GROUND WATER POLLUTION POTENTIAL OF HANCOCK COUNTY, OHIO

BY

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GROUND WATER POLLUTION POTENTIAL REPORT NO. 14

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ABSTRACT

A ground water pollution potential mapping program for Ohio has been developed under the direction of the Division of Water, Ohio Department of Natural Resources, using the DRASTIC mapping process. The DRASTIC system consists of two major elements: the designation of mappable units, termed hydrogeologic settings, and the superposition of a relative rating system for pollution potential.

Hydrogeologic settings form the basis of the system and incorporate the major hydrogeologic factors that affect and control ground water movement and occurrence including depth to water, net recharge, aquifer media, soil media, topography, impact of the vadose zone media, and hydraulic conductivity of the aquifer. These factors, which form the acronym DRASTIC, are incorporated into a relative ranking scheme that uses a combination of weights and ratings to produce a numerical value called the ground water pollution potential index. Hydrogeologic settings are combined with the pollution potential indexes to create units that can be graphically displayed on a map.

Hancock County lies within the generally flat-lying to gently rolling Till Plains section of the Central Lowlands physiographic province (Fenneman, 1938). The county is covered by variable thicknesses of glacial till, an unsorted mixture of silt and clay with variable amounts of sand and gravel. These unconsolidated glacial deposits are underlain by relatively flat-lying sequences of Paleozoic sedimentary rocks consisting primarily of dolomite from the Silurian System. Ground water yields are dependent on the type of aquifer and vary greatly throughout the county. Pollution potential indexes are moderately low to moderate in areas of sand/gravel interbedded in glacial till and in areas of moraine. Areas of river alluvium over sedimentary bedrock and glacial till, glacial till over solution limestone, thin glacial till over limestone, marsh/swamps, beaches, beach ridges, and sand dunes all have indexes with moderately high to high vulnerablities to contamination.

Ground water pollution potential analysis in Hancock County resulted in a map with symbols and colors which illustrate areas of varying ground water contamination vulnerability. Eight hydrogeologic settings were identified in Hancock County with computed ground water pollution potential indexes ranging from 91 to 188.

The ground water pollution potential mapping program optimizes the use of existing data to rank areas with respect to relative vulnerability to contamination. The ground water pollution potential map of Hancock County has been prepared to assist planners, managers, and local officials in evaluating the potential for contamination from various sources of pollution. This information can be used to help direct resources and land use activities to appropriate areas, or to assist in protection, monitoring, and clean-up efforts

TABLE OF CONTENTS

Number Page

LIST OF FIGURES

Number Page

LIST OF TABLES

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INTRODUCTION

The need for protection and management of ground water resources in Ohio has been clearly recognized. About 42 per cent of Ohio citizens rely on ground water for drinking and household use from both municipal and private wells. Industry and agriculture also utilize significant quantities of ground water for processing and irrigation. In Ohio, approximately 700,000 rural households depend on private wells; approximately 3,000 of these wells exist in Hancock County.

The characteristics of the many aquifer systems in the state make ground water highly vulnerable to contamination. Measures to protect ground water from contamination usually cost less and create less impact on ground water users than clean up of a polluted aquifer. Based on these concerns for protection of the resource, staff of the Division of Water conducted a review of various mapping strategies useful for identifying vulnerable aquifer areas. They placed particular emphasis on reviewing mapping systems that would assist in state and local protection and management programs. Based on these factors and the quantity and quality of available data on ground water resources, the DRASTIC mapping process (Aller et al., 1987) was selected for application in the program.

Considerable interest in the mapping program followed successful production of a demonstration county map and led to the inclusion of the program as a recommended initiative in the Ohio Ground Water Protection and Management Strategy (Ohio EPA, 1986). Based on this recommendation, the Ohio General Assembly funded the mapping program. A dedicated mapping unit has been established in the Division of Water, Ground Water Resources Section to implement the ground water pollution potential mapping program on a county-wide basis in Ohio.

ERM-Midwest, Inc. was selected by the Division of Water to assist in the timely production of these maps. Under the direct supervision of the Division of Water, ERM-Midwest completed the mapping process. All work has been extensively reviewed and field-checked by both ERM-Midwest and the Division of Water.

The purpose of this report and map is to aid in the protection of our ground water resources. This protection can be enhanced by understanding and implementing the results of this study which utilizes the DRASTIC system of evaluating an area's potential for ground water pollution. The mapping program identifies areas that are more or less vulnerable to contamination and displays this information graphically on maps. The system was not designed or intended to replace site-specific investigations, but rather to be used as a planning and management tool. The results of the map and report can be combined with other information to assist in prioritizing local resources and in making land use decisions.

APPLICATIONS OF POLLUTION POTENTIAL MAPS

The pollution potential mapping program offers a wide variety of applications in many counties. The ground water pollution potential map of Hancock County has been prepared to assist planners, managers, and state and local officials in evaluating the relative vulnerability of areas to ground water contamination from various sources of pollution. This information can be used to help direct resources and land use activities to appropriate areas, or to assist in protection, monitoring, and clean-up efforts.

An important application of the pollution potential maps for many areas will be assisting in county land use planning and resource expenditure allocation related to solid waste disposal. A county may use the map to help identify areas that are more or less suitable for land disposal activities. Once these areas have been identified, a county can collect more site-specific information and combine this with other local factors to determine site suitability.

Pollution potential maps may also be utilized successfully where non-point source contamination is a concern. Non-point source contamination occurs where land use activities over large areas impact water quality. Maps providing information on relative vulnerability can be used to guide the selection and implementation of appropriate best management practices in different areas. Best management practices should be chosen based upon consideration of the chemical and physical processes that occur from the practice, and the effect these processes may have in areas of moderate to high vulnerability to contamination. For example, the use of agricultural best management practices that limit the infiltration of nitrates, or promote denitrification above the water table, would be beneficial to implement in areas of relatively high vulnerability to contamination.

A pollution potential map can also assist in developing ground water protection strategies. By identifying areas more vulnerable to contamination, officials can direct resources to areas where special attention or protection efforts might be warranted. This information can be utilized effectively at the local level for integration into land use decisions and as an educational tool to promote public awareness of ground water resources. Pollution potential maps may also be used to prioritize ground water monitoring and/or contamination clean-up efforts. Areas that are identified as being vulnerable to contamination may benefit from increased ground water monitoring for pollutants or from additional efforts to clean up an aquifer.

Other beneficial uses of the pollution potential maps will be recognized by individuals in the county who are familiar with specific land use and management problems. Planning commissions and zoning boards can use these maps to help make informed decisions about the development of areas within their

jurisdiction. Developments proposed to occur within ground water sensitive areas may be required to show how ground water will be protected.

Regardless of the application, emphasis must be placed on the fact that the system is not designed to replace a site-specific investigation. The strength of the system lies in its ability to make a "first-cut approximation" by identifying areas that are vulnerable to contamination. Any potential applications of the system should also recognize the assumptions inherent in the system.

SUMMARY OF THE DRASTIC MAPPING PROCESS

The system chosen for implementation of a ground water pollution potential mapping program in Ohio, DRASTIC, was developed by the National Water Well Association for the United States Environmental Protection Agency. A detailed discussion of this system can be found in Aller et al., (1987).

The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using existing information. The vulnerability of an area to contamination is a combination of hydrogeologic factors, anthropogenic influences, and sources of contamination in any given area. The DRASTIC system focuses only on those hydrogeologic factors which influence ground water pollution potential. The system consists of two major elements: the designation of mappable units, termed hydrogeologic settings, and the superposition of a relative rating system to determine pollution potential.

The application of DRASTIC to an area requires the recognition of a set of assumptions made in the development of the system. DRASTIC evaluates the pollution potential of an area, assuming a contaminant with the mobility of water, introduced at the surface, and flushed into the ground water by precipitation. Most important, DRASTIC cannot be applied to areas smaller than one-hundred acres in size and is not intended or designed to replace site-specific investigations.

Hydrogeologic Settings and Factors

To facilitate the designation of mappable units, the DRASTIC system used the framework of an existing classification system developed by Heath (1984), which divides the United States into fifteen ground water regions based on the factors in a ground water system that affect occurrence and availability.

Within each major hydrogeologic region, smaller units representing specific hydrogeologic settings are identified. Hydrogeologic settings form the basis of the system and represent a composite description of the major geologic and hydrogeologic factors that control ground water movement into, through, and out of an area. A hydrogeologic setting represents a mappable unit with common hydrogeologic characteristics and, as a consequence, common vulnerability to contamination (Aller et al.,1987).

Figure 1 illustrates the format and description of a typical hydrogeologic setting found within Hancock County. Inherent within each hydrogeologic setting are the physical characteristics which affect the ground water pollution potential. These characteristics or factors identified during the development of the DRASTIC system include:

D - Depth to Water

R - Net Recharge

A - Aquifer Media

S - Soil Media

T - Topography

I - Impact of the Vadose Zone Media

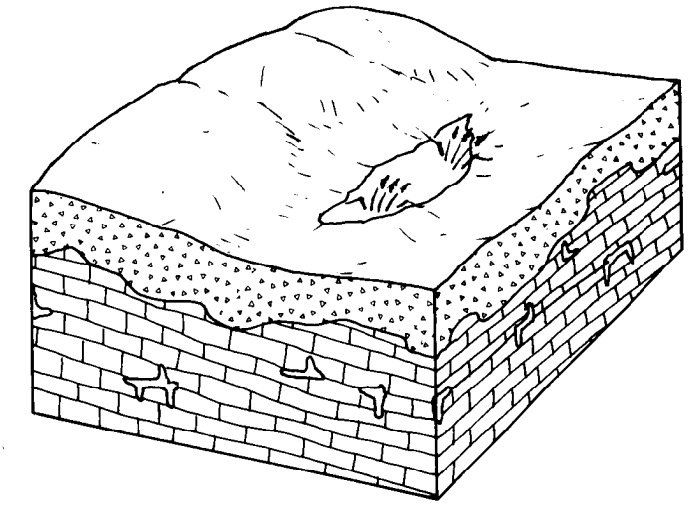
C - Conductivity (Hydraulic) of the Aquifer

These factors incorporate concepts and mechanisms such as attenuation, retardation, and time or distance of travel of a contaminant with respect to the physical characteristics of the hydrogeologic setting. Broad consideration of these factors and mechanisms coupled with existing conditions in a setting provide a basis for determination of the area's relative vulnerability to contamination.

Depth to water is considered to be the depth from the ground surface to the water table in unconfined aquifer conditions, or the depth to the top of the aquifer under confined aquifer conditions. The depth to water determines the distance a contaminant would have to travel before reaching the aquifer. The greater the distance the contaminant has to travel, the greater the opportunity for attenuation to occur or restriction of movement by relatively impermeable layers.

Net recharge is the total amount of water reaching the land surface that infiltrates into the aquifer measured in inches per year. Recharge water is available to transport a contaminant from the surface into the aquifer and also affects the quantity of water available for dilution and dispersion of a contaminant. Factors to be included in the determination of net recharge include contributions due to infiltration of precipitation, in addition to infiltration from rivers, streams and lakes, irrigation, and artificial recharge.

Aquifer media represents consolidated or unconsolidated rock material capable of yielding sufficient quantities of water for use. Aquifer media accounts for the various physical characteristics of the rock that provide mechanisms of attenuation, retardation, and flow pathways that affect a contaminant reaching and moving through an aquifer.



7Ac Glacial Till Over Solution Limestone

This hydrogeologic setting is characterized by low topography and solution limestone which is covered by varying thicknesses of glacial till. The till is principally unsorted deposits which may be interbedded with loess or localized deposits of sand and gravel. Surficial deposits have usually weathered to a clay loam. Although ground water occurs in both the glacial deposits and in the underlying limestone, the limestone, which typically contains solution cavities, generally serves as the principal aquifer. The limestone is in direct hydraulic connection with the glacial till and the glacial till serves as a source of recharge for the underlying limestone. Although precipitation is abundant in most of the region, recharge is moderate because of the relatively low permeability of the overlying glacial till. Depth to water is extremely variable depending, in part, on the thickness of the glacial till, but is typically moderately deep.

Figure 1. Format and description of the hydrogeologic setting - 7Ac Glacial Till Over Solution Limestone.

Soil media refers to the upper six feet of the unsaturated zone that is characterized by significant biological activity. The type of soil media can influence the amount of recharge that can move through the soil column due to variations in soil permeability. Various soil types also have the ability to attenuate or retard a contaminant as it moves throughout the soil profile. Soil media is based on textural classifications of soils and considers relative thicknesses and attenuation characteristics of each profile within the soil.

Topography refers to the slope of the land expressed as percent slope. The amount of slope in an area affects the likelihood that a contaminant will run off from an area or be ponded and ultimately infiltrate into the subsurface. Topography also affects soil development and often can be used to help determine the direction and gradient of ground water flow under water table conditions.

The impact of the vadose zone media refers to the attenuation and retardation processes that can occur as a contaminant moves through the unsaturated zone above the aquifer. The vadose zone represents that area below the soil horizon and above the aquifer that is unsaturated or discontinuously saturated. Various attenuation, travel time, and distance mechanisms related to the types of geologic materials present can affect the movement of contaminants in the vadose zone. Where an aquifer is unconfined, the vadose zone media represents the materials below the soil horizon and above the water table. Under confined aquifer conditions, the vadose zone is simply referred to as a confining layer. The presence of the confining layer in the unsaturated zone significantly impacts the pollution potential of the ground water in an area

Hydraulic conductivity of an aquifer is a measure of the ability of the aquifer to transmit water, and is also related to ground water velocity and gradient. Hydraulic conductivity is dependent upon the amount and interconnectivity of void spaces and fractures within a consolidated or unconsolidated rock unit. Higher hydraulic conductivity typically corresponds to higher vulnerability to contamination. Hydraulic conductivity considers the capability for a contaminant that reaches an aquifer to be transported throughout that aquifer over time.

Weighting and Rating System

DRASTIC uses a numerical weighting and rating system that is combined with the DRASTIC factors to calculate a ground water pollution potential index or relative measure of vulnerability to contamination. The DRASTIC factors are weighted from 1 to 5 according to their relative importance to each other with regard to contamination potential (Table 1). Each factor is then divided into ranges or media types and assigned a rating from 1 to 10 based on their significance to pollution potential (Tables 2-8). The rating for each factor is selected based on available information and professional judgement. The selected rating for each factor is multiplied by the assigned weight for each

factor. These numbers are summed to calculate the DRASTIC or pollution potential index.

Once a DRASTIC index has been calculated, it is possible to identify areas that are more likely to be susceptible to ground water contamination relative to other areas. The higher the DRASTIC index, the greater the vulnerability to contamination. The index generated provides only a relative evaluation tool and is not designed to produce absolute answers or to represent units of vulnerability. Pollution potential indexes of various settings should be compared to each other only with consideration of the factors that were evaluated in determining the vulnerability of the area.

Pesticide DRASTIC

A special version of DRASTIC was developed to be used where the application of pesticides is a concern. The weights assigned to the DRASTIC factors were changed to reflect the processes that affect pesticide movement into the subsurface with particular emphasis on soils. The process for calculating the Pesticide DRASTIC index is identical to the process used for calculating the general DRASTIC index. However, general DRASTIC and Pesticide DRASTIC numbers should not be compared because the conceptual basis in factor weighting and evaluation significantly differs.

TABLE 1. ASSIGNED WEIGHTS FOR DRASTIC FEATURES

Feature	General DRASTIC Weight	Pesticide DRASTIC Weight
Depth to Water	5	5
Net Recharge	4	4
Aquifer Media	3	3
Soil Media	2	5
Topography	1	3
Impact of the Vadose Zone Media	5	4
Hydraulic Conductivity of the Aquifer	3	2

TABLE 2. RANGES AND RATINGS FOR DEPTH TO WATER

DEPTH TO WATER (FEET)	
Range	Rating
0-5	10
5-15	9
15-30	7
30-50	5
50-75	3
75-100	2
100+	1
Weight: 5	Pesticide Weight: 5

TABLE 3. RANGES AND RATINGS FOR NET RECHARGE

NET RECHARGE (INCHES)	
Range	Rating
0-2	1
2-4	3
4-7	6
7-10	8
10+	9
Weight: 4	Pesticide Weight: 4

TABLE 4. RANGES AND RATINGS FOR AQUIFER MEDIA

AQUIFER MEDIA		
Range	Rating	Typical Rating
Massive Shale	1-3	2
Metamorphic/Igneous	2-5	3
Weathered Metamorphic / Igneous	3-5	4
Glacial Till	4-6	5
Bedded Sandstone, Limestone and Shale Sequences	5-9	6
Massive Sandstone	4-9	6
Massive Limestone	4-9	6
Sand and Gravel	4-9	8
Basalt	2-10	9
Karst Limestone	9-10	10
Weight: 3	Pesticide Weight: 3	

TABLE 5. RANGES AND RATINGS FOR SOIL MEDIA

SOIL MEDIA	
Range	Rating
Thin or Absent	10
Gravel	10
Sand	9
Peat	8
Shrinking and / or Aggregated Clay	7
Sandy Loam	6
Loam	5
Silty Loam	4
Clay Loam	3
Muck	2
Nonshrinking and Nonaggregated Clay	1
Weight: 2	Pesticide Weight: 5

TABLE 6. RANGES AND RATINGS FOR TOPOGRAPHY

TOPOGRAPHY (PERCENT SLOPE)	
Range	Rating
0-2	10
2-6	9
6-12	5
12-18	3
18+	1
Weight: 1	Pesticide Weight: 3

TABLE 7. RANGES AND RATINGS FOR IMPACT OF THE VADOSE ZONE MEDIA

IMPACT OF THE VADOSE ZONE MEDIA		
Range	Rating	Typical Rating
Confining Layer	1	1
Silt/Clay	2-6	3
Shale	2-5	3
LImestone	2-7	6
Sandstone	4-8	6
Bedded Limestone, Sandstone, Shale	4-8	6
Sand and Gravel with significant Silt and Clay	4-8	6
Metamorphic/Igneous	2-8	4
Sand and Gravel	6-9	8
Basalt	2-10	9
Karst Limestone	8-10	10
Weight: 5	Pesticide Weight: 4	

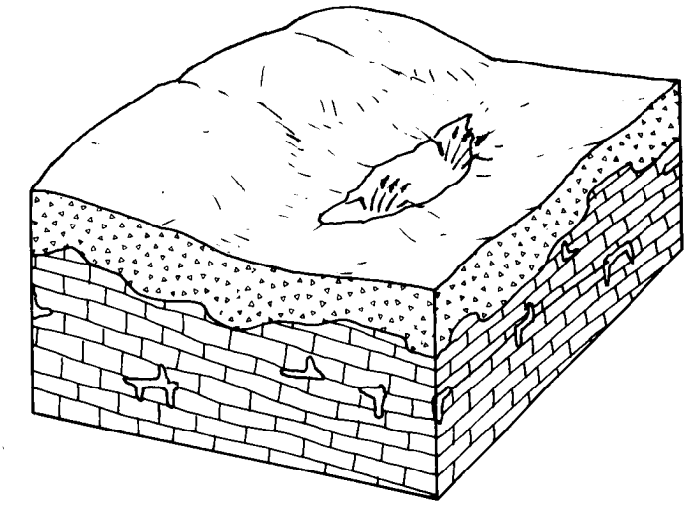
TABLE 8. RANGES AND RATINGS FOR HYDRAULIC CONDUCTIVITY

HYDRAULIC CONDUCTIVITY (GPD/FT^2)	
Range	Rating
1-100	1
100-300	2
300-700	4
700-1000	6
1000-2000	8
2000+	10
Weight: 3	Pesticide Weight: 2

Integration of Hydrogeologic Settings and DRASTIC Factors

Figure 2 illustrates the hydrogeologic setting 7Ac1, Glacial Till Over Solution Limestone, identified in mapping Hancock County, and the pollution potential index calculated for the setting. Based on selected ratings for this setting, the pollution potential index is calculated to be 153. This numerical value has no intrinsic meaning, but can be readily compared to a value obtained for other settings in the county. DRASTIC indexes for typical hydrogeologic settings and values across the United States range from 65 to 223. The diversity of hydrogeologic conditions in Hancock County produces settings with a wide range of vulnerability to ground water contamination. Calculated pollution potential indexes for the eight settings identified in the county range from 91 to 188.

Hydrogeologic settings identified in an area are combined with the pollution potential indexes to create units that can be graphically displayed on maps. Pollution potential analysis in Hancock County resulted in a map with symbols and colors that illustrate areas of ground water vulnerability. The map describing the ground water pollution potential of Hancock County is included with this report.



SETTING 7Ac1		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	NUMBER
Depth to Water	5'-15'	5	9	45
Net Recharge	4"-7"	4	6	24
Aquifer Media	Massive Limestone	3	7	21
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact Vadose Zone	Sand/Gravel w/Silt/Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		DRASTIC	INDEX	153

Figure 2. Description of the hydrogeologic setting - 7Ac1 Glacial Till Over Solution Limestone.

INTERPRETATION AND USE OF A GROUND WATER POLLUTION POTENTIAL MAP

The application of the DRASTIC system to evaluate an area's vulnerability to contamination produces hydrogeologic settings with corresponding pollution potential indexes. The higher the pollution potential index, the greater the susceptibility to contamination. This numeric value determined for one area can be compared to the pollution potential index calculated for another area.

The map accompanying this report displays both the hydrogeologic settings identified in the county and the associated pollution potential indexes calculated in those hydrogeologic settings. The symbols on the map represent the following information:

7Ac1 - defines the hydrogeologic region and setting
153 - defines the relative pollution potential

Here the first number (7) refers to the major hydrogeologic region and the upper and lower case letters (Ac) refer to a specific hydrogeologic setting. The following number (1) references a certain set of DRASTIC parameters that are unique to this setting and are described in the corresponding setting chart. The second number (153) is the calculated pollution potential index for this unique setting. The charts for each setting provide a reference to show how the pollution potential index was derived in an area.

The maps are color-coded using ranges depicted on the map legend. The color codes used are part of a national color-coding scheme developed to assist the user in gaining a general insight into the vulnerability of the ground water in the area. The color codes were chosen to represent the colors of the spectrum, with warm colors (red, orange, and yellow) representing areas of higher vulnerability (higher pollution potential indexes), and cool colors (greens, blues, and violet) representing areas of lower vulnerability to contamination.

The map also includes information on the locations of selected observation wells. Available information on these observation wells is referenced in Appendix A, Description of the Logic in Factor Selection. Large man-made features such as landfills, quarries, or strip mines have also been marked on the map for reference.

GENERAL INFORMATION ABOUT HANCOCK COUNTY

Hancock County occupies an area of approximately 532 square miles in northwest Ohio (Figure 3). It is bounded on the north by Wood County, on the east by Seneca and Wyandot counties, on the south by Hardin County, and on the west by Allen and Putnam counties. The county seat is Findlay. The estimated population of the county for 1994, according to the Ohio Department of Commerce (1991), is 65,536. Agriculture accounts for 75.4 percent of the land use in Hancock County (Ohio Department of Agriculture, 1992).

Physiography

The physiography of Hancock County consists of a mantle of unconsolidated glacial deposits overlying a sequence of relatively flat-lying sedimentary rocks. The majority of the county is located in the generally flat-lying to gently rolling Till Plains section (Figure 4) of the Central Lowlands physiographic province (Fenneman, 1938). Some hummocky terrain is associated with two east-west trending moraines crossing Hancock County.

The entire northern margin of the county and an area south of the Defiance Moraine referred to as the Findlay Embayment (Figure 4) are located in the Eastern Lake Plains section of the Central Lowlands physiographic province (Fenneman, 1938). This area consists of flat-lying topography with a series of generally east-west trending beach ridges occurring around and across the lake plains.

Drainage and Climate

Surface drainage in Hancock County is divided into three major river basins: the Maumee River basin (which includes the Blanchard River and its tributaries), the Portage River basin, and the Sandusky River basin. The Maumee River basin is the dominant drainage basin covering 73.7% of the county, followed by the Portage River basin (26.3%), and the Sandusky River basin (0.1%) (Ohio Department of Natural Resources, (ODNR) 1960 and 1966).

The climate of Hancock County is typical of the temperate mid-continent region, characterized by a wide range between summer and winter temperatures and moderate amounts of precipitation. The average monthly precipitation at the U.S. Weather Bureau Station at Findlay for the thirty year period from 1961 to 1990 ranged between 1.50 inches for February and 4.06 inches for July. The average annual precipitation for the county was 34.26 inches. The average annual temperature range for the same 30 year period was between 23.6°F (January) and 72.8°F (July) with an average annual temperature of 49.6°F (U.S. Department of Commerce, 1992).

Figure 3. Location of Hancock County

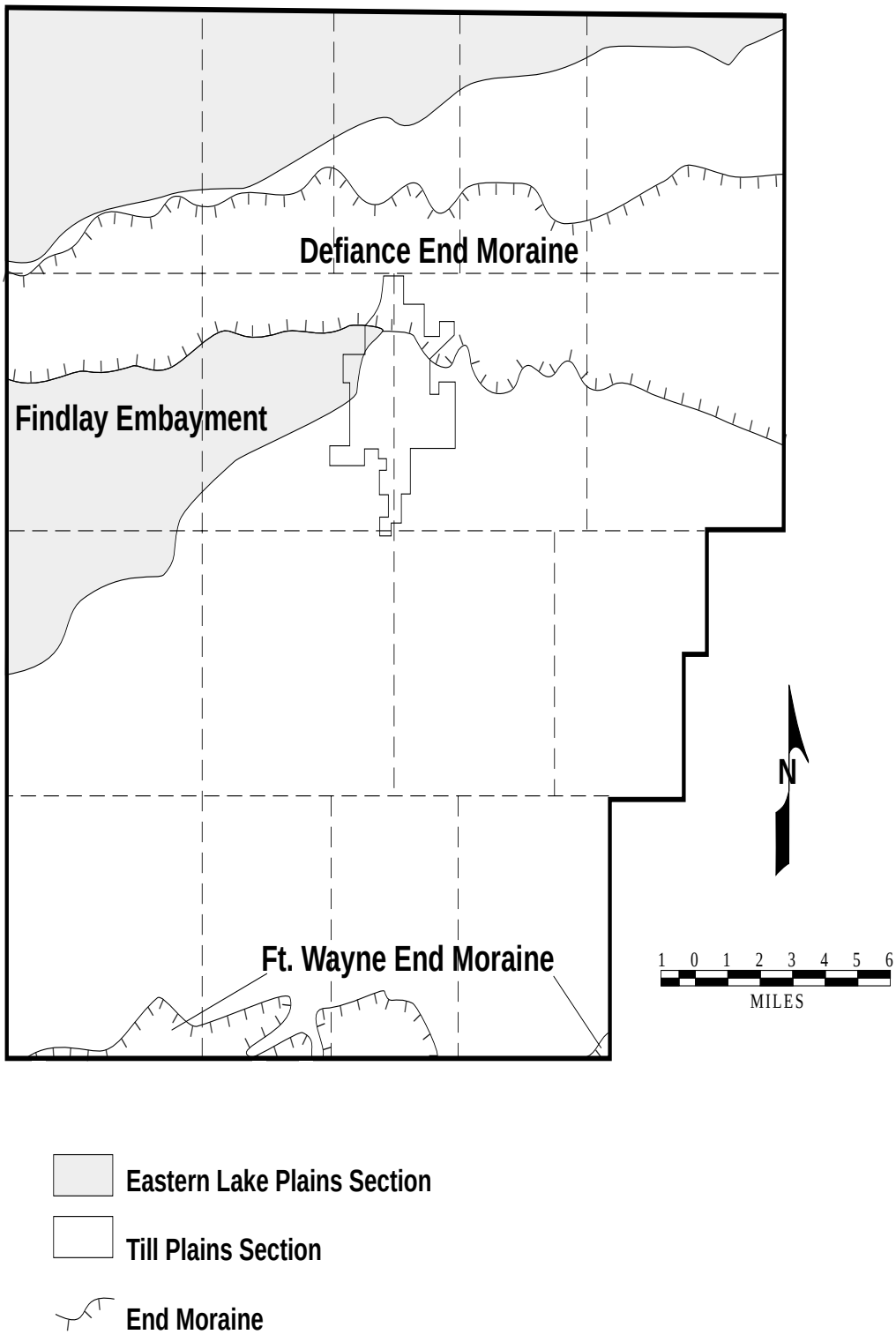


Figure 4. Physiographic sections of the Central Lowlands province in Hancock County, Ohio. (Modified from Metzger, 1984)

Glacial Geology

Approximately 2 million years ago, the Pleistocene Epoch commenced with a series of continental glaciers covering the northern half of North America. Four major glacial advances: the Nebraskan (oldest), Kansan, Illinoian, and Wisconsinan (youngest) are known to have occurred in North America during the Pleistocene Epoch. In Ohio, evidence exists for three glacial periods; the pre-Illinoian, which includes the Kansan and possibly the Nebraskan periods but is not reliably dated (Norton et al., 1983); the Illinoian, which occurred at least 120,000 years ago; and the Wisconsinan, which occurred between 70,000 and 10,000 years ago (Fullerton, 1986).

Continental glaciation greatly altered much of Ohio's preglacial landscape by burying its Tertiary topographic relief and drainage systems beneath a mantle of unconsolidated clastic deposits. This mantle consists of both sorted and unsorted deposits of clay, silt, sand, and gravel.

Glacial sediments deposited in Hancock County consist mainly of glacial till, an unsorted mixture of silt and clay with variable amounts of sand and gravel deposited directly from the ice sheet. Glacial till in the county comprises two basic landforms: flat to gently-rolling ground moraines, and hummocky end moraines. Ground moraines cover most of Hancock County and are generally 50 feet or less in thickness although some deposits are known to range in excess of 100 feet (Ohio Department of Natural Resources, well logs).

End moraines are deposited at the outer edge of a glacial ice sheet and often occur as long, hummocky ridges. Two east-west trending end moraines, the Defiance and Ft. Wayne Moraines, occur in Hancock County (Figure 5). The Defiance Moraine crosses through the county north of Findlay and the Fort Wayne Moraine crosses along the southern margin of the county (Goldthwait, et al., 1961). The thickness of the Defiance Moraine ranges between 52 and 102 feet with an approximate average of 80 feet. The Fort Wayne Moraine has a thickness ranging between 5 and 60 feet with an approximate average of 25 feet (Bauder, 1964).

Outwash deposits consisting of sorted sand and gravel are also commonly found in Hancock County, often as lenses of sand and gravel interbedded in the glacial till. South of the Defiance Moraine, an intermittent buried outwash deposit is generally found between the overlying glacial till and the underlying dolomite bedrock. The buried outwash deposit is known to range in thickness between 4 and 22 feet with an approximate average of 5 feet (Ohio Department of Natural Resources, well logs).

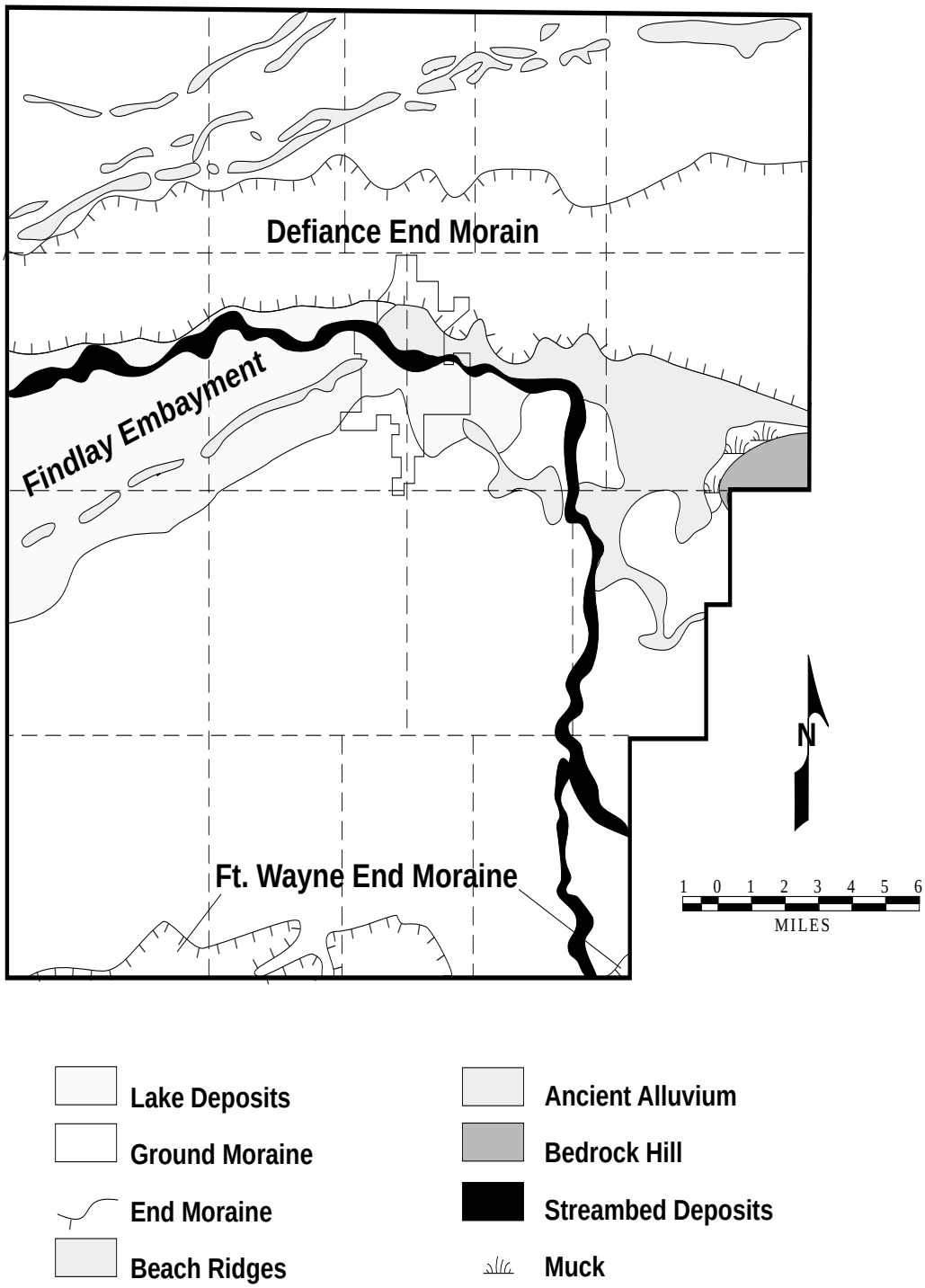


Figure 5. Surficial deposits map of Hancock County, Ohio. (Modified from Metzger, 1984)

As the last continental glacier retreated from Ohio, meltwater impounded between the Great Lakes drainage divide and the retreating glacier created a series of ancient glacial lakes in northwest Ohio. Beach ridges, remnants of the ancient lakes, were formed along the northern flank of the Defiance Moraine and along the southern margin of the Findlay Embayment (Figure 5). Beach ridges deposited by ancient glacial lakes Maumee I, II, and III occur along the perimeter of the lake plains region. Lake Whittlesey beach ridges cross through the northwestern corner of the county (Forsyth, 1959 and Bugh, 1962).

Bedrock Geology

Hancock County is underlain by a relatively flat-lying sequence of Paleozoic sedimentary rocks consisting primarily of dolomite from the Silurian System (Table 9). Bedrock beneath Hancock county consists of four formations: the Lockport Dolomite, the Greenfield Dolomite, the Tymochtee Dolomite, and undifferentiated Salina Group Dolomite (Figure 6).

The Silurian bedrock beneath Hancock County is generally comprised of a microcrystalline brown to gray argillaceous dolomite. Anhydrite and shale are interbedded with the dolomite in certain localities throughout the northwestern region of the state (Janssens, 1977).

The bedrock formations of Hancock County lie on top of a large regional structure referred to as the Findlay Arch. The arch, a geologic structure resulting from tectonic forces, influenced the present configuration of bedrock formations in Ohio. The Findlay Arch splits from the Cincinnati Arch in west-central Ohio and trends northeastward towards Ontario, Canada.

A large northward trending fault, the Bowling Green Fault, is believed to have formed in response to stresses caused by vertical uplift of the region. The fault appears to start somewhere in southeastern Hancock County and trends north through the county towards Michigan. Near Findlay, displacement of as much as a 100 feet is reported to have occurred along the fault, greatly altering the stratigraphic sequence of formations east and west of the fault line (ODNR, 1970).

SYSTEM	SERIES	GROUP	FORMATION	ROCK TYPE
SILURIAN	CAYUGAN	SALINA	Undifferentiated B, C, and E units locally recognized	Dolomite
			Tymochtee	Dolomite
			Greenfield	Dolomite
	NIAGARAN	LOCKPORT	Lockport	Dolomite

Table 9. Generalized Stratigraphic Column of Hancock County, Ohio. (Modified from Janssens, 1977)

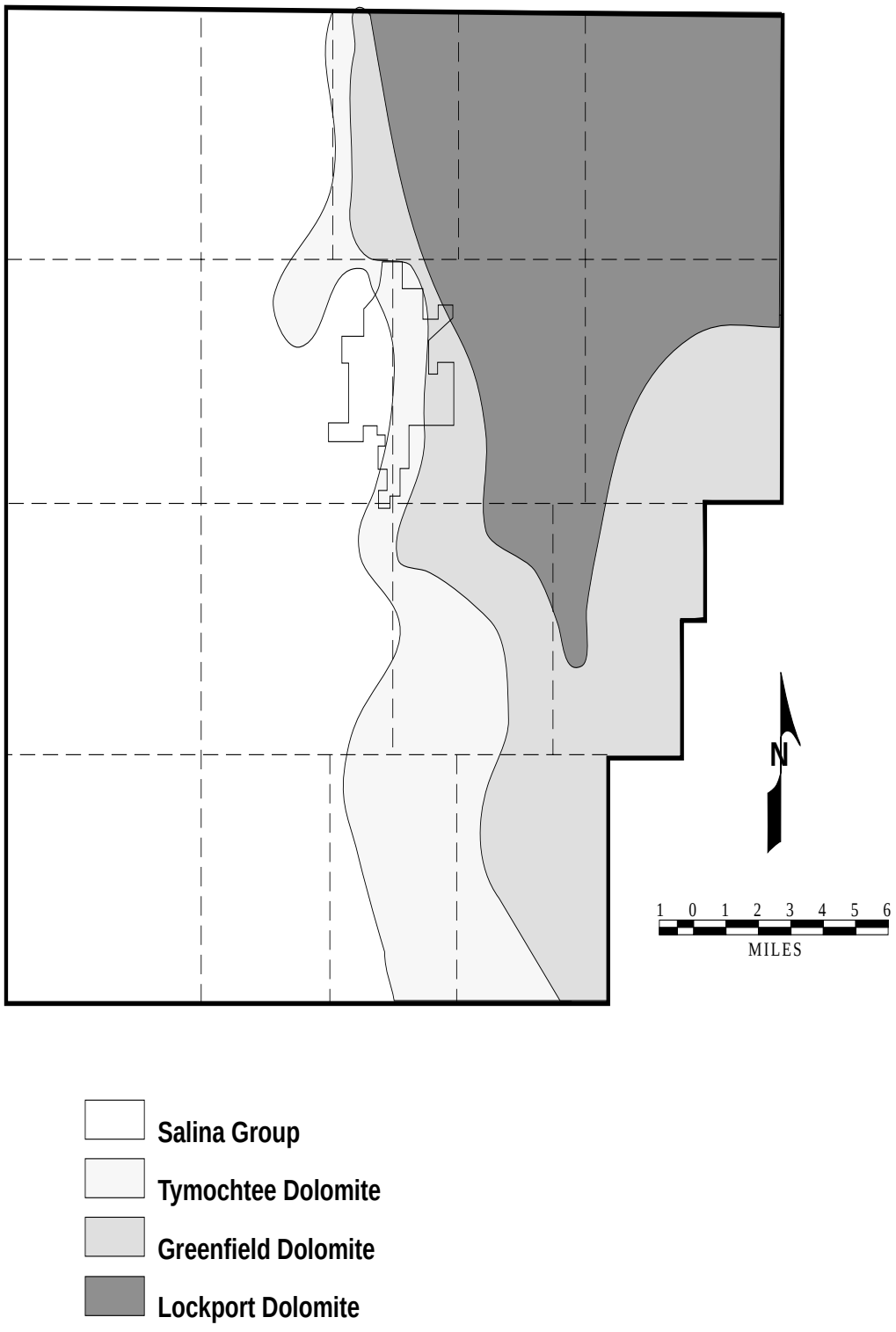


Figure 6. Bedrock Geology of Hancock County, Ohio. (Modified from Janssens, 1977)

Karst Geology

A unique geologic setting referred to as a karst terrain occurs in parts of northwestern Ohio. A karst terrain contains distinctive characteristics of relief and drainage resulting from the dissolution of limestone or dolomite by the action of surface and ground water (Bloom, 1978). Karst terrain typically has a strong underground drainage network ranging from fractures and minor solution channels to caverns with subterranean streams. Dolines (sinkholes), springs, sinking streams, ponors (swallow holes), and caves are surface expressions related to the underground drainage network.

A karstic terrain occurs in east-central Hancock County in the form of a large bedrock hill or ridge at the intersection of Hancock, Seneca, and Wyandot counties. The structure, referred to locally as "Limestone Ridge" consists of a highly porous and crystalline dolomite covered with a thin and patchy layer of glacial till through which the bedrock occasionally outcrops. Although karst features such as sinkholes are not commonly found, the Limestone Ridge is highly weathered with extensive fracturing and solution channels as described in well logs and observed in quarries on the structure. In addition, a cave consisting of a solution-enlarged joint occurs within the structure in Wyandot County (ODNR, 1970 and White, 1926). The weathered and porous nature of Limestone Ridge makes the structure an excellent aquifer, however, the thin cover of glacial till has left the aquifer vulnerable to surficial pollutants such as nitrates from manure and fertilizers (Metzger, 1984 and Stein, 1966).

Hydrogeology

In northwest Ohio, the thick sequence of carbonate bedrock from the Devonian and Silurian Periods comprises a vast regional aquifer that serves as a primary source of ground water for the counties in this region (ODNR, 1970). Hancock County lies near the center of this regional aquifer.

The hydrogeologic system of Hancock County consists of the regional carbonate aquifer buried by deposits of glacial till. The regional carbonate aquifer underlies all of Hancock County and serves as a primary source of ground water for much of the county's rural population. Ground water within the carbonate aquifer occurs in a network of interconnected fractures, bedding planes, and solution channels. Yields to individual wells drilled into the carbonate aquifer are highly variable, depending upon the number of fractures and solution channels intersected by the well bore.

Yields to wells in the eastern half of the county generally range up to 100 gallons per minute. Well yields for the western half of the county can range from 100 to 500 gallons per minute. Well yields for the karstic Limestone Ridge

in east-central Hancock County can range up to 700 gallons per minute (Schmidt, 1981; ODNR, 1970).

A potentiometric surface map of the carbonate aquifer for Hancock County (ODNR, 1970) shows a general northwest- trending slope, indicating regional ground water flow from sources of recharge in central Ohio towards zones of discharge along Lake Erie.

Overlying the bedrock aquifer of Hancock County is a mantle of glacial till. Generally, glacial till is not considered an aquifer because of its high clay-silt content and its low hydraulic conductivity, making it a poor source of ground water. However, weathered glacial till often has an interconnected network of vertical fractures which can impart an enhanced capability for ground water flow or contaminant migration (Freeze and Cherry, 1979). In addition, glacial till often contains intermittent water-bearing pockets of sand and gravel which serve as a source of recharge to the carbonate aquifer, and are a source of ground water for some domestic wells. Other potential sources of ground water include outwash deposits, beach ridges and alluvial deposits along the southern margin of the Defiance Moraine.

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APPENDIX A

DESCRIPTION OF THE LOGIC IN FACTOR SELECTION

Depth to Water

Depth to water was evaluated using information obtained from well logs on file with ODNR, Division of Water. In areas where well log data was sparse, water levels were inferred based on surrounding water level patterns, topographic expression of the land, and elevations of nearby surface water bodies. Water levels in domestic wells showed a strong hydraulic connection between the surficial glacial deposits and the underlying carbonate aquifer.

Depth to water in the Defiance Moraine had water level ratings ranging from 15 to 30 feet, DRASTIC rating seven (7), 30 to 50 feet (5), and 50 to 75 feet (3). All areas outside of the Defiance Moraine had water levels ranging from 5 to 15 feet (9) or 15 to 30 feet (7). Water levels in the Fort Wayne Moraine generally ranged from 15 to 30 feet.

Net Recharge

Recharge for much of the county was evaluated as ranging from 4 to 7 inches. A rating of (4) was used for areas covered by glacial till, based on recharge rates determined for area river basins in Pettyjohn and Henning (1979). Areas with sandy soils such, as the beach ridges, sand spits, and river alluvium, and those areas with thin or absent soils, were given a higher recharge rate of 7 to 10 inches (8).

Aquifer Media

The majority of Hancock County is underlain by an extensive carbonate aquifer consisting of dolomite (Schmidt, 1981; ODNR, 1967). This carbonate bedrock comprised the aquifer media for much of the central portion of the county between the Defiance and Fort Wayne Moraines where overburden thicknesses are generally less than 20 feet.

The carbonate aquifer in the county was evaluated as a massive limestone with a DRASTIC rating of (7) to reflect the greater degree of areal hydraulic

conductivity resulting from secondary porosity such as fracturing, jointing, and minor solution channels. Because of the solution channels and caves associated with the bedrock ridge located in the southeast corner of Big Lick Township (ODNR, 1970), this area was evaluated as a karst limestone aquifer with a DRASTIC rating of nine (9).

In areas that contained glacial drift in excess of 20 feet (Peterson, 1986a,b), the aquifer media was shifted to emphasize sand and gravel deposits contained in the drift. Sand and gravel deposits interbedded in glacial till are listed on many well logs throughout the county and a sand and gravel stratum of outwash commonly occurs on top of the bedrock (Ohio Department of Natural Resources, well logs).

Three areas were evaluated as having a sand and gravel aquifer. The Defiance Moraine was evaluated as a sand and gravel aquifer (5) to emphasize the intermittent water-bearing sand and gravel lenses occurring in the glacial till. South of the Defiance Moraine, a layer of sand and gravel deposited on top of the underlying bedrock is often encountered in well logs along with intermittent water-bearing sand lenses in the glacial till (Ohio Department of Natural Resources well logs). The sand and gravel aquifer for this region was given a DRASTIC rating of (6). Sand and gravel deposits associated with the beach ridges were assigned a DRASTIC rating of (8) because the deposits are laterally extensive, often well-sorted, and subareally exposed.

Soil Media

The classification of the soils are based upon the dominant soil properties as described in the soil survey for Hancock County (Rapparlie and Urban, 1973). The majority of soils in Hancock County have developed on the clay-rich glacial moraines and are classified as clay loams with a rating of (3). Silt loam (4) and sandy loam (6) soils are generally associated with the beach ridges, river alluvium, and outwash deposits.

Two soil series, the Hoytville and Toledo series, were classified as a "shrink/swell clay" with a DRASTIC rating of (7) because of their high shrink-swell potential, low sand and gravel composition, and high plastic indexes (Rapparlie and Urban, 1973). These two soil series commonly occurred in the lake plains region along the northern margin of the county.

Five soil series, the Joliet, Milton, Randolph, Ritchey, and Romeo series, were classified as "thin or absent" due to the close proximity of bedrock to the ground surface. These soil series are commonly associated with occasional bedrock knolls and rock outcrops in the southern half of the county (Stith, 1973).

Topography

The topography of Hancock County was evaluated using an Ohio Capability Analysis Program (OCAP) topographic map that grouped the county into the different DRASTIC topographic ranges as a function of soil type.

Generally, the topography in Hancock County is flat to gently-rolling with slopes ranging from 0% to 2% (10). The low relief is due, in part, to the extensive cover of glacial ground moraines.

Some relief occurs in the vicinity of the Defiance and Fort Wayne Moraines where slopes ranging from 2% to 6% (9) are common. Steeper slopes with a DRASTIC range of 6% to 12% (5), and 12% to 18% (3) are limited to escarpments found along streams and rivers that have cut into the surrounding glacial deposits.

Impact of the Vadose Zone

The impact of the vadose zone in retarding contaminant migration is generally determined by the type of material comprising the zone. In Hancock County, the vadose media is generally comprised of the unconsolidated glacial deposits present in the county such as clay rich glacial till or sandy beach ridges. However, in areas where the glacial deposits are thin or absent, the vadose media is comprised of dolomite bedrock.

In Hancock County, areas covered with a significant thickness of glacial till in excess of 20 feet (Peterson, 1986a,b) were evaluated as being a "sand and gravel with significant silt and clay" vadose media with a DRASTIC rating of five (5). For areas along the Defiance Moraine with water levels greater than 50 feet, the vadose media rating was lowered to a four (4). Areas that contained numerous sand and gravel pockets in the till (Ohio Department of Natural Resources, well logs) were given a higher rating of (6).

In areas where the cover of glacial till was less than 20 feet in thickness, the vadose zone was rated as a "sand and gravel with significant silt and clay" media with a rating of (7). For areas with "thin or absent" soils, the vadose media was changed to a massive limestone vadose with a (7) rating (Rapparlie and Urban, 1973; Stith, 1973).

North of the beach ridges in the lake plains region of the county, the vadose zone media in this area is generally a glacial till reworked by the action of waves. The material is clay-rich with low percentages of sand and gravel (Rapparlie and Urban, 1973) and was evaluated as being a silt/clay vadose media with a rating of (4).

Beach ridges and sand spits in Hancock County were evaluated as being a "sand and gravel" vadose media with a rating of (8) for areas with shallow water levels (less than 30 feet). For areas with water levels ranging from 30 to 50 feet, the vadose zone was changed to a "sand and gravel with significant silt and clay" media with a rating of (7) in order to reflect the influence of glacial till present beneath the beach ridges. For beach ridges with water levels in excess of 50 feet, the rating was lowered to a (4) rating. Information used to evaluate the beach ridges was obtained from well logs on file with ODNR, Division of Water; Forsyth (1959); and Rapparlie and Urban (1973).

For rivers flowing across areas with overburden thicknesses less than 20 feet, the vadose media was evaluated as being a massive limestone with a DRASTIC rating of (7). For areas with overburden in excess of 20 feet, the vadose media was evaluated as being "sand and gravel with significant silt and clay" with a DRASTIC rating of (8). The area comprising the Findlay Embayment was evaluated as having a vadose media of "sand and gravel with significant silt and clay" with a DRASTIC rating of (7) because of the numerous sand deposits scattered across the Embayment lake plain (Rapparlie and Urban, 1973).

Hydraulic Conductivity

The hydraulic conductivity of an aquifer is a measure of its ability to transmit ground water and is a function of the media comprising the aquifer (i.e. sand and gravel, sandstone, limestone, etc.). Aquifers with significant silt and clay have low hydraulic conductivities; whereas, aquifers that are porous and permeable (such as clean sands and gravels) or highly fractured and solutioned (such as cavernous or karst limestone bedrock) have high hydraulic conductivities.

The hydraulic conductivity for the carbonate aquifer for the northeastern quarter of the county was evaluated as 100 to 300 gpd/ft^2 with a DRASTIC rating of (2) based upon the transmissivities and yields to wells reported throughout the area (ODNR, 1970; Schmidt, 1981). The lower yields appear to correlate with the subcrop of the upper Lockport Dolomite in that region.

The hydraulic conductivity for the carbonate aquifer south of the Defiance Moraine was evaluated as being 300 to 700 gpd/ft^2 with a DRASTIC rating of (4). Higher well yields for the southern region appear to correlate with the Salina Group formations subcrop.

A rating of 1000 to 2000 gpd/ft^2 with a DRASTIC value of (8) was given for the karstic area in Big Lick Township based upon the reported high well yields for the area and the greater degree of fracturing, jointing, and solution channels observed in the bedrock.

Sand and gravel pockets occurring intermittently in the glacial till of the Defiance Moraine were evaluated as ranging from 100 to 300 gpd/ft^2 with a

DRASTIC rating of (2). A lower rating was chosen because intermittent sand and gravel lenses in glacial till generally are only moderately sorted which reduces their hydraulic conductivity. For areas south of the Defiance Moraine, the sand and gravel lenses were evaluated as being 300-700 gpd/ft^2 with a DRASTIC rating of (4). A higher rating was given because, in addition to numerous lenses in the glacial till, a stratum of outwash often is found between the glacial till and the dolomite bedrock.

The hydraulic conductivity for the beach ridges was evaluated as ranging between 300-700 gpd/ft^2 with a DRASTIC rating of (4) because the beach sands are often well-sorted deposits. For beach ridges with water levels in excess of 30 feet, the hydraulic conductivity was evaluated as being 100-300 gpd/ft^2 with a rating of (2). A lower rating was given in order to reflect the generally poorly-sorted nature of the water-bearing sand and gravel lenses in glacial till buried beneath the beach ridges.

The hydraulic conductivity for the sand and gravel aquifer comprising the river alluvium was estimated to be in the 100-300 gpd/ft^2 range with a corresponding DRASTIC rating of m(2).

APPENDIX B

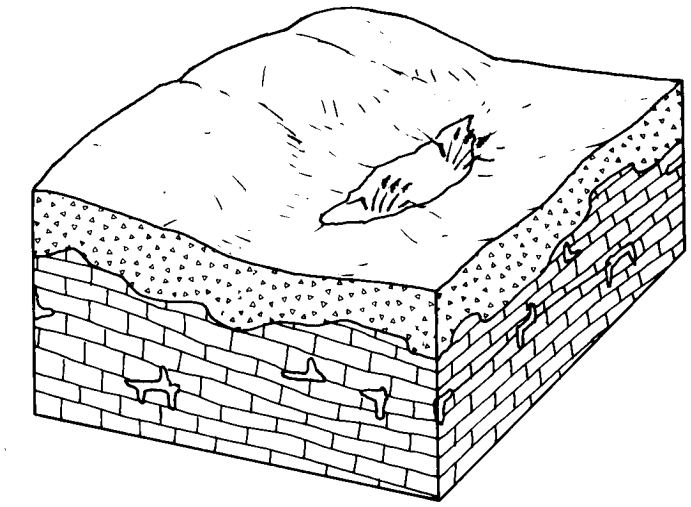
DESCRIPTION OF HYDROGEOLOGIC SETTINGS AND CHARTS

During the pollution potential mapping of Hancock County, eight hydrogeologic settings with the Glaciated Central Region were identified. The list of these settings, the range of pollution potential index calculations, and the number of pollution potential index calculations for each setting are provided in Table 10. Computed pollution potential index values range from 91 to 188

Table 10. Hydrogeologic Settings Mapped in Hancock County, Ohio

Hydrogeologic Settings	Range of GWPP Indexes	Number of Index Calculations
7Ac Glacial Till over Solution Limestone	121 to 178	30
7Af - Sand and Gravel interbedded in Glacial Till	95 to 164	57
7 C - Moraine	91 to 146	29
7Ec - River Alluvium over Sedimentary Bedrock	152 to169	6
7Ed - River Alluvium over Glacial Till	160 to 180	10
7Gb - Thin Glacial Till over Limestone	173 to 188	5
7H - Beaches, Beach Ridges, and Sand Dunes	118 to 180	28
7I - Marshes and Swamps	179	1

The following setting charts are a schematic breakdown of each hydrogeologic setting mapped in Hancock County. The charts provide information on how the ground water pollution potential indexes were derived and are a quick and easy reference for the accompanying ground water pollution potential map. The charts are grouped according to their respective hydrogeologic setting with an accompanying block diagram illustrating the characteristics of each setting. A complete discussion of the rating and evaluation of each factor in the hydrogeologic settings is provided in Appendix A, Description of the Logic in Factor Selection.



7Ac Glacial Till Over Solution Limestone

This hydrogeologic setting is characterized by low topography and solution limestone which is covered by varying thicknesses of glacial till. The till is principally unsorted deposits which may be interbedded with loess or localized deposits of sand and gravel. Surficial deposits have usually weathered to a clay loam. Although ground water occurs in both the glacial deposits and in the underlying limestone, the limestone, which typically contains solution cavities, generally serves as the principal aquifer. The limestone is in direct hydraulic connection with the glacial till, and the glacial till serves as a source of recharge for the underlying limestone. Although precipitation is abundant in most of the region, recharge is moderate because of the relatively low permeability of the overlying glacial till. Depth to water is extremely variable depending, in part, on the thickness of the glacial till, but is typically moderately deep.

GWPP index values for the hydrogeologic setting of moraine range from 121 to 178 with the total number of GWPP index calculations equaling 30.

Setting: 7Ac1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15'	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	153

Setting: 7Ac2		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	152

Setting: 7Ac3		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	143

Setting: 7Ac4		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	142

Setting: 7Ac5		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Thin/Absent	2	10	20
Topography	0-2%	1	10	10
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	165

Setting: 7Ac6		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Thin/Absent	2	10	20
Topography	2-6%	1	9	9
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	164

Setting: 7Ac7		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	147

Setting: 7Ac8		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	169

Setting: 7Ac9		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	159

Setting: 7Ac10		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Agg. Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	158

Setting: 7Ac11		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	157

Setting: 7Ac12		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Loam	2	5	10
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	146

Setting: 7Ac13		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	130

Setting: 7Ac14		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	122

Setting: 7Ac15		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	121

Setting: 7Ac16		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	126

Setting: 7Ac17		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	124

Setting: 7Ac18		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	156

Setting: 7Ac19		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	140

Setting: 7Ac20		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	132

Setting: 7Ac21		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	134

Setting: 7Ac22		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	167

Setting: 7Ac23		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	157

Setting: 7Ac24		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Thin/Absent	2	10	20
Topography	0-2%	1	10	10
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	175

Setting: 7Ac25		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	166

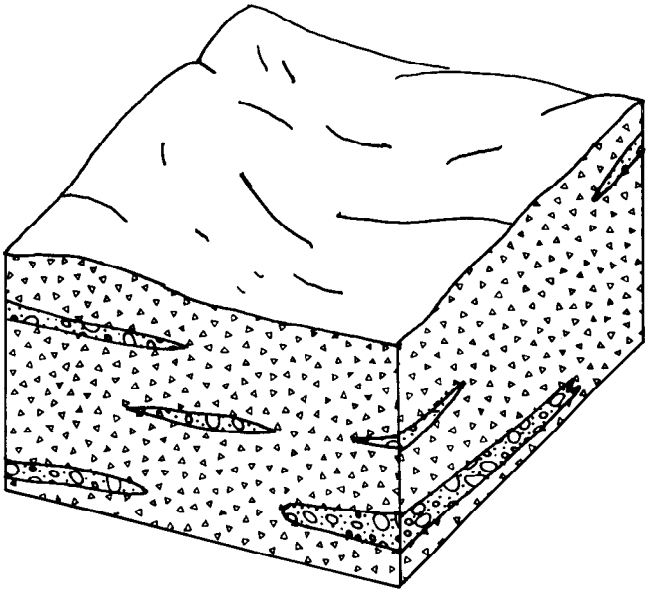
Setting: 7Ac26		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Sand	2	9	18
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	178

Setting: 7Ac27		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	161

Setting: 7Ac28		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Karst Lms.	3	9	27
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Karst Lms.	5	8	40
Hydraulic Conductivity	1000-2000	3	8	24
		GWPP	INDEX	166

Setting: 7Ac29		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Karst Lms.	3	9	27
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Karst Lms.	5	8	40
Hydraulic Conductivity	1000-2000	3	8	24
		GWPP	INDEX	170

Setting: 7Ac30		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	156



7Af Sand and Gravel Interbedded in Glacial Till

This hydrogeologic setting is characterized by low relief and sand and gravel deposits interbedded in glacial till. The till is composed primarily of clay with varying amounts of unsorted silt, sand, and gravel. The sand and gravel may be relatively thin and discontinuous, lens-shaped bodies, or thick layers which cover a large area. The thick units are usually confined to common horizons within the till. Ground water occurs in both the till and the sand and gravel; however, the sand and gravel serves as the principal aquifer. Recharge to the sand and gravel is primarily due to infiltration of precipitation through the till. Depth to water is highly variable, but averages around 30 feet. Soils are typically described as clay loams.

GWPP index values for the hydrogeologic setting of sand and gravel interbedded in glacial till range from 95 to 164 with the total number of GWPP index calculations equaling 57.

Setting: 7Af1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15'	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	140

Setting: 7Af2		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	139

Setting: 7Af3		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	130

Setting: 7Af4		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	129

Setting: 7Af5		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	125

Setting: 7Af6		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	134

Setting: 7Af7		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Loam	2	5	10
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	133

Setting: 7Af8		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	132

Setting: 7Af9		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	152

Setting: 7Af10		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	144

Setting: 7Af11		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	143

Setting: 7Af12		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Sand	2	9	18
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	155

Setting: 7Af13		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Sand	2	9	18
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	154

Setting: 7Af14		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	144

Setting: 7Af15		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Loam	2	5	10
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	143

Setting: 7Af16		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	142

Setting: 7Af17		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Silt Loam	2	4	8
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	141

Setting: 7Af18		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	98

Setting: 7Af19		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Sand	2	9	18
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	164

Setting: 7Af20		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	131

Setting: 7Af21		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	135

Setting: 7Af22		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	130

Setting: 7Af23		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	’	121

Setting: 7Af24		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Agg.Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	129

Setting: 7Af25		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	139

Setting: 7Af26		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	120

Setting: 7Af27		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	116

Setting: 7Af28		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	111

Setting: 7Af29		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	110

Setting: 7Af30		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	96

Setting: 7Af31		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	95

Setting: 7Af32		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	126

Setting: 7Af33		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	125

Setting: 7Af34		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	133

Setting: 7Af35		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	123

Setting: 7Af36		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	135

Setting: 7Af37		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	106

Setting: 7Af38		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	113

Setting: 7Af39		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	158

Setting: 7Af40		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	119

Setting: 7Af41		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Agg. Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	118

Setting: 7Af42		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	115

Setting: 7Af43		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	144

Setting: 7Af44		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Agg. Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	128

Setting: 7Af45		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Agg. Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	126

Setting: 7Af46		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	164

Setting: 7Af47		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	117

Setting: 7Af48		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	116

Setting: 7Af49		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Loam	2	5	10
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	114

Setting: 7Af50		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	4	12
		GWPP	INDEX	163

Setting: 7Af51		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	127

Setting: 7Af52		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	134

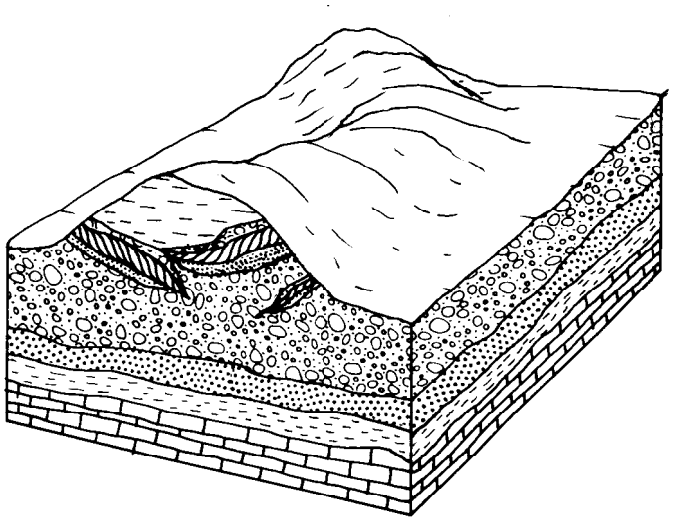
Setting: 7Af53		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	100

Setting: 7Af54		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Loam	2	5	10
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	124

Setting: 7Af55		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	143

Setting: 7Af56		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	159

Setting: 7Af57		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	6	18
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	147



7C Moraine

This hydrogeologic setting is characterized by moderate to moderately steep topography and varying thicknesses of mixed glacial deposits which overlie sequences of relatively flat-lying fractured sedimentary rocks. Sand and gravel within the morainal deposits may be well-sorted and serve as the principal aquifer in the area. These deposits also serve as a source of recharge for the underlying bedrock. Moraines also contain sediments that are typically unsorted and unstratified. These deposits contain more fines than outwash deposits, are less permeable, and are characteristic of glacial till. Moraines are typically mounds or ridges of till which were deposited along the margin of a stagnant or retreating glacier. Surficial deposits often weather to sandy loam. Precipitation is abundant throughout the region and ground water recharge is moderate. Water levels are extremely variable, based in part on the thickness of the glacial till, but are typically fairly shallow.

GWPP index values for the hydrogeologic setting of beaches, beach ridges and sand dunes range from 91 to 146 with the total number of GWPP index calculations equaling 29.

Setting: 7C1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30'	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	121

Setting: 7C2		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	120

Setting: 7C3		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sand	2	9	18
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	145

Setting: 7C4		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sand	2	9	18
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	6	30
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	146

Setting: 7C5		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Loam	2	5	10
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	124

Setting: 7C6		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Silt Loam	2	4	8
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	122

Setting: 7C7		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	111

Setting: 7C8		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	110

Setting: 7C9		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	95

Setting: 7C10		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	96

Setting: 7C11		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	91

Setting: 7C12		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	101

Setting: 7C13		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	130

Setting: 7C14		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	106

Setting: 7C15		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	104

Setting: 7C16		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	100

Setting: 7C17		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Agg. Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	118

Setting: 7C18		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	115

Setting: 7C19		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	113

Setting: 7C20		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Silt Loam	2	4	8
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	112

Setting: 7C21		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sand	2	9	18
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	140

Setting: 7C22		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	131

Setting: 7C23		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	116

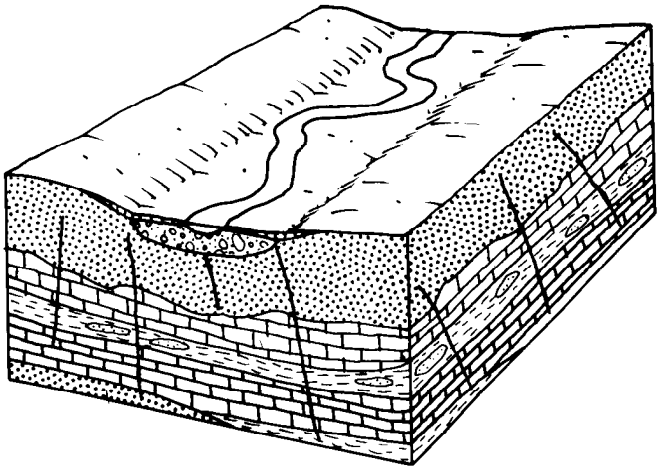
Setting: 7C24		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	135

Setting: 7C25		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	134

Setting: 7C26		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	123

Setting: 7C27		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	125

Setting: 7C28		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	5	15
Soil Media	Clay Loam	2	3	6
Topography	6-12%	1	5	5
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	5	25
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	116



7Ec Alluvium Over Sedimentary Rock

This hydrogeologic setting is characterized by low relief with thin to moderate thicknesses of modern, stream-deposited alluvium. The alluvium is composed of silt, sand, gravel, and clay. Depth to water is shallow, and the stream is usually in hydraulic contact with the alluvial deposits. The alluvial deposits are underlain by fractured sandstone, limestone, shale, or bedded sedimentary sequences. These rocks are described in settings 7Ac, 7Ad, 7Ae, and 7Gb. Usually the upper, weathered portion of the bedrock serves as the principal aquifer in this setting. The alluvial deposits may serve as a source of recharge to the bedrock. Soils are typically silty loams.

GWPP index values for the hydrogeologic setting of alluvium over sedimentary rock range from 152 to 169 with the total number of GWPP index calculations equaling 6.

Setting: 7Ec1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15'	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/ Silt & Clay	5	8	40
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	162

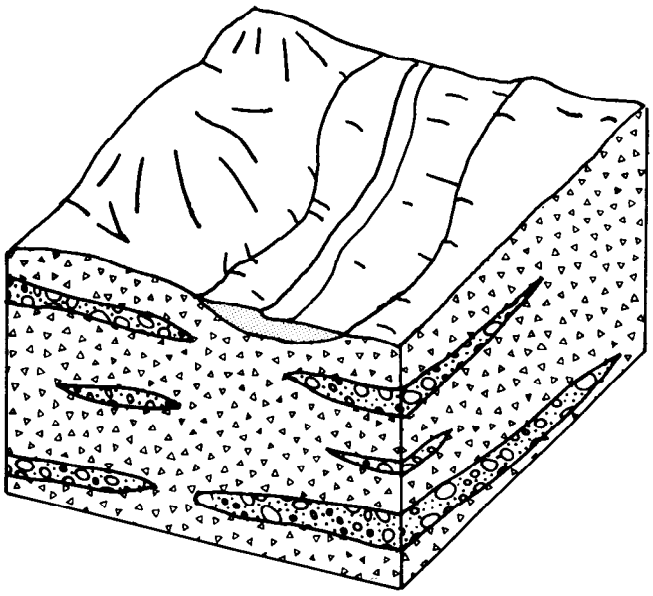
Setting: 7Ec2		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/ Silt & Clay	5	8	40
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	164

Setting: 7Ec3		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Thin/Absent	2	10	20
Topography	0-2%	1	10	10
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	169

Setting: 7Ec4		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	163

Setting: 7Ec5		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	166

Setting: 7Ec6		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Snad & Gravel	5	8	40
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	152



7Ed Alluvium Over Glacial Till

This hydrogeologic setting is characterized by low relief with thin to moderate thicknesses of modern, stream-deposited alluvium overlying glacial till. The alluvium is composed of silt, sand, gravel, and clay. The underlying sand and gravel lenses within the till serve as the aquifer. The depth to the water table is shallow, and the stream is usually in hydraulic connection with the alluvial deposits. Soils are typically classified as silty loams. The underlying till is described in setting 7Af. The alluvial deposits serve as a source of recharge for the sand and gravel lenses within the till. Recharge is moderately high.

GWPP index values for the hydrogeologic setting of alluvium over glacial till range from 160 to 180 with the total number of GWPP index calculations equaling 10.

Setting: 7Ed1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15'	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	165

Setting: 7Ed2		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Silt Loam	2	4	8
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	163

Setting: 7Ed3		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	161

Setting: 7Ed4		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	175

Setting: 7Ed5		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sand	2	9	18
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	180

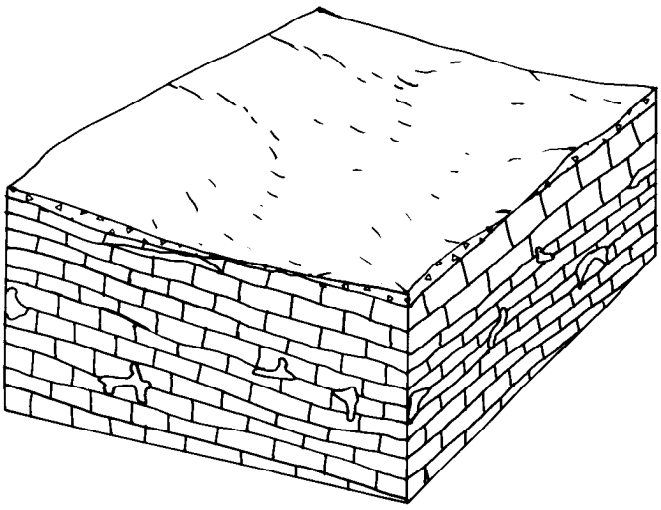
Setting: 7Ed6		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	174

Setting:7Ed7		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15'	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	160

Setting: 7Ed8		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15"	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	169

Setting: 7Ed9		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15'	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Loam	2	5	10
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	164

Setting: 7Ed10		GENERAL		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15'	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Silt Loam	2	4	8
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	162



7Gb Thin Till Over Limestone

This hydrogeologic setting is characterized by thin deposits of glacial till overlying limestone bedrock. In some areas the limestone is directly overlain by shale. The till and soil are usually very thin or absent in areas of steep relief. Till consists primarily of clay with little, if any, sand and gravel and does not serve as a source of water. Ground water is obtained from the upper, weathered, and solutioned portion of the limestone. Recharge is generally low, due to the steep relief and the presence of restrictive shale. Depth to water is fairly shallow where the shale is absent, but deepens with increased thickness of shale.

GWPP index values for the hydrogeologic setting of thin till over limestone range from 173 to 188 with the total number of GWPP index calculations equaling 5.

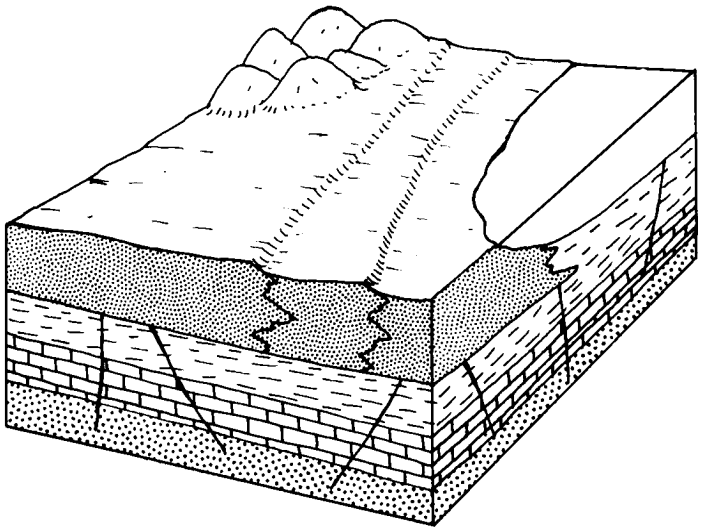
Setting: 7Gb1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30'	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Karst Lms.	3	9	27
Soil Media	Thin/Absent	2	10	20
Topography	0-2%	1	10	10
Impact of Vadose Zone	Karst Lms.	5	8	40
Hydraulic Conductivity	1000-2000	3	8	24
		GWPP	INDEX	188

Setting: 7Gb2		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Karst Lms.	3	9	27
Soil Media	Thin/Absent	2	10	20
Topography	2-6%	1	9	9
Impact of Vadose Zone	Karst Lms.	5	8	40
Hydraulic Conductivity	1000-2000	3	8	24
		GWPP	INDEX	187

Setting: 7Gb3		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Karst Lms.	3	9	27
Soil Media	Thin/Absent	2	10	20
Topography	6-12"	1	5	5
Impact of Vadose Zone	Karst Lms.	5	8	40
Hydraulic Conductivity	1000-2000	3	8	24
		GWPP	INDEX	175

Setting: 7Gb4		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Karst Lms.	3	9	27
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Karst Lms.	5	8	40
Hydraulic Conductivity	1000-2000	3	8	24
		GWPP	INDEX	174

Setting: 7Gb5		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Karst Lms.	3	9	27
Soil Media	Agg. Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Karst Lms.	5	8	40
Hydraulic Conductivity	1000-2000	3	8	24
		GWPP	INDEX	173



7H Beaches, Beach Ridges and Sand Dunes

This hydrogeologic setting is characterized by low relief, sandy surface soil that is predominantly silica sand, extremely high infiltration rates, and low sorptive capacity in the thin vadose zone. The water table is very shallow beneath the beaches bordering the Great Lakes. These beaches are commonly ground water discharge areas. The water table is slightly deeper beneath the rolling dune topography and the vestigial inland beach ridges. All of these areas serve as recharge sources for the underlying sedimentary bedrock aquifers, and they often serve as local sources of water supply.

GWPP index values for the hydrogeologic setting of beaches, beach ridges and sand dunes range from 118 to 180 with the total number of GWPP index calculations equaling 28.

Setting: 7H1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30'	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	164

Setting: 7H2		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	155

Setting: 7H3		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Loam	2	5	10
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	154

Setting: 7H4		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	151

Setting: 7H5		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	159

Setting: 7H6		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	150

Setting: 7H7		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Thin/Absent	2	10	20
Topography	2-6%	1	9	9
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	158

Setting: 7H8		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Thin/absent	2	10	20
Topography	0-2%	1	10	10
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	159

Setting: 7H9		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	143

Setting: 7H10		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	130

Setting: 7H11		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	129

Setting: 7H12		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	165

Setting: 7H13		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	134

Setting: 7H14		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Clay Loam	2	3	6
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	139

Setting: 7H15		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Clay Loam	2	3	6
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	150

Setting: 7H16		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Massive Lms.	3	7	21
Soil Media	Agg. Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Massive Lms.	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	152

Setting: 7H17		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	50-75’	5	3	15
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	118

Setting:7H18		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	138

Setting: 7H19		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Agg. Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	137

Setting: 7H20		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	144

Setting: 7H21		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	30-50’	5	5	25
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Loam	2	5	10
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	7	35
Hydraulic Conductivity	100-300	3	2	6
		GWPP	INDEX	133

Setting: 7H22		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sand	2	9	18
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	180

Setting: 7H23		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sandy Loam	2	6	12
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	175

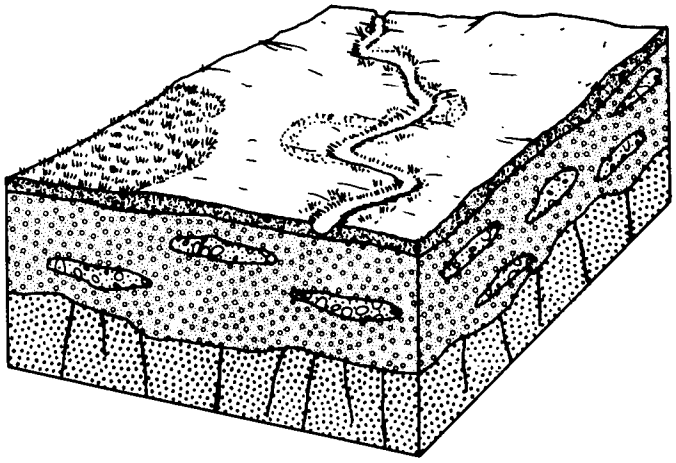
Setting: 7H24		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sandy Loam	2	6	12
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	174

Setting: 7H25		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Loam	2	5	10
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	165

Setting: 7H26		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Agg. Clay	2	7	14
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	169

Setting: 7H27		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15’	5	9	45
Net Recharge	4-7"	4	6	24
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Agg. Clay	2	7	14
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	168

Setting: 7H28		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	15-30’	5	7	35
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Sand	2	9	18
Topography	2-6%	1	9	9
Impact of Vadose Zone	Sand & Gravel	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	170



7I Swamp / Marsh

This hydrogeologic setting is characterized by low topographic relief, high water levels, and high organic silt and clay deposits. These wetlands occur along the courses of floodplains and in upland areas as a result of vertically restricted drainage. Common features of upland wetlands include those characteristics attributable to glacial activity, such as filled-in glacial lakes, potholes, and cranberry bogs. Recharge is moderate in most of the region due to restriction by clay-rich soils and limited by precipitation. The swamp deposits very rarely serve as significant aquifers but frequently recharge the underlying sand and gravel or bedrock aquifers.

GWPP index value for the hydrogeologic setting of swamp / marsh was 179 with the number of GWPP index calculations equaling 1.

Setting: 7I1		**GENERAL**		
FEATURE	RANGE	WEIGHT	RATING	INDEX
Depth to Water	5-15'	5	9	45
Net Recharge	7-10"	4	8	32
Aquifer Media	Sand & Gravel	3	8	24
Soil Media	Peat	2	8	16
Topography	0-2%	1	10	10
Impact of Vadose Zone	Sand & Gravel w/Silt & Clay	5	8	40
Hydraulic Conductivity	300-700	3	4	12
		GWPP	INDEX	179

Ground-Water Pollution Potential of HANCOCK COUNTY

by
Kelly C. Smith
ERM-Midwest, Inc.

Prepared in Cooperation with
Ohio Department of Natural Resources, Division of Water

1 0 1 2 Miles

1 0 1 2 Kilometers

CONTOUR INTERVAL 5 FEET

Description of Map Symbols

Hydrogeologic Region — 7Ad 6 — Hydrogeologic Setting

98 — Relative Pollution Potential

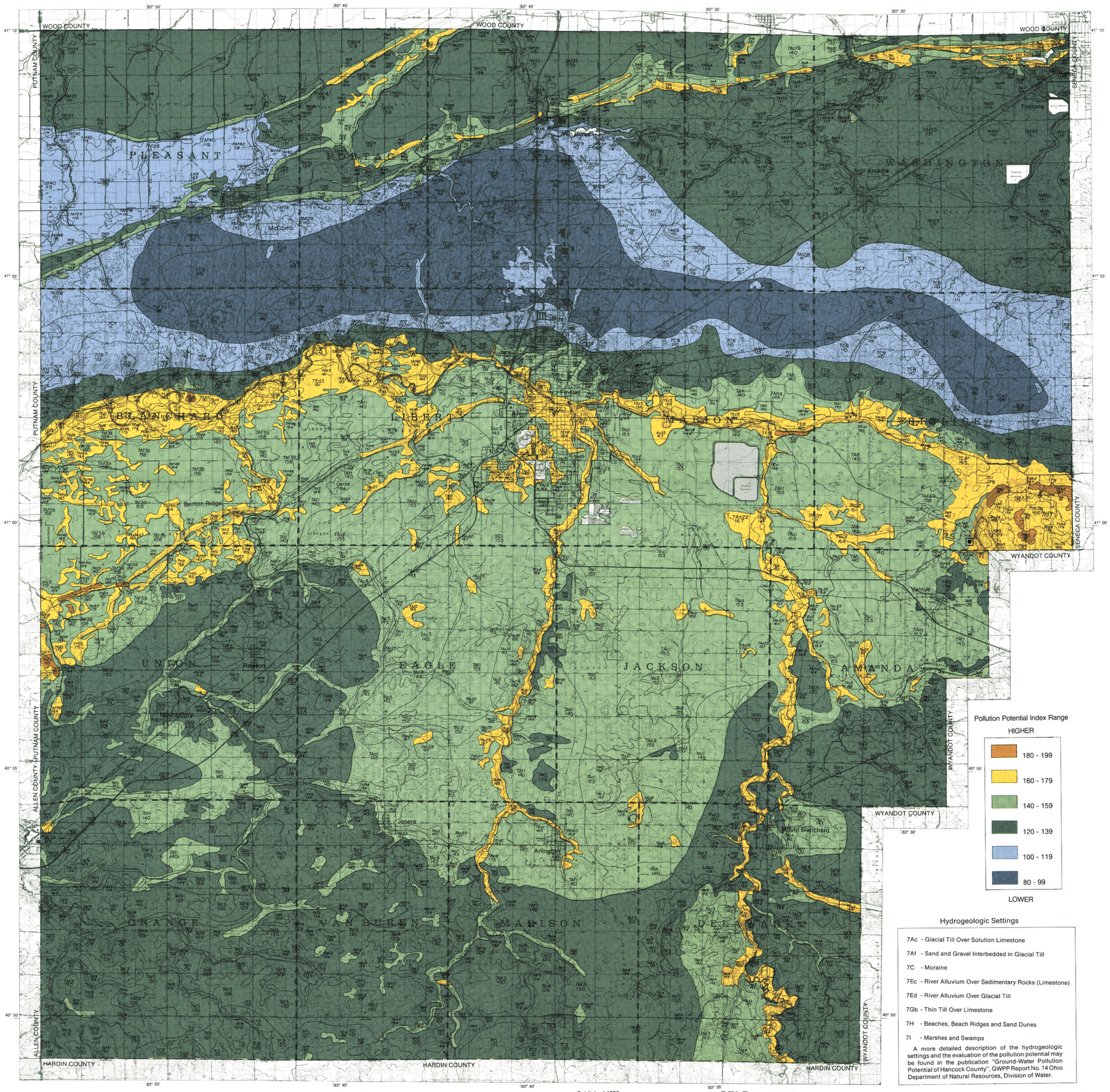
Gravel Pit / Quarry

Observation Well Site **

County Line

Township Line

Incorporated City Limit



** Observation well sites indicate the location of wells used to collect ground-water level information. These wells are part of the State observation well network. Hydrographs of the water levels recorded in these and other State observation wells can be obtained through ODNR-Division of Water.

The ground-water pollution potential of this county has been mapped using the methodology described in U.S. EPA Publication EPA/600-2-87/035, "DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings (Aller et al., 1987)".

Hydrogeologic Settings

- 7Ac - Glacial Till Over Solution Limestone
- 7Af - Sand and Gravel Interbedded in Glacial Till
- 7C - Moraine
- 7Ec - River Alluvium Over Sedimentary Rocks (Limestone)
- 7Ed - River Alluvium Over Glacial Till
- 7Gb - Thin Till Over Limestone
- 7H - Beaches, Beach Ridges and Sand Dunes
- 7I - Marshes and Swamps

A more detailed description of the hydrogeologic settings and the evaluation of the pollution potential may be found in the publication "Ground-Water Pollution Potential of Hancock County", GWPP Report No. 14 Ohio Department of Natural Resources, Division of Water.

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Nancy Swizynski
Cartographer