of information were consulted, compiled and modified in the preparation of the topical maps. USGS 7½-minute topographic quadrangles provided information for the maps of topography, drainage channels and watershed boundaries, and present land use. Present land use was modified using air photos of the Soil Conservation Service (SCS).

Bedrock geology and topography were obtained and modified from: 1. USGS 1°x2° geologic quadrangle maps (5, 10, 16, 17); 2. unpublished

field maps of the Indiana Geological Survey (IGS) in Bloomington, Indiana; 3. ground-water well logs on open file at the Indiana Department of Natural Resources, Division of Water (DNR); 4. seismic survey data of the IGS; and 5. a published map of bedrock topography of northern Indiana (6).

Surficial geology was modified from the USGS 1°x2° geologic quadrangles using field maps of the IGS. Glacial drift thicknesses were modified from a published map (15) using water well logs at the DNR. Landsat I satellite imagery of Hamilton County was included and discussed relative to buried preglacial valleys underlying poorly drained soils. A fence diagram correlating glacial deposits throughout the county was prepared from water well logs.

A general soils map (12) was included with a table of the engineering characteristics of the soil series in the county.

Water well records were used in preparing the ground water map.

Sanitary-landfill, site-suitability was prepared using previously prepared maps of this study and guidelines developed from several sources (2, 3, 13). Septic tank absorption field suitability was prepared using the detailed soil maps of the SCS (12). Materials resources were determined from previously prepared maps of this study and several IGS publications (1, 7, 8, 9, 14).

Results

The maps, tables and text of the complete report (4) can be used for various phases of land use planning in Hamilton County. The information is generalized and should only act as a starting point for planning, rather than as a replacement for specific onsite investigations.

Presently, the county has 80% of its acreage in farmland. A map of present land use (Figure 1) locates urban areas, pipelines, transportation systems and other cultural features. Developing industries and residential developments are best located where easy access to the area exists. This information is valuable in determining where future growth may occur by observing present and past trends of expansion.

A map of the general soil associations of Hamilton County (12) provides an overview of the soil types, textures, parent materials and drainage characteristics and slopes. Because of the importance of soils information to most aspects of land use, a more detailed map or analysis of specific sites is warranted (12).

Figure 2 shows areas of the county suitable for proper operation of septic tank absorption fields, which correlate well with the well-drained soil series. Most of the county has poorly drained soils, thus this map can be utilized to predict areas where wetness may be a problem for engineering operations.

Figure 3 shows the surficial geology of the county, which, except for a few small bedrock outcrops, is due entirely to Pleistocene glacial deposition. Six separate geologic units have been identified at the surface, and several others exist in the subsurface. A few of these units are of economic significance, particularly as a source for sand and

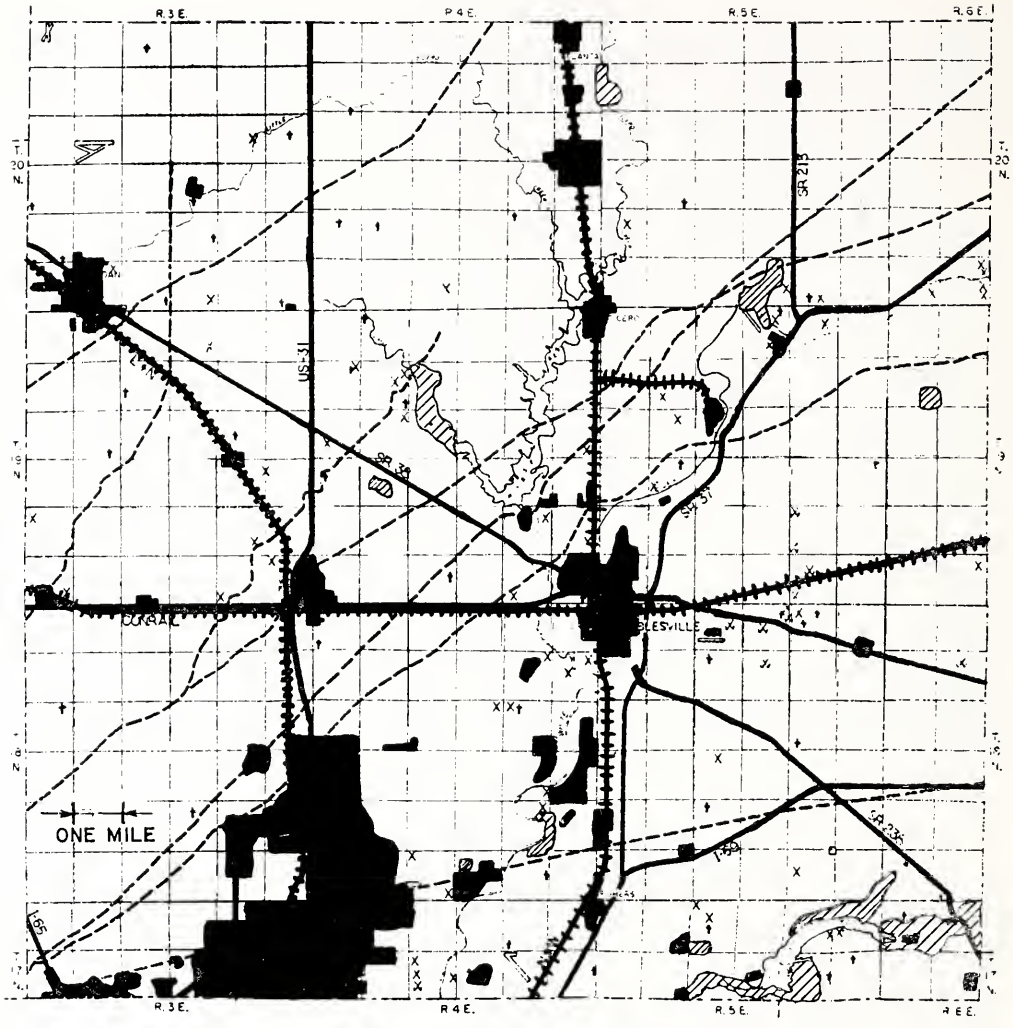

FIGURE 1. *Present land use in Hamilton County.*

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Airports
Cemeteries
Gravel Pits
Rock Quarries
Railroads
Interstate Highways
State, U.S. Highways
Pipelines, Oil, Gas and Products
Forests, Woodlands
Urbanized or Residential
Undeveloped or Agricultural

Information taken from USGS topographic quadrangles, SCS soil survey of Hamilton County (Hosteter, 1978), Burger, Keller and Wayne (1966) and recent aerial photos (1971)

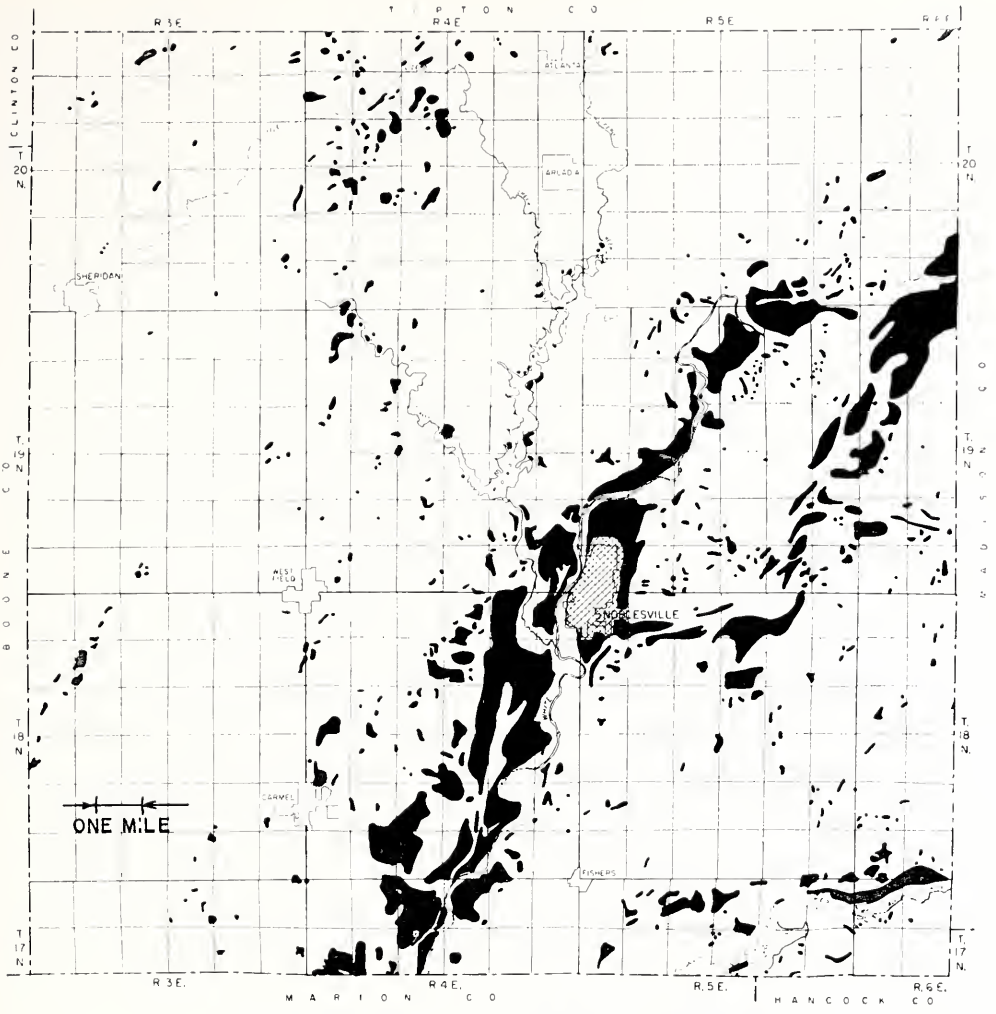

FIGURE 2. *Septic tank absorption field suitability.*

FIGURE B. *Septic tank absorption field suitability.*

Areas covered with soils with good permeabilities considered suitable for proper function of septic systems

Map modified from Hosteter (1978).

Cross-hatched area same as back.

gravel aggregates. Glacial outwash deposits, Qgv, and recent alluvial deposits, Qsa, provide the best sources for sand and gravel. Esker and kame deposits, Qgk, may provide locally significant amounts of aggregate material. Paludal muck, Qgm is a source of some peat, marl, muck and clay, but the unit is better as an indicator for underlying sand and gravel deposits. Bog and swamp deposits, Qmp, provide peat and other organic materials. Glacial till, Qt, is the principal deposit covering the county which may locally provide aggregates, clay and organic materials, but is generally considered to have low economic value.

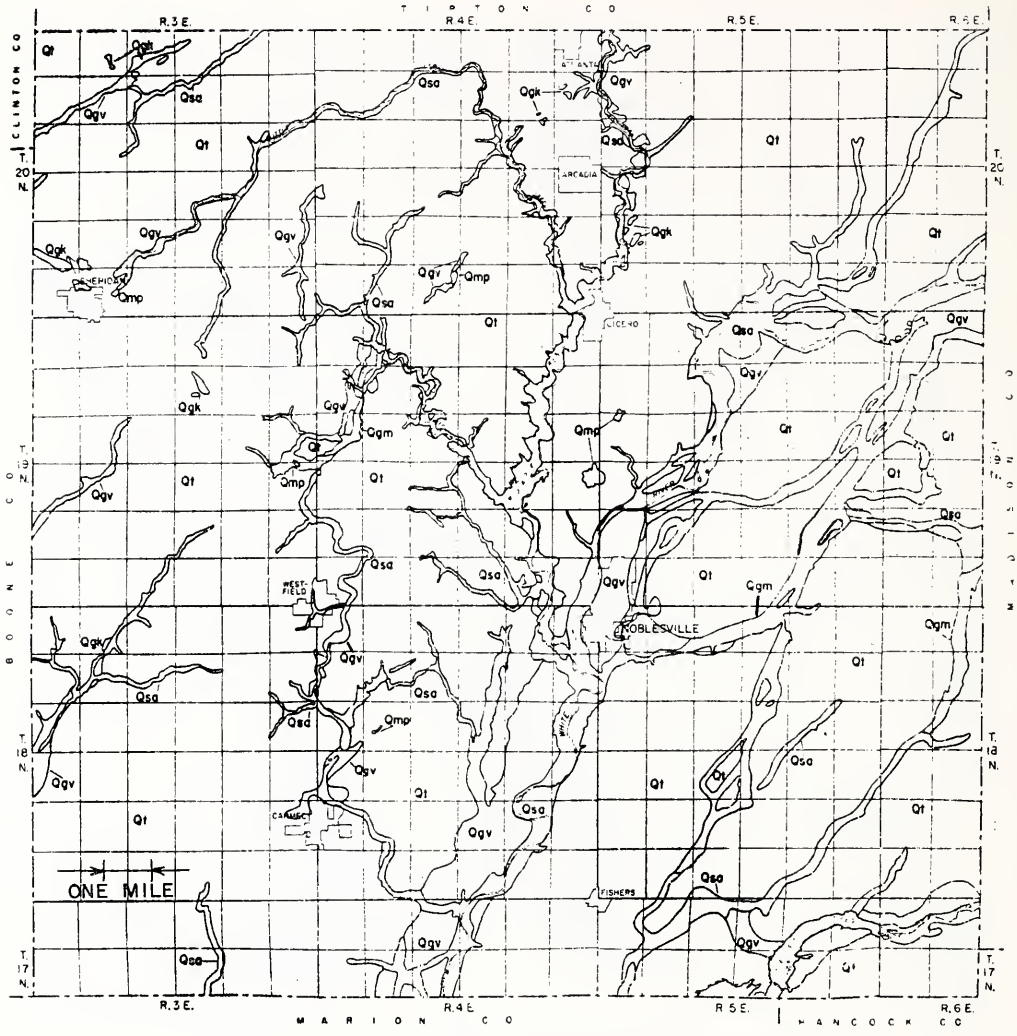

FIGURE 3. *Surficial geology of Hamilton County, Indiana.*

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RECENT	Martinsville Formation	Qsa—Alluvial silt, sand and gravel along present floodplains
		Qgm—Paludal muck or clay overlying sand and gravel
		Qmp—Paludal muck overlying peat or marl
QUARTERLY	Atherton Formation	Qgv—Outwash sand and gravel
	Trafalgar Formation	Qt—Glacial till
		Qgk—Sand and gravel in kames and eskers
SILURIAN		S—Limstone bedrock

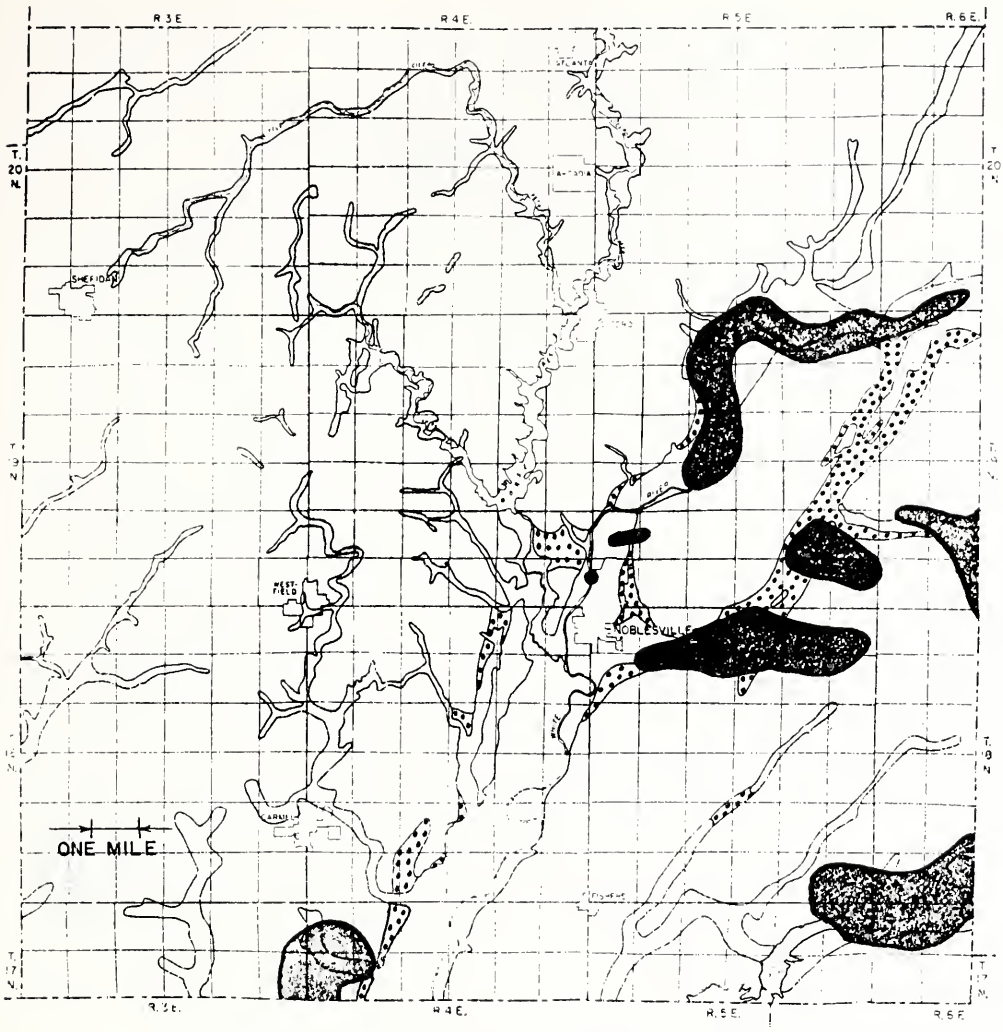

FIGURE 4. *Mineral resources of Hamilton County.*

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Sand and Gravel Potential Deposits

Rock, Areas Where Shallow Bedrock Exists (Less Than 50 Feet)

Peat, Marl and Muck

Several areas in the county are underlain by shallow limestone bedrock or sand and gravel deposits which are of economic significance. Figure 4 shows the material resources available in the county. Rock sources are considered valuable where limestone bedrock is within 50 feet of the surface.

Developments for industry or residential purposes require a good supply of water. Two surface water reservoirs owned by the Indianapolis Water Company, Morse and Geist Reservoirs, are present in

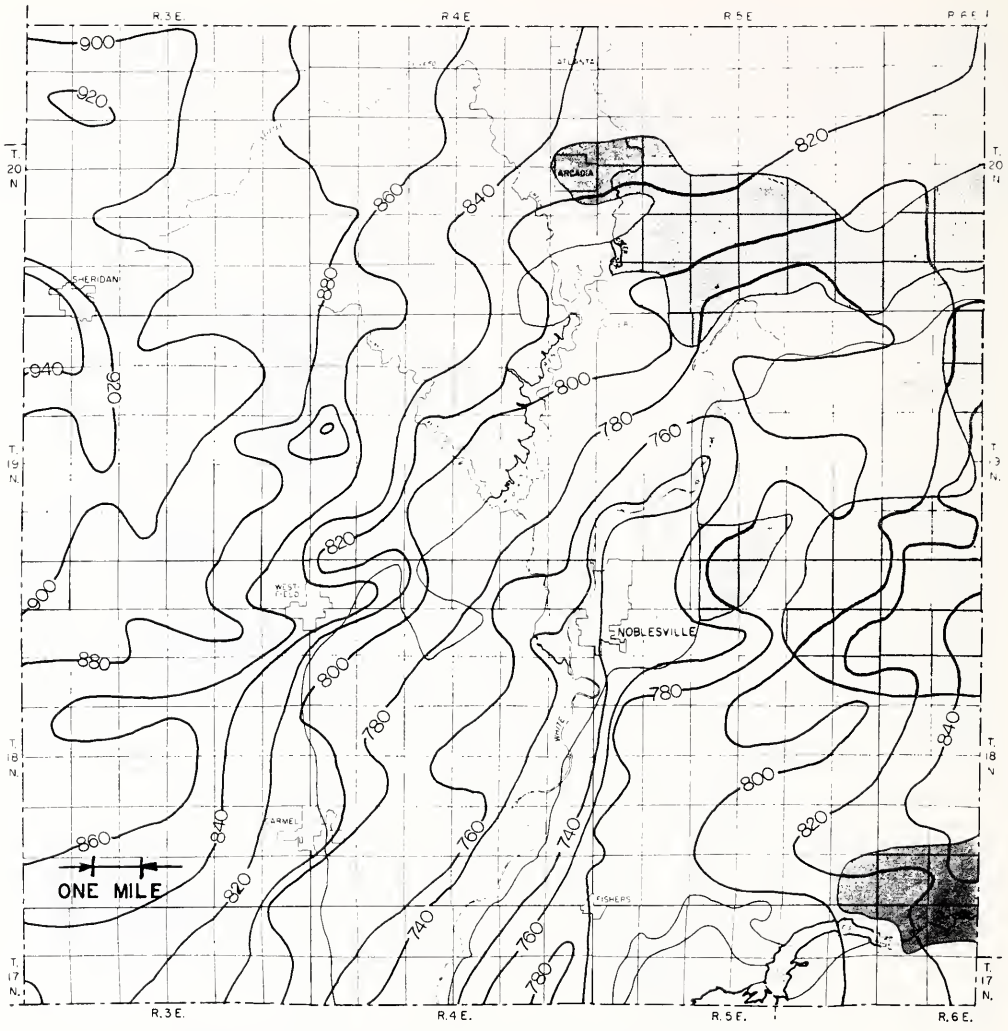

FIGURE 5. *Ground water availability and static water levels.*

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Contour Interval 20 feet

Areas where wells tap rock aquifers and some sand and gravel aquifers

Areas where wells tap sand and gravel aquifers, and some rock aquifers

Boundary of Principal Pleistocene Aquifer

Data sources were water well logs on open file at Indiana Department of Natural Resources, Division of Water at Indianapolis, Indiana.

Hamilton County. Although used as water supplies the principal source of water is ground water, which represents a vast, untapped resource in this area. Ground water availability in Hamilton County has been detailed in an atlas by the Department of Natural Resources, Division of Water in Indianapolis (17). Figure 5 shows general availability of ground water as well as the contoured elevations of the static water levels in wells throughout the county. The major source of water is the Principal Pleistocene Aquifer, composed of glacial outwash and alluvial sands and gravels. From this map and topographic information depths to static water levels can be determined, enabling one to predict lift requirements of well pumps and to interpret general ground water flow which occurs perpendicular to the water-level contours. Flow directions are important in siting water supply wells, which should be upgradient to sources of contamination such as sanitary landfills or septic tank absorption fields. Sanitary landfills should not be located such that regional ground water flow is through the fill material.

As Hamilton County becomes more urbanized, there will be a great need for properly planned sites for solid waste disposal. Presently, sanitary landfills are the accepted method of dealing with the majority of municipal and many industrial wastes. Figure 6 shows areas of the county where certain limitations exist for siting sanitary landfills. Several limiting parameters are used for designating site suitability including: 1. high permeability of existing surface or near-surface geologic materials; 2. extent of floodplain; 3. existence of limestone bedrock within 50 feet of the base of the completed fill; and 4. presence of aquifers within 50 feet of the base of the fill.

Conclusions

A brief overview has been presented to aid in the general land use planning of Hamilton County, Indiana. Using the extensive inventory of the county (4), planners can make more appropriate decisions related to land use. Before any final determinations are made, detailed onsite investigations should be carried out. However, the information in this report provides a suitable starting point for analysis and consideration of geologic and other physical factors important for proper land use.

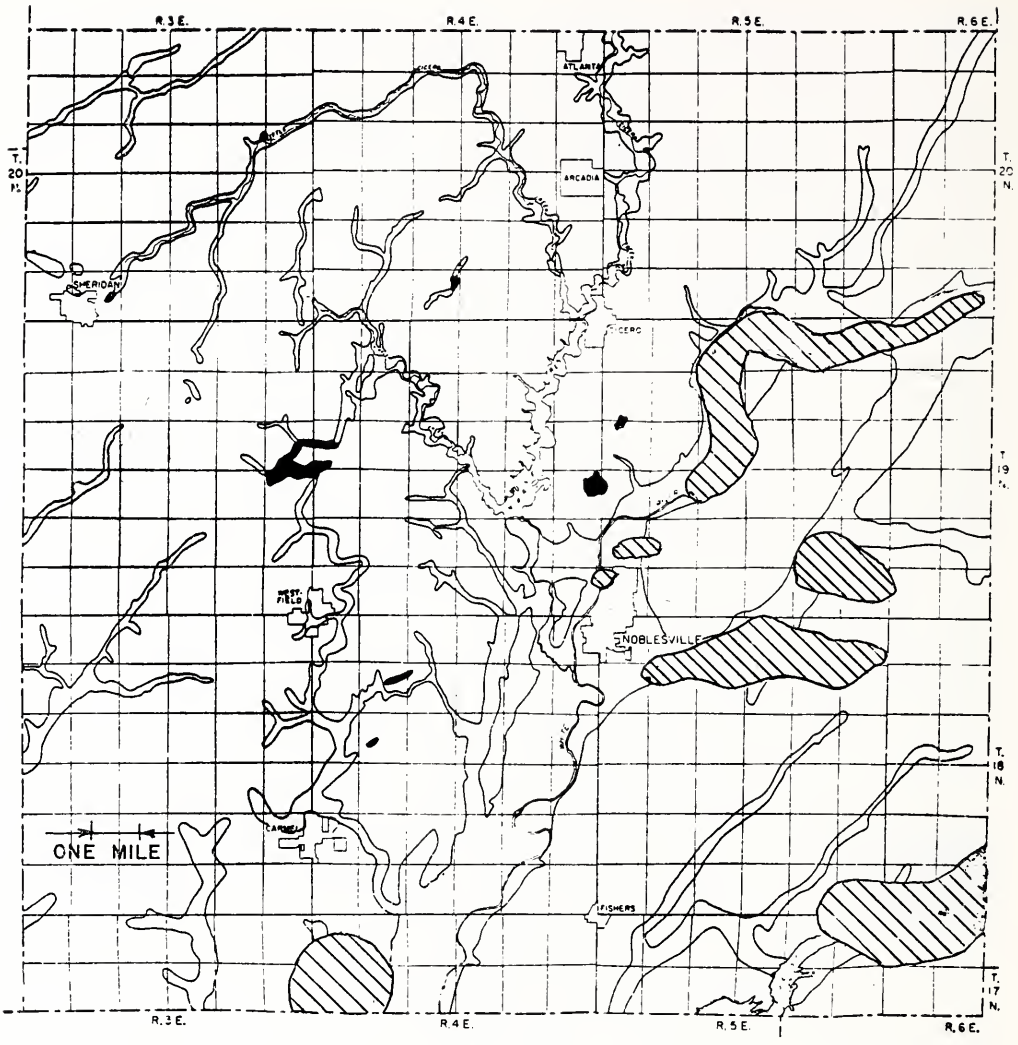

FIGURE 6. *Santiary landfill site suitability.*

FIGURE 6. *Sanitary landfill site suitability.*

Areas where severe limitations exist due to sand and gravel at surface, extreme permeability of materials, flooding, shallow aquifers or lack of adequate cover materials.

Areas where moderate to severe limitations arise from shallow (less than 50 feet) limestone bedrock.

Areas where moderate to severe limitations arise from buried, shallow sand and gravel (less than 30 feet).

Areas where slight to moderate limitations arise. Mostly till and impermeable soils cover these locations.

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