**SCHOOL OF
CIVIL ENGINEERING
INDIANA
DEPARTMENT OF HIGHWAYS**

JOINT HIGHWAY
RESEARCH PROJECT
JHRP-83-11

ENGINEERING SOILS MAP OF
HANCOCK COUNTY, INDIANA

E. M. Gefell

PURDUE UNIVERSITY

Final Report

ENGINEERING SOILS MAP OF HANCOCK COUNTY, INDIANA

TO: H. L. Michael, Director
Joint Highway Research Project

August 30, 1983

Project: C-36-51B

FROM: Robert D. Miles

File: 1-5-2-71

Attached is the Final Report on the "Engineering Soils Map of Hancock County, Indiana." The soils map and report were produced by Mr. E. M. Gefell, Research Associate on our staff, under the direction of Professor Robert D. Miles.

This is the 71st county engineering soils map completed by the Airphoto Interpretation and Site Selection Laboratory. Mr. Gefell developed this map and report using aerial photographs, literature, IDOH soil borings and limited field studies. The map and report are valuable resource material for planning and development of engineered facilities in Hancock County.

The Report is presented to the Board as evidence of completion of the Hancock County engineering soils mapping project.

Sincerely,

Robert D. Miles /ms

Robert D. Miles
Research Engineer

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Final Report
ENGINEERING SOILS MAP OF HANCOCK COUNTY, INDIANA

by

E. M. Gefell
Research Associate

Joint Highway Research Project

Project No.: C-36-51B

File No.: 1-5-2-71

Prepared as Part of an Investigation

Conducted by

Joint Highway Research Project
Engineering Experiment Station
Purdue University

In Cooperation with

Indiana Department of Highways

Purdue University
West Lafayette, Indiana
August 30, 1983

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All airphotos used in connection with the preparation of this report automatically carry the following credit line: photographed for Commodity Stabilization Service, Performance and Aerial Photography Division; United States Department of Agriculture.

Engineering Soils Map
of
Hancock County, Indiana

Introduction

The engineering soils map of Hancock County, Indiana (see Figure 1) was produced primarily by interpretation of aerial photographs. A photomosaic, shown in Figure 2, was constructed with 1939 aerial photographs and the land form - parent material associations delineated by stereoscopic inspection. Aerial photographic interpretation was done in compliance with accepted principles of observation (1)*. The aerial photographs used were taken for the U.S. Department of Agriculture and were printed at an approximate scale of 1:20,000.

The Agricultural Soil Survey of Hancock County (2) was used as a cross - reference to check soil boundaries and as a source of additional climatic, transportation, population, drainage, occupational and other data about the county. Several field trips were taken to the county to verify aerial photographic interpretations of land forms, parent materials, and surface soil textures and to resolve ambiguous details. Additional soil boundary modifications were made based on soil sampling and other field reconnaissance work. Standard symbols developed by the staff of the Airphoto Interpretation Laboratory, School of Civil

* note: numbers in parenthesis footnote references.

Figure 2. 1950 Photomosaic
of Hancock County, Indiana

1 1/2 0 1
Scale in Miles

Engineering, Purdue University were used to identify the land form - parent material associations, surface soil textures, and other miscellaneous areas (eg., gravel pits, lakes and ponds, etc.) on the engineering soils map. The map and report were part of an on - going effort to complete a comprehensive, county by county engineering soils survey of the State of Indiana using a standard set of symbols. All map units of any given county were to correlate with those of all adjacent counties. In some places, this author's interpretations of land forms and parent materials did not match exactly with the interpretations of others. Where these disparities occurred, every effort was made to maintain the continuity of the soil units in question in the transitional zone near the county lines.

The county drainage maps were generally used to make the engineering soil base maps. However, due to discrepancies found between the Hancock County Drainage Map and adjacent completed engineering soil maps (due to shrinkage and stretching of the original cloth copy) the recent General Highway and Transportation Map of Hancock County (1978) was used as a base instead.

Description of The Area

General

Hancock County is located in east - central Indiana and is basically rectangular in shape, being offset somewhat to the east in the northern half in a right angle, stair - step manner (see Figure 1). Hancock County is bordered on the west by Marion

County, to the north by Hamilton and Madison Counties, to the east by Henry and Rush Counties, and to the south by Shelby County. It has an area of approximately 195,000 acres or 307 square miles (2), with a maximum north - south distance of 17 miles and a maximum east - west distance of about 19.5 miles. The City of Greenfield, located in south - central Hancock County about 20 miles east of Indianapolis, is the seat of government. The City of Fortville, located about 11.5 miles north - northwest of Greenfield, and Cumberland, located approximately 10.0 miles to the west are the other major centers of population in the county. Other smaller towns or cities include New Palestine, Philadelphia, McCordsville, Shirley, and Charlottesville. Total county population according to the 1980 census is 43,939, of which 27,777 lived in areas classified as rural (3). Population data for the townships and major urban areas in the county are shown in Table 1.

Table 1. 1980 Population Data For Hancock County (3).

<u>City</u>	<u>Population</u>
Fortville	2,787
Cumberland	3,375
Greenfield	11,439
<u>Township</u>	
Blue River	1,201
Brandywine	1,658
Brown	2,703
Buck Creek	4,675
Center	16,135
Green	1,686
Jackson	1,884
Sugar Creek	8,114
Vernon	5,884

Table 2 shows the population growth for Hancock County and the City of Greenfield between 1830 and 1980.

Table 2. Population Growth Of Hancock County, (1830 - 1980)(4).

Year	Hancock Cty.	Greenfield	Year	Hancock Cty.	Greenfield
1830	1,436		1910	19,030	4,448
1840	7,535		1920	17,210	4,168
1850	9,698		1930	16,605	4,188
1860	12,802		1940	17,303	4,821
1870	15,123		1950	20,332	6,159
1880	17,123		1960	26,665	9,049
1890	17,829	3,100	1970	35,096	9,986
1900	19,189	4,489	1980	43,939 (3)	11,439 (3)

Hancock County is served by both road and railway transportation facilities. Several railway lines cross the county, providing railway links to nearly anywhere in North America outside the county. The major east - west roadways in the county are I - 70 and US 40. US 52 crosses the southwest corner of the county and US 36 crosses the northwest corner of the county. SR 9 carries the bulk of the north - south traffic. Small airports are located at Greenfield and McCordsville, and a larger facility is located near Mt. Comfort (2). Additional smaller landing strips are found scattered throughout the county.

Most of the land in Hancock County was in agricultural use in 1979 (5). Urban and forested land comprised most of the remainder of the county. Table 3 shows 1979 land use distribution as determined by the Indiana State Services Planning Agency.

Table 3. 1979 Land Use Data For Hancock County (5).

Land Use	Acres

Agricultural	181,090
Forest	10,230
Urban	8,670
Water	390
Barren	100
Other	360

200,840 total.	

Agriculture was the largest industry in Hancock County (2). There were no major heavy industries, however, many residents worked in factories and other businesses in Indianapolis and Anderson. A pharmacology research company located just west of Greenfield was the largest single industrial employer in Hancock County. Hogs were the main livestock raised, followed by feeder and dairy cattle.

Most of the water used for industrial and municipal purposes in Hancock County was obtained from water wells which intersected sand and gravel layers in the glacial drift (4). Few wells exceeded 150 feet in depth and yields of 750 gpm were common. The maximum recorded yield in the county as of 1975 was 1,000 gpm from wells near Greenfield. Wells which penetrated bedrock had

maximum yields of approximately 100 gpm. Bedrock of Devonian age generally out - produced formations of Silurian age. Surface water was used only nominally as of 1975 (4).

Cllimate

Hancock County, Indiana had a humid continental climate and was on the fringe of the area whose weather was influenced by the Great Lakes (2). Cool, Canadian air masses alternated with tropical air masses from the south providing the area with an invigorating and variable climate. Seasonal temperature changes were moderate, while extreme temperature fluctuations on a day - to - day basis were not uncommon. Climatological data recorded at the Greenfield weather station between 1934 and 1963 are shown in Table 4.

A record high of 109^o F was set at the Greenfield weather station in July, 1936 (6). The lowest temperature recorded was -18^o F in January, 1963. The mercury rose above 90^o an average of 34 days every year and remained below freezing an average of 28 days per year.

Precipitation was rather evenly distributed throughout the year, although that which occurred during the spring and early summer generally exceeded that which fell in the fall and winter months. Average annual precipitation was 38.39 inches (6). The probability of unusually heavy rains occurring in short periods of time is shown in Table 4. Snowfall generally averaged about 22

LATITUDE 39° 47' N.
LONGITUDE 85° 46' W.
ELEV. 900 FT.

TABLE 4. CLIMATOLOGICAL SUMMARY (6)

STATION GREENFIELD, INDIANA

MEANS AND EXTREMES FOR PERIOD 1934-1963

Month	Temperature (°F)							Mean degree days	Precipitation Totals (inches)							Mean number of days					Month	
	Means			Extremes					Mean	Greatest daily	Year	Snow, Sleet					Precip. 10 inch or more	Temperatures				
	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year					Mean	Maximum monthly	Year	Greatest daily	Year		90° and above	32° and below	32° and below 0° and below		
																						Max.
(a)	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	27	27	27	27	27
Jan.	36.0	21.2	29.6	72	1943	-18	1943	1076	2.90	2.36	1937	3.4	12.0	1938	7.0	1938	5	0	9	27	27	27
Feb.	40.9	22.0	32.0	69	1934*	-18	1931	913	2.29	2.07	1930	1.0	13.0	1942	7.0	1941	5	0	7	24	24	24
Mar.	50.6	30.4	40.5	83	1938	-6	1943	269	3.55	2.20	1938	4.9	16.0	1940	8.0	1948	8	0	2	19	19	19
Apr.	62.9	40.8	51.9	89	1942	17	1930	293	3.66	3.03	1948	7	5.3	1937	5.0	1937	8	0	0	6	6	6
May	74.3	51.3	62.8	96	1934	27	1947	149	4.39	2.87	1947	7	7	1930	7	1930	9	1	0	4	4	4
June	83.5	60.8	72.2	104	1934	38	1945	21	4.30	2.30	1938	0	0	0	0	0	8	9	0	0	0	0
July	87.5	64.1	75.8	108	1938	45	1942	0	3.82	2.53	1935	0	0	0	0	0	8	11	0	0	0	0
Aug.	86.0	62.5	74.3	104	1938	41	1948	9	2.74	2.48	1938	0	0	0	0	0	5	9	0	0	0	0
Sept.	79.6	55.7	67.4	103	1939	29	1942	75	3.04	2.72	1935	0	0	0	0	0	5	4	0	0	0	0
Oct.	68.1	44.2	56.2	91	1935	20	1932*	298	2.41	2.75	1939	7	7	1942*	7	1942*	3	0	0	3	3	3
Nov.	51.2	32.8	41.9	81	1930	-2	1930	687	2.82	3.40	1935	1.9	8.3	1930	4.0	1938*	5	0	2	24	24	24
Dec.	39.8	23.5	31.7	88	1931	-14	1930	1017	2.17	1.53	1936	3.8	14.3	1935	6.5	1943	4	0	8	25	25	25
Year	43.5	42.5	53.0	108	July 1938	-18	Jan. 1936	1404	28.39	3.72	Sept. 1935	21.6	16.0	Mar. 1940	9.0	Mar. 1949	72	34	28	130	130	130

(a) Average length of record, years.

† Trace, an amount too small to measure.

** Base 65°F

* Also on earlier dates, months, or years.

* Less than one half

CLIMATE OF GREENFIELD, INDIANA

Greenfield, located in Hancock County in Central Indiana, has an unobscuring climate because of the frequent changes of the weather. Pleasant, cloudless days are interspersed with some rainy days throughout the year. Monsoon rains are unknown but rainfall is usually adequate in all seasons favoring a diversified agriculture. In the summer when moisture utilization is high, a dry month of below normal rainfall affects lawns, pastures, and crops.

Weather changes every few days come from the passing of weather fronts and associated centers of low and high air pressure. In general, a high brings lower temperatures, lower humidity and sunny days. An approaching low brings increasing temperatures, increasing southerly wind, higher humidity, and commencement of rain or showers. This activity is greatest in the spring and least in late summer and early fall.

Precipitation is rather evenly distributed throughout the year, a happy contrast to some areas of the United States that have a "dry season" and require irrigation to maintain green vegetation. The table of monthly rainfall for past years in this report shows the variation of rainfall that may be expected. There is a tendency for spring and early summer rains to exceed winter precipitation. The spring rains are very reliable insuring near maximum soil moisture going into summer when evaporation losses exceed rainfall and dry soils become more probable. A severe drought has never been experienced. About one-third of the annual rainfall flows into streams and out of the area. Future needs may require conservation of this water.

The probability for unusually heavy rains in just a few hours is indicated by a weather study of the area:			
Frequency in 100 years	Rain in 1 hour	6 hours	12 hours
5	2.4	4.0	4.8
10	2.1	3.3	3.8
20	1.7	2.8	3.2

Snowfall has varied considerably. Snow occurs in the summer. Some winters have much snow and others have very little. An occasional snow storm may happen toward and along roads but at the same time the snow blanket protects winter grains from the very cold air that usually follows. Heaviest snow storms are those out of the northwest. In these cases northwesterly, abundant moisture flows in from the Gulf of Mexico. A stream out of the northwest, with an inward flow of colder, drier air, leaves less snow. Some winters are thus cold but snowfall is normal or less.

Relative humidity is not measured at this station but estimates are possible from the climatology of the area. Relative humidity varies on sunny summer days from a percent in the 40's in the early afternoon to the 90's about sunrise. Relative humidity rises and falls much as temperature does during a typical day but the highest percent usually occurs with the minimum temperature and the lowest percent with the maximum temperature. A cold front is next in importance in changing relative humidity downward.

Winds blow most frequently from the southwest, however, in one or two of the winter months, prevailing winds are northwest. Damaging winds have three sources. In the order of diminishing areal coverage but increasing intensity, they are: low winds arising through the region, thunderstorms, and tornadoes. Only 9 tornadoes have been reported in the county since 1918. Very few were of sufficient size to injure people and property. Thunderstorms, including incidences of lightning and thunder, occur about 27 days of the year. Most of these occur in the spring and early summer. They are seldom so severe as to cause loss of life, property, or crops. Death dealing snow or fog is unknown.

Heating degree days in the above table provide a comparative number for calculating heating requirements between different places and different times. Fuel consumption for heating is proportional to degree day totals, so a month with twice the heating degree days of another month requires twice as much fuel for heating. Degree days for a single day are obtained by subtracting the mean temperature from 63 degrees.

The growing season (defined here as the number of days between the last spring and first fall temperature of 32°F) averages 177 days in length. The season is 193 days or more in 100 of the years, 172 days or more in 25% of the years, less than 140 days in 25% of the years, and less than 145 days in 100 of the years.

Many days of the year are nearly ideal in temperature. A few days, in the summer when temperatures exceed 90°, or decline below zero in the winter, tend to obscure this fact. The fall season is considered by many as the best time of year for outdoor activities. Spring is also a favorable season but actually this season has more days of rain and thunderstorms. In the fall the atmosphere is total peace and quiet. Air and soil temperatures are warmer in autumn than any other time of the year, thus, convective activity is diminished. Heavy dew are sunny and showers are less frequent.

Table 4, continued.

Average Temperature (°F)

Total Precipitation (Inches)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1916	33.7	31.8	32.5	32.0	32.1	32.3	31.2	30.6	27.8	24.6	21.3	18.4	32.80
1917	31.1	30.8	30.5	30.5	30.7	30.6	29.0	27.8	24.6	21.3	18.4	15.9	31.70
1918	27.8	27.2	26.7	26.5	26.0	25.0	24.7	24.1	21.0	18.4	15.9	13.4	26.06
1919	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.00
1920	33.8	31.6	32.2	32.6	32.6	32.6	31.6	30.6	27.2	24.6	21.3	18.4	31.44
1921	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.1	32.10
1922	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1923	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1924	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1925	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1926	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1927	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1928	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1929	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1930	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1931	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1932	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1933	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1934	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1935	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1936	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1937	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1938	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1939	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1940	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1941	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1942	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1943	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50
1944	29.8	27.0	25.0	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.5	24.50

STATION HISTORY

This study of local climate is possible because citizens of the community for many years previously donated a few minutes a day, seven days a week, reading and recording weather information from government instruments. The Greenfield weather station has been located at the H. S. Post Office since June 1, 1940, where William Harbaugh was observer until his retirement on October 8, 1963. Charles R. Shapp is presently taking observations. Earlier observers, dates of service, and direction of station from the post office are: S. S. Bonta, February 1, 1887 to August 31, 1887; A. P. Bonta, September 1, 1887 to October 31, 1907; M. C. Gable, November 1, 1907 to June 30, 1911; Frank Karsch, July 1, 1911 to June 30, 1919, on high school grounds at North and Pennsylvania Streets; F. A. Miller, November 1, 1919 to June 30, 1926, 122 to 1/2 mile west; John S. Souder, June 1, 1926 to June 1, 1940, 3 blocks south and 4 blocks east.

EXTREMES AND DATES OF OCCURRENCE (1903-1963)

Month	Highest Temperature	Lowest Temperature	Greatest Daily Precipitation	Greatest Monthly Snowfall
Jan.	71° 1/26/53	-21° 1/19/50	3.36 1/14/33	21.5 1913
Feb.	70° 2/22/22	-16° 2/23/50	2.07 2/23/50	21.5 1910
Mar.	71° 3/27/38	-6° 3/8/53	2.85 3/14/22	31.5 1906
Apr.	71° 4/27/35	16° 4/23/23	3.10 4/14/22	3.5 1913
May	71° 5/31/36	27° 5/9/47	2.81 5/16/42	3 1950
June	106° 6/28/36	18° 6/5/45	6.44 6/27/32	
July	109° 7/11/36	65° 7/7/42	4.51 7/6/15	
Aug.	106° 8/27/36	60° 8/31/35	3.91 8/22/26	
Sept.	103° 9/16/39	26° 9/26/28	3.32 9/23/55	
Oct.	71° 10/6/51	35° 10/29/25	2.80 10/6/10	2.5 1917
Nov.	71° 11/1/50	-2° 11/25/50	3.40 11/16/55	9.6 1932
Dec.	71° 12/13/51	-18° 12/16/54	2.15 12/11/31	16.3 1915

This table summarizes for a 30-year period the dates when low temperatures such as 32°F. last occurred in the spring and first occurred in the fall. The average date is given in the 50% column. The table shows that the last temperature of 32° or lower in the spring occurs after May 4 in 25% of the years, and before October 8 in the fall. Probabilities for other temperatures are indicated. Reference: Risks of Freezing Temperatures--Spring and Fall in Indiana, by L. A. Schaal, J. E. Brunan, F. R. Morrison.

inches per year. The heaviest single day snowfall was eight inches recorded on March 10, 1949.

Winds ordinarily blew from the southwest, however, northwesterly winds sometimes prevailed in one or two months of the winter. Wind speeds 20 feet above the ground surface averaged approximately 7.0 mph during September and about 11.0 mph during winter and early spring.

Drainage

Hancock County lies entirely within the White River drainage basin of the State of Indiana (7). The northwest corner of the county lies in the White River basin proper while the rest of the county lies in the East Fork subdivision of that drainage system.

Locally, drainage was sub - parallel with the water flowing toward the southwest in a regionally dendritic pattern (see Figure 3). Preglacial rivers drained to the west in bedrock valleys (see Figure 4). Sugar and Brandywine Creeks flowed to the west in the northern half of the county before turning southwestward, apparently due to a broad band of ridge moraine located in the eastern half of the county. Clusters of infiltration basins and scattered kettles were common in areas of ridge moraine, some associated with deposits of peat and muck.

Several glacial sluiceways formed by the meltwaters of the Wisconsin glacial transected areas of ridge and ground moraine. The most prominent of these was associated with the

Figure 4. Map Showing Preglacial Bedrock Valleys and Present Drainage System (21)

present-day watercourse of Brandywine Creek. Some of the glacial sluiceways were occupied by underfit streams while others were apparently not drained. In some cases, water drained in opposite directions from a high point within a sluiceway (7).

The degradational processes of the Blue River and Brandywine and Sugar Creeks resulted in some of the most prominent relief found in the county. The Blue River was entrenched by the action of Wisconsin glacial meltwater and was subsequently partially filled by outwash sediments (4). The other large streams in the county, particularly Sugar and Brandywine Creeks, underwent a similar process but on a smaller scale.

No natural lakes were found in the county, however, man-made and natural ponds were found scattered throughout the area (7). Numerous ditches were excavated and several streams dredged to improve drainage conditions and free low-lying areas of standing water. Flooding was not uncommon along major streams, and depressions in the ridge and ground moraine were commonly subjected to seasonal flooding (ie., during the spring).

Physiography

Hancock County is located in the Till Plains section of the Central Lowlands physiographic province of the United States (8). It is located in the Tipton Till Plains region of the State of Indiana (see Figure 5).

FIGURE 5. Map of Indiana Showing Physiographic Units , Glacial Boundaries and Location of Hancock County. Modified from Indiana Geol. Survey Rept. Prog. 7, Fig. 1.

Topography

The topography of Hancock County (see Figure 6) was generally flat to gently undulating, broken occasionally by stream valleys and hummocky tracts of ridge moraine. Areas of kettle - kame topography were found in association with the ridge moraine and shallow, former glacial meltwater channels were found on flat areas of ground moraine between and intersecting with present stream valleys.

The greatest relief in the county, about 80 feet, occurs in the southeast corner of the county near the Blue River and its main tributaries, Sixmile and Nameless Creeks (4). The highest elevation, 1035 feet above mean sea level, occurs just north of the town of Shirley in the northeast part of the county. The lowest elevation, 781 feet, is found in the Sugar Creek Valley near the Shelby County line (4).

Bedrock Geology

The bedrock formations found beneath the overburden in Hancock County, shown in Figure 7, were of Silurian and Devonian age (4). The rock lithology of both ages was limestone or dolomite, however, strata of Silurian age was more argillaceous. A generalized stratigraphic column for central Hancock County is shown in Table 5.

The bedrock in Hancock County was overlain in most places by 50 to 250 feet of glacial drift (4). The thickness of the drift

CONTOUR INTERVAL, 50 FEET

FIGURE 6. TOPOGRAPHIC MAP OF HANCOCK COUNTY (4)

FIGURE 7. BEDROCK MAP OF HANCOCK COUNTY (4)

TABLE 5. INFERRED GEOLOGIC COLUMN FOR CENTRAL HANCOCK COUNTY (4)

Geological Units	Dominant Lithology	Range of Depth	Approximate Thickness	Elevation at Top of Unit
Glacial Drift	clay-till-s&g	0-150	150	900 (Surf. Elev.)
Devonian	ls-dolo	150-200	50	725
Silurian	dolo-ls-sh	200-350	150	675
Maquoketa	sh-ls	350-1000	650	500
Trenton	dolo-ls	1000-1150	125	-100
Black River	dolo-ls	1150-1500	350	-225
Chazy	sh	1500-1525	25	-575
Knox	dolo	1525-3025	1500	-600
Eau Claire	ss-sh-dolo-ls	3025-3625	600	-2100
Mt. Simon	ss	3625-4400	800	-2700
Precambrian	"granite"	4400	XXX	-3500

abbreviations: s&g = sand & gravel; sh = shale; ls = limestone; dolo = dolomite; ss = sandstone.

was primarily a function of the preglacial bedrock topography (see Figure 8) being generally thickest over old bedrock valleys and thinnest over old bedrock highs. There were no known outcrops in Hancock County at the time this report was written (7). A generalized geologic profile along I - 70, shown in Figure 9, illustrates the relationship between the glacial drift and the bedrock formations.

Hancock County lies just west of the apex of a large anticline known as the Cincinnati Arch (see Figure 10). The beds dip about 15 feet per mile to the southwest. The Fortville fault, a high angle fault with a displacement of about 50 feet, cuts across the northwest corner of the county.

Glacial Geology

Most of the overburden in Hancock County was deposited during at least three distinct glacial episodes. Material deposited by the earlier Kansan and Illinoian glacial periods was overlain by the more recent overburden deposited by the Wisconsinan glacial ice sheet which receded approximately 10 to 12 thousand years ago. Most of the glacial drift exposed at the surface was of Wisconsinan age, however, it is possible that some Illinoian (Butterville Formation) or Kansan (Cloverdale Formation) drift was exposed where relatively deep erosional cuts were made in the overburden by Six Mile, Nameless, Brandywine, and Sugar Creeks (9). The Wisconsinan drift, or Trafalgar Formation, was divided into the upper Cartersburg and lower Center Grove Till Members by

FIGURE 8 BEDROCK TOPOGRAPHY OF HANCOCK COUNTY (22)

FIGURE 9. GENERALIZED GEOLOGIC CROSS SECTION OF HANCOCK COUNTY
APPROXIMATELY ALONG I-70 (4).

FIGURE 10 REGIONAL BEDROCK STRUCTURE OF HANCOCK COUNTY, INDIANA (21)

a thin layer of fossiliferous silt known as the *Vertigo alphestris oughtoni* bed (9). Figure 11 shows the relationship between the various Pleistocene deposits in Hancock County.

Drift thickness varied from less than 100 feet to greater than 300 feet (see Figure 12) (10). Drift over 300 feet thick was found associated with a deep, preglacial bedrock valley found along the western county line. The drift was less than 100 feet thick in the southeast and northeast parts of the county. Drift thickness varied between 100 and 200 feet throughout most of the rest of the county.

Ridge moraine was found in the eastern half of the county whereas ground moraine predominated throughout the western half of the county. The ridge moraine mapped by the author correlated reasonably well with that mapped by Malott (11) and Leverett (12). However, the ridge moraine mapped by the author and shown on the engineering soils map which accompanies this report was found primarily in patches and isolated areas which were occasionally connected by narrow bands, except along the eastern county line where it was more contiguous. The ridge moraine mapped by Malott consisted of two tracts, one which skirted the eastern county line and another which stretched in an arc from the northeast corner to the southwest corner of the county. Infiltration basins and ice block depressions, some with associated peat and muck, were numerous in the generally more permeable, coarser textured ridge moraine. Large (> 10 acres) areas of highly organic topsoils located in swales in the ground moraine

FIGURE 11. FACIES OF THE TIPTON TILL
PLAIN GLACIAL DEPOSITS (9)

FIGURE 12. DRIFT THICKNESS OF HANCOCK COUNTY (10)

were more numerous than those found in the ridge moraine.

Outwash deposits in Hancock County consisted primarily of glacial sluiceway systems which were found predominantly in the central and western parts of the county. Some of the sluiceways were up to 3/4 of a mile wide, such as those associated with the present stream course of Brandywine Creek. Another major sluiceway system was associated with the upper reaches of Buck Creek in the northwest part of the county. Relatively long, narrow deposits of peat or muck were found associated with the Brandywine sluiceway system, the largest of which was located in sections 4 and 9, T16N, R7E. A broad band of outwash terrace was found adjacent to the Blue River in the southeast corner of the county. These outwash terrace deposits were part of extensive glacial valley - fill sands and gravels deposited by Wisconsin glacial meltwaters along the present course of the Blue River (4).

Kames and eskers were found throughout both the ridge and ground moraine. Clusters of kames were found in sections 16 and 28 and 29, T17N, R8E in the ridge moraine. Three large (ie., more than 40 acres) kames were located in sections 17 and 18, T16N, R7E.

ENGINEERING SOIL AREAS

Glacial Deposits

Glacial deposits in Hancock County, Indiana include ridge

and ground moraine. The ridge moraine is found primarily in the eastern half of the county while ground moraine predominated in the western half. Kames and eskers are considered glacial deposits but were herein discussed as glacio - fluvial deposits.

Ridge Moraine

Ridge moraine in Hancock County was generally well - defined and was characterized by hummocky topography with local relief which varied from about 10 to 30 feet. Kames within the ridge moraine stood up to approximately 30 feet or more above the surrounding land surface, while the bottom of small kettle ice block, or infiltration basins were found to lie 10 to 15 feet beneath the surrounding land surface.

Swells in the ridge moraine typically had a silt loam or sandy loam surface soil which extended to a depth of approximately 8 to 15 inches (2). The surface soil was underlain to a depth of about 26 to 44 inches by a clay loam with pebbles and some gravel. The basic underlying parent material of the ridge moraine was a silty loam-till with pebbles and some gravel. Boulders may be expected within the ridge moraine, sometimes appearing in clusters or "boulder trains". No such trains were documented in the literature reviewed nor were any suggested by the available borehole data. Areas where boulders appeared to be common were found associated with areas of past or present fluvial activity during field investigations and were located on the map which accompanies this report by a symbol listed under "Mis-

cellaneous" in the map legend. Swales in the ridge moraine were characterized by a silt loam or clayey-silt loam surface soil which extended to a depth of about 6 to 14 inches. A sandy loam was found beneath the surface soil to a depth of approximately 12 to 32 inches, which in turn was underlain by a silt loam with pebbles and some gravel which reached a depth of about 36 to 72 inches (2). A silty loam-till with pebbles and some gravel, the basic parent material of the ridge moraine, was found beneath the silt loam.

Generalized profiles developed from agricultural and roadway soil survey data are shown for both swells and swales in ridge moraine on the left-hand side of the engineering soil map.

Roadway soil survey data obtained from boreholes along S.R. 9 (13) in the ridge moraine about 1.5 miles north of Greenfield revealed the following generalized texture related variations with depth for that section of ridge moraine:

Table 6. Ridge Moraine Borehole Texture Data,
(boreholes 31,32,33,34) (13).

Depth(feet)	AASHTO	percent					
		Sand	Silt	Clay	LL	PL	PI
0.0 - 1.5	A - 4(0)	51	31	18	22	17	5
1.5 - 3.0	A - 6(10)	29	32	39	35	18	17
3.0 - 4.5	A - 4(0)	45	33	22	21	15	6
4.5 - 6.0	A - 4(2)	36	35	29	22	15	7

The borehole data indicated the generally sandy texture which was typical of the ridge moraine soils. Note the increase in plasticity between about 1.5 to 3.0 feet, a common phenomenon in the B - horizon where clay minerals and clay - sized particles tend to accumulate. For more detailed information for the numbered boreholes shown on the engineering soils map, refer to Appendix A in the back of this report.

Moisture content, specific gravity, and pH data obtained from analysis of soil samples taken from boreholes 31, 32, 33, and 34 and adjacent holes in ridge moraine are shown in Table 7. Figure 13 gives the grain size distribution, plasticity indices, maximum wet and dry densities, and optimum water content of a soil sample taken from the B - horizon in ridge moraine along S.R. 9 in Hancock County. The graph shows the relationship between dry density and CBR for the particular soil sample used.

Ground Moraine

Ground moraine in Hancock County was characterized by a gently undulating land surface wherein the relief generally did not exceed about 10 to 15 feet. The broad, extensive, nearly flat areas of ground moraine were broken occasionally by stream dissection, old glacial sluiceways, ice block depressions, sandy knolls or kames, and small tracts of ridge moraine, particularly in the north - central part of the county.

Table 7. Ridge Moraine Soil Property Data (13)

Map Borehole Number	Survey Boring Number	Station	Offset Line "0"	Sample Number	Depth (ft.)	Natural Moisture Content (%)	Specific Gravity	pH
31	1	162+00	21' Lt.	SS-1	1.0-2.5		2.69	7.2
32	2	165+00	23' Rt.	Bag	3.5-4.5		2.75	6.9
32	2	165+00	23' Rt.	SS-3	6.0-7.5	13.5		
32	2	165+00	23' Rt.	SS-5	11.0-12.5	31.0		
33	3	167+87	48' Rt.	SS-2	3.5-5.0		2.76	7.2
33	3	167+87	48' Rt.	SS-3	6.0-7.5	21.3		
	4	172+00	28' Lt.	SS-3	6.0-7.5	23.6		
	4	172+00	28' Lt.	SS-7	21.0-22.5	7.6		
34	5	175+00	27' Rt.	Bag	1.5-3.0		2.82	8.2
34	5	175+00	27' Rt.	JS-11	5.0-5.5	24.8		
	6	163+50	24' Lt.	JS-8	2.4-2.9	18.4		
	7	169+37	33' Lt.	SS-2	3.5-5.0	19.8		
	TP-8	163+50	24' Rt.	Bag 1 & 2	1.5-2.5		2.75	7.3

Figure 13. Ridge Moraine Soil Property Data for a Sample From the B-Horizon (13)

MAX. WET DENSITY: 130.1 pcf
 MAX. DRY DENSITY: 112.0 pcf
 OPTIMUM MOISTURE: 16.0 %

CLASSIFICATION: CLAY A-6 (12)
 4.8% GRAVEL
 23.4% SAND
 37.0% SILT
 34.8% CLAY

SIEVE SIZE	% PASSING
10	<u>95.2</u>
40	<u>89.8</u>
200	<u>71.8</u>

LL = 36.6
 PL = 17.8
 PI = 18.8

CBR = 1.6 %

LEGEND. ○ CBR At 0.1" Penetration
 △ CBR At 0.2" Penetration

Swells in the ground moraine were characterized by a silt loam surface soil which was underlain to a depth of about 12 - 34 inches by a sandy loam (2). A sandy-clay loam extended from an average depth of 24 inches to approximately 54 inches. A clay loam till with some pebbles and gravel, the basic parent material of the ground moraine, was found beneath the sandy - clay loam.

Swales in the ground moraine typically had a silt loam or silty - clay loam surface soil which was underlain at a depth of 8 to 24 inches by a sandy - clay loam. The sandy - clay loam was underlain at a depth of about 60 inches by a clay loam with some pebbles and gravel, the basic parent material of the ground moraine. Generalized profiles developed from agricultural and roadway soil survey data and field sampling are shown on the left - hand side of the engineering soils map which accompanies this report for both high and low topographic positions in the ground moraine. Profiles for all the other engineering soil areas subsequently described are also shown on the map.

The textural data shown in Table 8 were arrived at by averaging the values of several soil samples taken at various depths obtained from roadway soil survey borings made in ground moraine throughout the county.

Table 8. Ground Moraine Borehole Texture Data, (boreholes 2,3,4,5, 6,14,15,16,20,23, and 38) (14),(15).

Depth(feet)	AASHTO	percent			LL	PL	PI
		Sand	Silt	Clay			
0.0 - 1.5	A - 6	37	37	26	32	19	13
1.5 - 3.0	A - 7	21	40	39	51	23	28
3.0 - 4.5	A - 5	38	34	28	25	18	7
4.5 - 6.0	A - 6	41	28	31	32	17	15
6.0 - 8.5	A - 3	57	21	22	21	12	9
8.5 - 10.0	A - 6	31	37	32	28	16	12

The borehole data indicated that the texture of ground moraine soils was generally less coarse than ridge moraine soils (see Table 6). However, inspection of the AASHTO classification shows the ground moraine soil ranged from A - 3 to A - 7, indicative of the textural variations found within the heterogeneous deposits of ground moraine. Again note the increase in plasticity in the B-horizon at a depth of about 1.5 - 3.0 feet.

The engineering soil data shown in Table 9 and Figures 14 and 15 were obtained by analysis of soil samples taken from borehole #36 in the ground moraine. It should be understood, as previously mentioned, that the texture of soils developed in ground moraine can vary greatly and the engineering properties vary accordingly. The engineering soil properties shown, although site - specific, may provide the engineer with some idea of the kinds of values which might be expected for the tests indicated for samples taken from ground moraine in Hancock County.

Table 9. Ground Moraine Soil Property Data (15).

CBR TEST RESULTS

Station: 61+60 Boring #2
 Offset: 45' Rt
 Depth: 0.5-2.0
 Description: Dark Gray Clay Loam with trace of organic matter A-6(9)
 Max. Std. Proctor Dry Density 107.4
 Optimum Moisture: 17.8

Specimen	Average Water Content, %		Initial Dry Density, pcf	% Max. Dry Dens. pcf	Swell, %	CBR, %
	As Molded	After Soaking				
1	18.1	22.9	94.6	87.4	0.40	0.87
2	18.2	23.3	96.7	89.4	0.40	1.21
3	18.5	21.6	100.5	92.9	0.30	3.67
4	18.4	21.4	101.6	94.0	0.30	3.32
5	18.4	18.8	106.8	99.4	0.08	6.30
6	<u>18.3</u>	<u>19.2</u>	107.6	100.2	0.20	6.71
Average	18.3	21.2				
	<u>Dry Density, pcf</u>		<u>% Max. Dry Density</u>		<u>Selected CBR, %</u>	
	107.4		100		6.6	
	102.0		95		4.0	
	96.7		90		1.6	

Sample Description Dark gray clay loam with trace of organic matter A-6(9)

Test Type: Standard Proctor; Mold Size 4 in.

Hammer wt. 5.5 lbs.; Drop 12 in., 3 layers, 25 blows/layer.

Maximum Dry Density 107.4 lbs./cu. ft. Optimum Moisture 17.8 %

Remarks Max. Wet Density 127.5 pcf

Figure 14. Ground Moraine Soil Property Data (15).

Figure 15. Ground Moraine Soil Property Data(15).

Dry Density pcf	% Max. Dry Density	Selected CBR %
107.4	100	6.6
102.0	95	4.0
96.7	90	1.6

Depth: 0.5 - 2.0

Description: Dark Gray Clay, loam with
trace of organic matter A-6(9)

Max. Std. Proctor Dry Density 107.4

Optimum Moisture: 17.8

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Some Roadway borehole data for Wisconsinan age (Trafalgar Formation) till revealed a distinct increase in N-values between a depth of about 10 to 15 feet (19), presumably associated with the fossiliferous silt bed (9). An example of this phenomenon is given in Table 10 which lists N-values for a borehole made in Wisconsinan drift in Hancock County (19).

Table 10. Penetration Data for Ground Moraine (19)

Sample #	Soil Classification	N-value	depth(ft)
1	Brown clayey silt with trace gravel	15	3.5-5.0
2	Gray sand with gravel	55	8.5-10
3	Gray clayey silt with trace gravel	29	13.5-15
4	Gray clayey silt with trace gravel	28	18.5-20
5	Gray sand and gravel with silt	30	23.5-25
6	Gray sand and gravel with silt	33	28.5-30
7	Gray clayey silt with trace sand and gravel	41	33.5-35
8	(same as sample 7)	43	38.5-40
9	(same as sample 7)	42	43.5-45
10	(same as sample 7)	40	48.5-50

Table 11 gives the areal distribution of the pedalogical soil series which developed on ground and ridge moraine in Hancock County as a percent of total county area.

Table 11. Relative Distribution of Soil Series Developed on Ground and Ridge Moraine (2).

Soil Series	Percent of County Area
Brookston	33.0
Crosby	40.1
Miami	14.0

	87.1 total

Ridge and ground moraine comprised nearly 90 percent of the county surface area and were by far the predominant engineering soil areas in Hancock County. There were small inclusions of soil series other than the three primary ones shown in the ridge and ground moraine. The engineering properties of these and all other pedalogical soil series subsequently mentioned with regard to the engineering soil areas are listed in Appendix B of this report. Appendices C through F give soil characteristics useful for planning various engineering facilities.

GLACIO - FLUVIAL DEPOSITS

Glacio - fluvial deposits, as herein defined, included all land form - parent material associations deposited by waters derived from the continental ice sheets. Outwash terraces, glacial sluiceways, thin outwash - covered drift, and kames and eskers were considered the glacio - fluvial deposits found in Hancock County, Indiana.

Outwash Terraces

Outwash terraces were found in the southeast corner of Hancock County adjacent to the Blue River and along two of its main tributaries, Six Mile and Brandywine Creeks. Outwash terrace deposits differed from recent river terraces in that they were composed primarily of sediment (mostly sand and gravel) derived from the Wisconsin ice sheet and were deposited by meltwaters. Recent river terraces were composed of recently eroded sediments and outwash sands and gravels which had been reworked (ie., moved, abraided and further rounded) by post - glacial fluvial processes. The outwash terraces along the Blue River were generally broader and more extensive than those found along Six Mile and Brandywine Creeks and their contemporary counterparts, the recent river terraces.

Both recent river and outwash terrace deposits were formed by similar processes and were composed of comparable parent materials. Subsequently, similar soils developed on them. Outwash

terraces, in general, varied more greatly in texture laterally, (presumably because they were broader and were deposited by water which varied more in velocity and sediment size carrying capacity), and were generally more coarse and more poorly sorted than the recent river terraces. Outwash terrace deposits were commonly overlain by approximately 8 to 15 inches of a silt loam or sandy silt loam surface soil which was underlain to a depth of about 20 to 34 inches by a sandy - silt loam soil (2). Between about 26 to 48 inches was found a gravelly - clay loam which was underlain by stratified sands and gravel with some cobbles and boulders, the basic parent material of outwash terraces.

The primary pedological soil series which developed on the outwash terraces was the Ockley soil. Rensselaer and Westland soils were also found on the outwash terraces, however, they were developed in the low - lying sluiceway channels, current scars, and infiltration basins (2). Numerous operating and abandoned gravel pits were located on the outwash terraces. The Ockley soil series occupies about 2.5 percent of the surface area of Hancock County (2).

Glacial Sluiceways

Glacial sluiceways were most common in the ground moraine, however, they were also found in the ridge moraine and as braided stream - like channels on the outwash terraces. In some cases, streams occupied parts or all of old sluiceway systems or cut

across them, reworking the old sluiceway sediments and depositing new alluvial material. Present drainage appeared to be in opposite directions from a high point within some of the sluiceways and man - made drainage trenches were not uncommon to help facilitate the movement of water. Surface soils near the upper reaches of many small streams near the drainage divides were virtually analogous to undisturbed glacial sluiceway sediments, regardless of whether or not these present drainageways ever served as melt-water channels.

Sluiceways Over Outwash Terraces

Glacial sluiceways were found on the outwash terraces along the Blue River in the southeast corner of Hancock County. These sluiceways were characterized by a loam or silty - clay loam surface soil which was underlain at a depth of about 12 to 15 inches by a clay loam with pebbles which extended to a depth of about 36 to 48 inches (2). The clay loam graded into the stratified sand and gravel parent material of the outwash terraces through a one to two feet thick transitional zone. Several operating gravel pits were located in the sluiceways on the agricultural map sheets (2). The Westland, Rensselaer, and Whitaker pedalogical soil series were developed on the sluiceways over outwash terraces.

Sluiceways Within Ground and Ridge Moraine

Glacial sluiceways within ground and ridge moraine were characterized by a silty - clay loam surface soil which was underlain at a depth of about 12 inches by a clay loam with pebbles that extended to a depth of about 36 to 52 inches (2). The clay loam was underlain by a stratified sandy - silt loam with some gravel. The stratified sluiceway sediments, which may contain up to 10 percent gravel (2), were generally underlain at a depth of approximately 10 to 12 feet by a sandy loam or loamy till soil with some gravel, the basic parent materials of ridge and ground moraine, respectively.

Glacial sluiceways were not used extensively as a source of sand and gravel (2) with the exception of the sluiceway system associated with the present course of Brandywine Creek. Several ponds were found on the 1941 aerial photography where gravel pits were operating or were abandoned. Numerous additional gravel pits were located on the agricultural map sheets along the sluiceway system associated with Brandywine Creek. Roadway soil survey borehole texture data for Sluiceways are shown in Table 12.

Table 12. Sluiceways Textural Data (boreholes 11,25, and 30)(14),(16)

Depth(feet)	AASHTO	percent					
		Sand	Silt	Clay	LL	PL	PI
1.0 - 2.5	A - 7 - 6	22	50	28	42	22	20
2.5 - 4.0	A - 7 - 2	26	40	34	41	19	22
4.0 - 5.5	A - 6	52	29	19	28	14	14
5.5 - 7.0	A - 5	45	37	18	25	15	10
7.0 - 8.5	A - 4	62	27	11	19	17	2

The borehole data indicated the general increase in sand content with depth to 8.5 feet. The sluiceway sediments within the ground and ridge moraine areas may extend to a depth of 20 feet or more. Note also that the surface soils were of moderate plasticity. Table 13 shows the relative distribution of the pedalogical soil series which were developed on sluiceways in Hancock County, Indiana.

Table 13. Distribution of Soil Series Developed on Glacial
Sluiceways (2).

Soil Series	Percent of County Area
Rensselaer	1.5
Westland	0.5
Whitaker	0.3

	2.3 total.

Westland soils not associated with sluiceways were found on recent river and outwash terraces, however, these areas comprised a small amount of the total 2.3 percent of the county covered by the Rensselaer, Westland, and Whitaker soil series, the soils which developed on the glacial sluiceways.

Thin Outwash Over Drift

Numerous areas where water had deposited a thin (less than 5 feet) layer of outwash or alluvial material were found in Hancock County along present and abandoned watercourses. These areas differ from terrace deposits in that the ground surface is not as smooth, presumably because the blanket of alluvial material was not thick enough to mask the former land surface. Areas of thin outwash over drift also differ from areas of water - reworked till (discussed with alluvial deposits) in that some deposition

took place, whereas areas of till which were reworked by water were more rugged due to lack of significant sediment deposition.

Areas of thin outwash over till were characterized by a loam or sandy loam surface soil which was underlain at a depth of about 10 to 15 inches by a sandy - clay loam with gravel which extended to a depth of about 34 to 54 inches (2). Beneath the sandy - clay loam was found a stratified sandy - silt loam or loam to a depth of 56 to 60 inches. Beneath about 60 inches was found the parent material of the drift, usually a loam or sandy loam - till in the case of ground and ridge moraine, respectively.

The primary pedalogical soil series which developed on areas of thin outwash over drift were the Whitaker and Martinsville. Soils commonly found adjacent to areas of thin outwash over drift are the Westland, Ockley and Rensselaer soil series. These areas comprised less than 1.0 percent of the total county area (2).

Kames and Eskers

Numerous kames and esker - like features were found in Hancock County (see Glacial Geology for locations of prominent features). Kames and eskers, although both composed of glacial sands and gravels, are thought to have formed by somewhat different processes and by definition are of different shapes. Kames are usually knob - like hills several acres in size ranging up to

about 35 feet in height. Eskers are narrow, winding ridges between about 10 to 20 feet in height and from several hundred yards to several miles in length. Although several of the kames in Hancock County were quite large, (ie., > 40 acres), the eskers were subdued features generally not exceeding 0.5 miles in length and 10 feet in height.

A silt loam surface soil was developed on kames and eskers. It was underlain at a depth of about 13 inches by a clay loam which extended to a depth of about 21 inches (2). Gravelly - clay loam underlaid the clay loam to a depth of approximately 50 inches. Beneath about 50 inches was found stratified sand and gravelly sand, the parent material of kames and eskers.

Glacio-fluvial deposits were utilized as sources of sand and gravel for concrete aggregate and roadway subgrade fill. Table 14 shows fragment size distribution and lithology data for a valley-train (outwash terrace or sluiceways) and a kame deposit in Hancock County. These data may be useful in evaluating possible new aggregate sources with respect to specific engineering purposes.

Ockley soils with small inclusions of Miami soils were developed on the kames and eskers found in Hancock County (2). Kames and eskers were not extensively utilized as a source of sand and gravel, although there was evidence on the 1941 aerial photographs of past excavation and some pits were operating at the time of this writing. Kames and eskers comprised less than one percent of the total county area.

Table 14
Grain Size Distribution of Valley-train and Kame Deposits
from Schneider and Gray (1966)

<p style="text-align: center;">Size Analysis of Samples of the Outwash Facies of the Atherton Formation NE$\frac{1}{2}$, NW$\frac{1}{2}$, sec. 9, T.15N., R.7E.</p>			
Sand/Gravel Ratio	Percentage by Weight		
	$\frac{1}{2}$ - $\frac{1}{4}$ "	$\frac{1}{4}$ -1"	1-4"
61/39	23	10	67

<p style="text-align: center;">Size Analyses of Samples of the Kame Facies of the Trafalgar Formation SE$\frac{1}{2}$, SW$\frac{1}{2}$, sec. 29, T.17N., R.7E.</p>	
Grain Size	Percentage by Weight
Gravel:	
1" to 4"	32
$\frac{1}{2}$ to 1"	16
$\frac{1}{4}$ to $\frac{1}{2}$ "	7
Sand:	
Below $\frac{1}{4}$ "	45

<p style="text-align: center;">Lithologic Composition of Gravel Fractions from Samples of the Kame Facies of the Trafalgar Formation SE$\frac{1}{2}$, SW$\frac{1}{2}$, sec. 29, T.17N., R.7E.</p>	
Rock Type	Percentage by Weight
Limestone	20
Dolomitic limestone	22
Dolomite	32
Other sedimentary rocks	9
Igneous rocks	10
Metamorphic rocks	6

Alluvial Deposits

Flood Plains

The broadest flood plain in Hancock County was that of the Blue River which was nearly a half mile wide at the Shelby County line. Other relatively major flood plains were developed along Six Mile, Nameless, Brandywine, Sugar, and Buck Creeks, however, none of them exceeded one quarter of a mile in width.

Flood plain surface soils were characteristically silt loams or silty - clay loams, possibly with some pebbles (2). The surface soil was underlain at a depth of 12 to 26 inches by a loam or stratified silty - clay loam which was underlain at a depth of approximately 30 to 54 inches by a stratified sandy - silty - clay loam, or a stratified gravelly - sandy loam, the basic parent materials of the flood plain soils.

Several sand pits were operating in flood plain soils in Hancock County, particularly along Brandywine and Sugar Creeks. Several ponds were located within the flood plains, perhaps associated with former sand pit operations. Small swampy areas and deposits of peat or muck were not uncommon in the alluvial plains, particularly adjacent to the valley walls.

The primary soils developed on the flood plains were the Eel, Genesee, Shoals, and Sloan soil series. Table 15 gives the

areal distribution of these soils in Hancock County.

Table 15. Distribution of Flood Plain Soil Series (2).

Soil Series	Percent of County Area
Eel	1.2
Genesee	0.9
Shoals	1.7
Sloan	1.8

	5.6 total.

Recent River Terraces

Recent River terraces include all the terrace deposits that were formed post - glacially (ie., after the meltwaters had abated). Recent river terraces were generally smaller than outwash terraces and were confined to areas immediately adjacent to current watercourses. They were generally topographically lower and were composed of finer, better sorted sands and gravels than the outwash terraces. The sand and gravel was primarily recently eroded, however, substantial quantities were probably redeposited outwash sands and gravels. The better sorting of recent river as compared to outwash sands and gravels may be attributed to a lower water velocity and more consistent flow rates in contemporary rivers as opposed to meltwater channels.

Most of the recent river terraces in Hancock County were found along Six Mile, Nameless, Brandywine, and Sugar Creeks.

Recent river terraces were characterized by a silt loam or sandy - clay loam surface soil which extended to a depth of approximately 14 to 20 inches. The surface soil was underlain to a depth of 46 to 68 inches by a gravelly - clay loam or sandy - clay loam which in turn was underlain by stratified sand and gravel or sandy - silt loam with gravel, the basic parent materials of recent river terrace soils.

The primary pedological soil series developed on recent river terraces were the Ockley and Westland. Gravel pits were not uncommon on recent river terraces, particularly along Sugar and Brandywine Creeks. Recent river and outwash terraces covered about 3.0 percent of the county surface area (2).

Water - Reworked Till

Many areas of water - reworked till were found in Hancock County. These areas were characterized by a gently rolling land surface and were identified on the aerial photographs by a bland, blurry surface soil texture appearance with subdued but definite relief. These areas were always associated with past or present watercourses, particularly near drainage divides, within old sluiceway systems, and at past or present stream junctions where water commonly passed through overflow channels. Areas of water reworked till developed anywhere that water intermittently flowed

over the land surface, eroding and redepositing the material present but adding little new sediment.

The water essentially scoured the land surface in a sheet-wash effect and tended to remove some of the fines (silt and clay) leaving a sand loam surface soil. An increase in sand content is expected to a depth of about 2.5 to 4.0 feet. Beneath this depth is found a thin zone of clay accumulation which is underlain by the native parent material, the glacial till of the ridge or ground moraine. Field investigations revealed dense accumulations of boulders exposed by action of the water which are not uncommon in areas of water - reworked till. The pedalogical soil series developed on water - reworked till included the Martinsville and Whitaker (2). These soils are also found on thin outwash over till. Table 16 shows the areal distribution of these soils in Hancock County.

Table 16. Distribution of Soil Series Developed on Areas of Thin Outwash Over and Water - Reworked Till (2).

Soil Series	Percent of County Area
Martinsville	0.4
Whitaker	0.3

	0.7 total

Depressional Deposits

Peat and Muck

Numerous deposits of peat and muck were found in Hancock County, particularly in areas of ridge moraine and along old glacial sluiceways systems and present stream channels. Two large areas of peat and muck, up to two miles in length were found along the Brandywine sluiceway system in the north - central part of the county. Numerous small deposits of peat and muck associated with infiltration or kettle - like basins dotted some areas of ridge moraine. Deposits of peat and muck were uncommon in the ground moraine, except along sluiceways and stream channels.

Some areas of peat and muck were overlain by up to 12 inches of an organic-silty-clay surface soil, while peat and muck was found at the surface in other areas. Peat or muck generally extended to a depth of 36 to 72 inches according to agricultural soil survey data (2), however, it was known that peat and muck may extend to tens of feet beneath the surface in such deposits. The peat and muck was generally underlain by a transitional zone of a loamy organic soil or organic-sandy-clay loam. Beneath the transitional zone was found the basic parent material of the surrounding land form, usually glacial till of the ridge moraine, outwash of the sluiceway, or alluvial soils of the flood plains and terraces.

The Palms soil series was developed on deposits of peat and

muck in Hancock County (2). According to agricultural soil survey data, the Palms series covered about 0.2 percent of the county surface area.

Areas of Highly Organic Topsoil

Areas of highly organic topsoil were found in association with swales or shallow ice - block depressions in the ground and ridge moraine. These areas were found mostly in ground moraine and were commonly associated with shallow, poorly developed sluiceway systems. Highly organic topsoil was also found in infiltration basins in ridge moraine and terrace deposits. Not all areas were shown on the map because of small size.

Areas of highly organic topsoil were commonly overlain by 8 to 14 inches of an organic silt or organic silty clay surface soil. The surface soil was underlain to a depth of about 32 to 40 inches by an organic silt loam or an organic silty - clay loam. The organic soils were underlain by a thin (0 to 12 inches) layer of clay loam or silty - clay loam which in turn was underlain by a sandy loam or silt loam glacial till. In some places, a thin (2 to 6 inch) layer of a non-organic clay or silty-clay overlaid the organic surface soil.

The Milford and Kokomo soil series were developed on areas of highly organic topsoil (2). The areal distribution of these soil series in Hancock County is shown in Table 17.

Table 17. Distribution of Soil Series Developed on Areas
of Highly Organic Topsoil (2).

Soil Series	Percent of County Area
Kokomo	1.1
Milford	0.5

	1.6 total.

Areas of High Boulder Accumulation

Field investigations revealed several areas of high boulder concentration in Hancock County as previously mentioned with respect to some of the engineering soil areas. The evidence found did not suggest the presence of boulder trains which were deposited by the glaciers as such, but rather that the action of water had left behind the relatively large rock fragments which it could not move. Areas of high boulder concentration were found in areas of water - reworked till and thin outwash over till. An area was also located along the margin of a recent river terrace where it met an old outwash terrace in the southeast corner of the county along the Blue River. Some areas of high boulder concentration were found in ridge and ground moraine, commonly associated with recent alluvial activity. Areas of high boulder concentration were identified by a symbol shown under the "miscellaneous" heading of the map legend.

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APPENDIX A - Borehole Data *

Job Borehole Number	Map Borehole Number	Station	Offset	Sample Depth (ft.)	Classification		Percent				
					Textural	AASHTO	Sand	Silt	Clay	LL	PI
			Line 'B'		I - Project 70-3(22) 86 P.E. (14)						
1	1	333+00	42' Lt.	3.5- 4.5	Mottled Br.-Gr. Clay	A-6(12)	29	36	35	40	22
5	2	345+00	42' Lt.	0.0- 2.5	Mottled Br.-Gr. Silty Clay loam	A-6(9)	22	53	25	32	13
7	3	351+00	42' Lt.	4.0- 6.0	Brown clay loam	A-4(4)	45	30	25	21	9
11	4	363+00	42' Lt.	1.5- 3.0	Dark Gray Clay	A-7-6(16)	20	39	41	48	25
16	5	375+00	42' Lt.	3.5- 4.5	Brown Clay loam	A-6(7)	34	36	30	29	12
19	6	384+00	42' Rt.	4.0- 6.0	Brown Sandy Clay	A-2-4(0)	78	13	9	22	8
23	7	396+00	42' Rt.	4.5- 6.0	Tan Loam	A-4(6)	36	45	19	26	10
27	8	408+00	42' Rt.	2.0- 3.0	Gray Clay loam	A-7-6(13)	42	29	29	45	27
30	9	417+00	42' Lt.	1.0- 6.0	Brown Clay loam	A-6(8)	40	32	28	33	17
36	10	435+00	42' Lt.	0.0- 1.5	Light Gray Clay loam	A-4(5)	41	37	22	24	10
39	11	444+00	42' Rt.	2.0- 3.5	Brown Clay loam	A-6(8)	41	37	22	31	16
41	12	450+00	42' Rt.	8.0-10.0	Brown Sandy loam	A-4(1)	63	28	9	17	NP
49	13	472+00	42' Lt.	5.0- 7.5	Brown Sandy loam	A-4(2)	57	30	13	24	3
56	14	491+00	42' Rt.	4.0- 6.0	Brown Clay	A-7-6(12)	37	27	36	43	22
56	14	491+00	42' Rt.	7.0- 8.5	Gray Clay loam	A-4(5)	42	31	27	24	10
58	15	497+00	42' Rt.	9.5-12.0	Mottled Br.-Gr. Clay	A-6(8)	31	37	32	28	12
62	16	509+00	42' Rt.	1.5- 3.0	Brown Clay	A-7-6(17)	22	40	38	51	28
68	17	527+00	42' Rt.	1.0- 3.0	Dark Gray Clay loam	A-6(11)	39	37	24	39	23
77	18	552+00	42' Lt.	3.0- 3.5	Mottled Br.-Gr. Clay	A-7-6(15)	27	36	37	45	24
77	18	552+00	42' Lt.	5.5- 6.0	Gr.-Br. Clay loam	A-6(10)	26	45	29	31	14
84	19	569+00	42' Rt.	5.0- 5.5	Gr.-Br. Clay loam	A-4(7)	33	41	26	24	9
87	20	579+00	42' Lt.	4.0- 5.0	Br. Clay loam	A-4(8)	42	32	26	21	3
91	21	591+00	42' Lt.	3.0- 3.5	Br. Sandy Clay	A-6(8)	51	11	38	40	21
97	22	609+00	42' Lt.	2.0- 9.0	Brown Clay loam	A-4(6)	41	30	29	25	9
101	23	620+00	42' Lt.	7.0- 8.0	Lt. Br. Sandy Loam	A-2-4(0)	73	11	16	17	7
107	24	637+00	42' Lt.	2.0- 4.0	Gr.-Br. Clay	A-6(7)	36	31	33	30	11
113	25	649+00	42' Lt.	2.0- 4.0	Mottled Tan-Gray Clay	A-7-6(17)	13	44	43	51	28
113	25	649+00	42' Lt.	5.0- 7.0	Brown Sandy loam	A-6(6)	52	29	19	28	14
113	25	649+00	42' Lt.	7.0- 8.5	Brown Sandy loam	A-4(1)	62	27	11	19	2
113	25	649+00	42' Lt.	8.5-10.0	Gray Silty Clay loam	A-4(8)	12	62	26	19	7

APPENDIX A - Continued

Job Borehole Number	Map Borehole Number	Station	Offset	Sample Depth (ft.)	Classification		Percent				
					Textural	AASHTO	Sand	Silt	Clay	LL	PI
					RS Project No. 8030 (1) (18)						
RB- 2	26	217+00	20' Lt.	1.0- 4.0	Clay	A-6(14)	22	47	31	37	20
RB-10	27	383+00	12' Rt.	1.0- 2.5	Silty clay	A-6(15)	15	53	32	36	18
					SOS Project No. 9930 (1) (17)						
B-11	28	71+50	15' Lt.	2.0- 5.0	Brown Silty Clay	A-6(11)	16	54	30	35	15
					ST-Project No. 3630 (A) (16)						
RB- 1	29	114+73	9' Lt.	1.0- 2.5	Silty Clay loam	A-7-6(19)	18	54	28	45	22
RB- 1	29	114+73	9' Lt.	8.5-10.0	loam	A-4(1)	32	52	16	21	14
RB- 2	30	144+22	11' Lt.	1.0- 3.0	clay loam	A-7-6(15)	22	50	28	42	20
RB- 2	30	144+22	11' Lt.	6.0- 7.5	loam	A-4(1)	39	46	15	22	7
					ST-Project No. 177-7(A) P.E. (13)						
1	31	162+00	21' Lt.	1.0- 2.5	Sandy loam	A-4(0)	51	31	18	22	17
2	32	165+00	23' Rt.	3.5- 4.5	Clay loam	A-4(0)	45	33	22	21	15
3	33	167+87	48' Rt.	3.5- 5.0	Clay loam	A-4(2)	36	35	29	22	15
5	34	175+00	27' Rt.	1.5- 3.0	Clay	A-6(10)	29	32	39	35	17
					Project No. S-296 (4) P.E. (15)						
1	35	58+00	15' Lt.	0.5- 2.0	Brown Clay	A-7-6(15)	25	37	38	47	23
2	36	61+60	45' Rt.	4.0- 6.0	Gr. Cl. lm. w/tr. organ.	A-6(9)	30	42	28	34	20
8	37	89+00	27' Lt.	2.0- 4.0	Brown Clay	A-6(5)	48	20	32	25	13
14	38	114+00	27' Rt.	0.0- 2.0	Br. Sdy. Cl. lm. w/gravel	A-6(4)	50	22	28	31	20

* Note: Last Number in Parenthesis Following Job Titles Footnotes References.

Appendix B – Table of Estimated

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
Brookston: Br	0-1 or ponded	<i>Ft</i>				<i>Pct</i>
		0-12	Silty clay loam	CL	A-6 or A-7	0
		12-54	Clay loam	CL or CH	A-6 or A-7	0
Crooby: CrA	1-3	54-60	Loam	CL	A-4 or A-6	0-3
		0-12	Silt loam	CL-ML or CL	A-4 or A-6	0
		12-40	Clay loam	CL	A-6 or A-7	0-2
Eel: Ee	2-4	40-60	Loam	ML, CL-ML, or CL	A-4 or A-6	0-3
		0-12	Silt loam	CL or CL-ML	A-4 or A-6	0
		12-39	Silt loam, loam, clay loam	CL or ML	A-4 or A-6	0
Genesee: Ge	>4	39-60	Sand, sandy loam	SM, SM-SC	A-2-4, A-4, or A-6	0
		0-12	Silt loam	CL or ML	A-4 or A-6	0
		12-54	Silt loam, loam	CL or ML	A-4 or A-6	0
Kokomo: Ko	0-1 or ponded	54-60	Sandy loam, loamy sand	SM, SM-SC	A-2-4, A-4	0
		0-11	Silty clay loam	CL or CH	A-7 or A-6	0
		11-44	Silty clay loam, clay loam	CL or CH	A-6 or A-7	0
Martinsville: MaA, MaB2	>4	44-60	Loam	CL	A-4 or A-6	0-3
		0-13	Loam	CL, CL-ML	A-4 or A-6	0
		13-54	Clay loam, sandy clay loam, sandy loam	CL, CL-ML, or SM-SC	A-4, A-2, or A-6	0
Miami: MmA, MmB2, MmC2, MmD2	>4	54-60	Sand and silt loam	SM-SC or SC	A-4 or A-2-4	0
		0-6	Silt loam	CL, CL-ML, or CL	A-4 or A-6	0
		6-33	Clay loam	CL	A-6 or A-7	0
MpC3, MpD3	>4	33-60	Loam	ML, CL-ML, or CL	A-4 or A-6	0-3
		0-6	Clay loam	CL	A-6 or A-7	0
		6-23	Clay loam	CL	A-6 or A-7	0
Milford: Mr	0-1 or ponded	23-60	Loam	ML, CL-ML, or CL	A-4 or A-6	0-3
		0-9	Silty clay loam	CL or CH	A-7	0
		9-40	Silty clay and silty clay loam	CL or CH	A-7	0
Ockley: OcA, OcB2, OcC2	>4	40-60	Silty clay loam, silt loam	CL	A-7 or A-6	0
		0-13	Silt loam, loam	CL or CL-ML	A-4 or A-6	0
		13-21	Clay loam	CL	A-4 or A-6	0
Palms: Ps	0-1 or ponded	21-49	Gravelly clay loam	CL or SC	A-6 or A-7	0-2
		49-60	Gravelly sand	SP, SP-SM, GP, or GP-GM	A-1-b	1-5
		0-30	Muck	Pt		0
Rensselaer: Re	0-1 or ponded	30-45	Loam	CL-ML or CL	A-4 or A-6	0-3
		45-60	Gravelly loamy sand	SP-SM or SM	A-1-b or A-2	0-5
		0-11	Silty clay loam	CL or CH	A-6 or A-7	0
Shoals: Sh	1-3	11-42	Clay loam, silty clay loam	CL	A-6 or A-7	0
		42-60	Silt loam, sandy loam, clay loam, and sand	CL-ML, CL, SM-SC, or SC	A-4	0
		0-11	Silt loam	CL or CL-ML	A-4 or A-6	0
Sloan: So	0-1 or ponded	11-60	Loam, silt loam, clay loam, and sandy loam	ML	A-4	0-3
		0-13	Silty clay loam	ML or CL	A-4, A-5, A-6, or A-7	0
		13-34	Clay loam, loam	ML or CL	A-6 or A-7	0
		34-60	Sandy loam, loam, loamy sand	CL-ML or CL	A-4 or A-6	0

Engineering Soil Properties (2).

Percentage passing sieve—				Liquid limit	Plasticity index	Perme- ability	Available water capacity	Reaction	Potential frost action	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
100	98-100	95-100	75-95	36-48	15-20	<i>In per hour</i> 0.6-2.0	<i>In per in soil</i> 0.21-0.23	pH 6.1-7.3	High	Moderate.
98-100	96-100	85-95	75-85	36-52	18-30	0.6-2.0	0.15-0.19	6.1-7.8		Moderate.
90-100	85-95	75-90	55-70	22-30	7-15	0.2-0.6	0.05-0.19	7.4-8.4		Moderate.
100	95-100	80-100	50-90	22-34	6-15	0.6-2.0	0.22-0.24	5.6-6.5	High	Low.
92-99	90-97	78-90	65-75	37-50	17-31	0.06-0.2	0.15-0.19	5.1-7.8		Moderate.
90-94	85-89	75-87	50-64	17-30	2-14	0.06-0.2	0.05-0.19	7.9-8.4		Low.
100	100	90-100	75-85	26-36	6-15	0.6-2.0	0.22-0.24	6.1-7.3	High	Low.
100	100	90-100	75-85	26-40	5-15	0.6-2.0	0.17-0.21	6.6-7.3		Low.
100	90-100	50-70	10-40	15-25	NP-5	0.6-2.0	0.05-0.13	6.6-8.4		Low.
100	100	90-100	75-85	26-36	6-15	0.6-2.0	0.22-0.24	6.1-7.8	Moderate	Low.
100	100	90-100	75-85	26-40	5-15	0.6-2.0	0.17-0.21	6.6-8.4		Low.
100	90-100	50-70	10-40	15-25	NP-5	0.6-2.0	0.05-0.13	6.6-8.4		Low.
100	98-100	85-95	75-85	35-55	15-30	0.6-2.0	0.21-0.23	6.1-7.3	High	Moderate.
98-100	98-100	95-100	75-85	38-55	15-30	0.06-0.2	0.15-0.20	6.1-8.4		Moderate.
90-100	85-95	75-90	55-70	25-35	10-20	0.06-0.2	0.05-0.19	7.9-8.4		Low.
100	95-100	80-100	60-85	22-33	4-12	0.6-2.0	0.20-0.22	5.1-6.5	Moderate	Low.
100	95-100	65-90	30-80	20-35	6-17	0.6-2.0	0.15-0.19	5.1-7.8		Low.
98-100	95-100	50-80	10-50	15-25	4-9	2.0-6.0	0.19-0.21	7.4-8.4		Low.
100	95-100	85-100	50-90	23-34	6-15	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	Low.
92-99	90-97	80-95	65-85	37-50	17-31	0.6-2.0	0.15-0.19	5.1-7.8		Moderate.
90-94	85-90	75-85	50-64	17-30	2-14	0.2-0.6	0.05-0.19	7.9-8.4		Low.
95-100	90-100	80-100	65-85	35-50	15-30	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	Low.
92-99	90-97	80-95	65-85	37-50	17-31	0.6-2.0	0.15-0.19	5.1-7.8		Moderate.
90-94	85-90	75-85	50-64	17-30	2-14	0.2-0.6	0.05-0.19	7.8-8.4		Low.
100	100	95-99	90-99	42-58	19-32	0.2-0.6	0.21-0.23	6.1-7.3	High	High.
100	100	95-99	85-99	41-61	23-38	0.2-0.6	0.12-0.18	6.6-8.4		High.
100	98-100	90-99	70-99	34-50	15-31	0.2-0.6	0.15-0.20	7.4-8.4		Moderate.
100	95-100	80-100	60-90	22-33	4-12	0.6-2.0	0.22-0.24	5.6-7.3	Moderate	Low.
100	75-100	65-90	50-90	20-35	8-17	0.6-2.0	0.15-0.20	5.1-6.5		Moderate.
70-85	45-75	40-70	35-55	30-45	11-25	0.6-2.0	0.12-0.14	5.6-6.5		Moderate.
30-70	25-55	7-20	2-10	<2	0	>20	0.02-0.04	7.9-8.4		Low.
95-100	95-100	80-85	55-75	12-30	6-12	>20	>0.35-0.45	5.1-8.4	High	High.
70-75	65-75	35-55	10-25	<5	NP	0.2-2.0	0.17-0.19	6.1-8.4		Low.
						0.2-2.0	0.05-0.07	6.1-8.4		Low.
100	100	95-100	85-85	40-54	20-32	0.2-0.6	0.21-0.23	6.1-7.3	High	Moderate.
100	100	90-100	70-80	33-47	15-26	0.06-0.2	0.15-0.19	6.1-7.8		Moderate.
98-100	98-100	95-100	40-60	<30	4-9	0.06-0.2	0.19-0.21	7.4-8.4		Low.
100	100	90-100	65-80	22-36	6-15	0.6-2.0	0.22-0.24	6.1-7.3	High	Low.
95-100	90-100	70-80	55-70	32-40	3-8	0.6-2.0	0.19-0.21	6.6-8.4		Low.
100	100	90-100	85-85	30-45	8-15	0.6-2.0	0.21-0.23	6.1-7.8	High	Moderate.
100	90-100	85-85	75-85	30-45	11-18	0.6-2.0	0.17-0.19	6.6-7.8		Moderate.
95-100	90-100	80-85	65-80	25-35	6-15	0.6-2.0	0.08-0.13	6.6-8.4		Low.

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
Westland: We	Pt 0-1 or ponded	0-11	Clay loam	CL	A-6	Pet 0
		11-32	Clay loam, silty clay loam	CL	A-6	0
		32-48	Gravelly clay loam, gravelly loam	CL	A-6	0-3
		48-60	Very gravelly loamy sand	GP, GP-GM, SP, or SP-SM	A-1-b	1-5
Whitaker: Wh	1-3	0-11	Loam	CL or CL-ML	A-4 or A-6	0
		11-56	Clay loam, sandy clay loam, loam, and sandy loam	CL or SC	A-6 or A-7	0
		56-60	Sandy loam, loamy sand, and sand	CL, ML, CL-ML, or SM-SC	A-4	0

¹NP = Nonplastic.

Appendix C - Engineering Interpretations

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Brookston: Br	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics.
Crosby: CrA	Fair: 8 to 14 inches of suitable material.	Unsuited	Poor: high potential frost action; fair to poor compaction characteristics and stability; fair to poor shear strength.	Medium to low shear strength; medium compressibility; low permeability of compacted soil; good to fair compaction characteristics.
Eel: Ee	Good	Unsuited ¹	Poor: high potential frost action; fair compaction characteristics and stability; fair to poor shear strength.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Genesee: Ge	Good	Unsuited ¹	Fair: moderate potential frost action; fair to poor shear strength; fair compaction characteristics and stability.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Kokomo: Ko	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair to poor compaction characteristics.
Martinsville: MaA, MaB2	Fair: 6 to 15 inches of suitable material.	Unsuited for gravel; sand below a depth of 60 inches in some places.	Fair: moderate potential frost action; fair to poor shear strength and compaction characteristics; fair stability.	Medium to low shear strength; low to medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3	Fair where slopes are 0 to 12 percent: 6 to 12 inches of suitable material. Poor where slopes are 12 to 18 percent: hazard of erosion.	Unsuited	Fair: moderate frost action; fair to poor shear strength and compaction characteristics; fair to poor stability.	Medium to low shear strength; medium compressibility; low permeability of compacted soil; fair compaction characteristics.

Appendix B - Table of Estimated Engineering Soil Properties (2).

Soil series and deep symbols	Depth to seasonal high water table	Depth from surface	CDEA section	Classification		Coarse fraction greater than 2 number	Percentage passing term--				Liquid limit	Plasticity index	Permeability	Available water capacity	Shrinkage	Potential frost action	Shrink-swell potential
				Unified	AASHTO		No. 4 (4.75 mm)	No. 10 (2.0 mm)	No. 40 (0.425 mm)	No. 200 (0.075 mm)							
Brookston: B-	0-1 or ponded	0-12 0-24 12-24 14-40	Silt (clay) loam. Clay loam. Loam.	CL CL or CH CL	A-4 or A-7 A-6 or A-7 A-6 or A-4	0 0 0-3	100 100-100 100-100	100-100 100-100 100-100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	10-20-40 0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	High Moderate Moderate	Moderate Moderate Moderate
Cowley: G-A	1-3	0-12 12-40 40-40	Silt loam. Clay loam. Loam.	CL-MI or CL CL ML, CL-MI, or CL	A-4 or A-6 A-6 or A-7 A-4 or A-6	0 0-3 0-3	100 100-100 100-100	100-100 100-100 100-100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	High Moderate Low	Moderate Moderate Low
Del: E-	2-4	0-12 12-30 30-40	Silt loam. Silt loam, loam, clay loam. Sand, sandy loam.	CL or CL-MI CL or ML SM, SM-SC	A-4 or A-6 A-4 or A-6 A-2-4, A-4, or A-6	0 0 0	100 100 100	100 100 100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	High Low Low	Moderate Low Low
Genesee: G-	1-3	0-12 12-30 30-40	Silt loam. Silt loam, loam. Sandy loam, loamy sand.	CL or ML CL or ML SM, SM-SC	A-4 or A-6 A-4 or A-6 A-2-4, A-4	0 0 0	100 100 100	100 100 100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	Moderate Low Low	Moderate Low Low
Kidder: K-	0-1 or ponded	0-12 12-40 40-40	Silt clay loam. Silt clay loam, clay loam. Loam.	CL or CH CL or CH CL	A-7 or A-6 A-4 or A-7 A-4 or A-6	0 0 0-3	100 100-100 100-100	100-100 100-100 100-100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	High Moderate Low	Moderate Moderate Low
Martinsville: MaL, MaH	1-3	0-12 12-30 30-40	Loam. Clay loam, sandy clay loam, sandy loam. Sand and silt loam.	CL, CL-MI CL, CL-MI, or CL SM-SC or SC	A-4 or A-6 A-4, A-2, or A-6 A-4 or A-2-4	0 0 0	100 100 100	100 100 100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	Moderate Low Low	Moderate Low Low
Miam: MmL, MmH, MmCL, MmCH	1-3	0-12 12-30 30-40	Silt loam. Clay loam. Loam.	CL, CL-MI, or CL CL ML, CL-MI, or CL	A-4 or A-6 A-6 or A-7 A-4 or A-6	0 0 0-3	100 100 100	100 100 100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	Moderate Low Low	Moderate Low Low
MyCL, MyCH	1-3	0-12 12-30 30-40	Clay loam. Clay loam. Loam.	CL CL ML, CL-MI, or CL	A-4 or A-7 A-4 or A-7 A-4 or A-6	0 0 0-3	100 100 100	100 100 100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	Moderate Low Low	Moderate Low Low
Niles: N-	0-1 or ponded	0-12 12-30 30-40	Silt clay loam. Silt clay and silt clay loam. Silt clay loam, silt loam.	CL or CH CL or CH CL	A-7 A-7 A-7 or A-6	0 0 0	100 100 100	100 100 100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	High High Moderate	High High Moderate
Oakley: OaL, OaH, OaCL	1-3	0-12 12-30 30-40	Silt loam. Clay loam. Gravelly clay loam. Gravelly sand.	CL or CL-MI CL CL or SC SP, SP-SM, GP, or GP-GM	A-4 or A-6 A-4 or A-6 A-4 or A-7 A-1-5	0 0 0-3 1-3	100 100 100-100 100-100	100-100 100-100 100-100 100-100	100-100 100-100 100-100 100-100	100-100 100-100 100-100 100-100	10-40 10-40 10-40 10-40	10-20 10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3 0.1-1.3	Moderate Low Moderate Low	Moderate Low Moderate Low
Palm: P-	0-1 or ponded	0-12 12-30 30-40	Mud.	P		0	100	100	100-100	100-100	10-40	10-20	>30	>0.25-0.45	0.1-1.3	High	High
Reynolds: R-	0-1 or ponded	0-12 12-30 30-40	Silt clay loam. Clay loam, silt clay loam. Silt loam, sandy loam, clay loam, and sand.	CL or CH CL CL-MI, CL, SM-SC, or SC	A-4 or A-7 A-4 or A-7 A-4	0 0 0	100 100 100	100 100 100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	High Moderate Low	Moderate Moderate Low
Roads: R-	1-3	0-12 12-30 30-40	Silt loam. Loam, silt loam, clay loam, and sandy loam.	CL or CL-MI ML	A-4 or A-6 A-6	0 0-3	100 100	100 100	100-100 100-100	100-100 100-100	10-40 10-40	10-20 10-20	As per test 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18	0.1-1.3 0.1-1.3	High Low	Low Low
Sage: S-	0-1 or ponded	0-12 12-30 30-40	Silt clay loam. Clay loam. Sandy loam, loam, loamy sand.	ML or CL ML or CL CL-MI, or CL	A-4, A-6, A-6, or A-7 A-4 or A-7 A-4 or A-6	0 0 0	100 100 100	100 100 100	100-100 100-100 100-100	100-100 100-100 100-100	10-40 10-40 10-40	10-20 10-20 10-20	As per test 0.5-1.0 0.5-1.0 0.5-1.0	0.21-0.23 0.15-0.18 0.05-0.19	0.1-1.3 0.1-1.3 0.1-1.3	High Moderate Low	Moderate Moderate Low

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	USDA texture	Classification		Coarse fraction greater than 3 inches
				Unified	AASHTO	
Westland: We	<i>Ft</i> 0-1 or ponded	<i>In</i> 0-11 11-32 32-48 48-60	Clay loam Clay loam, silty clay loam Gravelly clay loam, gravelly loam Very gravelly loamy sand	CL CL CL GP, GP-GM, SP, or SP-SM	A-6 A-6 A-6 A-1-b	<i>Pct</i> 0 0 0-3 1-5
Whitaker: Wh	1-3	0-11 11-56 50-60	Loam Clay loam, sandy clay loam, loam, and sandy loam Sandy loam, loamy sand, and sand	CL or CL-ML CL or SC CL, ML, CL-ML, or SM-SC	A-4 or A-6 A-6 or A-7 A-4	0 0 0

¹NP = Nonplastic.

Appendix C - Engineering Interpretations

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Brookston: Br	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics.
Crosby: CrA	Fair: 8 to 14 inches of suitable material.	Unsuited	Poor: high potential frost action; fair to poor compaction characteristics and stability; fair to poor shear strength.	Medium to low shear strength; medium compressibility; low permeability of compacted soil; good to fair compaction characteristics.
Eel: Ee	Good	Unsuited ¹	Poor: high potential frost action; fair compaction characteristics and stability; fair to poor shear strength.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Geneseo: Ge	Good	Unsuited ¹	Fair: moderate potential frost action; fair to poor shear strength; fair compaction characteristics and stability.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Kokomo: Ko	Poor: very poorly drained.	Unsuited	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair to poor compaction characteristics.
Martinsville: MaA, MaB2	Fair: 6 to 15 inches of suitable material.	Unsuited for gravel; sand below a depth of 60 inches in some places.	Fair: moderate potential frost action; fair to poor shear strength and compaction characteristics; fair stability.	Medium to low shear strength; low to medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3	Fair where slopes are 0 to 12 percent; 6 to 12 inches of suitable material. Poor where slopes are 12 to 18 percent; hazard of erosion.	Unsuited	Fair: moderate frost action; fair to poor shear strength and compaction characteristics; fair to poor stability.	Medium to low shear strength; medium compressibility; low permeability of compacted soil; fair compaction characteristics.

- Continued.

Percentage passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Potential frost action	Shrink-swell potential
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.075 mm)							
95-100	90-100	85-95	65-75	27-38	11-20	<i>In per hour</i> 0.6-2.0	<i>In per in. of soil</i> 0.18-0.21	<i>pH</i> 6.1-7.3	High.....	Moderate.
95-100	90-100	80-90	65-75	30-40	20-30	0.06-0.2	0.16-0.19	6.1-7.3		Moderate.
65-75	60-70	55-70	50-70	30-40	20-30	0.06-0.2	0.10-0.12	6.1-8.4		Moderate.
40-70	25-55	10-20	2-10	0	NP	>20	0.02-0.04	7.9-8.4		Low.
100	95-100	85-100	60-90	22-33	4-12	0.6-2.0	0.20-0.22	5.6-7.3	High.....	Low.
98-100	95-100	50-85	40-60	30-47	12-26	0.6-2.0	0.15-0.18	5.1-8.4		Moderate.
98-100	95-100	90-100	35-60	15-21	4-9	0.6-2.0	0.05-0.07	7.9-8.4		Low.

of the Pedological Soil Series (2).

Soil features affecting—Cont.

Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Seasonal high water table at a depth of 0 to 1 foot, or ponded; underlying material has moderately slow permeability; suitable for pit-type ponds.	Underlying material has moderately slow permeability; depressional; very poorly drained; runoff very slow or ponded.	Not needed; depressional; runoff very slow or ponded.	Generally not needed; depressional; very poorly drained.
Seasonal high water table at a depth of 1 foot to 3 feet; slow permeability; most areas suitable for pit-type ponds.	Somewhat poorly drained; slow permeability.	Generally not needed; runoff slow; features are favorable.	Generally not needed; features are favorable; moderately erodible.
Seasonal high water table at a depth of 2 to 4 feet; underlain by sand and gravel; not suitable in most areas.	Moderately well drained; moderate permeability; subject to occasional flooding.	Generally not needed; nearly level; runoff slow.	Generally not needed; nearly level; runoff slow.
Moderate permeability; deep to water table; underlain by sand and gravel; seepage.	Well drained; moderate permeability; subject to occasional flooding.	Generally not needed; nearly level; runoff slow.	Generally not needed; nearly level; runoff slow.
Seasonal high water table at a depth of 0 to 1 foot, or ponded; slow permeability; suitable for pit-type ponds.	Very poorly drained; slow permeability; runoff very slow or ponded.	Not needed; depressional; runoff very slow or ponded; very poorly drained.	Not needed; depressional; runoff very slow or ponded; very poorly drained.
Moderate permeability; deep to water table; underlain by permeable sand; seepage.	Well drained	Generally not needed; slopes are generally short; runoff slow or medium; features favorable.	Features are favorable.
Moderately slow permeability; deep to water table; slope hinders pit-type ponds; some areas where slopes are 6 to 18 percent are suitable for pit-type ponds.	Well drained; small seeps in some places; on severely eroded areas the clay loam surface layer does not dry as fast.	Features are favorable where slopes are 0 to 2 percent; generally not needed. Moderate erosion hazard where slopes are 2 to 12 percent. Unsuitable where slopes are 12 to 18 percent.	Features are favorable; slopes of more than 6 percent erode easily; runoff medium to rapid.

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	
Milford: Mr.....	Poor: very poorly drained.	Unsuited.....	Poor: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics.
Oakley: OcA, OcB2, OcC2.	Fair: 8 to 13 inches of suitable material.	Good.....	Fair: moderate frost action; fair shear strength; good to fair compaction characteristics; fair stability.	Surface layer and subsoil have medium to low shear strength and compressibility; medium to low permeability of compacted soil; and fair compaction characteristics. Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics.
Palms: Ps.....	Poor: very poorly drained.	Unsuited ¹	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material unstable.	Muck is unsuited. Underlying material has medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; and fair compaction characteristics.
Rensselaer: Re.....	Poor: very poorly drained.	Unsuited ¹	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics; moderate shrink-swell.
Shoals: Sn.....	Good.....	Unsuited ¹	Poor: high potential frost action; fair to good shear strength and compaction characteristics; medium to high compressibility.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Sloan: So.....	Poor: very poorly drained.	Unsuited ¹	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair shear strength; good to fair compaction characteristics; fair stability.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.
Westland: We.....	Poor: very poorly drained.	Good.....	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics; fair stability.	Surface layer and subsoil have medium to low shear strength; medium to low compressibility; low permeability of compacted soil; and fair compaction characteristics. Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics.
Whitaker: Wh.....	Good.....	Poor.....	Poor: high potential frost action; fair to poor shear strength and compaction characteristics; fair to poor stability.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.

¹These soils are underlain by sand and gravel at a depth below 5 feet in some areas.

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	
Milford: Mr.....	Poor: very poorly drained.	Unsuited.....	Poor: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics.
Oekley: OcA, OcB2, OcC2.	Fair: 8 to 13 inches of suitable material.	Good.....	Fair: moderate frost action; fair shear strength; good to fair compaction characteristics; fair stability.	Surface layer and subsoil have medium to low shear strength and compressibility; medium to low permeability of compacted soil; and fair compaction characteristics. Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics.
Palms: Ps.....	Poor: very poorly drained.	Unsuited ¹	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material unstable.	Muck is unsuited. Underlying material has medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; and fair compaction characteristics.
Rensselaer: Re.....	Poor: very poorly drained.	Unsuited ¹	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics; moderate shrink-swell.
Shoals: Sn.....	Good.....	Unsuited ¹	Poor: high potential frost action; fair to good shear strength and compaction characteristics; medium to high compressibility.	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; poor to good compaction characteristics.
Sloan: So.....	Poor: very poorly drained.	Unsuited ¹	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair shear strength; good to fair compaction characteristics; fair stability.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.
Westland: We.....	Poor: very poorly drained.	Good.....	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics; fair stability.	Surface layer and subsoil have medium to low shear strength; medium to low compressibility; low permeability of compacted soil; and fair compaction characteristics. Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics.
Whitaker: Wh.....	Good.....	Poor.....	Poor: high potential frost action; fair to poor shear strength and compaction characteristics; fair to poor stability.	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics.

¹These soils are underlain by sand and gravel at a depth below 5 feet in some areas.

Soil features affecting—Cont.

Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Grassed waterways
Moderately slow permeability; seasonal high water table at a depth of 0 to 1 foot, or ponded; suitable for pit-type ponds.	Poorly drained; moderately slow permeability; runoff very slow or ponded.	Not needed; depressional; runoff very slow or ponded; poorly drained.	Not needed; depressional; runoff very slow or ponded; poorly drained.
Moderate permeability; deep to water table; underlain by sand and gravel; seepage.	Well drained.	Features are favorable where slopes are 0 to 12 percent; generally not needed; gravelly subsoil.	Features are favorable where slopes are 0 to 12 percent; generally not needed; runoff moderate to rapid; erodes easily.
Seasonal high water table at a depth of 0 to 1 foot, or ponded; most areas are suited to pit-type ponds where water table remains high throughout the year.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material unstable; generally poor outlets.	Not needed; depressional; very poorly drained.	Not needed; depressional; very poorly drained.
Seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; some undrained areas are suitable for pit-type ponds where water table remains high throughout the year.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; sand and silt below a depth of 4 feet need special attention.	Not needed; depressional; very poorly drained.	Not needed; depressional very poorly drained.
Seasonal high water table at a depth of 1 foot to 3 feet; subject to occasional flooding.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; subject to occasional flooding; sand and silt below a depth of 4 feet need special attention.	Not needed; features are favorable.	Generally not needed; features are favorable.
Seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate permeability; subject to flooding; undrained areas are suitable for pit-type ponds where the water table remains high throughout the year.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; subject to flooding; sand and silt below a depth of 4 feet need special attention; usually poor outlets.	Generally not needed; depressional; very poorly drained.	Generally not needed; depressional; very poorly drained.
Seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; underlain by sand and gravel; most undrained areas are suitable for pit-type ponds.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; sand and gravel below a depth of 4 feet need special attention.	Generally not needed; depressional; very poorly drained.	Generally not needed; depressional; very poorly drained.
Seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability; underlain by sand; seepage.	Somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability; silt and sand below a depth of 4 feet need special attention.	Features are favorable; generally not needed.	Features are favorable; generally not needed.

Appendix D - Soil Limitations for

Soil series and map symbols	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns
Brookston: Br	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell; high potential frost action.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Crosby: CrA	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action.	Slight
Eel: Ee	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding; moderate potential frost action.	Slight: subject to occasional flooding.
Genesee: Ge	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding; moderate potential frost action.	Slight: subject to occasional flooding.
Kokomo: Ko	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Martinsville: MaA, MaB2	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders development.	Slight
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders development. Severe where slopes are 6 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: hazard of erosion; slope hinders development and maintenance. Severe where slopes are 12 to 18 percent: hazard of erosion; slope hinders development.
Milford: Mr	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe if undrained: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Ockley: OcA, OcB2, OcC2	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development.	Moderate: moderate shrink-swell.	Moderate where slopes are 0 to 6 percent: moderate shrink-swell. Severe where slopes are 6 to 12 percent: slope hinders development.	Slight
Palms: Pa	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.

Soil series and map symbol	Suitability as shown on—			Soil features affecting—	Soil features affecting—(Cont)			
	Topsoil	Subsoil and gravel	Wood 22		Forest, pasture, crops	Drainage for crops and pasture	Terrace and fireweeds	Crooked waterways
Wichita: M ₁	Poor: very poorly drained	Dissected	Poor: poorly drained, seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell	Medium to low shear strength; medium to high compressibility; low permeability of compacted soil; fair compaction characteristics	Occasionally slow permeability; seasonal high water table at a depth of 0 to 1 foot, or ponded; suitable for pasture ponds	Poorly drained; moderately slow permeability; seasonally very slow	Not needed; depressed; seasonally slow or ponded; poorly drained	Not needed; depressed; seasonally slow or ponded; poorly drained
Osage: O ₁ A, O ₂ A, O ₃ A	Poor: 8 to 12 inches of surface material	Good	Poor: moderate frost action; low shear strength; good to fair compaction characteristics; fair stability	Surface layer and subsoil have medium to low shear strength and compressibility; medium to low permeability of compacted soil; and fair compaction characteristics Subsoil having low high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics	Medium permeability; deep to water table; suitable for acid and gravel; average	Well drained	Features are favorable where slope are 8 to 12 percent; generally not needed; generally not needed	Features are favorable where slope are 8 to 12 percent; generally not needed; a small modification to road, water ways
Fulton: P ₁	Poor: very poorly drained	Dissected	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; require material suitable	Moist is assumed Underlying material has medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; and fair compaction characteristics	Seasonal high water table at a depth of 0 to 1 foot, or ponded; most areas are suited to pasture except where water table remains high throughout the year	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; require material suitable; generally poor results	Not needed; depressed; very poorly drained	Not needed; depressed; very poorly drained
Amesbury: P ₂	Poor: very poorly drained	Dissected	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to poor shear strength and compaction characteristics	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics; moderate shrink-swell	Seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; water saturated areas are suitable for pasture ponds where water table remains high throughout the year	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; acid and salt below a depth of 1 foot need special attention	Not needed; depressed; very poorly drained	Not needed; depressed very poorly drained
Boyle: B ₁	Good	Dissected	Poor: high potential frost action; low to good shear strength and compaction characteristics; medium to high compressibility	Medium to low shear strength; medium compressibility; low to medium permeability of compacted soil; good to good compaction characteristics	Seasonal high water table at a depth of 1 foot to 2 feet; not well to occasional flooding	Seasonally poorly drained; seasonal high water table at a depth of 1 foot to 2 feet; subject to occasional flooding; acid and salt below a depth of 1 foot need special attention	Not needed; features are favorable	Generally not needed; features are favorable
Boyle: B ₂	Poor: very poorly drained	Dissected	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; low shear strength; good to fair compaction characteristics; fair stability	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics	Seasonal high water table at a depth of 0 to 1 foot, or ponded; medium permeability; subject to flooding; saturated areas are suitable for pasture ponds where water table remains high throughout the year	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; subject to flooding; acid and salt below a depth of 1 foot need special attention; seasonally poor results	Generally not needed; depressed; seasonally very poorly drained	Generally not needed; depressed; seasonally very poorly drained
Westland: W ₁	Poor: very poorly drained	Good	Poor: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; fair to good shear strength and compaction characteristics; fair stability	Surface layer and subsoil have medium to low shear strength; medium to low compressibility; low permeability of compacted soil; and fair compaction characteristics Underlying material has high shear strength; low compressibility; high permeability of compacted soil; and good compaction characteristics	Seasonal high water table at a depth of 0 to 1 foot, or ponded; medium to slow permeability; suitable for acid and gravel; most saturated areas are suitable for pasture ponds	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability; acid and gravel below a depth of 1 foot need special attention	Generally not needed; depressed; seasonally very poorly drained	Generally not needed; depressed; seasonally very poorly drained
Wichita: W ₂	Good	Poor	Poor: high potential frost action; low to good shear strength and compaction characteristics; low to poor stability	Medium to low shear strength; medium compressibility; medium to low permeability of compacted soil; fair to good compaction characteristics	Seasonal high water table at a depth of 1 foot to 2 feet; moderate permeability; suitable for road, average	Seasonally poorly drained; seasonal high water table at a depth of 1 foot to 2 feet; moderate permeability; acid and salt below a depth of 1 foot need special attention	Features are favorable; generally not needed	Features are favorable; generally not needed

These soils are underlain by sand and gravel at a depth below 2 feet in some areas.

Appendix D - Soil Limitations for

Soil series and map symbols	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns
Brookston: Br	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell; high potential frost action.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Crosby: CrA	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action.	Slight
Eel: Ee	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding; moderate potential frost action.	Slight: subject to occasional flooding.
Genesee: Ge	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding; moderate potential frost action.	Slight: subject to occasional flooding.
Kokomo: Ko	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Martinsville: MaA, MaB2	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders development.	Slight
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders development. Severe where slopes are 6 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: hazard of erosion; slope hinders development and maintenance. Severe where slopes are 12 to 18 percent: hazard of erosion; slope hinders development.
Milford: Mr	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe if undrained: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Ocklev: OcA, OcB2, OcC2	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development.	Moderate: moderate shrink-swell.	Moderate where slopes are 0 to 6 percent: moderate shrink-swell. Severe where slopes are 6 to 12 percent: slope hinders development.	Slight
Palma: Pa	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.

Town and Country Planning (2).

Local roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell; high potential frost action.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded. ¹	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Severe: high potential frost action; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell.	Severe: slow permeability; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Slight	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; clay loam texture moderately affects workability.
Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Severe: subject to occasional flooding; moderate potential frost action.	Severe: subject to occasional flooding.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; slow permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded. ¹	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; silty clay texture severely affects workability.
Moderate: moderate potential frost action; moderate to low shrink-swell.	Slight	Severe: permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: permeable stratified sand at a depth of less than 5 feet; hazard of leachate flow to ground water.
Moderate where slopes are 0 to 12 percent: moderate potential frost action.	Moderate where slopes are 0 to 12 percent: moderately slow permeability; slope causes moderate hazard of effluent seepage.	Moderate where slopes are 0 to 6 percent: moderate hazard of effluent seepage; slopes of 2 to 6 percent moderately hinder development.	Slight where slopes are 0 to 12 percent.
Severe where slopes are 12 to 18 percent: slope hinders development.	Severe where slopes are 12 to 18 percent: severe hazard of erosion and effluent seepage.	Severe where slopes are 6 to 18 percent: slope severely hinders development.	Moderate where slopes are 12 to 18 percent: slope moderately hinders development.
Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell.	Severe: moderately slow permeability; poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded. ¹	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; silty clay texture severely affects workability.
Moderate: moderate potential frost action; moderate shrink-swell.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope causes moderate hazard of effluent seepage.	Severe: less than 5 feet deep to rapidly permeable sand and gravel; severe hazard of effluent seepage to ground water.	Severe: less than 5 feet deep to rapidly permeable sand and gravel; severe hazard of leachate flow to ground water.
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; unstable organic material; high compressibility; high potential frost action.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material promotes undesirable aquatic growth.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; organic material does not provide satisfactory cover.

Appendix D -

Soil series and map symbols	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns
Rensselaer: Re	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Shoals: Sh	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding.
Sloan: So	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Westland: We	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Whitaker: Wh	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Slight

¹If floor of the lagoon is nearly impermeable material at least 2 feet thick, depth to water table can be disregarded.

Appendix D - Soil Limitations for Town and Country Planning (2).

Soil series and map symbols	Drainage with basement	Drainage without basement	Commercial or light industrial developments	Landscaping and forests	Land roads, airports, and parking lots	Residential developments	Seepage basins	Sanitary landfills (leachate type)
Brookton: Bt	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell; high potential frost action	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell; high potential frost action	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate permeability	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded
Cowley: Ck	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell; high potential frost action	Light	Severe: high potential frost action; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell	Severe: slow permeability; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet	Light	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; clay blocks severely restrict water availability
Dal: Ea	Severe: subject to occasional flooding	Severe: subject to occasional flooding; moderate potential frost action	Severe: subject to occasional flooding; moderate potential frost action	Light: subject to occasional flooding	Severe: subject to occasional flooding; moderate potential frost action	Severe: subject to occasional flooding	Severe: subject to occasional flooding	Severe: subject to occasional flooding; permeability restricted; sand at a depth of less than 3 feet; severe hazard of leachate flow to ground water
Gauche: Ga	Severe: subject to occasional flooding	Severe: subject to occasional flooding; moderate potential frost action	Severe: subject to occasional flooding; moderate potential frost action	Light: subject to occasional flooding	Severe: subject to occasional flooding; moderate potential frost action	Severe: subject to occasional flooding	Severe: subject to occasional flooding	Severe: subject to occasional flooding; permeability restricted; sand at a depth of less than 3 feet; severe hazard of leachate flow to ground water
Edmonton: Ea	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate shrink-swell	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate shrink-swell	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; slow permeability	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; clay blocks severely restrict water availability
Marionville: Msk, MskB	Light	Light	Light where slopes are 0 to 2 percent; Moderate where slopes are 2 to 6 percent; slope limited development	Light	Moderate: moderate potential frost action; moderate to low shrink-swell	Light	Severe: permeability restricted; sand at a depth of less than 3 feet; severe hazard of leachate flow to ground water	Severe: permeability restricted; sand at a depth of less than 3 feet; severe hazard of leachate flow to ground water
Marionville: Msk, MskB, MskC, MskD, MskE	Light where slopes are 0 to 6 percent; Moderate where slopes are 6 to 12 percent; slope limited development; Severe where slopes are 12 to 18 percent; slope limited development	Light where slopes are 0 to 6 percent; Moderate where slopes are 6 to 12 percent; slope limited development; Severe where slopes are 12 to 18 percent; slope limited development	Light where slopes are 0 to 6 percent; Moderate where slopes are 6 to 12 percent; slope limited development; Severe where slopes are 12 to 18 percent; slope limited development	Light where slopes are 0 to 6 percent; Moderate where slopes are 6 to 12 percent; slope limited development; Severe where slopes are 12 to 18 percent; slope limited development	Moderate where slopes are 0 to 12 percent; moderate potential frost action; Severe where slopes are 12 to 18 percent; slope limited development	Moderate where slopes are 0 to 6 percent; moderate permeability; slope exceeds moderate based on effluent seepage; Severe where slopes are 6 to 18 percent; slope exceeds moderate based on effluent seepage	Moderate where slopes are 0 to 6 percent; moderate permeability; slope exceeds moderate based on effluent seepage; Severe where slopes are 6 to 18 percent; slope exceeds moderate based on effluent seepage	Light where slopes are 0 to 12 percent; Moderate where slopes are 12 to 18 percent; slope moderately limited development
Milford: M	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell	Severe if undrained: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; high shrink-swell	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; clay blocks severely restrict water availability
Osborne: OsA, OsB, OsC	Light where slopes are 0 to 6 percent; Moderate where slopes are 6 to 12 percent; slope limited development	Moderate: moderate shrink-swell	Moderate where slopes are 0 to 6 percent; moderate shrink-swell; Severe where slopes are 6 to 12 percent; slope limited development	Light	Moderate: moderate potential frost action; moderate shrink-swell	Light where slopes are 0 to 6 percent; Moderate where slopes are 6 to 12 percent; slope exceeds moderate based on effluent seepage	Severe: less than 3 feet deep to rapidly permeable sand and gravel; severe hazard of leachate flow to ground water	Severe: less than 3 feet deep to rapidly permeable sand and gravel; severe hazard of leachate flow to ground water
Palmer: Pa	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; variable organic material; high compressibility	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; variable organic material; high compressibility	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; variable organic material; high compressibility	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; variable organic material; high potential frost action	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; variable organic material; high potential frost action	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; variable organic material; high potential frost action

Appendix D -

Soil series and map symbols	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns
Rensselaer: Re	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Shoals: Sh	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding.
Sloan: So	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Westland: We	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.
Whitaker: Wh	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Slight

*If floor of the lagoon is nearly impermeable material at least 2 feet thick, depth to water table can be disregarded.

Continued.

Local roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill (trench type)
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; permeable stratified sand at a depth of less than 5 feet; se- vere hazard of effluent seepage to ground water.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; permeable stratified sand at a depth of less than 5 feet; se- vere hazard of leachate flow to ground water.
Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action.	Severe: subject to occasional flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: subject to occasional flooding; permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.
Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; mod- erate to low shrink-swell.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to occasional flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately slow permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; rapidly permeable sand and gravel at a depth of less than 5 feet; severe hazard of efflu- ent seepage to ground water.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; rapidly permeable sand and gravel at a depth of less than 5 feet; severe hazard of leach- ate flow to ground water.
Severe: high potential frost action; somewhat poorly drain- ed; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell.	Severe: somewhat poorly drain- ed; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability.	Severe: permeable stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage to ground water.	Severe: permeable stratified sand at a depth of less than 5 feet; severe hazard of leachate flow to ground water.

Appendix E – Soil Limitations For Recreational Purposes (2).

Soil series and map symbols	Campsites	Picnic grounds, parks, and extensive play areas	Playgrounds and athletic fields	Paths and trails	Golf course fairways
Brookston: Br	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Crawley: CrA	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Severe: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.
Ed: Ed	Severe: floods during season of use.	Slight	Moderate: floods during season of use.	Slight	Severe: floods during season of use.
Genesee: Ge	Severe: floods during season of use.	Slight	Moderate: floods during season of use.	Slight	Severe: floods during season of use.
Kokomo: Ko	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Martinsville: MaA, MaB2	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games.	Slight	Slight
Miami: MmA, MmB2, MmC2, MmD2, MpC3, MpD3	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games. Severe where slopes are 6 to 18 percent: slope hinders use for some games.	Slight where slopes are 0 to 12 percent. Moderate where slopes are 12 to 18 percent or in severely eroded areas: subject to erosion; clay loam surface of severely eroded areas affects foot trafficability.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders use; severely eroded areas affect foot trafficability. Severe where slopes are 12 to 18 percent: slope limits use; severely eroded areas affect foot trafficability.
Millford: Mf	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.

Appendix D - Continued.

Bed name and map symbol	Dwellings with basements	Dwellings without basements	Commercial or light industrial developments	Landscaping and lawns	Local roads, streets, and parking lots	Explosive tank storage facilities	Storage lagoons	Runways (airports) (breach types)
Scumline: Sh	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 2 feet, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately close permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; permeable frost-heaved soil at a depth of less than 3 feet; severe hazard of effluent seepage to ground water.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 3 feet, or ponded; permeable frost-heaved soil at a depth of less than 3 feet; severe hazard of leachate flow to ground water.
Beach: Bs	Severe: subject to seasonal flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to seasonal flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to seasonal flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to seasonal flooding.	Severe: subject to seasonal flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action.	Severe: subject to seasonal flooding; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Severe: subject to seasonal flooding; permeable stratified sand at a depth of less than 3 feet; severe hazard of effluent seepage to ground water.	Severe: subject to seasonal flooding; permeable stratified sand at a depth of less than 3 feet; severe hazard of leachate flow to ground water.
Shrub: Sh	Severe: subject to seasonal flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to seasonal flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to seasonal flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to seasonal flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to seasonal flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: subject to seasonal flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to seasonal flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: subject to seasonal flooding; very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.
Wetland: Ww	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe if undrained: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderate if artificially drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; high potential frost action; moderate to low shrink-swell.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; moderately close permeability.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; rapidly permeable sand and gravel at a depth of less than 1 foot; severe hazard of effluent seepage to ground water.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot, or ponded; rapidly permeable sand and gravel at a depth of less than 1 foot; severe hazard of leachate flow to ground water.
Wetland: Wt	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; high potential frost action; moderate to low shrink-swell.	High.	Severe: high potential frost action; somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate to low shrink-swell.	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 foot to 3 feet; moderate permeability.	Severe: permeable stratified sand at a depth of less than 3 feet; severe hazard of effluent seepage to ground water.	Severe: permeable stratified sand at a depth of less than 3 feet; severe hazard of leachate flow to ground water.

¹If flow of the liquid is nearly impervious material at least 3 feet thick, depth to water table can be disregarded.

Appendix E - Soil Limitations For Recreational Purposes (2).

Soil series and map symbols	Campsites	Picnic grounds, parks, and extensive play areas	Playgrounds and athletic fields	Paths and trails	Golf course fairways
Brookston: Br	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Crosby: CrA	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Severe: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.	Moderate: somewhat poorly drained; slow permeability; slow to dry after rain.
Yel: Ee ¹	Severe: floods during season of use.	Slight	Moderate: floods during season of use.	Slight	Severe: floods during season of use.
Genesee: Ge ¹	Severe: floods during season of use.	Slight	Moderate: floods during season of use.	Slight	Severe: floods during season of use.
Kokomo: Ko	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Martinsville: MaA, MaB2.	Slight	Slight	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games.	Slight	Slight
Miami: Mm ¹ A, MmB2, MmC2, MmD2, MmG3, MmP3.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development. Severe where slopes are 12 to 18 percent: slope hinders development.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games. Severe where slopes are 6 to 18 percent: slope hinders use for some games.	Slight where slopes are 0 to 12 percent. Moderate where slopes are 12 to 18 percent or in severely eroded areas: subject to erosion; clay loam surface of severely eroded areas affects foot trafficability.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders use; severely eroded areas affect foot trafficability. Severe where slopes are 12 to 18 percent: slope limits use; severely eroded areas affect foot trafficability.
Millard: M ¹	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained.

Oakley: OcA, OcB2, OcC2	ed; ponding; remains wet for long periods.	Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders development.	ed; ponding; remains wet for long periods.	Slight where slopes are 0 to 2 percent. Moderate where slopes are 2 to 6 percent: slope hinders use for some games. Severe where slopes are 6 to 12 percent: slope hinders use for some games.	ed; ponding; remains wet for long periods.	Slight	ed; ponding; remains wet for long periods; slow permeability. Slight where slopes are 0 to 6 percent. Moderate where slopes are 6 to 12 percent: slope hinders use.
Palmis: P5	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.	Severe: very poorly drained; ponding; remains wet for long periods; organic material unsuitable for heavy foot traffic.
Reusselaer: Re	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Shoals: Sh	Severe: floods during season of use; somewhat poorly drained.	Moderate: floods during season of use; somewhat poorly drained.	Moderate: floods during season of use; somewhat poorly drained.	Severe: floods during season of use; somewhat poorly drained.	Moderate: floods during season of use.	Moderate: floods during season of use.	Severe: floods during season of use.
Shoan: So	Severe: flooding; very poorly drained; remains wet for long periods.	Severe: very poorly drained; remains wet for long periods.	Severe: very poorly drained; remains wet for long periods.	Severe: flooding; very poorly drained; remains wet for long periods.	Severe: very poorly drained; remains wet for long periods.	Severe: very poorly drained; remains wet for long periods.	Severe: flooding; very poorly drained; remains wet for long periods.
Westland: Wn	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.	Severe: very poorly drained; ponding; remains wet for long periods.
Whitaker: Wh	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.	Moderate: somewhat poorly drained; slow to dry after rains.

¹Frequency and intensity of flooding extremely variable; onsite inspection required.

Appendix F - Other Properties

Soil name and location	Depth	Horizon	Textural class	Size class and particle diameter				F
				Very coarse sand to fine sand (2.0 to 0.1 mm)	Very coarse sand (2.0 to 1.0 mm)	Coarse sand (1.0 to 0.5 mm)	Medium sand (0.5 to 0.25 mm)	
Kokomo silty clay loam: NW¼ sec. 14, T. 15 N., R. 6 E.	<i>Inches</i>							
	0-9	Ap	Silty clay loam	11.8				
	9-11	A12	Silty clay loam	11.5				
	11-14	B1g	Silty clay loam	9.7				
	14-21	B21tg	Silty clay loam	7.5				
	21-29	B22tg	Silty clay loam	5.6				
	29-38	B23tg	Silty clay loam	3.7				
	38-44	11B3	Loam	22.2				
Martinsville loam: SW¼ sec. 24, T. 17 N., R. 6 E.	44-60	11C	Loam	27.6				
	0-8	Ap	Loam	24.1	3.2	3.2	4.2	
	8-13	A2	Silt loam	14.5	.8	1.5	2.9	
	13-25	B21t	Clay loam	15.6	.8	1.0	2.5	
	25-32	B22g	Sandy clay loam	18.5	.3	.2	.6	
	32-40	B23g	Sandy loam	25.4	.2	.2	.2	
	40-50	B3	Sandy loam	31.2	.2	.2	.5	
	50-54	C1	Loamy sand	33.3	.1	.3	.8	
Milford silty clay loam: NW¼ sec. 29, T. 17 N., R. 8 E.	54-81	C2	Sandy loam	13.8	.1	.2	.3	
	0-9	Ap	Silty clay loam	1.3				
	9-12	B21g	Silty clay	.6				
	12-21	B22g	Silty clay	.5				
	21-36	B23g	Silty clay loam	.3				
	36-40	B3	Silty clay loam	.1				
	40-45	C1	Silty clay loam	.3				
	45-61	C2	Silty clay loam	.8				
Sloan silty clay loam: SW¼ sec. 19, T. 16 N., R. 6 E.	0-5	Ap	Loam	25.6				
	5-12	A12	Loam	5.8				
	12-19	B21g	Loam	22.4				
	19-24	B22g	Clay loam	21.7				
	24-37	B23g	Clay loam	23.1				
	37-47	B3g	Clay loam	24.3				
	47-63	C1	Loam	28.7	2.8	3.3	9.2	
	63-72	C1	Sandy loam	71.3	10.0	20.4	26.5	
Whitaker loam: NW¼ sec. 24, T. 17 N., R. 6 E.	0-9	Ap	Loam	35.2	2.9	3.2	10.9	
	9-11	A2	Loam	38.4	3.2	2.0	10.1	
	11-24	B21t	Clay loam	23.8	.8	1.0	5.7	
	24-33	B22t	Loam	32.3	1.2	1.1	7.7	
	33-39	B3t	Sandy loam	59.1	1.9	3.9	16.6	
	39-56	C1	Sandy loam	44.0	.3	7.1	19.2	
	56-64	C2	Sandy loam	43.7		.1	5.5	

Appendix E - Ball Limitations For Recreational Purposes (2):

[illegible]

Parameters and estimates of the time continuously available and the time not available

Appendix F - Other Property

Soil name and location	Depth	Horizon	Textural class	Size class and particle diameter				F
				Very coarse sand to fine sand (2.0 to 0.1 mm)	Very coarse sand (2.0 to 1.0 mm)	Coarse sand (1.0 to 0.5 mm)	Medium sand (0.5 to 0.25 mm)	
Kokomo silty clay loam: NW 1/4 sec. 14, T. 15 N., R. 6 E.	<i>Inches</i>							
	0-9	Ap	Silty clay loam	11.8				
	9-11	A12	Silty clay loam	11.5				
	11-14	B1g	Silty clay loam	9.7				
	14-21	B21tg	Silty clay loam	7.5				
	21-29	B22tg	Silty clay loam	5.6				
	29-38	B23tg	Silty clay loam	3.7				
	38-44	HB3	Loam	22.2				
Martinsville loam: SW 1/4 sec. 24, T. 17 N., R. 6 E.	44-60	HC	Loam	27.6				
	0-8	Ap	Loam	24.1	3.2	3.2	4.2	
	8-13	A2	Silt loam	14.5	.8	1.5	2.9	
	13-25	B21t	Clay loam	15.6	.8	1.0	2.5	
	25-32	B22g	Sandy clay loam	18.5	.3	.2	.6	
	32-40	B23g	Sandy loam	25.4	.2	.2	.2	
	40-50	B3	Sandy loam	31.2	.2	.2	.5	
	50-54	C1	Loamy sand	33.3	.1	.3	.8	
Milford silty clay loam: NW 1/4 sec. 20, T. 17 N., R. 8 E.	54-61	C2	Sandy loam	13.8	.1	.2	.3	
	0-9	Ap	Silty clay loam	1.3				
	9-12	B21g	Silty clay	.6				
	12-21	B22g	Silty clay	.5				
	21-36	B23g	Silty clay loam	.3				
	36-40	B3	Silty clay loam	.1				
	40-45	C1	Silty clay loam	.3				
	45-61	C2	Silty clay loam	.8				
Sloan silty clay loam: SW 1/4 sec. 19, T. 16 N., R. 6 E.	0-5	Ap	Loam	25.6				
	5-12	A12	Loam	5.8				
	12-19	B21g	Loam	22.4				
	19-24	B22g	Clay loam	21.7				
	24-37	B23g	Clay loam	23.1				
	37-47	B3g	Clay loam	24.3				
	47-63	C1	Loam	28.7	2.8	3.3	9.2	
	63-72	C1	Sandy loam	71.3	10.0	20.4	26.5	
Whitaker loam: NW 1/4 sec. 24, T. 17 N., R. 6 E.	0-9	Ap	Loam	35.2	2.9	3.2	10.9	
	9-11	A2	Loam	38.4	3.2	2.0	10.1	
	11-24	B21t	Clay loam	23.8	.8	1.0	5.7	
	24-33	B22t	Loam	32.3	1.2	1.1	7.7	
	33-39	B3t	Sandy loam	59.1	1.9	3.9	16.6	
	39-56	C1	Sandy loam	44.0	.3	7.1	19.2	
	56-64	C2	Sandy loam	43.7		.1	5.5	

ies of Selected Soils (2).

Size class and particle diameter						Organic carbon	Reaction (1:1 soil-water suspension)	Extractable	
Fine sand (0.25 to 0.1 mm)	Very fine (0.10 to 0.05 mm)	Silt (0.05 to 0.002 mm)	Clay (less than 0.002 mm)	Total sand (2.0 to 0.05 mm)	Coarse fraction (more than 2.0 mm)			Phosphorus	Potassium
				Percent	Percent of whole soil	Percent	pH	Pounds per acre	Pounds per acre
	5.6	49.3	33.3	17.4		2.28	6.8	21	225
	5.5	49.2	33.8	17.0		2.11	6.7	24	225
	4.8	49.1	36.4	14.5		.96	6.8	4	180
	4.2	51.1	37.2	11.7			6.9	4	225
	3.3	51.5	39.6	8.9	1.0		7.2	2	240
	2.6	58.9	34.8	6.3			7.5	2	210
	10.8	48.6	18.4	33.0	2.2		8.0	2	135
	10.5	41.5	20.4	38.1	5.2		8.0	2	105
13.5	15.0	46.0	14.9	39.1			7.6	25	135
9.3	10.5	62.1	12.9	25.0			7.7	7	105
11.3	15.0	40.8	28.6	30.6			7.1	6	195
17.4	33.8	27.0	20.7	52.3			7.5	10	165
24.8	39.6	18.3	16.7	65.0			7.6	17	150
30.3	37.2	14.5	17.1	68.4			7.6	33	150
32.1	41.1	17.3	8.3	74.4			7.2	10	75
13.2	45.6	38.6	2.0	59.4			8.4	2	30
	1.4	58.8	38.5	2.7		3.2	7.8	106	180
	.9	54.5	44.0	1.5		2.0	7.3	11	165
	.7	58.3	40.5	1.2		1.0	7.7	6	150
	.6	65.3	33.8	.9			7.7	11	225
	.4	68.1	31.4	.5			7.8	11	240
	.7	69.0	30.0	1.0			7.9	4	240
	1.2	68.7	29.3	2.0			8.1	1	165
	7.7	41.1	25.6	33.3		2.0	7.5	58	210
	7.4	41.5	25.3	33.2		2.0	7.7	27	165
	7.1	44.5	26.0	29.5		.99	7.5	14	180
	6.6	43.3	28.4	28.3		.75	7.2	19	180
	7.3	42.2	27.4	30.4			7.1	15	180
	7.5	41.0	27.2	31.8			7.4	30	195
13.4	6.0	38.7	26.6	34.7	4.0		7.5	22	195
14.4	7.6	6.4	14.7	78.9	12.6		7.8	8	60
18.2	7.6	44.5	12.7	42.8			7.1	12	90
23.0	7.0	36.7	17.9	45.4			6.8	4	105
16.3	5.9	38.3	32.0	29.7			5.8	4	195
22.3	7.0	35.1	25.6	39.3			6.7	2	180
36.7	5.0	16.1	19.8	64.1			6.8	3	165
16.4	8.0	32.7	15.3	52.0	10.0		8.2	3	105
38.1	26.9	24.3	5.1	70.6			8.4	4	45

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Appendix F - Other Properties of Selected Soils (2).

Soil name and location	Depth	Soil class	Textural class	Soil fines and particle diameter				Soil fines and particle diameter						Organic carbon	Reactive Si (1) with water (mg/kg)	Extractable						
				Very coarse sand for fine sand (0.0 to 0.1 mm)	Very coarse sand (0.1 to 1.0 mm)	Clayey sand (0.1 to 0.5 mm)	Medium sand (0.5 to 0.25 mm)	Fine sand (0.25 to 0.1 mm)	Very fine (0.1 to 0.05 mm)	Silt (0.05 to 0.002 mm)	Clay (less than 0.002 mm)	Total sand (0.05 to 0.002 mm)	Coarse fraction (more than 0.05 mm)			Percent of organic acid	Percent	pH	Phosphorus	Potassium		
Kalamazoo silty clay loam - NW 1/4 sec 14, T. 13 N., R. 6 E.	0-5	Ap	Silty clay loam	11.8					3.4	49.1	22.2	17.8		Percent of organic acid	Percent	pH	Phosphorus	Potassium				
	5-11	A12	Silty clay loam	11.5					3.3	49.2	22.8	17.9										
	11-14	B1g	Silty clay loam	9.7					4.5	49.1	26.4	14.2										
	14-21	B12g	Silty clay loam	7.9					4.2	50.1	27.2	11.7										
	21-28	B22g	Silty clay loam	3.9					3.7	51.5	33.9	9.5	1.8									
	28-38	B32g	Silty clay loam	3.7					3.9	50.9	34.9	5.3										
	38-44	B32g	Loam	22.2					10.4	49.6	18.9	31.0	2.3									
	44-48	B32	Loam	27.9					10.5	41.5	20.4	38.1	3.2									
	Mantua (silt) loam - SW 1/4 sec 24, T. 17 N., R. 6 E.	0-5	Ap	Loam	24.2	2.2	2.2	6.2	13.5	13.0	46.0	14.9	39.2							Percent of organic acid	Percent	pH
5-11		A1	Silt loam	14.3	4	1.2	2.8	8.5	8.5	53.1	12.9	35.9										
11-21		B21	Clay loam	13.2	4	1.5	2.1	7.2	13.0	48.4	28.6	25.6										
21-31		B22g	Sandy clay loam	18.9	3	2	8	17.4	33.4	37.0	30.7	10.3										
31-40		B22g	Sandy loam	20.4	2	2	2	24.8	39.0	18.2	16.7	15.6										
40-50		B2	Sandy loam	21.2	2	2	8	20.2	27.2	14.2	17.2	18.4										
50-54		C1	Loamy sand	22.3	3	3	8	22.3	42.1	17.3	8.2	14.4										
54-61		C2	Sandy loam	11.8	3	3	3	13.3	40.4	38.0	2.9	10.9										
Mantua silty clay loam - NW 1/4 sec 28, T. 17 N., R. 6 E.		0-5	Ap	Silty clay loam	1.2					1.4	58.9	28.2	2.7		Percent of organic acid	Percent	pH	Phosphorus	Potassium			
	5-12	B21g	Silty clay	6					6	54.1	44.0	1.2										
	12-21	B22g	Silty clay	3					7	56.3	40.5	1.8										
	21-30	B22g	Silty clay loam	3					6	52.3	22.8	4										
	30-40	B2	Silty clay loam	3					9	58.1	16.4	3										
	40-43	C1	Silty clay loam	3					9	59.9	33.9	1.9										
	43-45	C2	Silty clay loam	8					1.2	68.7	29.2	2.0										
	Mantua silty clay loam - SW 1/4 sec 15, T. 17 N., R. 6 E.	0-5	Ap	Loam	25.8					7.7	41.1	25.6	32.3							Percent of organic acid	Percent	pH
5-12		A12	Loam	5.8					7.4	41.1	25.9	33.2										
12-14		B21g	Loam	22.4					7.7	44.3	26.0	29.2										
14-18		B22g	Clay loam	31.7					6.6	43.1	28.4	29.2										
18-27		B22g	Clay loam	22.1					7.3	42.2	27.9	30.4										
27-47		B2g	Clay loam	28.3					7.0	41.0	27.2	31.8										
47-49		C1	Loam	16.7					6.0	36.7	36.9	36.7										
49-72		C2	Sandy loam	71.3	2.9	2.2	6.2	13.4	7.8	5.4	14.7	75.5	4.0									
Mantua loam - NW 1/4 sec 24, T. 17 N., R. 6 E.		0-5	Ap	Loam	15.3	2.9	2.2	10.9	18.2	7.6	44.3	12.7	42.6		Percent of organic acid	Percent	pH	Phosphorus	Potassium			
	5-11	A1	Loam	28.4	3.2	3.6	7	25.0	7.8	45.7	17.8	42.4										
	11-20	B21	Clay loam	37.9	4	1	1	34.3	2.9	33.3	23.0	39.7										
	20-25	B22g	Loam	32.3	1.2	1.1	7.7	22.3	7.0	39.3	22.6	29.3										
	25-39	B2g	Sandy loam	19.1	1.9	1.9	10.9	25.2	3.0	35.3	14.8	44.1										
	39-49	C1	Sandy loam	44.9	3	7.1	15.2	16.4	8.0	32.0	13.5	52.5										
	49-64	C2	Sandy loam	42.7		3	5.5	36.1	36.9	34.3	1.1	79.8

LEGEND

MAJOR FEATURES

	Lake or Pond		River or Stream
	Road		Railroad
	Boundary		Contour Line
	Elevation		Spot Elevation
	Water		Marsh
	Swamp		Forest
	Cultivated Land		Pasture
	Bare Ground		Urban Area

SMALL FEATURES

	Small Lake or Pond		Small River or Stream
	Small Road		Small Railroad
	Small Boundary		Small Contour Line
	Small Elevation		Small Spot Elevation
	Small Water		Small Marsh
	Small Swamp		Small Forest
	Small Cultivated Land		Small Pasture
	Small Bare Ground		Small Urban Area

VERTICAL SYMBOLS

Symbol for vertical features

	Vertical Feature
	Vertical Feature
	Vertical Feature
	Vertical Feature
	Vertical Feature

ENGINEERING SOILS MAP HANCOCK COUNTY INDIANA

INDIANA

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