GROUND WATER POLLUTION POTENTIAL OF DELAWARE COUNTY, OHIO

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ABSTRACT

A groundwater pollution potential map of Delaware County has been prepared 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 incorporate hydrogeologic factors that 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.

Ground water pollution potential analysis in Delaware County resulted in a map with symbols and colors, which illustrate areas of varying ground water pollution potential indexes ranging from 70 to 164.

Delaware County lies entirely within the Glaciated Central hydrogeologic setting. Limestones and dolomites of the Silurian and Devonian Systems compose the aquifer in the western third of the county. Yields in the uppermost carbonate aquifers range from 25 gallons per minute (gpm) to 100 gpm throughout the county. Yields over 100 gpm are possible from larger diameter wells drilled deeper into the limestone. The higher yields are more common in the western part of Delaware County. Shales of the Devonian System and lower Mississippian System comprise the aquifer in the central portion of the county. Yields from these rocks are poor, typically yielding less than 5 gpm. The Berea Sandstone of the Mississippian System in the eastern portion of the county yields 5 to 25 gpm. Sandstones and sandy shale of the Cuyahoga Formation yield 3 to 10 gpm in the eastern portion of the county.

Sand and gravel lenses interbedded in the glacial till locally serve as aquifers in portions of southern Delaware County where there is sufficient thickness of glacial drift. In some areas, the sand and gravel lenses may lie directly on top of the shale bedrock and serve as the aquifer or provide additional recharge to the underlying bedrock. Yields for these sand and gravel lenses range from 5 to 25 gpm.

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 Delaware 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 area, or to assist in protection, monitoring, and clean-up efforts.

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INTRODUCTION

The need for protection and management of ground water resources in Ohio has been clearly recognized. About 42 percent 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 750,000 rural households depend on private wells; 8213 of these wells exist in Delaware 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 remediation 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, Water Resources Section to implement the ground water pollution potential mapping program on a countywide basis in Ohio.

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 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 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 Delaware 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 expenditures related to solid waste disposal. A county may use the map to help identify areas that are suitable for 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 be applied 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 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 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.

Individuals in the county who are familiar with specific land use and management problems will recognize other beneficial uses of the pollution potential maps. Planning commissions and zoning boards can use these maps to help make informed decisions about the development of areas within their jurisdiction. Developers proposing projects 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

DRASTIC was developed by the National Ground Water Association for the United States Environmental Protection Agency. This system was chosen for implementation of a ground water pollution potential mapping program in Ohio. 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. Vulnerability 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 that 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 under the assumption that a contaminant with the mobility of water is introduced at the surface and flushed into the ground water by precipitation. Most important, DRASTIC cannot be applied to areas smaller than 100 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 15 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 Delaware County. Inherent within each hydrogeologic setting are the physical characteristics that affect the ground water pollution potential. These characteristics or factors identified during the development of the DRASTIC system include:

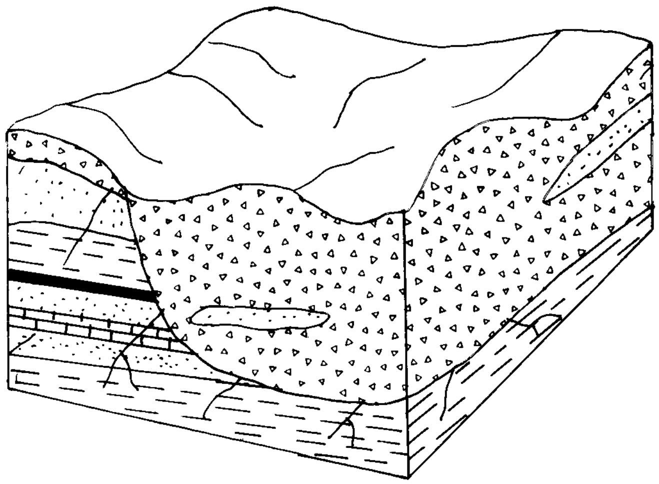
D – Depth to Water
R – Net Recharge
A – Aquifer Media
S – Soil Media
T – Topography
I – Impact of the Vadose Zone Media
C – Conductivity (Hydraulic) of the Aquifer

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 the aquifer measured in inches per year. Recharge water is available to transport a contaminant from the surface into the aquifer and 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.



<u>7D-Buried Valley</u>

This hydrogeologic setting is found in southern Delaware County. The buried valley lacks surficial expression and is not overlain by a modern stream. The setting is characterized by overlying flat ground moraine and rolling, hummocky end moraines. The aquifer consists of relatively thin sand and gravel lenses interbedded with glacial till. These sand and gravel deposits differ as to lateral extent and thickness and are found at varying depths. Yields range from 5 to 25 gpm. The vadose zone is composed of loamy to clayey glacial till. The till may be fractured or jointed, particularly in areas where it is predominantly thin and weathered. Depth to water is variable and depends primarily upon how deep the underlying sand and gravel lenses are. Soils are commonly clay loams. Recharge varies depending upon the thickness of till and depth to water.

GWPP index values for the hydrogeologic setting of Buried Valley range from 87 to 115, with the total number of GWPP index calculations equaling 4.

Figure 1. Format and description of the hydrogeologic setting - 7D Buried Valley.

Soil media refers to the upper six feet of the unsaturated zone that is characterized by significant biological activity. The type of soil media influences 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 slope of an area affects the likelihood that a contaminant will run off 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 has a significant impact on 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 judgment. 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 for use 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. Where other agricultural practices, such as the application of fertilizers, are a concern, general DRASTIC should be used to evaluate relative vulnerability to contamination. 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 differs significantly. Table 1 lists the weights used for general and pesticide DRASTIC.

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**
Shale	1-3	2
Glacial Till	4-6	5
Sandstone	4-9	6
Limestone	4-9	6
Sand and Gravel	4-9	8
Interbedded Ss/Sh/Ls/Coal	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
Shrink/Swell Clay	7
Sandy Loam	6
Loam	5
Silty Loam	4
Clay Loam	3
Muck	2
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
Interbedded Ss/Sh/Ls/Coal	4-8	6
Sand and Gravel with Silt and Clay	4-8	6
Glacial Till	2-6	4
Sand and Gravel	6-9	8
Karst Limestone	8-10	10
Weight: 5	Pesticide Weight: 4	

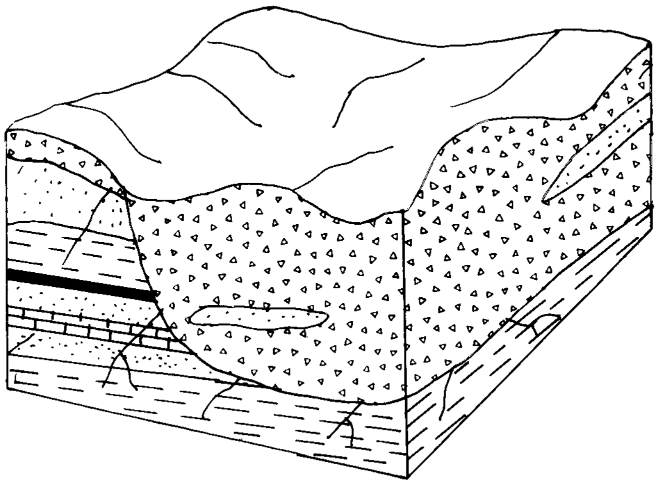
Table 8. Ranges and ratings for hydraulic conductivity

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 7D1, Buried Valley, identified in mapping Delaware 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 115. 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 45 to 223. The diversity of hydrogeologic conditions in Delaware County produces settings with a wide range of vulnerability to ground water contamination. Calculated pollution potential indexes for the thirteen settings identified in the county range from 70 to 164.

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 Delaware 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 Delaware County is included with this report.



SETTING 7D1		GENERAL		
FEATURE	**RANGE**	**WEIGHT**	**RATING**	**NUMBER**
Depth to Water	30-50	5	5	25
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	Till	5	4	20
Hydraulic Conductivity	300-700	3	4	12
		DRASTIC	INDEX	115

Figure 2. Description of the hydrogeologic setting - 7D1 Buried Valley.

INTERPRETATION AND USE OF GROUND WATER POLLUTION POTENTIAL MAPS

The application of the DRASTIC system to evaluate an area's vulnerability to contamination produces hydrogeologic settings with corresponding pollution potential indexes. The susceptibility to contamination is greater as the pollution potential index increases. 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:

7D1 - defines the hydrogeologic region and setting
115 - defines the relative pollution potential

Here the first number (**7**) refers to the major hydrogeologic region and the upper case letter (**D**) refers 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 (**115**) 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.

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 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 DELAWARE COUNTY

Demographics

Delaware County occupies approximately 440 square miles in north central Ohio (Figure 3). Delaware County is bounded to the north by Marion County, to the northeast by Morrow County to the east by Knox County and Licking County, to the south by Franklin County, and to the west by Union County.

The approximate population of Delaware County, based upon year 2000 census estimates, is 109,989 (Department of Development, Ohio County Profiles, 2002). It is one of the fastest growing counties in the United States, with a 64.3% increase in population between 1990 and 2000. The city of Delaware is the largest community and the county seat. Agriculture accounts for roughly 74 percent of the land usage in Delaware County. Primary crops include corn, wheat, oats, soybeans, and hay (Matanzo et al., 1969). Woodlands, residential, and open water are the other major land cover in the county. More specific information on land usage can be obtained from the Ohio Department of Natural Resources, Division of Real Estate and Land Management (REALM), Resource Analysis Program (formerly OCAP).

Climate

The *Hydrologic Atlas for Ohio* (Harstine, 1991) reports an average annual temperature of approximately 51 degrees Fahrenheit for Delaware County. The average temperatures decrease slightly towards the east. Harstine (1991) shows that precipitation approximately averages 37 inches per year for the county, with precipitation decreasing towards the west. The mean annual precipitation for the city of Delaware is 37.58 inches per year based upon a twenty-year (1961-1980) period (Owenby and Ezell, 2002). The mean annual temperature at the city of Delaware for the same twenty-year period is 50.0 degrees Fahrenheit (Owenby and Ezell, 2002).

Physiography and Topography

Delaware County lies within the Central Till Plains Lowland Province (Frost, 1931, Fenneman, 1938, and Bier, 1956). Brockman (1998) and Schiefer (2002) determined that the majority of Delaware County belongs in the Central Ohio Clayey Till Plain and that the southeastern corner of the county is part of the Columbus Lowland. Delaware County is characterized by flat ground moraine that is nearly horizontal. Topography is in the form of linear, hummocky end moraines, and kames and eskers.

Figure 3. Location map of Delaware County, Ohio.

Modern Drainage

The divide between the headwaters of the Lake Erie Basin and the Ohio River Basin lies to the north of Delaware County in northern Marion County and southern Crawford County. The drainage of Delaware County lies to the south of this divide, entirely within the Ohio River Basin. Four primary streams, (west to east) the Scioto River, Olentangy River, Alum Creek, and Big Walnut Creek, and their tributaries drain Delaware County to the south. These streams all follow a nearly parallel north-south course. Each of these has a reservoir that lies within Delaware County: O'Shaughnessy Reservoir on the Scioto River, Delaware Lake on the Olentangy River, Alum Creek Lake on Alum Creek, and Hoover Reservoir on Big Walnut Creek.

Pre- and Inter-Glacial Drainage Changes

The drainage patterns of Delaware County have changed significantly as a result of the multiple glaciations. The drainage changes are complex and not yet fully understood. More research and data are necessary in both Delaware County and adjacent counties. Particularly, well log data for deeper wells that penetrate the entire drift thickness would be helpful in making interpretations. This would allow for a more accurate reconstruction of the system of buried valleys and former drainage channels for the county.

Prior to glaciation, the drainage in Ohio is referred to as the Teays Stage. The Teays River drained the southern and western two thirds of the state and was the master stream for what is now the upper Ohio River Valley. Stout et al. (1943) proposed that two large, unnamed tributaries drained Delaware County (Figure 4). One drained to the southwest into Union County and later into the Teays River. The other tributary had several branches draining south into Franklin County and into the Groveport River, a major tributary of the Teays River. Stout et al. (1943) speculated that the Groveport River originated near Wooster in Wayne County and flowed south to northeastern Fairfield County. Here the path of the Groveport River veered westward until it merged with the Teays River in Clark County. Schmidt and Goldthwait (1958) and Dove (1960) disagreed with this western path, suggesting that the Groveport River followed a more southwesterly course and merged with the Teays River further south in Madison County.

As ice advanced through Ohio during the pre-Illinoian (Kansan) glaciations, northerly and western drainage ways were blocked, including the Teays Drainage System. Flow backed-up these numerous tributaries, forming several large lakes. These lakes over-topped, creating spillways and cutting new channels. New drainage systems began to evolve (Stout et al., 1943). The downcutting by these new streams was believed to be relatively rapid and, in many places, the new channels were cut over 100 feet deeper than the previous Teays River System valleys. The new drainage system is referred to as the Deep Stage due to this increased downcutting. Stout et al. (1943) suggested that Delaware County drained to the south into the Columbus River (Figure 5). The Columbus River had a course somewhat

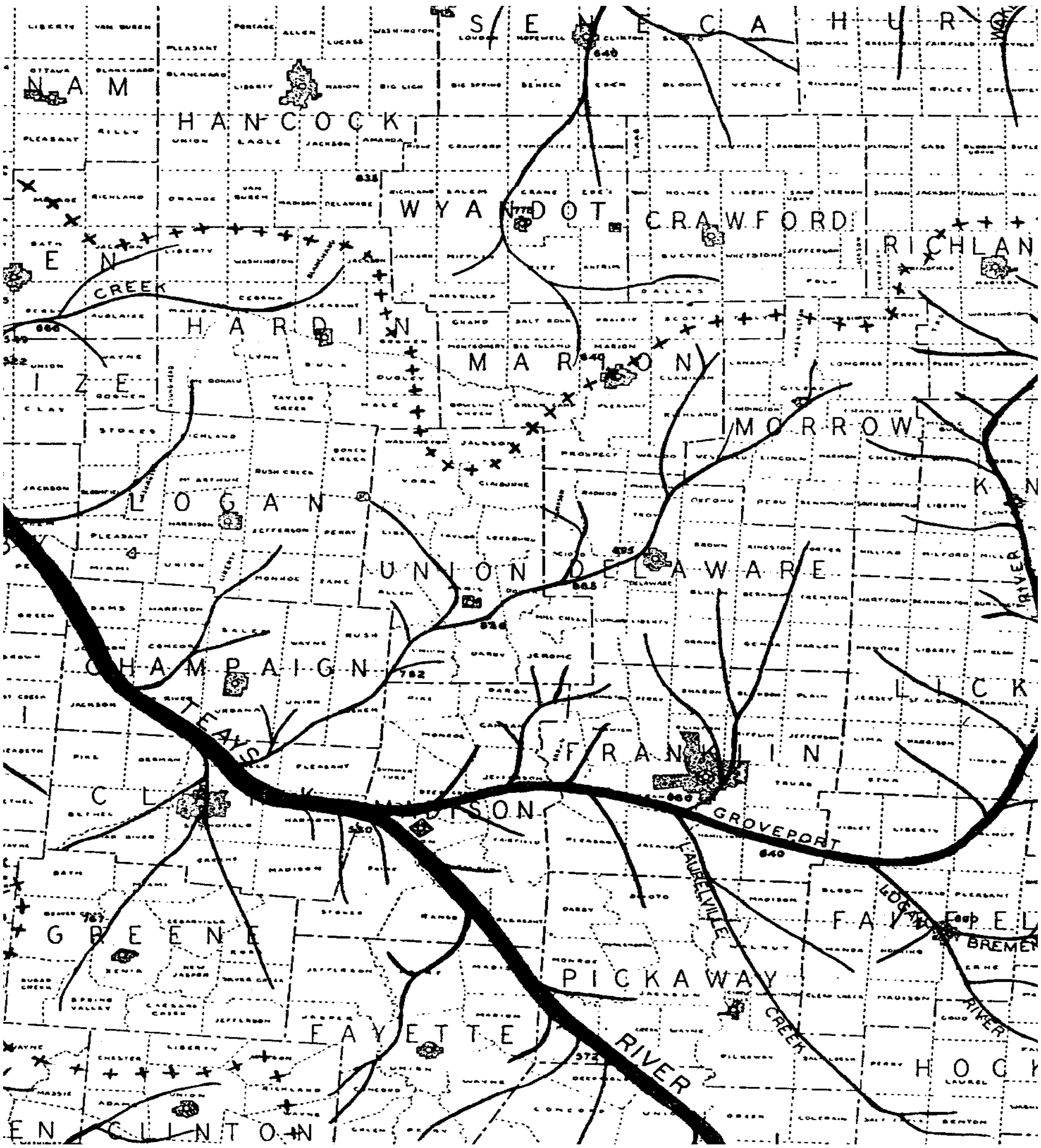


Figure 4. Teays Stage drainage in Delaware County (after Stout et al., 1943).

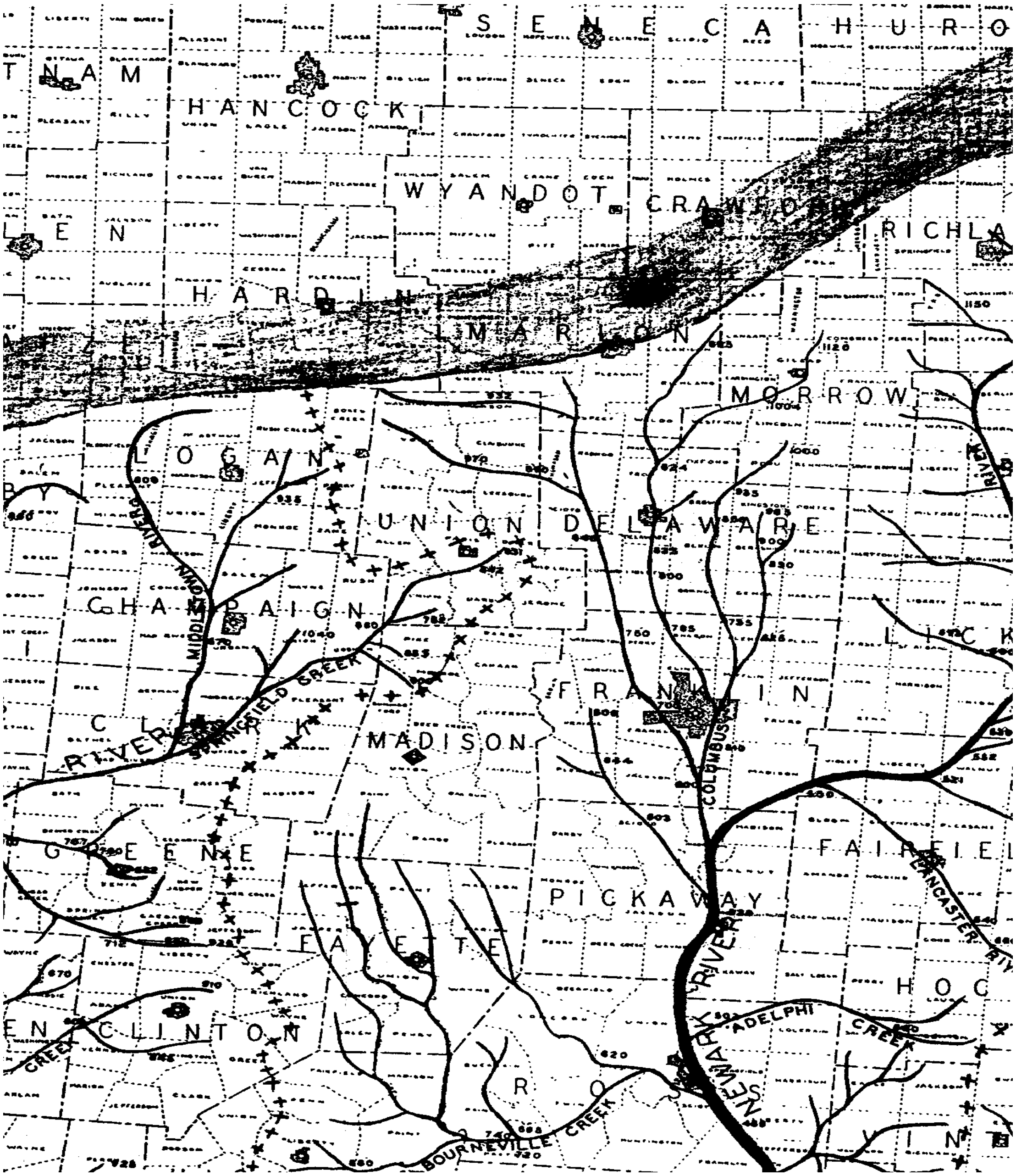


Figure 5. Deep Stage drainage in Delaware County (after Stout et al., 1943).

similar to the present Scioto River. It was a major tributary of the Newark River that flowed south into the Cincinnati River, a precursor of the Ohio River. Within Delaware County the tributaries of the Columbus River are thought to have occupied what is now the Scioto and Olentangy Rivers (Stauffer et al., 1911).

Thick sequences of coarse sand and gravel outwash were deposited by meltwater derived from the latest, or Wisconsinan, glaciation. In southern Delaware County and in Franklin County modern stream drainages closely follow the course of channels filled with this outwash. This is the case for the Olentangy River, Alum Creek, Walnut Creek, and the Scioto River. The modern rivers are all believed to be post-glacial in nature (Stauffer et al., 1911 and Schmidt and Goldthwait, 1958). This is perhaps best evidenced by major stretches of the Scioto River in southern Delaware County that have cut through glacial drift and are now actively eroding the bedrock surface. In northern Delaware County the Scioto River and the Olentangy River appear to have younger valleys than in the southern reaches, where these streams cut through outwash (Stauffer et al., 1911 and Schmidt and Goldthwait, 1958).

Glacial Geology

During the Pleistocene Epoch (2 million to 10,000 years before present (Y.B.P.)) several episodes of ice advance occurred in northwestern Ohio. Older ice advances that predate the most recent (Brunhes) magnetic reversal (about 730,000 Y.B.P.) are now commonly referred to as pre-Illinoian (formerly Kansan). Evidence for these earlier glaciations is lacking or obscured. Goldthwait et al. (1961), Pavey et al. (1999), the Ohio Superconducting Super Collider (SSC), State of Ohio (1987), and Westgate (1926) report that the last advance, the Late Wisconsinan Ice Sheet, deposited the surficial till in Delaware County.

The glacial deposits in Delaware County fall into two main types: (glacial) till and ice-contact sand and gravel (kames, eskers) deposits. Drift is an older term that collectively refers to the entire sequence of glacial deposits. Overall, drift is thicker in valleys in the southern portion of the county (ODNR, Division of Geological Survey, Open File Bedrock Topography and ODNR, Division of Water, Glacial State Aquifer Map).

Till is an unsorted, non-stratified (non-bedded), mixture of sand, gravel, silt, and clay deposited directly by the ice sheet. There are two main types or facies of glacial till. Lodgement till is "plastered-down" or "bulldozed" at the base of an actively moving ice sheet. Lodgement till tends to be relatively dense and compacted and pebbles typically are angular, broken, and have a preferred direction or orientation. "Hardpan" and "boulder-clay" are two common terms used for lodgement till. Ablation or "melt-out" till occurs as the ice sheet melts or stagnates away. Debris bands are laid down or stacked as the ice between the bands melts. Ablation till tends to be less dense, less compacted, and slightly coarser as meltwater commonly washes away some of the fine silt and clay.

Till has a relatively low inherent permeability. Permeability in till is in part dependent upon the primary porosity of the till, which reflects the texture (fineness or coarseness) of the particular till. Vertical permeability in till is controlled largely by factors influencing the secondary porosity such as fractures (joints), worm burrows, root channels, sand seams, etc. (Brockman and Szabo, 2000 and Haefner, 2000). Fractures may also interconnect the sand and gravel lenses.

At the land surface, till accounts for two primary landforms: ground moraine and end moraine. Ground moraine (till plain) is relatively flat to gently rolling. End moraines are ridge-like, with terrain that is steeper and more rolling or hummocky. End moraines commonly serve as a local drainage divide due to their ridge-like nature. The Powell moraine lies on the southwest border between Delaware County and Franklin County. Here, it has a nearly east-west path. Around its confluence with the Olentangy River, the Powell moraine curves northward until it follows a north-south path beginning near the towns of Galena and Sunbury. Here the Big Walnut Creek follows the path of the moraine. The Broadway moraine is north of the Powell moraine, mimicking a similar curve that starts at the boundary between Union County and Delaware County until it is nearly north-south near the town of West Liberty in Morrow County. The Broadway moraine has a smaller bend through the middle of Delaware County as it seemingly curves around the city of Delaware.

Kames and eskers are ice contact features. They are generally composed of masses of poorly sorted sand and gravel with minor till, deposited in depressions, holes, tunnels, or other cavities in the ice. As the surrounding ice melts, a mound of sediment remains behind. Typically, these deposits may collapse or flow as the surrounding ice melts. These deposits may display high angle, distorted or tilted beds, faults, and folds. The best examples of ice contact deposits are found in the village of Radnor in the northwestern corner of Delaware County.

Bedrock Geology

Bedrock underlying the surface of Delaware County belongs to the Silurian, Devonian, and Mississippian Systems. Carbonate (limestone and dolomite) bedrock underlies the western third of Delaware County; the central portion is underlain by shale, and interbedded sandstones and shales underlie the eastern third. Table 9 summarizes the bedrock stratigraphy found in Delaware County. The ODNR, Division of Geological Survey, has Open-File Reconnaissance Bedrock Geological Maps completed at a 1:24,000 scale USGS topographic map base available for the entire county. The ODNR, Division of Water, has Open File Bedrock State Aquifer maps available for the county also.

Silurian and Devonian carbonates are found in the western third of Delaware County. The oldest unit typically encountered by water wells is the Silurian Lockport Group. The Lockport Group rocks were associated with tidal reefs deposited in warm, high-energy shallow seas. Overlying the Lockport Group are rocks of the Silurian Tymochtee and Greenfield Formations, which were also deposited in warm, shallow seas. The uppermost Silurian unit is the Salina Undifferentiated Group that consists of dolomites, fine-grained limestones, and some minor evaporite deposits such as gypsum. These rocks were deposited in warm, shallow tidal areas. The uppermost carbonate units are the fossiliferous Columbus

Table 9. Bedrock stratigraphy of Delaware County

System	Group/Formation (Symbol)	Lithologic Description
Mississippian	Cuyahoga Group (Mcg)	Gray to brown shale with interbedded fine-grained sandstone and siltstone. Local thickness usually <100 feet. Moderate aquifer, typically yielding 5-25 gpm.
	Sunbury Shale (Ms)	Black to brownish-black, carbonaceous, thin-bedded, and fissile shale. Poor aquifer, typically yielding <5 gpm.
	Berea Sandstone (Mb)	Light bluish-gray very fine-grained sandstone. Bedding is variable, grains are tightly cemented. Local thickness <100 feet. Very poor aquifer, typically yielding <5 gpm.
	Bedford Shale (Mbd)	Gray to brown, soft, massive, fine-grained, clay-rich shale. Local thickness <100 feet. Very poor aquifer, typically yielding <5 gpm.
Devonian	Ohio and Olentangy Shales (Dohol)	Black to brownish-black, thin-bedded, organic, pyritic, carbonaceous shale. Thickness >100 feet in eastern part of the county, and thins westward. Poor aquifer, typically yielding <5 gpm.
	Delaware and Columbus Limestones (Ddc)	The Delaware is a gray to brown thin-bedded to massive, argillaceous, carbonaceous limestone. The Columbus is a gray to brown, fossiliferous, massive-bedded limestone and dolomite. Karst features are common in the Columbus. In much of Crawford County, these units are >100 feet in thickness. Yields are usually 5-100 gpm. Thickness and yields for these formations decreases toward the western edge of the county. The water quality deteriorates in areas where these units are overlain by thick Ohio and Olentangy Shale.
Silurian	Undifferentiated Salina Dolomite (Sus)	Gray to brown, thin-bedded, argillaceous dolomite. Thin evaporite zones common. Thickness >100 feet. Yields may exceed 100 gpm when fractures or solution features are encountered.
	Tymochtee and Greenfield Dolomites (Stg)	Thin- to massive-bedded, olive-gray to yellowish-brown. The Tymochtee contains shale partings. The Greenfield has a laminated dolomite lithology. Combined thickness exceeds 100 feet. Yields can be >100 gpm, especially in the Tymochtee.
	Lockport Dolomite (Sl)	White to medium gray, medium to massive-bedded dolomite. Commonly contains cavernous solution zones. Thickness >100 feet. Yields can exceed 100 gpm, especially in cavernous or solution zones.

and Delaware Limestones. These rocks were deposited in warm, high-energy seas and reef areas.

Devonian-age Ohio and Olentangy Shale (ODNR, Division of Water, Bedrock State Aquifer Map, 2000) underlies much of central Delaware County in an area from the Olentangy River to the Little Walnut Creek in the north and Walnut Creek in the south. These thick, dark brown to black fissile shales were deposited in deep oceans that had limited circulation of fresher waters and sediments. These shales are rich in organic matter, pyrite, and locally, natural gas.

Mississippian-age rocks show a shift to deltaic, fluvial, and shoreline deposits. The oldest unit is the Bedford Shale, which is found across east central Delaware County. It is comprised of very fine-grained silt and clay particles deposited in the outer (distal) margins of a delta. The Berea Sandstone overlies the Bedford Shale in eastern Delaware County. It consists of fine-grained, tightly cemented sand particles that consisted of river sediments that were re-deposited along adjacent shorelines. The Sunbury Shale overlies the Berea Sandstone and is similar to the Devonian Ohio Shale. This unit may indicate the localized return to a low circulation environment. The Mississippian Cuyahoga Formation is found along the eastern margin of Delaware County. This unit is composed of interbedded fine-grained sandstones, shales, and siltstones and represents deltaic to fluvial sediments deposited in a rapidly fluctuating, shoreline environment.

Ground Water Resources

Ground water in Delaware County is obtained from both unconsolidated (glacial-alluvial) and consolidated (bedrock) aquifers. Glacial aquifers are primarily associated with thin lenses of sand and gravel interbedded with till. Sand and gravel deposits are more commonly utilized in areas with underlying shale bedrock. The carbonate aquifer is an important regional aquifer for most of northwestern and west central Ohio and occupies the western third of Delaware County. Interbedded sandstone and shale aquifers in the eastern portion of the county provide ample yields for domestic and farm needs. Yields from shales in the central portion of Delaware County are typically low and are marginal for supplying even domestic needs. Completed water wells typically penetrate multiple bedrock units.

Yields exceeding 100 gpm (ODNR, Div. Of Water, Open File, Bedrock State Aquifer Map, 2000, ODNR, Div. Of Water, 1970, and Haiker, 1994) are available from deep, larger diameter wells drilled into the Silurian Salina Undifferentiated Group, the Tymochtee and Greenfield Dolomites, and the Lockport Dolomite. These formations extend across the western third of the county. Yields for the Devonian Columbus and Delaware Limestones vary from 25-100 gpm to 5-25 gpm (ODNR, Div. of Water, Open File, Bedrock State Aquifer Map, 2000, ODNR, Div. Of Water, 1970, and Haiker, 1994). The trend of increasing yields in deeper wells drilled into the carbonates is a generalization. The amount of fracturing, solution, and vuggy (porous) zones has great local importance. Deeper wells are also more likely to contain highly mineralized water and have objectionable water quality.

Carbonate aquifers that underlie the thick sequence of shales in central Delaware County may not be desirable (ODNR, Div. of Water, Open File, Bedrock State Aquifer Map, 2000). Water underlying the shale tends to be very high in sulfur, hydrogen sulfide, and iron.

The Devonian Ohio and Olentangy Shales in central Delaware County are a poor source of ground water. Yields are typically less than 5 gpm (ODNR, Div. of Water, Open File, Bedrock State Aquifer Map, 2000 and Haiker, 1994). Typically, the uppermost 10 to 15 feet of the shale is weathered and broken and provides the most water. Wells drilled deeper into the shale provide increased well storage, but little additional water. The water quality becomes more objectionable with depth. Yields from the Mississippian Bedford Shale in east central Delaware County and the Sunbury Shale in eastern Delaware County are also typically less than 5 gpm (ODNR, Div. of Water, Open File, Bedrock State Aquifer Map, 2000 and Haiker, 1994). Wells drilled into the Berea Sandstone beneath the Sunbury Shale have poor water quality due to the composition of the shale. Yields from the Mississippian Berea Sandstone in eastern Delaware County range from 5 to 25 gpm (ODNR, Div. of Water, Open File, Bedrock State Aquifer Map, 2000 and Haiker, 1994). Yields obtained from the interbedded fine-grained sandstones, shales, and siltstones of the Cuyahoga Formation in the southeastern corner of the county also yield 5 to 25 gpm (ODNR, Div. of Water, Open File, Bedrock State Aquifer Map, 2000 and Haiker, 1994).

Yields from sand and gravel lenses interbedded with the fine-grained till averages 5 to 25 gpm (ODNR, Div. of Water, Glacial State Aquifer Map, 2000 and Haiker, 1994). The sand and gravel may also directly overlie the bedrock, and yield 5 to 25 gpm as well. The drillers may penetrate the bedrock directly below the sand and gravel. In such cases the bedrock acts as a "screen" to help filter fines out of the gravel (ODNR, Div. of Water, Open File, Bedrock State Aquifer Map, 2000 and Haiker, 1994). It is important to note that sand and gravel wells are much more commonly utilized in central Delaware County as the underlying shale is a much poorer aquifer than the carbonates to the west or sandstones to the southeast.

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APPENDIX A
DESCRIPTION OF THE LOGIC IN FACTOR SELECTION

Depth to Water

This factor was primarily evaluated using information from water well log records on file at the Ohio Department of Natural Resources (ODNR), Division of Water, Water Resources Section (WRS). Approximately 8213 water well log records are on file for Delaware County. Data from roughly 2,000 located water well log records were analyzed and plotted on U.S.G.S. 7-1/2 minute topographic maps during the course of the project. Static water levels and information as to the depths at which water was encountered were taken from these records. The *Ground Water Resources of Delaware County* (Haiker, 1994) provided generalized depth to water information throughout the county. Depth to water trends mapped in adjoining Franklin County (Angle, 1995), Licking County (Angle, 1995), Knox County (Aller and Ballou, 1990), Marion County (Angle, 2003), and Union County (Angle, 2004) were used as a guideline. Topographic and geomorphic trends were utilized in areas where other sources of data were lacking.

Depths to water of 0 to 5 (10) and 5 to 15 feet (9) were selected for most of the alluvial settings and in areas of ground moraine with thin till. Depths of 15 to 30 feet (7) were used for the majority of Delaware County for ground moraine with moderate thickness of till and some of the more subdued end moraines. Depths of 30 to 50 feet (5) were utilized for the uplands between streams particularly in the southern portion of the county. Depths of 30 to 50 feet (5) were also used for the higher relief end moraines. Depths to water of 50 to 75 feet (3) and 75 to 100 feet (2) were utilized for higher relief uplands lying between major stream valleys in the southern portion of the county.

Net Recharge

Net recharge is the precipitation that reaches the aquifer after evapotranspiration and run-off. This factor was evaluated using many criteria, including depth to water, topography, soil type, surface drainage, vadose zone material, aquifer type, and annual precipitation. General estimates of recharge provided by Pettyjohn and Henning (1979) and Dumouchelle and Schiefer (2002) proved to be helpful. Recharge ratings from Franklin County (Angle, 1995), Licking County (Angle, 1995), Knox County (Aller and Ballou, 1990), Marion County (Angle, 2003), and Union County (Angle, 2004) were used as a guideline.

Values of 7 to 10 inches per year (8) were assigned to portions of the Olentangy River and Alum Creek valleys adjacent to Franklin County. Values of 4 to 7 inches per year (6) were used for areas with moderate recharge. These areas include the majority of the settings in the county. Values of 2 to 4 inches per year (3) were utilized for areas with thicker till or shale and till. Many of these areas were also uplands with greater depths to water.

Aquifer Media

Information on evaluating aquifer media was obtained primarily from the *Ground Water Resources of Delaware County* (Haiker, 1994). Open File Bedrock Reconnaissance Maps and Open File Bedrock Topography Maps, based upon U.S.G.S. 7-1/2 minute topographic maps from the ODNR, Division of Geological Survey proved helpful. Aquifer ratings from neighboring Franklin County (Angle, 1995), Licking County (Angle, 1995), Knox County (Aller and Ballou, 1990), Marion County (Angle, 2003), and Union County (Angle, 2004) were used as a guideline. The ODNR, Division of Water, Glacial State Aquifer Map and Bedrock State Aquifer Map were an important source of aquifer data. Water well log records on file at the ODNR, Division of Water, were the primary source of aquifer information.

Most of the bedrock and most of the interbedded lenses of sand and gravel are semi-confined or leaky; however, for the purposes of DRASTIC, they have been evaluated as being unconfined (Aller et al., 1987). An aquifer rating of (8) was applied to limestones bordering Franklin County that exhibit karst solution features. Massive limestone was evaluated as the aquifer in the 7Ac-Glacial Till over Limestone and in adjacent settings with carbonate aquifers. A rating of (7) was applied to the Silurian and Devonian limestones that comprise the aquifer in western Delaware County. An aquifer rating of (6) was applied to deep limestone underlying thick till and shale in west central Delaware County. In this area lower yields are associated with the Delaware Limestone. The overlying thick, lower permeability till and shale may also reduce both the recharge and yield of these deep limestone aquifers.

An aquifer rating of (4) was used for interbedded sandstone and shale aquifers of the Cuyahoga Formation in eastern Delaware County. An aquifer rating of (4) was selected for sandstone and fine sandstone aquifers of the Berea Sandstone in eastern Delaware County. An aquifer rating of (3) was utilized for shale aquifers of the Ohio and Olentangy Shale in central Delaware County. An aquifer rating of (3) was also used for limited areas of the Sunbury Shale in eastern Delaware County. An aquifer rating of (2) was selected for clayey shale associated with the Bedford Shale in east central Delaware County.

For sand and gravel aquifers a rating of (7) was given to moderately high-yielding outwash and alluvium along the Olentangy River adjacent to Franklin County. Sand and gravel aquifers elsewhere were assigned a rating of (6) or (5) depending upon how clean, coarse, and thick the deposits were. Yields and information from well log data were used to determine the aquifer rating for these sand and gravel deposits.

Soils

Soils were mapped using the data obtained from the *Soil Survey of Delaware County* (Matanzo et al., 1969). Each soil type was evaluated and given a rating for soil media. Evaluations were based upon the texture, permeability, and shrink-swell potential for each soil material. Special emphasis is placed upon determining the most restrictive layer. The soils of Delaware County showed a high degree of variability. This is a reflection of the parent material. Table 10 is a list of the soils, parent materials, setting, and corresponding DRASTIC values for Delaware County.

Shrink-swell (non-aggregated) clays (7) were selected for areas of very shallow limestone or shale bedrock. In Delaware County these areas of very shallow bedrock are adjacent to major streams. Shrink-swell clays (7) were also considered for some minor areas of very clayey alluvium. Soils were considered to be sandy loam (6) for a limited number of exposures of outwash/kame sand and gravel. These areas reflected kames and eskers near the village of Radnor or terraces flanking the Scioto River and the Olentangy River. Loam (5) soils and silt loams (4) were designated for alluvial and floodplain deposits. These occur adjacent to the major drainages of Delaware County. Clay loam (3) soils were evaluated for the majority of the county including till overlying ground moraine and end moraine. Peat (8) soils occur in a very small area where high organic content and poor drainage occur.

Topography

Topography, or percent slope, was evaluated using U.S.G.S. 7-1/2 minute quadrangle maps and the *Soil Survey of Delaware County* (Matanzo et al., 1969). Slopes of 0 to 2 percent (10) were selected for almost all of the settings in Delaware County due to the overall flat lying to gently rolling topography and low relief. Slopes of 0 to 2 percent (10) were used for most areas of ground moraine or alluvial deposits. Slopes of 2 to 6 percent (9) were assigned to most end moraines exhibiting hummocky terrain, as well as areas of stream-dissected ground moraine. Slopes of 6 to 12 percent (5) and 12 to 18 percent (3) were selected for steep, highly dissected uplands adjacent to major streams.

Impact of the Vadose Zone Media

Information on evaluating vadose zone media was obtained from the *Ground Water Resources of Delaware County* (Haiker, 1994). Open File Bedrock Reconnaissance Maps and Open File Bedrock Topography Maps, based upon U.S.G.S. 7-1/2 minute topographic maps from the ODNR, Division of Geological Survey proved helpful. Vadose zone media ratings from neighboring Franklin County (Angle, 1995), Licking County (Angle, 1995), Knox County (Aller and Ballou, 1990), Marion County (Angle, 2003), and Union County (Angle, 2004) were used as a guideline. The ODNR, Division of Water, Glacial State Aquifer Map and Bedrock State Aquifer Map were an important source of vadose zone media data. The *Soil Survey of Delaware County* (Matanzo et al., 1969) provided valuable information on parent materials. The *Glacial Map of Ohio* and *Quaternary Geology of Ohio* (Goldthwait et al., 1961 and Pavey et al., 1999) were useful in delineating vadose zone media. Water well log records on file at the ODNR, Division of Water, were the primary source of vadose zone media information.

Table 10. Delaware County soils

Soil Name	Parent Material/ Setting	DRASTIC Rating	Soil Media
Alexandria	Clayey till	3	Clay loam
Algiers	Alluvium	4	Silt loam
Bennington	Clayey till	3	Clay loam
Blount	Loamy till	3	Clay loam
Bonpas	Silty and clayey alluvium	7	Shrink-swell clay
Cardington	Clayey till	3	Clay loam
Casco-Fox	Limy sand and gravel	6	Sandy loam
Condit	Clayey till	3	Clay loam
Eel	Till	5	Loam
Fox	Silty or loamy till over outwash	6	Sandy loam
Genesee	Limy till	4	Silt loam
Loudonville	Sandy till	4	Silt loam
McGary	Limy till, alluvial, thin to limestone	7	Shrink-swell clay
Millsdale	Clayey till, thin to limestone	7	Shrink-swell clay
Milton	Limy till, thin to limestone	7	Shrink-swell clay
Morley	Silty clay loam or clay loam	3	Clay loam
Ockley	Silty or loamy till	5	Loam
Pewamo	Clayey till	3	Clay loam
Randolph	Thin till	7	Shrink-swell clay
Rarden	Clayey shale	7	Shrink-swell clay
Ritchey	Limy till, thin to limestone	7	Shrink-swell clay
Ross	Alluvium	4	Silt loam
Shoals	Alluvium	4	Silt loam
Sleeth	Silty or loamy till	5	Loam
Sloan	Alluvium	4	Silt loam
Thackery	Loamy till over kames	6	Sandy loam
Westland	Silty and loamy till over kames	6	Sandy loam
Willette	Bogs, swamps	8	Peat

The vadose zone media is a critical component of the overall DRASTIC rating in Delaware County. The rating varies with the restrictive properties of the various glacial materials. The higher the proportion of silt and clay and the greater the compaction (density) of the sediments, the lower the permeability and the lower the vadose zone media are rated.

Sand and gravel with silt and clay that has a rating of (6) was selected as the vadose zone material for a kame/outwash deposit in Radnor in the northwestern part of Delaware County. Sand and gravel with silt and clay that has a rating of (6) was also used for alluvial deposits associated with the Scioto River and portions of the Olentangy River. Sand and gravel with silt and clay that has a rating of (5) was used for some tributaries of the Scioto River and for most portions of the upper Olentangy River, Alum Creek, and Big Walnut Creek. Till with a vadose zone media rating of (5) was selected for most areas of ground moraine and end moraine in the county. Till with a vadose zone media rating of (4) was assigned to till in areas of ground moraine adjacent to Franklin County and Licking County. In these areas the till had incorporated a high proportion of local shale bedrock that increased the fine, clayey texture of the soil. A vadose rating of (4) or (3) was also used to delineate areas where till was thick. In areas of thick till the proportion of the till that is weathered and fractured becomes lower. The lower ratings for till (4) or (3) were common in the 7J-Glacial Complex hydrogeologic setting. Silt and clay with a rating of (5) or (4) was applied to smaller tributaries throughout Delaware County. The ratings varied depending upon how relatively fine-grained the alluvium was in the particular tributary.

Limestone with a rating of (6) was selected as the vadose zone media for areas of very thin drift (less than 5 feet). These areas are commonly adjacent to the Scioto River in Delaware County. Limestone with silt, clay and sand with a rating of (6) was selected as the vadose zone media for areas were streams have down cut and thin alluvium overlies limestone bedrock. These areas are found adjacent to the Scioto River and Olentangy River in Delaware County. Limestone with fractured till with a rating of (6) was chosen for areas of thin till (less than 25 feet) overlying limestone for large portion of western Delaware County.

Fine sandstone with a rating of (4) was assigned to an area of Berea Sandstone in eastern Delaware County with very thin till cover. Sandstone and till with a rating of (5) was used for areas of thin till (less than 25 feet) overlying the Berea Sandstone in eastern Delaware County. Interbedded sandstone and shale with till that has a rating of (5) was selected for areas where thin till covered the Cuyahoga Formation in southeastern Delaware County.

Shale with a rating of (3) was chosen for areas where very thin till (less than 5 feet) overlies shale bedrock in southern Delaware County. Shale with silt, clay and sand with a rating of (3) or (4) was selected for areas where thin alluvium and shale overly the limestone aquifer in central Delaware County. Shale and till with a rating of (5) was used for areas where thin till (less than 25 feet) overlies a shallow, shale aquifer in Delaware County. Shale and till with a rating of (4) was utilized for areas where a combination of moderately thick till and shale overly either the limestone or shale aquifer in central Delaware County. Shale and till with a rating of (3) was used for areas where the combined thickness of shale and till overlying the limestone aquifer exceeded 100 feet.

Hydraulic Conductivity

Information on evaluating the hydraulic conductivity was obtained from the maps and report of the ODNR, Div. of Water, (1970) and the *Ground Water Resources of Delaware County* (Haiker, 1994). Open File Bedrock Reconnaissance Maps and Open File Bedrock Topography Maps, based upon U.S.G.S. 7-1/2 minute topographic maps from the ODNR, Division of Geological Survey proved helpful. Hydraulic conductivity ratings from neighboring Franklin County (Angle, 1995), Licking County (Angle, 1995), Knox County (Aller and Ballou, 1990), Marion County (Angle, 2003), and Union County (Angle, 2004) were used as a guideline. The ODNR, Division of Water, Glacial State Aquifer Map and Bedrock State Aquifer Map were an important source of hydraulic conductivity data. Water well log records on file at the ODNR, Division of Water, were the primary source of hydraulic conductivity information. Textbook tables (Freeze and Cherry, 1979, Fetter, 1980, and Driscoll, 1986) were useful in obtaining estimated values for hydraulic conductivity in a variety of sediments.

Values for hydraulic conductivity correspond to aquifer ratings; i.e., the more highly rated aquifers have higher values for hydraulic conductivity. A hydraulic conductivity rating of 700-1000 gallons per day per square foot (gpd/ft^2) (6) was selected for clean outwash deposits along the Olentangy River. The remaining sand and gravel aquifers were given hydraulic conductivity ratings of 300-700 gpd/ft^2 (4) or 100-300 gpd/ft^2 (2). The hydraulic conductivity rating depended upon how clean and well-sorted the sand and gravel deposits were. Typically, well yields are used to infer the properties of the sand and gravel deposits.

Devonian and Silurian limestone aquifers adjacent to the Scioto River and the Olentangy River were assigned a hydraulic conductivity rating of 700-1000 gpd/ft^2 (6). These rocks along the rivers tend to have a high degree of solution and fracturing. The other limestone aquifers were given a hydraulic conductivity of 300-700 gpd/ft^2 (4). Interbedded sandstone and shale in southeastern Delaware County were assigned hydraulic conductivity of 100-300 gpd/ft^2 (2) because of higher well yields in this area. Sandstone aquifers are given a hydraulic conductivity rating of 100-300 gpd/ft^2 (2) for most areas with Berea Sandstone. Fine sandstone was given a rating of 1-100 gpd/ft^2 (1) for a low-yielding area of Berea Sandstone bordering Franklin County. Interbedded sandstone and shale was given a rating of 1-100 gpd/ft^2 (1) for most areas of the Cuyahoga Formation with moderate to low well yields. All shale aquifers were assigned a hydraulic conductivity rating of 1-100 gpd/ft^2 (1).

APPENDIX B

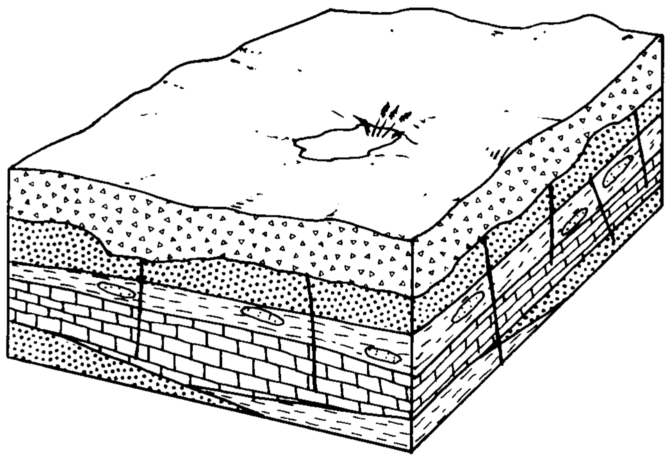
DESCRIPTION OF HYDROGEOLOGIC SETTINGS AND CHARTS

Ground water pollution potential mapping in Delaware County resulted in the identification of thirteen hydrogeologic settings within the Glaciated Central Region. The list of these settings, the range of pollution potential index calculations, and the number of index calculations for each setting are provided in Table 11. Computed pollution potential indexes for Delaware County range from 70 to 164.

Table 11. Hydrogeologic settings mapped in Delaware County, Ohio

Hydrogeologic Settings	Range of GWPP Indexes	Number of Index Calculations
7 Aa-Glacial till over bedded sedimentary rocks	86-134	35
7 Ac-Glacial till over solution limestone	85-153	33
7Ad-Glacial till over sandstone	113-133	10
7 Ae-Glacial till over shale	70-127	31
7Af-Sand and gravel interbedded in glacial till	87-140	25
7Bc-Outwash over limestone	148-154	3
7 C-Moraine	74-136	65
7 D-Buried valleys	87-115	4
7 Ec-Alluvium over sedimentary rock	121-162	31
7 Ed-Alluvium over glacial till	135-141	5
7 Ee-Alluvium over outwash	139-164	6
7 G-Thin glacial till over bedded sedimentary bedrock	135-156	8
7 J-Glacial complex	87-139	33

The following information provides a description of each hydrogeologic setting identified in the county, a block diagram illustrating the characteristics of the setting, and a listing of the charts for each unique combination of pollution potential indexes calculated for each setting. The charts provide information on how the ground water pollution potential index was derived and are a quick and easy reference for the accompanying ground water pollution potential map. 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.

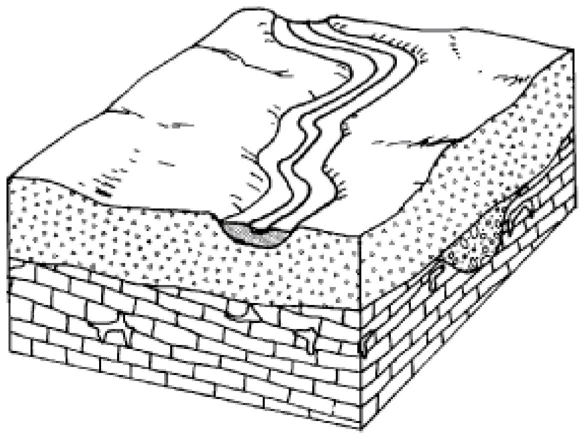


7Aa-Glacial Till over Bedded Sedimentary Rocks

This hydrogeologic setting has two variations in Delaware County. Limestone bedrock in west central Delaware County is overlain by relatively thick glacial till and shale. The area is characterized by flat lying to gently rolling topography and low relief. The vadose zone is comprised of glacial till and low permeability shale. Yields from the limestone bedrock average 5 to 25 gpm. Soils are usually clay loams. Depth to water is shallow to moderate. Recharge is typically low due to the thick, impermeable till and shale.

In eastern Delaware County, thin glacial till overlies the interbedded sandstones, siltstones, and shales of the Mississippian Cuyahoga Formation. The vadose zone is composed of clayey glacial till. The till may be fractured or jointed, particularly in areas where it is predominantly thin and weathered. Where the till is very thin the interbedded sandstone and shale may function as the vadose. Depth to water is commonly shallow, averaging less than 35 feet. Soils are generally clay loams. The aquifer is usually fractured, interbedded Mississippian fine-grained sandstones and shales. Yields from the bedrock typically range from 5 to 25 gpm. Recharge is moderately low due to clayey nature of the soils and vadose zone.

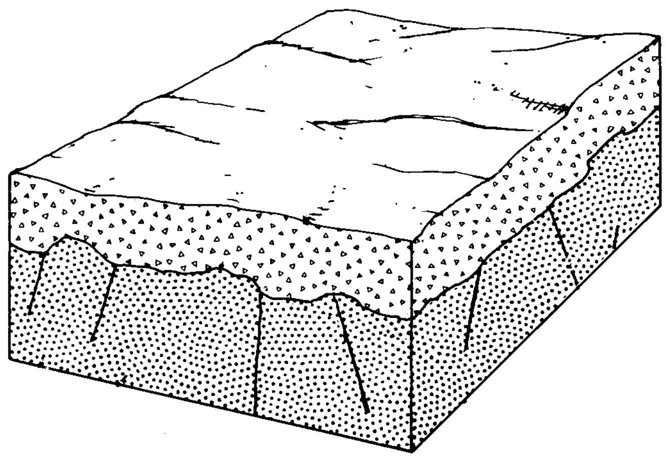
GWPP index values for the hydrogeologic setting of Glacial Till over Bedded Sedimentary Rocks range from 86 to 134, with the total number of GWPP index calculations equaling 35.



7Ac-Glacial Till over Solution Limestone

This hydrogeologic setting is limited to the western third of Delaware County. The area is characterized by flat-lying topography and very low relief. The vadose zone consists primarily of silty to clayey glacial till. The till may be fractured or jointed, particularly in areas where it is predominantly thin and weathered. In areas where the till is very thin, fractured limestone may be considered the vadose zone media. The aquifer is composed of fractured Silurian and/or Devonian limestones and dolomites. These carbonate rocks may contain significant solution features. Depth to water is highly variable depending partly upon the thickness of overlying till and local topographic relief. Soils are typically clay loams derived from till. Maximum ground water yields greater than 100 gpm are possible from the Silurian Lockport, Tymochtee, Greenfield and Salina Groups. Yields range from 5 to 100 gpm for the Devonian carbonate units. Recharge is moderately high due to the permeable nature of the aquifer, relatively flat lying topography, and moderate permeability of the till. Recharge is lower in areas where the till is thicker.

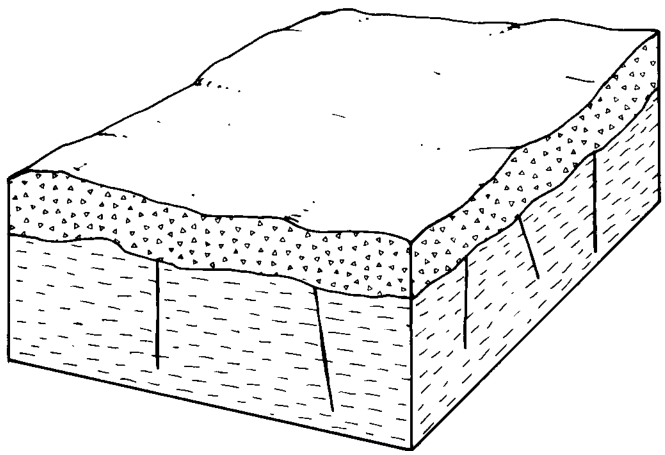
GWPP index values for the hydrogeologic setting of Glacial Till over Solution Limestone range from 85 to 153, with the total number of GWPP index calculations equaling 33.



7Ad Glacial Till over Sandstone

This hydrogeologic setting is limited to eastern Delaware County. Wells completed in this area are shallow and completed in sandstone; shale is not encountered in this vicinity. This setting is characterized by relatively flat-lying to gently rolling topography. The aquifer commonly consists of fractured, fine-grained sandstone. Depths to water are usually fairly shallow, averaging less than 30 feet. Soils are clay loams derived from the underlying tills. The vadose zone is typically fractured till. In areas were the till is very thin, fractured sandstone is the vadose zone media. Yields usually average 5 to 25 gpm. Recharge is generally moderately high due to the shallow depth to water and relatively high permeability of the sandstone.

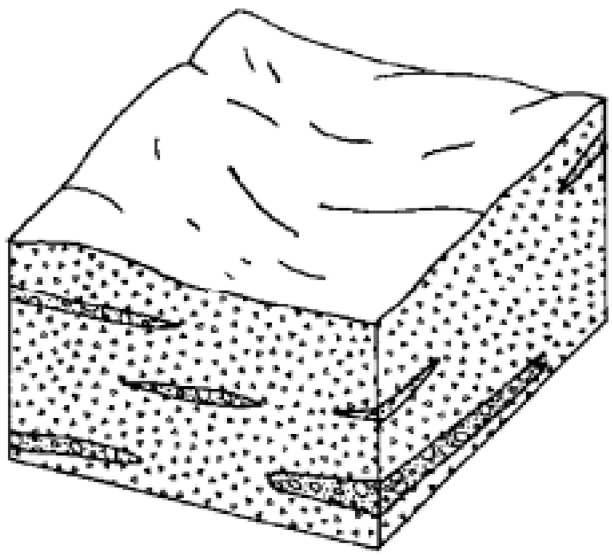
GWPP index values for the hydrogeologic setting of Glacial Till over Sandstone ranges from 113 to 133, with the total number of GWPP index calculations equaling 10.



7Ae-Glacial Till over Shale

This hydrogeologic setting is widespread in eastern and central Delaware County. The area is characterized by flat-lying topography and very low relief. The vadose zone is composed of clayey glacial till. The till may be fractured or jointed, particularly in areas where it is predominantly thin and weathered. Where the till is very thin, shale may function as the vadose. Depth to water is typically shallow, averaging less than 20 feet. Soils are generally clay loams. The aquifer is usually fractured, massive black Devonian-age shale or fine-grained, silty Mississippian Bedford Shale. Yields from the shale are typically less than 5 gpm. Recharge is moderately low due to the clayey vadose zone and soils and then impermeable nature of the shale bedrock.

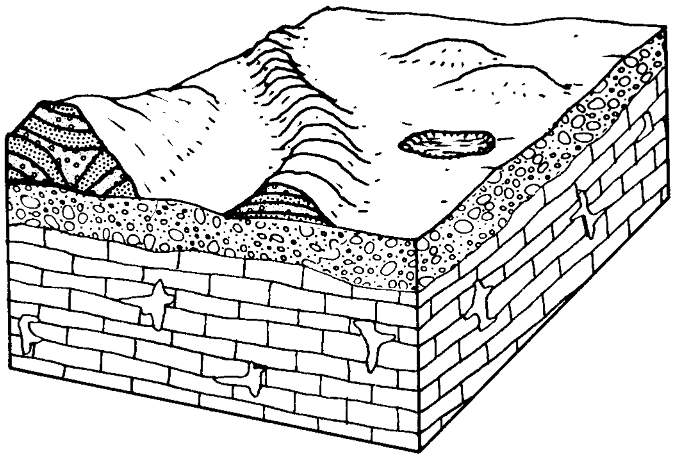
GWPP index values for the hydrogeologic setting of Glacial Till over Shale range from 70 to 127, with the total number of GWPP index calculations equaling 31.



7Af-Sand and Gravel Interbedded in Glacial Till

This hydrogeologic setting is located in central and eastern Delaware County. The area is characterized by flat lying to slightly rolling topography. The setting is commonly associated with areas of ground moraine. The vadose zone is composed of silty to clayey glacial till. The till may be fractured or jointed, particularly in areas where it is predominantly thin and weathered. Depth to water is variable, typically averaging less than 50 feet. Soils are generally clay loams. The aquifer consists of thin lenses of sand and gravel interbedded in the glacial till. Groundwater yields range from 5 to 25 gpm. Recharge is moderate due to the moderate thickness of the overlying glacial till.

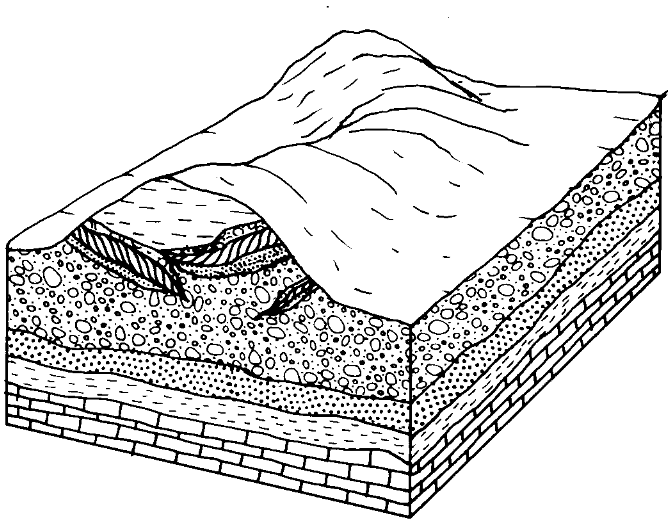
GWPP index values for the hydrogeologic setting of Sand and Gravel Interbedded in Glacial Till range from 87 to 140, with the total number of GWPP index calculations equaling 25.



7Bc Outwash over Limestone

This hydrogeologic setting is limited to northwestern Delaware County near the town of Radnor where low kames and eskers overlie the limestone bedrock. Topography is relatively flat. The sand and gravel is too thin to comprise the aquifer; therefore, ground water is obtained from the underlying limestone bedrock. The sand and gravel with silt and clay till composes the vadose zone. Precipitation moving through the drift recharges the bedrock. Yields of 100 to 500 gpm may be obtained from the underlying limestone. The number of fractures and solution features encountered within the limestone help to determine the yield. Depth to water is generally less than 20 feet. Soils are sandy loams or silt loams. Recharge is moderately high due to the permeable soils and vadose, the shallow depth to water, and the flat topography.

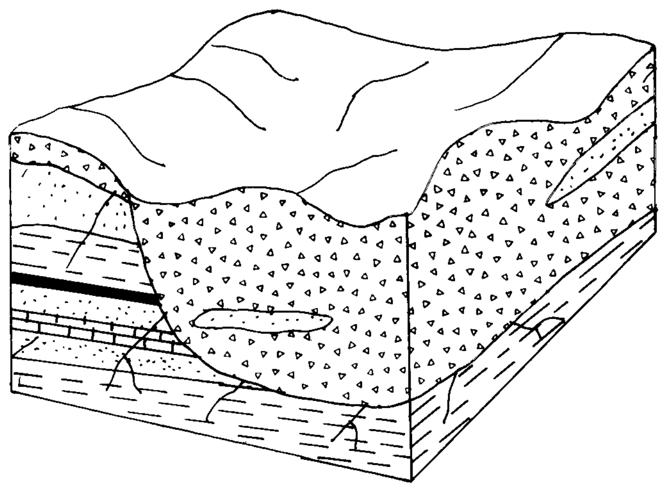
The GWPP index values for the hydrogeologic setting Outwash over Limestone range from 148 to 154, with the total number of calculations equaling 3.



7C-Moraine

This hydrogeologic setting consists of segments of the end moraines that cross Delaware County. This setting is characterized by hummocky to rolling topography. Relief tends to become steeper near the margins of the moraine, especially if enhanced by the downcutting of an adjacent stream. The aquifer consists of relatively thin sand and gravel lenses interbedded with glacial till within the moraine. These sand and gravel deposits differ as to lateral extent and thickness and are found at variable depths. Yields range from 5 to 25 gpm. If sand and gravel lenses are not encountered or if they are too thin, wells are completed in the underlying bedrock. The bedrock aquifer may be limestone, sandstone or shale. The yields vary and are typical for each rock type. The vadose zone is composed of loamy to clayey glacial till. The till may be fractured or jointed, particularly in areas where it is predominantly thin and weathered. In areas of thin till the bedrock may serve as part of the vadose zone. Depth to water is variable and depends primarily upon how deep the underlying aquifer is and how thick the till is. Soils are commonly clay loams. Recharge is moderately high due to the proximity of sand and gravel lenses to the surface and the amount of weathering and fracturing in the till. As the till thickens and depth to water increases, the recharge becomes lower. The end moraines are the primary local sources of recharge.

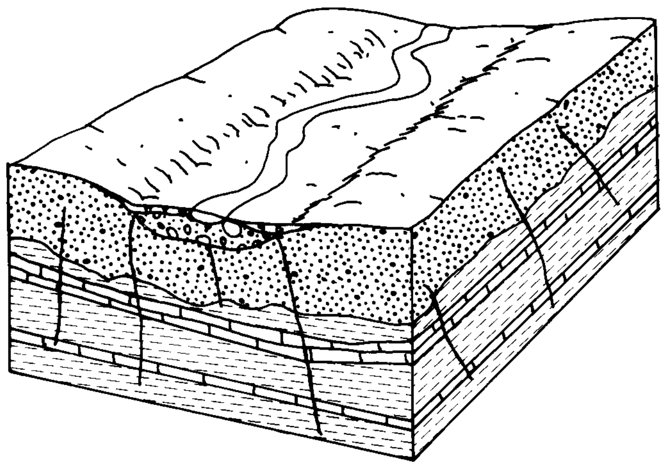
GWPP index values for the hydrogeologic setting of Moraine range from 74 to 136, with the total number of GWPP index calculations equaling 65.



7D-Buried Valley

This hydrogeologic setting is found in southern Delaware County. The buried valley lacks surficial expression and is not overlain by a modern stream. The setting is characterized by overlying flat ground moraine and rolling, hummocky end moraines. The aquifer consists of relatively thin sand and gravel lenses interbedded with glacial till. These sand and gravel deposits differ as to lateral extent and thickness and are found at varying depths. Yields range from 5 to 25 gpm. The vadose zone is composed of loamy to clayey glacial till. The till may be fractured or jointed, particularly in areas where it is predominantly thin and weathered. Depth to water is variable and depends primarily upon how deep the underlying sand and gravel lenses are. Soils are commonly clay loams. Recharge varies depending upon the thickness of till and depth to water.

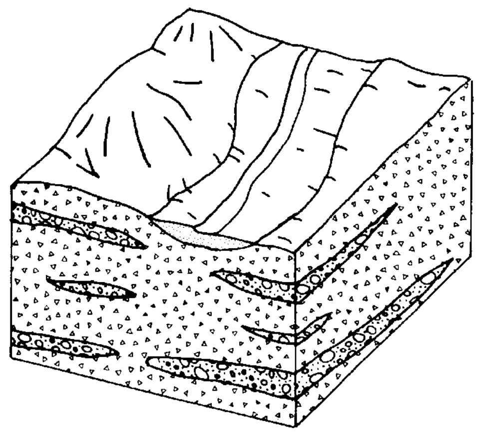
GWPP index values for the hydrogeologic setting of Buried Valley range from 87 to 115, with the total number of GWPP index calculations equaling 4.



7Ec-Alluvium over Sedimentary Rock

This hydrogeologic setting is common throughout Delaware County and is comprised of flat-lying floodplains and stream terraces containing thin to moderate thicknesses of modern alluvium. This setting is similar to the 7Ed-Alluvium over Glacial Till except that the underlying aquifers consist of bedrock. The vadose zone consists of the silty to clayey alluvial deposits. Bedrock may function as the vadose where the alluvium is thin. Depth to water is commonly very shallow, averaging less than 20 feet. The alluvium may be in direct hydraulic connection with the underlying bedrock or there may be thin till or lacustrine deposits in between. Yields vary depending upon the type of underlying bedrock. Soils on the floodplain vary depending on the nature of the alluvium. Recharge is typically moderately high due to the flat-lying topography, shallow depth to water, the moderate permeability of the soils, and the varying permeability of the underlying bedrock.

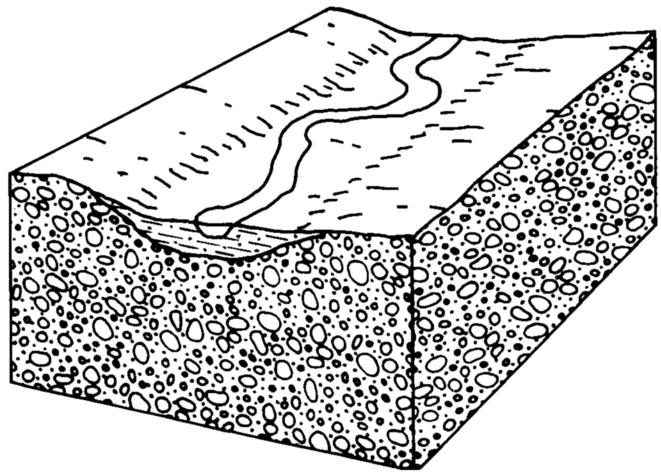
The GWPP index values for the hydrogeologic setting Alluvium over Sedimentary Rocks range from 121 to 162, with the total number of GWPP index calculations equaling 31.



7Ed-Alluvium over Glacial Till

This hydrogeologic setting is comprised of flat-lying floodplains and stream terraces containing thin to moderate thicknesses of modern alluvium. This setting is found in eastern Delaware County and is similar to the 7Af–Sand and Gravel interbedded in Glacial Till setting, except for the presence of the modern stream and related deposits. The setting is also similar to the 7Ec-Alluvium over Sedimentary Rock, except that the underlying aquifer consists of shallow sand and gravel lenses instead of bedrock. The stream may or may not be in direct hydraulic connection with the underlying sand and gravel lenses that comprise the aquifer. The surficial, silty alluvium is typically more permeable than the underlying till, but is too thin to be considered the aquifer. The vadose zone consists of the silty to clayey alluvial deposits. Soils are silt loams or loams. Yields commonly range from 5 to 25 gpm from the sand and gravel lenses. Depth to water is typically shallow with depths averaging less than 20 feet. Recharge is moderately high due to the shallow depth to water, flat-lying topography, and the moderate permeability of the glacial till and alluvium.

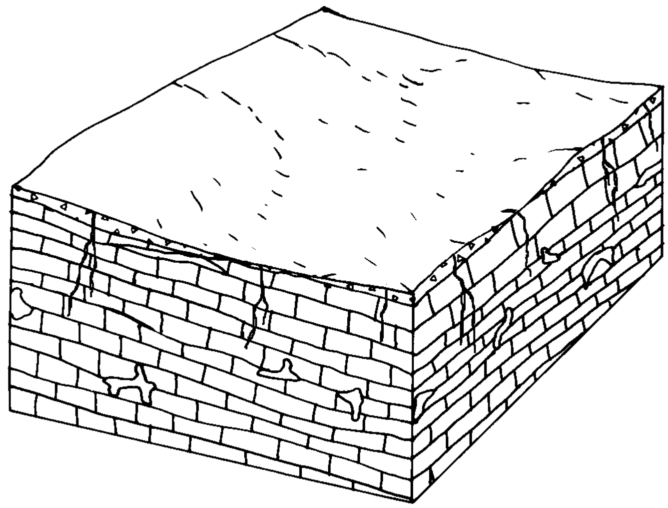
The GWPP index values for the hydrogeologic setting Alluvium over Glacial Till range from 135 to141, with the total number of GWPP index calculations equaling 5



7Ee Alluvium Over Outwash

This hydrogeologic setting is limited to some major valleys in southern Delaware County that do not have an adequate thickness of drift to be considered buried valleys. The setting is characterized by low relief floodplains and low terraces with thin to moderate thicknesses of modern alluvium overlying outwash. The alluvium is comprised of clay, silt, and fine sand. Soils are typically silt loams or loams. The depth to water is shallow, averaging less than 20 feet. Streams are in hydraulic connection with the alluvium and are typically in connection with the underlying sand and gravel outwash. The outwash consists of coarse, moderately well sorted, stratified sand and gravel. Yields up to 100 gpm may be possible from properly developed, large-diameter wells. Recharge is high due to the permeable soils and vadose, the flat topography, and the shallow depth to water.

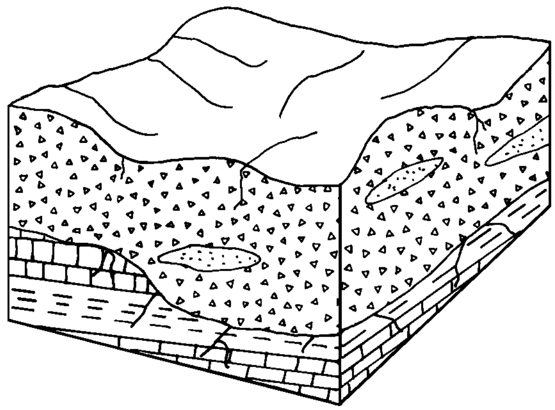
The GWPP index values for the hydrogeologic setting of Alluvium Over Outwash range from 139 to 164, with the total number of GWPP index calculations equaling 6.



7G Thin Glacial Till Over Bedded Sedimentary Rock

This hydrogeologic setting is located in the western part of Delaware County, primarily flanking the Scioto River or the Olentangy River. This setting is characterized by gently rolling to flat lying topography and deposits of thin, patchy glacial till overlying limestone bedrock. The till is usually less than 10 feet thick and consists of varying amounts of unsorted clay, silt, and sand with minor pebbles and cobbles. Ground water is obtained from the underlying, fractured Silurian or Devonian limestone. Yields greater than 100 gpm are possible from the underlying bedrock. Depth to water is shallow to moderate, averaging less than 50 feet. Soils are shrink-swell (aggregated) clays derived from weathered limestone. Recharge is moderately high due to the close proximity of the limestone to the surface.

GWPP index values for the hydrogeologic setting of Thin Glacial Till Over Bedded Sedimentary Rock range from 135 to 156, with the total number of GWPP index calculations equaling 8.



7J-Glacial Complex

This setting is found in the southern and eastern portions of Delaware County. The surface topography is flat and has low relief. Modern streams typically do not overly these deposits. The setting is characterized by a thick sequence of glacial till. The aquifer consists of thinner, less continuous lenses of sand and gravel interbedded with thicker sequences of fine-grained glacial till or the underlying bedrock. Yields vary from 5 to 25 gpm for wells completed in the sand and gravel lenses. Yields for bedrock vary according to the bedrock type. The setting is similar to the 7D-Buried Valley except that the sand and gravel lenses are less common, less continuous in lateral extent, and the overall thickness of drift is somewhat less. Soils are usually clay loams derived from the overlying glacial till. Depths to water are variable and depend on drift thickness and depth to the aquifer. Recharge is variable and depends upon drift thickness and depth to water.

GWPP index values for the hydrogeologic setting of Glacial Complex range from 87 to 139, with the total number of GWPP index calculations equaling 33.

Table 12. Hydrogeologic Settings, DRASTIC Factors, and Ratings

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% slope)	Vadose Zone Media	Hydraulic Conductivity	Rating	Pesticide Rating_
7Aa1	15-30	2-4	limestone	Clay loam	6-12	shale + till	300-700	106	118
7Aa2	15-30	2-4	limestone	Clay loam	0-2	shale + till	300-700	108	130
7Aa3	15-30	2-4	limestone	Clay loam	2-6	shale + till	300-700	107	127
7Aa4	5-15	2-4	limestone	Clay loam	6-12	shale + till	300-700	113	125
7Aa5	5-15	2-4	limestone	Clay loam	2-6	shale + till	300-700	117	137
7Aa6	30-50	2-4	limestone	Clay loam	2-6	shale + till	300-700	97	117
7Aa7	5-15	4-7	limestone	Clay loam	2-6	shale + till	300-700	134	153
7Aa8	15-30	4-7	limestone	Clay loam	0-2	shale + till	300-700	125	146
7Aa9	30-50	4-7	limestone	Clay loam	2-6	shale + till	300-700	114	133
7Aa10	5-15	2-4	limestone	Clay loam	0-2	shale + till	300-700	118	140
7Aa11	5-15	2-4	limestone	Clay loam	0-2	shale + till	300-700	123	144
7Aa12	15-30	2-4	limestone	Clay loam	0-2	shale + till	300-700	113	134
7Aa13	15-30	2-4	limestone	Clay loam	2-6	shale + till	300-700	112	131
7Aa14	50-75	2-4	limestone	Clay loam	0-2	shale + till	300-700	91	113
7Aa15	75-100	2-4	limestone	Clay loam	0-2	shale + till	300-700	86	108
7Aa16	30-50	4-7	limestone	Clay loam	0-2	shale + till	300-700	113	135
7Aa17	15-30	2-4	limestone	Clay loam	6-12	shale + till	300-700	108	119
7Aa18	5-15	2-4	limestone	Clay loam	2-6	shale + till	300-700	122	141
7Aa19	15-30	4-7	interbedded ss + sh	Clay loam	2-6	till	1-100	114	135
7Aa20	15-30	4-7	interbedded ss + sh	Clay loam	0-2	till	1-100	115	138
7Aa21	5-15	4-7	interbedded ss + sh	Clay loam	0-2	till	1-100	125	148
7Aa22	15-30	4-7	interbedded ss + sh	Clay loam	0-2	till	1-100	110	134
7Aa23	15-30	4-7	interbedded ss + sh	Clay loam	2-6	till	1-100	109	131
7Aa24	15-30	2-4	limestone	Clay loam	6-12	shale + till	300-700	103	115
7Aa25	5-15	4-7	interbedded ss + sh	Clay loam	0-2	till	100-300	123	146
7Aa26	5-15	4-7	interbedded ss + sh	Clay loam	0-2	till	1-100	120	144
7Aa27	30-50	4-7	interbedded ss + sh	Clay loam	0-2	till	1-100	95	120
7Aa28	30-50	4-7	interbedded ss + sh	Clay loam	2-6	till	1-100	99	121
7Aa29	5-15	4-7	interbedded ss + sh	Clay loam	2-6	till	1-100	124	145
7Aa30	5-15	4-7	interbedded ss + sh	Clay loam	0-2	int ss+sh/till	1-100	125	148
7Aa31	0-5	4-7	interbedded ss + sh	Clay loam	0-2	int ss+sh/till	1-100	130	153
7Aa32	0-5	4-7	interbedded ss + sh	Clay loam	0-2	till	1-100	130	153
7Aa33	15-30	4-7	interbedded ss + sh	Clay loam	0-2	till	100-300	118	140

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% slope)	Vadose Zone Media	Hydraulic Conductivity	Rating	Pesticide Rating_
7Aa34	5-15	4-7	interbedded ss + sh	Clay loam	0-2	till	100-300	128	150
7Aa35	5-15	4-7	interbedded ss + sh	Clay loam	0-2	int ss+sh/till	100-300	128	150
7Ac1	5-15	4-7	limestone	Clay loam	0-2	lst/frac till	300-700	148	167
7Ac2	0-5	4-7	limestone	Clay loam	0-2	lst/frac till	300-700	153	172
7Ac3	5-15	4-7	limestone	Clay loam	0-2	till	300-700	143	163
7Ac4	15-30	4-7	limestone	Clay loam	0-2	till	300-700	133	153
7Ac5	5-15	4-7	limestone	Clay loam	2-6	lst/frac till	300-700	147	164
7Ac6	15-30	4-7	limestone	Clay loam	0-2	lst/frac till	300-700	138	157
7Ac7	15-30	4-7	limestone	Clay loam	2-6	lst/frac till	300-700	137	154
7Ac8	5-15	4-7	limestone	Clay loam	2-6	till	300-700	142	160
7Ac9	15-30	4-7	limestone	Sandy loam	0-2	till	300-700	139	168
7Ac10	15-30	4-7	limestone	Clay loam	6-12	lst/frac till	300-700	133	142
7Ac11	15-30	4-7	limestone	Clay loam	2-6	till	300-700	132	150
7Ac12	30-50	2-4	limestone	Loam	6-12	till	700-1000	111	126
7Ac13	30-50	4-7	limestone	Clay loam	2-6	lst/frac till	300-700	127	144
7Ac14	30-50	4-7	limestone	Clay loam	0-2	lst/frac till	300-700	128	147
7Ac15	30-50	4-7	limestone	Clay loam	0-2	till	300-700	123	143
7Ac16	30-50	4-7	limestone	Clay loam	2-6	till	300-700	122	140
7Ac17	15-30	4-7	limestone	Clay loam	2-6	lst/frac till	700-1000	143	158
7Ac18	30-50	4-7	limestone	Clay loam	2-6	till	300-700	120	139
7Ac19	30-50	4-7	limestone	Clay loam	2-6	till	700-1000	123	140
7Ac20	30-50	4-7	limestone	Clay loam	2-6	till	300-700	117	136
7Ac21	15-30	4-7	limestone	Clay loam	6-12	till	300-700	128	138
7Ac22	50-75	2-4	limestone	Clay loam	6-12	till	300-700	86	98
7Ac23	75-100	2-4	limestone	Clay loam	2-6	till	300-700	85	105
7Ac24	50-75	2-4	limestone	Clay loam	2-6	till	700-1000	96	114
7Ac25	50-75	2-4	limestone	Clay loam	2-6	till	300-700	95	114
7Ac26	30-50	4-7	limestone	Clay loam	6-12	lst/frac till	300-700	123	132
7Ac27	50-75	2-4	limestone	Clay loam	6-12	till	300-700	91	102
7Ac28	50-75	2-4	limestone	Clay loam	0-2	till	300-700	96	117
7Ac29	75-100	2-4	limestone	Clay loam	0-2	till	300-700	91	112
7Ac30	30-50	4-7	limestone	Clay loam	6-12	till	300-700	118	128
7Ac31	75-100	2-4	limestone	Clay loam	2-6	till	300-700	90	109
7Ac32	75-100	2-4	limestone	Clay loam	6-12	till	300-700	86	97
7Ac33	50-75	4-7	limestone	Clay loam	6-12	lst/frac till	300-700	108	118
7Ad1	5-15	4-7	sandstone	Clay loam	0-2	till	100-300	128	150
7Ad2	15-30	4-7	sandstone	Clay loam	0-2	till	100-300	118	140
7Ad3	15-30	4-7	sandstone	Clay loam	0-2	ss + till	100-300	118	140

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% slope)	Vadose Zone Media	Hydraulic Conductivity	Rating	Pesticide Rating_
7Ad4	15-30	4-7	sandstone	Clay loam	2-6	till	100-300	117	137
7Ad5	15-30	4-7	fine sandstone	Loam	2-6	fine sandstone	1-100	113	141
7Ad6	5-15	4-7	fine sandstone	Clay loam	0-2	till	100-300	123	146
7Ad7	5-15	4-7	sandstone	Clay loam	2-6	ss + till	100-300	127	147
7Ad8	5-15	4-7	sandstone	Clay loam	0-2	ss + till	100-300	128	150
7Ad9	0-5	4-7	sandstone	Clay loam	0-2	ss + till	100-300	133	155
7Ad10	15-30	4-7	sandstone	Clay loam	2-6	ss + till	100-300	117	137
7Ae1	5-15	4-7	shale	Clay loam	2-6	till	1-100	121	142
7Ae2	5-15	4-7	shale	Clay loam	0-2	till	1-100	122	145
7Ae3	5-15	4-7	shale	Clay loam	6-12	shale + till	1-100	117	130
7Ae4	15-30	4-7	shale	Clay loam	2-6	till	1-100	111	132
7Ae5	15-30	4-7	shale	Clay loam	0-2	till	1-100	112	135
7Ae6	15-30	4-7	shale	Clay loam	2-6	shale + till	1-100	111	132
7Ae7	15-30	4-7	shale	Clay loam	0-2	shale + till	1-100	112	135
7Ae8	5-15	4-7	shale	Clay loam	0-2	shale + till	1-100	122	145
7Ae9	5-15	4-7	shale	Clay loam	2-6	shale + till	1-100	121	142
7Ae10	30-50	4-7	shale	Clay loam	0-2	till	1-100	102	125
7Ae11	30-50	4-7	shale	Clay loam	0-2	shale + till	1-100	102	125
7Ae12	15-30	4-7	shale	Clay loam	2-6	till	1-100	106	128
7Ae13	5-15	4-7	shale	Clay loam	2-6	till	1-100	116	138
7Ae14	5-15	4-7	shale	Clay loam	0-2	till	1-100	117	141
7Ae15	15-30	4-7	shale	Clay loam	12-18	shale	1-100	95	106
7Ae16	75-100	2-4	shale	Clay loam	0-2	till	1-100	70	94
7Ae17	30-50	4-7	shale	Clay loam	2-6	shale + till	1-100	101	122
7Ae18	30-50	4-7	shale	Clay loam	2-6	till	1-100	96	118
7Ae19	15-30	4-7	shale	Clay loam	6-12	shale + till	1-100	107	120
7Ae20	15-30	4-7	clay shale	Clay loam	2-6	till	1-100	108	129
7Ae21	15-30	4-7	clay shale	Clay loam	0-2	till	1-100	109	132
7Ae22	5-15	4-7	clay shale	Clay loam	0-2	till	1-100	119	142
7Ae23	5-15	4-7	clay shale	Clay loam	2-6	till	1-100	113	135
7Ae24	15-30	4-7	shale	Clay loam	6-12	till	1-100	107	120
7Ae25	5-15	4-7	clay shale	Clay loam	2-6	till	1-100	118	139
7Ae26	5-15	4-7	clay shale	Clay loam	2-6	shale + till	1-100	118	139
7Ae27	15-30	4-7	clay shale	Clay loam	12-18	shale	1-100	92	103
7Ae28	30-50	4-7	clay shale	Clay loam	6-12	till	1-100	94	107
7Ae29	15-30	4-7	clay shale	Clay loam	2-6	shale + till	1-100	108	129
7Ae30	15-30	4-7	clay shale	Clay loam	6-12	shale + till	1-100	104	117
7Ae31	0-5	4-7	shale	Clay loam	0-2	till	1-100	127	150

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% slope)	Vadose Zone Media	Hydraulic Conductivity	Rating	Pesticide Rating_
7Af1	15-30	4-7	sand and gravel	Clay loam	0-2	till	300-700	130	150
7Af2	30-50	4-7	sand and gravel	Clay loam	0-2	till	300-700	120	140
7Af3	50-75	2-4	sand and gravel	Clay loam	2-6	till	300-700	87	107
7Af4	15-30	4-7	sand and gravel	Clay loam	12-18	till	300-700	118	125
7Af5	30-50	4-7	sand and gravel	Clay loam	2-6	till	300-700	119	137
7Af6	50-75	2-4	sand and gravel	Clay loam	0-2	till	300-700	93	114
7Af7	15-30	4-7	sand and gravel	Clay loam	2-6	till	300-700	129	147
7Af8	5-15	4-7	sand and gravel	Clay loam	0-2	till	300-700	140	160
7Af9	5-15	4-7	sand and gravel	Clay loam	2-6	till	300-700	136	154
7Af10	15-30	4-7	sand and gravel	Clay loam	2-6	till	300-700	126	144
7Af11	5-15	4-7	sand and gravel	Clay loam	0-2	till	300-700	137	157
7Af12	15-30	4-7	sand and gravel	Clay loam	0-2	till	300-700	127	147
7Af13	15-30	4-7	sand and gravel	Clay loam	2-6	till	100-300	115	136
7Af14	15-30	4-7	sand and gravel	Clay loam	0-2	till	100-300	116	139
7Af15	15-30	4-7	sand and gravel	Clay loam	2-6	till	300-700	121	140
7Af16	30-50	4-7	sand and gravel	Clay loam	2-6	till	300-700	116	134
7Af17	50-75	2-4	sand and gravel	Clay loam	2-6	till	300-700	89	108
7Af18	15-30	4-7	sand and gravel	Clay loam	6-12	till	300-700	122	132
7Af19	15-30	4-7	sand and gravel	Clay loam	2-6	till	100-300	120	140
7Af20	30-50	4-7	sand and gravel	Clay loam	0-2	till	300-700	117	137
7Af21	5-15	4-7	sand and gravel	Clay loam	0-2	till	100-300	134	156
7Af21	5-15	4-7	sand and gravel	Clay loam	0-2	till	100-300	134	156
7Af22	15-30	4-7	sand and gravel	Clay loam	0-2	till	100-300	119	142
7Af23	15-30	4-7	sand and gravel	Clay loam	0-2	till	100-300	124	146
7Af24	15-30	4-7	sand and gravel	Clay loam	2-6	till	100-300	123	143
7Af25	0-5	4-7	sand and gravel	Clay loam	0-2	till	100-300	139	161

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% slope)	Vadose Zone Media	Hydraulic Conductivity	Rating	Pesticide Rating_
7Bc1	5-15	4-7	limestone	Sandy loam	0-2	sd + gvl w/sl + cl	300-700	154	182
7Bc2	5-15	4-7	limestone	Loam	0-2	sd + gvl w/sl + cl	300-700	152	177
7Bc3	5-15	4-7	limestone	Clay loam	0-2	sd + gvl w/sl + cl	300-700	148	167
7C1	30-50	4-7	limestone	Clay loam	6-12	till	300-700	118	128
7C2	30-50	4-7	limestone	Clay loam	0-2	till	300-700	123	143
7C3	30-50	4-7	limestone	Clay loam	2-6	till	300-700	122	140
7C4	15-30	4-7	limestone	Clay loam	2-6	till	300-700	132	150
7C5	15-30	4-7	limestone	Clay loam	0-2	till	300-700	133	153
7C6	15-30	4-7	limestone	Clay loam	6-12	till	300-700	128	138
7C7	15-30	4-7	limestone	Clay loam	6-12	lst/frac till	300-700	133	142
7C8	30-50	4-7	limestone	Clay loam	2-6	lst/frac till	300-700	127	144
7C9	15-30	4-7	shale	Clay loam	0-2	till	1-100	112	135
7C10	15-30	4-7	shale	Clay loam	2-6	till	1-100	111	132
7C11	15-30	4-7	shale	Clay loam	2-6	shale + till	1-100	111	132
7C12	15-30	4-7	shale	Clay loam	0-2	shale + till	1-100	112	135
7C13	15-30	2-4	limestone	Clay loam	2-6	shale + till	300-700	107	127
7C14	15-30	2-4	limestone	Clay loam	0-2	shale + till	300-700	108	130
7C15	30-50	2-4	limestone	Clay loam	0-2	shale + till	300-700	98	120
7C16	30-50	2-4	limestone	Clay loam	2-6	shale + till	300-700	97	117
7C17	15-30	4-7	limestone	Clay loam	2-6	shale + till	300-700	124	143
7C18	15-30	4-7	shale	Clay loam	2-6	till	1-100	106	128
7C19	30-50	4-7	shale	Clay loam	2-6	till	1-100	96	118
7C20	75-100	2-4	limestone	Clay loam	2-6	till	300-700	85	105
7C21	50-75	2-4	limestone	Clay loam	6-12	till	300-700	86	98
7C22	50-75	2-4	sand and gravel	Clay loam	2-6	till	300-700	87	107
7C23	75-100	2-4	sand and gravel	Clay loam	2-6	till	300-700	87	106
7C24	15-30	4-7	sand and gravel	Clay loam	2-6	till	300-700	129	147
7C25	30-50	4-7	sand and gravel	Clay loam	2-6	till	300-700	119	137
7C26	75-100	2-4	limestone	Clay loam	2-6	till	300-700	90	109
7C27	50-75	2-4	limestone	Clay loam	2-6	till	300-700	95	114
7C28	30-50	4-7	sand and gravel	Clay loam	2-6	till	300-700	114	133
7C29	30-50	4-7	limestone	Clay loam	2-6	till	300-700	117	136
7C30	50-75	2-4	limestone	Clay loam	6-12	shale + till	300-700	91	102
7C31	50-75	2-4	limestone	Clay loam	2-6	shale + till	300-700	90	110
7C32	15-30	4-7	shale	Clay loam	6-12	shale + till	1-100	102	116
7C33	50-75	2-4	shale	Clay loam	2-6	till	1-100	74	96

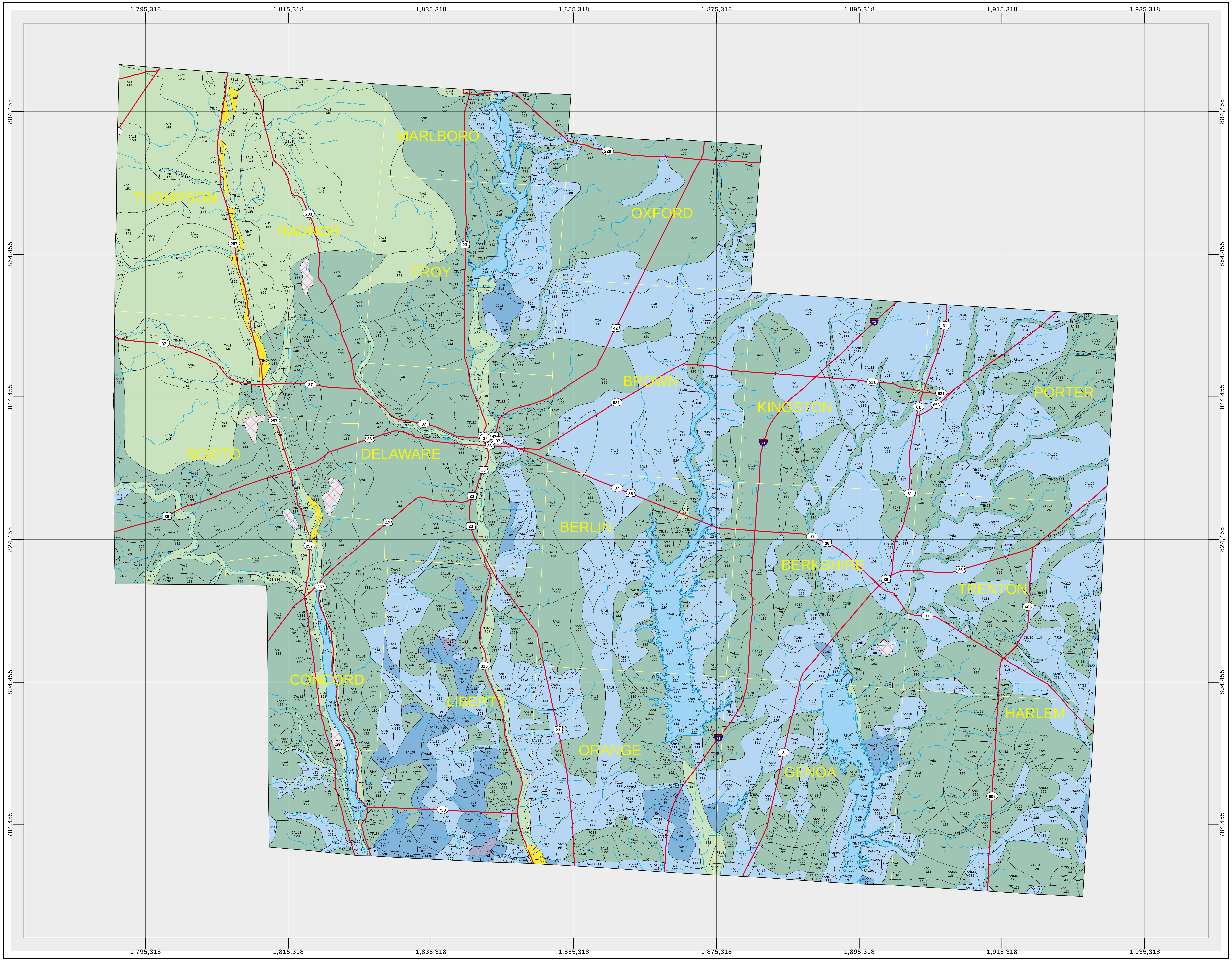
Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% slope)	Vadose Zone Media	Hydraulic Conductivity	Rating	Pesticide Rating_
7C34	5-15	4-7	shale	Clay loam	6-12	shale + till	1-100	112	126
7C35	30-50	4-7	limestone	Clay loam	2-6	shale + till	300-700	117	136
7C36	15-30	4-7	limestone	Clay loam	6-12	shale + till	300-700	128	138
7C37	15-30	4-7	shale	Clay loam	6-12	shale + till	1-100	107	120
7C38	5-15	4-7	shale	Clay loam	2-6	till	1-100	121	142
7C39	5-15	4-7	shale	Clay loam	2-6	shale + till	1-100	121	142
7C40	15-30	4-7	sandstone	Clay loam	0-2	till	100-300	118	140
7C41	15-30	4-7	sandstone	Clay loam	2-6	till	100-300	117	137
7C42	15-30	4-7	sandstone	Clay loam	2-6	ss + till	100-300	117	137
7C43	5-15	4-7	sandstone	Clay loam	2-6	till	100-300	127	147
7C44	30-50	4-7	sand and gravel	Clay loam	2-6	till	300-700	116	134
7C45	15-30	4-7	sand and gravel	Clay loam	2-6	till	300-700	126	144
7C46	30-50	4-7	sandstone	Clay loam	2-6	till	100-300	107	127
7C47	30-50	4-7	sandstone	Clay loam	0-2	till	100-300	108	130
7C48	15-30	4-7	interbedded ss + sh	Clay loam	2-6	till	1-100	114	135
7C49	5-15	4-7	sand and gravel	Clay loam	2-6	till	300-700	136	154
7C50	30-50	4-7	shale	Clay loam	2-6	till	1-100	101	122
7C51	30-50	4-7	shale	Clay loam	0-2	till	1-100	102	125
7C52	30-50	4-7	sand and gravel	Clay loam	6-12	till	300-700	112	122
7C53	30-50	4-7	sand and gravel	Clay loam	6-12	till	300-700	110	121
7C54	50-75	2-4	sand and gravel	Clay loam	2-6	till	300-700	92	111
7C55	50-75	2-4	sand and gravel	Clay loam	2-6	till	300-700	89	108
7C56	50-75	2-4	sand and gravel	Clay loam	6-12	till	300-700	85	96
7C57	15-30	4-7	sand and gravel	Clay loam	6-12	till	300-700	122	132
7C58	15-30	4-7	sand and gravel	Clay loam	6-12	till	300-700	117	128
7C59	15-30	4-7	sand and gravel	Clay loam	2-6	till	300-700	121	140
7C60	30-50	4-7	sand and gravel	Clay loam	2-6	till	300-700	111	130
7C61	30-50	4-7	sand and gravel	Clay loam	6-12	till	300-700	107	118
7C62	30-50	4-7	sand and gravel	Clay loam	0-2	till	300-700	117	137
7C63	30-50	4-7	shale	Clay loam	6-12	till	1-100	97	110
7C64	30-50	4-7	shale	Clay loam	6-12	till	1-100	92	106
7C65	15-30	4-7	clay shale	Clay loam	2-6	till	1-100	108	129

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% slope)	Vadose Zone Media	Hydraulic Conductivity	Rating	Pesticide Rating_
7D1	30-50	4-7	sand and gravel	Clay loam	0-2	till	300-700	115	136
7D2	30-50	4-7	sand and gravel	Clay loam	2-6	till	300-700	114	133
7D3	50-75	2-4	sand and gravel	Clay loam	2-6	till	300-700	87	107
7D4	15-30	4-7	sand and gravel	Clay loam	2-6	till	100-300	115	136
7Ec1	0-5	4-7	limestone	Silty loam	0-2	sd + gvl w/sl + cl	300-700	150	173
7Ec2	5-15	4-7	limestone	Sandy loam	0-2	sd + gvl w/sl + cl	700-1000	155	182
7Ec3	5-15	4-7	limestone	Sandy loam	0-2	sd + gvl w/sl + cl	300-700	149	178
7Ec4	5-15	4-7	limestone	Silty loam	0-2	sd + gvl w/sl + cl	700-1000	156	176
7Ec5	5-15	4-7	limestone	Silty loam	0-2	sd + gvl w/sl + cl	300-700	145	168
7Ec6	5-15	4-7	limestone	Sandy loam	0-2	sd + gvl w/sl + cl	700-1000	160	186
7Ec7	5-15	4-7	limestone	Shrink/swell clay	0-2	ls + sl/cl/sd	700-1000	162	191
7Ec8	5-15	4-7	limestone	Loam	0-2	sd + gvl w/sl + cl	700-1000	158	181
7Ec9	5-15	4-7	limestone	Silty loam	0-2	sd + gvl w/sl + cl	300-700	150	172
7Ec10	5-15	4-7	limestone	Shrink/swell clay	0-2	ls + sl/cl/sd	300-700	156	187
7Ec11	5-15	4-7	limestone	Peat	0-2	silt + clay	300-700	148	184
7Ec12	5-15	4-7	limestone	Silty loam	0-2	silt + clay	700-1000	151	172
7Ec13	5-15	4-7	limestone	Silty loam	0-2	silt + clay	300-700	145	168
7Ec14	5-15	4-7	shale	Silty loam	0-2	silt + clay	1-100	124	150
7Ec15	15-30	4-7	limestone	Sandy loam	2-6	sd + gvl w/sl + cl	300-700	138	165
7Ec16	5-15	4-7	shale	Loam	0-2	sd + gvl w/sl + cl	1-100	126	155
7Ec17	5-15	4-7	limestone	Silty loam	0-2	sh + sl/cl/sd	300-700	132	157
7Ec18	5-15	4-7	limestone	Loam	0-2	sh + sl/cl/sd	300-700	134	162
7Ec19	15-30	4-7	limestone	Loam	2-6	sh + sl/cl/sd	300-700	123	149
7Ec20	15-30	4-7	limestone	Silty loam	2-6	sh + sl/cl/sd	300-700	121	144
7Ec21	5-15	4-7	limestone	Loam	0-2	sd + gvl w/sl + cl	300-700	147	173
7Ec22	5-15	4-7	limestone	Silty loam	0-2	sh + sl/cl/sd	300-700	137	161
7Ec23	5-15	4-7	limestone	Loam	0-2	ls + sl/cl/sd	300-700	152	177
7Ec24	5-15	4-7	limestone	Silty loam	0-2	silt + clay	700-1000	146	168
7Ec25	5-15	4-7	shale	Shrink/swell clay	0-2	silt + clay	1-100	125	161
7Ec26	5-15	4-7	clay shale	Loam	0-2	silt + clay	1-100	123	152
7Ec27	5-15	4-7	clay shale	Silty loam	0-2	silt + clay	1-100	121	147

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% slope)	Vadose Zone Media	Hydraulic Conductivity	Rating	Pesticide Rating_
7Ec28	5-15	4-7	sandstone	Loam	0-2	sd + gvl w/sl + cl	100-300	132	160
7Ec29	5-15	4-7	sandstone	Silty loam	0-2	silt + clay	100-300	130	155
7Ec30	5-15	4-7	interbedded ss + sh	Silty loam	0-2	silt + clay	1-100	127	153
7Ec31	5-15	4-7	interbedded ss + sh	Loam	0-2	sd + gvl w/sl + cl	1-100	129	158
7Ed1	5-15	4-7	sand and gravel	Silty loam	0-2	silt + clay	300-700	139	162
7Ed2	5-15	4-7	sand and gravel	Loam	0-2	sd + gvl w/sl + cl	300-700	141	167
7Ed3	5-15	4-7	sand and gravel	Silty loam	0-2	sd + gvl w/sl + cl	300-700	139	162
7Ed4	5-15	4-7	sand and gravel	Silty loam	0-2	silt + clay	100-300	136	161
7Ed5	5-15	4-7	sand and gravel	Loam	0-2	sd + gvl w/sl + cl	100-300	135	163
7Ee1	5-15	7-10	sand and gravel	Silty loam	0-2	sd + gvl w/sl + cl	700-1000	164	184
7Ee2	5-15	7-10	sand and gravel	Loam	0-2	sd + gvl w/sl + cl	300-700	149	175
7Ee3	5-15	4-7	sand and gravel	Silty loam	0-2	sd + gvl w/sl + cl	300-700	142	165
7Ee4	5-15	4-7	sand and gravel	Loam	0-2	sd + gvl w/sl + cl	300-700	144	170
7Ee5	5-15	4-7	sand and gravel	Loam	0-2	sd + gvl w/sl + cl	300-700	141	167
7Ee6	5-15	4-7	sand and gravel	Silty loam	0-2	sd + gvl w/sl + cl	300-700	139	162
7G1	5-15	4-7	limestone	Shrink/swell clay	0-2	limestone	300-700	156	187
7G2	5-15	4-7	limestone	Shrink/swell clay	2-6	limestone	300-700	155	184
7G3	15-30	4-7	limestone	Shrink/swell clay	0-2	limestone	300-700	146	177
7G4	15-30	4-7	limestone	Shrink/swell clay	2-6	limestone	300-700	145	174
7G5	15-30	4-7	limestone	Shrink/swell clay	2-6	limestone	700-1000	151	178
7G6	15-30	4-7	limestone	Shrink/swell clay	0-2	limestone	700-1000	152	181
7G7	30-50	4-7	limestone	Shrink/swell clay	2-6	limestone	700-1000	141	168
7G8	30-50	4-7	limestone	Shrink/swell clay	2-6	limestone	300-700	135	164
7J1	15-30	4-7	limestone	Clay loam	0-2	till	300-700	128	149
7J2	30-50	4-7	limestone	Clay loam	0-2	till	300-700	118	139

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% slope)	Vadose Zone Media	Hydraulic Conductivity	Rating	Pesticide Rating_
7J3	15-30	4-7	shale	Clay loam	0-2	till	1-100	107	131
7J4	30-50	4-7	shale	Clay loam	0-2	till	1-100	97	121
7J5	50-75	2-4	sand and gravel	Clay loam	2-6	till	300-700	92	111
7J6	50-75	2-4	sand and gravel	Clay loam	0-2	till	300-700	93	114
7J7	30-50	4-7	sand and gravel	Clay loam	0-2	till	300-700	115	136
7J8	30-50	4-7	sand and gravel	Clay loam	2-6	till	300-700	114	133
7J9	75-100	2-4	sand and gravel	Clay loam	0-2	till	300-700	88	109
7J10	75-100	2-4	sand and gravel	Clay loam	2-6	till	300-700	87	106
7J11	5-15	4-7	shale	Clay loam	0-2	till	1-100	117	141
7J12	15-30	4-7	sand and gravel	Clay loam	2-6	till	300-700	124	143
7J13	15-30	4-7	interbedded ss + sh	Clay loam	0-2	till	1-100	110	134
7J14	15-30	4-7	sand and gravel	Clay loam	0-2	till	300-700	122	143
7J15	15-30	4-7	sand and gravel	Clay loam	2-6	till	300-700	121	140
7J16	30-50	4-7	sand and gravel	Clay loam	2-6	till	300-700	111	130
7J17	15-30	4-7	shale	Clay loam	2-6	till	1-100	106	128
7J18	30-50	4-7	sand and gravel	Clay loam	0-2	till	300-700	112	133
7J19	30-50	4-7	sand and gravel	Clay loam	2-6	till	300-700	119	137
7J20	15-30	4-7	sand and gravel	Clay loam	2-6	till	300-700	129	147
7J21	15-30	4-7	sand and gravel	Clay loam	0-2	till	300-700	130	150
7J22	30-50	4-7	sand and gravel	Clay loam	0-2	till	300-700	120	140
7J23	5-15	4-7	sand and gravel	Clay loam	2-6	till	300-700	139	157
7J24	15-30	4-7	sand and gravel	Clay loam	0-2	till	100-300	119	142
7J25	5-15	4-7	sand and gravel	Clay loam	0-2	till	100-300	129	152
7J26	5-15	4-7	interbedded ss + sh	Clay loam	0-2	till	1-100	120	144
7J27	5-15	4-7	sand and gravel	Clay loam	2-6	till	100-300	128	149
7J28	15-30	4-7	sand and gravel	Clay loam	2-6	till	100-300	118	139
7J29	15-30	4-7	interbedded ss + sh	Clay loam	2-6	till	1-100	109	131
7J30	0-5	4-7	sand and gravel	Clay loam	0-2	till	100-300	134	157

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography (% slope)	Vadose Zone Media	Hydraulic Conductivity	Rating	Pesticide Rating_
7J31	15-30	4-7	sandstone	Clay loam	0-2	till	100-300	113	136
7J32	15-30	4-7	interbedded ss + sh	Clay loam	0-2	till	100-300	113	136
7J33	5-15	4-7	interbedded ss + sh	Clay loam	0-2	till	100-300	123	146



Ground Water Pollution Potential of Delaware County

by

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Divison of Water

Ground Water Pollution Potential maps are designed to evaluate the susceptibility of ground water to contamination from surface sources. These maps are based on the DRASTIC system developed for the USEPA (Aller et al., 1987). The DRASTIC system consists of two major elements: the designation of mappable units, termed hydrogeologic settings, and a relative rating system for determining the ground water pollution potential within a hydrogeologic setting. The application of DRASTIC to an area requires the recognition of a set of assumptions made in the development of the system. The evaluation of pollution potential of an area assumes that a contaminant with the mobility of water is introduced at the surface and is flushed into the ground water by precipitation. DRASTIC is not designed to replace specific on-site investigations.

In DRASTIC mapping, hydrogeologic settings form the basis of the system and incorporate the major hydrogeologic factors that affect and control ground water movement and occurrence. The relative rating system is based on seven hydrogeologic factors: Depth to water, net Recharge, Aquifer media, Soil media, Topography, Impact of the vadose zone media, and hydraulic Conductivity. These factors form the acronym DRASTIC. The relative rating system uses a combination of weights and ratings to produce a numerical value called the ground water pollution potential index. Higher index values indicate higher susceptibility to ground water contamination. Polygons (outlined in black on the map at left) are regions where the hydrogeologic setting and the pollution potential index are combined to create a mappable unit with specific hydrogeologic characteristics, which determine the region's relative vulnerability to contamination. Additional information on the DRASTIC system, hydrogeologic settings, ratings, and weighting factors is included in the report.

Description of Map Symbols

Hydrogeologic Region → 7D24 ← Hydrogeologic Setting
170 ← Relative Pollution Potential

Legend

Colors are used to depict the ranges in the pollution potential indexes shown below. Warm colors (red, orange, yellow) represent areas of higher vulnerability (higher pollution potential indexes), while cool colors (green, blue, violet) represent areas of lower vulnerability to contamination (lower pollution potential indexes).

- Roads
- Streams
- Lakes
- Townships

Index Ranges

- Not Rated
- Less Than 79
- 80 - 99
- 100 - 119
- 120 - 139
- 140 - 159
- 160 - 179
- 180 - 199
- Greater Than 200

N

Black grid represents the State Plane South Coordinate System (NAD27, feet).

0 1 2 3 4 5
Miles

0 1 2 4 6 8
Kilometers

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