GROUND WATER POLLUTION POTENTIAL
OF GREENE COUNTY, OHIO

BY

WAYNE JONES

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ABSTRACT

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

Ground water pollution potential analysis in Greene County resulted in a map with symbols and colors which illustrate areas of varying ground water contamination vulnerability. Nine hydrogeologic settings were identified in Greene County with computed ground water pollution potential indexes ranging from 71 to 204.

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 Greene County has been prepared to assist planners, managers, and local officials in evaluating the potential for contamination from various sources of pollution. This information can be used to help direct resources and land use activities to appropriate areas, or to assist in protection, monitoring, and clean-up efforts.

TABLE OF CONTENTS

Page

Abstract ii
Table of Contents iii
List of Figures iv
List of Tables v
Acknowledgements vi
Introduction 1
Applications of Pollution Potential Maps 2
Summary of the DRASTIC Mapping Process 3
    Hydrogeologic Settings and Factors 3
    Weighting and Rating System 6
    Pesticide DRASTIC 7
    Integration of Hydrogeologic Settings and DRASTIC Factors 11
Interpretation and Use of a Ground Water Pollution Potential Map 13
General Information About Greene County 14
    Physiography and Climate 14
    Modern Drainage 15
    Pre-and Inter-glacial Drainage and Topography 17
    Bedrock Geology 20
    Hydrogeology 22
References 24
Unpublished Data 28
Appendix A, Description of the Logic in Factor Selection 29
    Depth to Water 29
    Net Recharge 30
    Aquifer Media 31
    Soils 31
    Topography 32
    Hydraulic Conductivity 34
Appendix B, Description of the Hydrogeologic Settings and Charts 35

LIST OF FIGURES

Number Page

1. Format and description of the hydrogeologic setting - 7D Buried Valley 5
2. Description of the hydrogeologic setting - 7D1 Buried Valley 12
3. Location of Greene County 16
4. Teays and Deep Stage drainage in southwestern Ohio 18

LIST OF TABLES

Number Page

1. Assigned weights for DRASTIC features 7
2. Ranges and ratings for depth to water 8
3. Ranges and ratings for net recharge 8
4. Ranges and ratings for aquifer media 9
5. Ranges and ratings for soil media 9
6. Ranges and ratings for topography 10
7. Ranges and ratings for impact of the vadose zone media 10
8. Ranges and ratings for hydraulic conductivity 11
9. Monthly 30 Year Average for Precipitation and Temperature 15
10. Bedrock Stratigraphy of Greene County, Ohio 21
11. Greene County Soils 33
12. Hydrogeologic Settings Mapped in Greene County, Ohio 35

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Map print production and review:	J. Gerrie McCall David Orr Michael Hallfrisch
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Desktop publishing and report design:	David Orr J. Gerrie McCall

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 700,000 rural households depend on private wells; 4,000 of these wells exist in Greene County.

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

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

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

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

The DRASTIC mapping system allows the pollution potential of any area to be evaluated systematically using existing information. 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 which influence ground water pollution potential. The system consists of two major elements: the designation of mappable units, termed hydrogeologic settings, and the superposition of a relative rating system to determine pollution potential.

The application of DRASTIC to an area requires the recognition of a set of assumptions made in the development of the system. DRASTIC evaluates the pollution potential of an area 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 Greene County. Inherent within each hydrogeologic setting are the physical characteristics which affect the ground water pollution potential. These characteristics or factors identified during the development of the DRASTIC system include:

D - Depth to Water

R - Net Recharge

A - Aquifer Media

S - Soil Media

T - Topography

I - Impact of the Vadose Zone Media

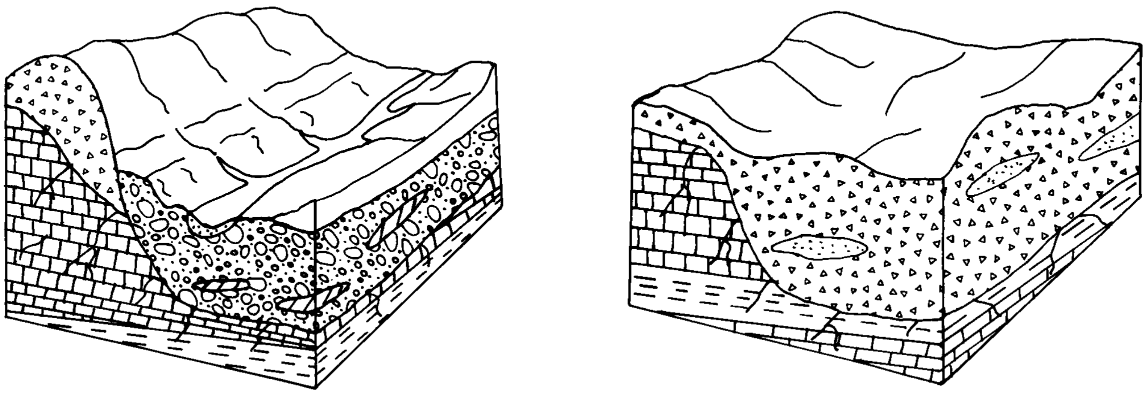
C - Conductivity (Hydraulic) of the Aquifer

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

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

Net recharge is the total amount of water reaching the land surface that infiltrates 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.



(a) (b)

7D Buried Valley

This hydrogeologic setting varied considerably across Greene County. The buried valleys were created by pre-glacial or interglacial rivers which downcut deeply into the bedrock. The differing glacial deposits filling these valleys can be best illustrated by describing the two common forms or types mapped within Greene County.

One common form of buried valley deposits (Block Diagram a) is best exemplified by the Mad River Valley. The valley is occupied by a modern river and floodplain containing abundant outwash and kame deposits, and is easy to distinguish from the surrounding till and bedrock uplands. The depth to water is usually less than 30 feet. The upper portion of the valley commonly contains 50 to 100 feet of sand and gravel outwash with minor till or fine lacustrine deposits. Yields over 500 gpm are possible from properly constructed wells. Soils are typically loams or sandy loams. The streams are usually in direct hydraulic connection with the aquifer. Recharge is typically high.

The other common form of buried valley (Block Diagram b) is best exemplified by a valley in eastern Greene County. These valleys are typically overlain by end moraines, and the rolling topography makes it difficult to distinguish the valleys from surrounding areas. They contain either intermittent steams or no streams at all. The aquifer consists of thin lenses of sand and gravel interbedded in very thick sequences of fine-grained till and lacustrine deposits. Yields are commonly less than 25 gpm. Soils are typically clay loams. Depth to water is typically greater than 50 feet. Recharge is generally moderate to low. GWPP index values for these settings are usually less than 120 and are often less than 100.

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 judgement. The selected rating for each factor is multiplied by the assigned weight for each factor. These numbers are summed to calculate the DRASTIC or pollution potential index.

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

Pesticide DRASTIC

A special version of DRASTIC was developed to be used where the application of pesticides is a concern. The weights assigned to the DRASTIC factors were changed to reflect the processes that affect pesticide movement into the subsurface with particular emphasis on soils. 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
Massive Shale	1-3	2
Metamorphic / Igneous	2-5	3
Weathered Metamorphic / Igneous	3-5	4
Glacial Till	4-6	5
Bedded Sandstone, Limestone and Shale Sequences	5-9	6
Massive Sandstone	4-9	6
Massive Limestone	4-9	6
Sand and Gravel	4-9	8
Basalt	2-10	9
Karst Limestone	9-10	10
Weight: 3	Pesticide Weight: 3	

TABLE 5. RANGES AND RATINGS FOR SOIL MEDIA

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

TABLE 6. RANGES AND RATINGS FOR TOPOGRAPHY

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

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

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

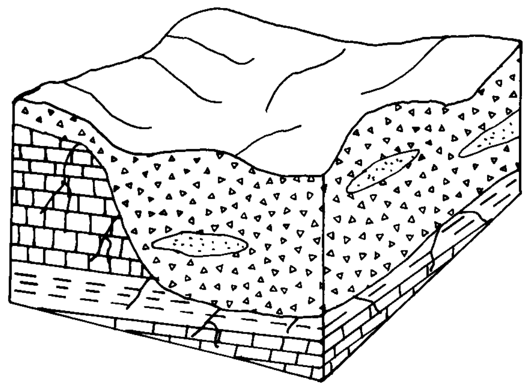
TABLE 8. RANGES AND RATINGS FOR HYDRAULIC CONDUCTIVITY

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

Integration of Hydrogeologic Settings and DRASTIC Factors

Figure 2 illustrates the hydrogeologic setting 7D1, Buried Valley, identified in mapping Greene 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 106. This numerical value has no intrinsic meaning, but can be readily compared to a value obtained for other settings in the county. DRASTIC indexes for typical hydrogeologic settings and values across the United States range from 65 to 223. The diversity of hydrogeologic conditions in Greene County produces settings with a wide range of vulnerability to ground water contamination. Calculated pollution potential indexes for the six settings identified in the county range from 71 to 204.

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 Greene 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 Greene 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	Silt Loam	2	4	8
Topography	6-12%	1	5	5
Impact of Vadose Zone	Silt/Clay	5	4	20
Hydraulic Conductivity	100-300	3	2	6
		DRASTIC	INDEX	106

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

INTERPRETATION AND USE OF A GROUND WATER POLLUTION POTENTIAL MAP

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

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

7D1 - defines the hydrogeologic region and setting
106 - 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 (106) 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 GREENE COUNTY

Greene County is located in the west-central part of Ohio and occupies an area of 415 square miles (Figure 3). The county seat is Xenia, which is located approximately 55 miles southwest of Columbus. Greene County is bordered by Clark County to the north, Montgomery County to the west, Warren and Clinton Counties to the south, and Fayette and Madison Counties to the east.

The population of Greene County, according to the 1990 Census, is 136,731 (Ohio Department of Development 1990). The population of Xenia is 24,664 (Ohio Department of Development, 1990). Fairborn is the largest city in Greene County with a population of 31,300 (Ohio Department of Development, 1990). Agricultural lands in western Greene County are being converted to housing as the Dayton metropolitan area encroaches eastward. Because of the large supply of ground water available in the Mad River Valley, several large industries and Wright Patterson Air Force Base have located near Fairborn.

Physiography and Climate

Greene County lies within the Till Plains section of the Central Lowlands Physiographic Province (Fenneman, 1938). Surface topography varies from gently sloping outwash terraces to the rolling hills of the eroding end moraines. Stream valleys dissect the rolling topography throughout the county.

The weather service station at the City of Xenia, Xenia 6 SSE, has recorded a mean annual temperature of 51.7 degrees Fahrenheit for the thirty-year period of 1961-1990 (U.S. Department of Commerce, 1992) as shown in Table 9. According to Harstine (1991), precipitation increases to the south across the county. Harstine (1991) also noted that temperatures increase slightly from north to south across the county. The average precipitation value as recorded at the Xenia 6 SSE station is 39.56 inches, based on a 30 year record from 1961 to 1990 (U.S. Department of Commerce, 1992)(Table 9).

Table 9. Monthly 30 Year Average for Precipitation and Temperature (United States Department of Commerce. 1992)

Month	**Precipitation** (inches) **Xenia**	**Temperature** (degrees Fahrenheit)
January	2.18	26.9
February	2.25	30.4
March	3.60	41.9
April	3.78	52.0
May	4.41	61.8
June	3.50	69.6
July	4.21	72.9
August	3.74	71.0
September	3.02	64.9
October	2.71	53.7
November	3.23	43.1
December	2.93	32.1
Annual	**39.56**	**51.7**

Modern Drainage

The Little Miami River and its tributaries drain the central portion of Greene County. The Little Miami River joins the Ohio River near Cincinnati in Hamilton County. The main tributaries to the Little Miami River are Massie Creek, North Fork Massie Creek, South Fork Massie Creek, Beaver Creek, Little Beaver Creek, Sugar Creek, Little Sugar Creek, Caesar Creek, North Branch Caesar Creek, South Branch Caesar Creek, Glady's Run, Anderson Fork, and Painters Creek.

A small section of southeastern Greene County is part of the Scioto River Basin and is drained by West Branch Rattlesnake Creek and other small tributaries of Paint Creek.

In the far northwestern portion of Greene County, the Mad River flows southwesterly and joins the Great Miami River at Dayton in Montgomery County.

Figure 3. Location of Greene County

Pre-and Inter-glacial Drainage and Topography

Prior to glaciation the main drainage system in Ohio was the Teays River (Figure 4a). The Teays River was part of a major drainage system that had its origin in the Piedmont of North Carolina and flowed through Ohio, exiting the state in Mercer County (Norris and Spicer, 1959). The Teays was a very mature river system that left broad, flat valleys in the bedrock surface.

The Teays River flowed several miles north of Greene County, yet some of its major tributaries had their headwaters in Greene County (Kulibert, 1977). The Hamilton River, the largest tributary of the Teays in Ohio, originated in Greene County (Stout et al., 1943). Flowing to the southwest, the Hamilton River joined the Teays in south-central Indiana (Norris et al., 1956). In Greene County, the depth to the bedrock surface in the main Hamilton River channel is greater than 250 feet (Norris et al., 1956). Stout et al. (1943) also identified a small set of Teays tributaries which flow to the north in Greene County.

During pre-Illinoian (Kansan) glaciation, ice blocked the Teays flow, causing damming and lake formation. Even though Kansan ice never reached Greene County, the effects of blocked drainage and subsequent lake formation are evident. Fine-grained deposits, called Minford Silts, are the direct evidence of this episode of slackwater deposition. Remnants of the Minford Silts are found at depth in some of the northerly flowing tributaries of the Teays in Greene County.

When water eventually overflowed the drainage divides and established new drainage patterns, Deep Stage was born. Deep Stage was a period of deep erosion of existing river valleys to a level below the elevation of Teays Time (Norris et al., 1956). Deep Stage drainage followed Teays drainage in Greene County very closely as the southwesterly flowing Hamilton River was not ponded by pre-Illinoian ice (Norris et al., 1956). The Illinoian ice advance brought Deep Stage to a close with a drainage similar to current patterns in the county.

Glacial Geology

The Pleistocene Epoch (2 million to 10,000 Y.B.P.) was a period with several distinct episodes of continental glaciation in North America, including Ohio. Four distinct episodes of ice advance occurred during the Pleistocene. Only the last two (Illinoian and Wisconsinan) have left deposits in Greene County (Eyles and Westgate, 1987 and Norris et al., 1956).

Illinoian deposits are relegated to the depths of the deepest buried valleys of the pre-glacial Teays Stage drainage (Norris et al., 1956).

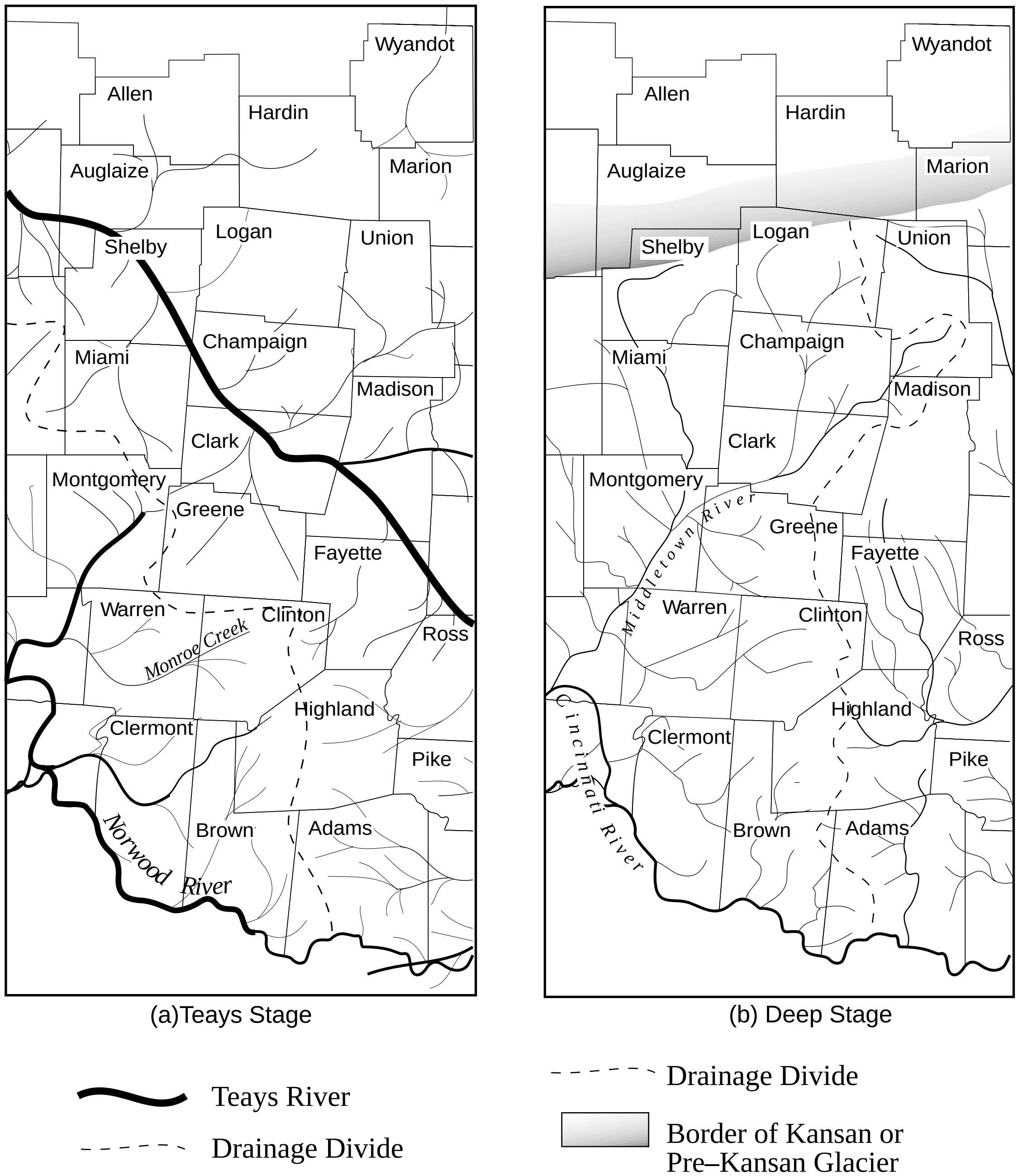


Figure 4. Teays and Deep Stage drainage in southwestern Ohio
(Modified from Stout et al., 1943)

As Wisconsinan ice of the Erie Lobe advanced into southwestern Ohio, the outlier of bedrock in Logan and Champaign counties modified the ice-path (Forsyth, 1956). The ice sheet split into two lobes, following the major valleys of the area. The western lobe is referred to as the Miami Lobe and the eastern lobe is called the Scioto Lobe (Dreimanis and Goldthwait, 1973 and Quinn and Goldthwait, 1979). The lobes then aligned in a north-south pattern, with the Miami Lobe moving east-southeast and the Scioto Lobe moving west across Greene County in an interlobate pattern. The two ice sheets' advance and retreat across Greene County accounts for the extensive nature of the deposits present.

The wide variety of glacial deposits found in Greene County include glacial till, ground moraine, end moraine, kames, kame moraines (ice-contact features), outwash, outwash plains, and valley train. In the current river valleys glacial deposits are covered by a mantle of recent alluvium.

Glacial till is a heterogenous, non-sorted, non-stratified mixture of gravel, sand, silt, and clay deposited directly by glacial ice. Tills can be either a melt-out "ablation" till or a compact "lodgement" till. Moving ice deposits a hard lodgement till; melting ice deposits a softer ablation till. The greatest thicknesses of till can be found in the eastern two-thirds of the county. The areas with thick end moraines (Reesville and Cuba) may have over 100 feet of till. Ground moraine till thicknesses are quite variable measuring from less than 20 feet to greater than 100 feet.

Ground moraines are relatively flat-lying to gently rolling upland areas composed of till with some lenses or stringers of interbedded sand and gravel deposits. The most extensive deposits of ground moraine can be found between the Reesville and the Cuba end moraines.

Two end or terminal moraines are found in Greene County (Goldthwait et al., 1961). End moraines are ridge-like structures composed primarily of till, with rolling or hummocky terrain. From west to east the two end moraines are the Cuba and the Reesville Moraines. Both moraines were deposited by Scioto Lobe ice (Norris et al., 1956).

Kames and kame moraines are the major ice-contact features found within the county. Kames are irregular ridges of stratified sand and gravel deposited by flowing water in cracks and crevaces in the ice. In Greene County kames join together to form moraines. Kame moraine complexes are found along Beaver Creek, in the Little Miami Valley from Alpha to Yellow Springs, and east of Fairborn.

Because of the configuration of the ice during the Wisconsinan glacial period, Greene County has extensive deposits of outwash. Outwash is sand and gravel deposits that are well sorted by moving water in front of the ice sheet. Norris et al. (1956) have classified outwash deposits in Greene County as outwash-plain, valley-train, and as stratified outwash layers.

The retreat of early Scioto Lobe ice caused meltwaters in front of the ice sheet to deposit an extensive outwash plain west of Xenia and in portions of Beavercreek Township (Norris et al., 1956). Like a kame deposit, an outwash plain thins away from the ice sheet. Subsequent erosion undoubtedly removed some of this sheet of outwash, yet a great deal still remains.

Valley-train deposits are composed of outwash deposited in pre-existing drainage channels. Meltwater carrying large amounts of glacially derived sediments poured down these channels as the ice melted. The water washed out the finer material, leaving coarse outwash sand and gravel deposits. Valley-train deposits are present in the Little Miami, Mad River, and Beaver Creek valleys. Several deep gorges were cut in the bedrock during the time of valley-train deposition. Gorges at Yellow Springs, Clifton, Bellbrook, and in southern Beavercreek Township were all eroded while valley-train outwash was being deposited elsewhere (Carman, 1972 and Norris et al., 1956).

Bedrock Geology

The consolidated deposits of Greene County are of Ordovician and Silurian ages. The extensive glacial activity has greatly modified the bedrock surface in Greene County. Exceptional sand and gravel aquifers at shallow depths are present in western Greene County. Bedrock aquifers can be found throughout the county.

The rocks of Silurian age are the youngest formations found in Greene County. Composed of limestones, shales, and dolomites, Silurian rocks are found beneath the glacial deposits in the eastern half of the county, and above 920 ft. Mean Sea Level (M.S.L.) in the far western portions of the county (Norris et al., 1956). Complete exposures of the Silurian Section can be found in John Bryant State Park located in central Greene County. The Silurian Formations in Greene County consist of the Cedarville, Springfield, Euphemia, Massie, Laurel, Osgood, Dayton, and Brassfield (Table 10).

The youngest formation in the Silurian section is the Cedarville Dolomite. A white to blue-gray dolomite, the Cedarville Dolomite, is a massive cliff former (Horvath and Sparling, 1967). The Cedarville is fossiliferous, containing brachiopods, crinoids, and coral (Kleffner and Ausich, 1988).

Going lower in the section the Springfield Dolomite is gray, thin-bedded dolomite with a brick-like appearance (Horvath and Sparling, 1967). An important spring horizon, the Springfield averages less than 10 feet in thickness.

Under the Springfield Limestone is the Euphemia Dolomite. A thick, unevenly bedded dolomite, the Euphemia is a cliff former in central Greene County along the Little Miami River. The Euphemia is porous and massive in structure.

Table 10. Bedrock Stratigraphy of Greene County, Ohio
(Modified from Horvath and Sparling, 1967 and Carmen, 1972.)

SYSTEM	SERIES	FORMATIONS
SILURIAN	Niagaran	Cedarville dolomite
		Springfield dolomite
		Euphemia dolomite
		Massie shale
	?	
	Alexandrian	Laurel limestone
		Osgood shale
		Dayton limestone
		Brassfield limestone
ORDOVICIAN	Cincinnatian	Undifferentiated Ordovician

The Massie Shale is a very soft, easily eroded clay-shale. The presence of the resistant Euphemia above and the erosive Massie below allows the spectacular cliffs that are formed along the Little Miami River. The Massie clay-shale was named for its outcrop along Massie Creek (Norris et al., 1956).

Underlying the Massie is the Laurel Limestone. The Laurel is a medium-grained, dolomitic limestone containing residues of clay, silt, chert, pyrite, and glauconite (Horvath and Sparling, 1967). The thin Laurel Dolomite grades into the Osgood Shale (Norris et al., 1956).

Below the Laurel lies the Osgood Shale. Considered a clay-shale, although some limestone is found in the upper section, the lower section is completely shale (Horvath and Sparling, 1967). The Osgood is hard and blocky and can be considered a good formation marker (Norris et al., 1956).

Underlying the Osgood is the Dayton Formation. The Dayton is a highly fossiliferous limestone or dolomite (Kleffner and Ausich, 1988). Fine-grained and dense, the Dayton has been quarried extensively in Greene County (Horvath and Sparling, 1967).

The basal Silurian unit is the Brassfield Limestone. The Brassfield is a coarse-grained, massive bedded, crystalline limestone. Horvath and Sparling (1967) report porous, dolomitic materials in the lower Brassfield. The upper Brassfield is more thinly bedded and fossiliferous (Horvath and Sparling, 1967).

The Ordovician Undifferented is an interbedded shale, limestone, and dolomite. The shale is grayish-red, dolomitic, and fossiliferous. The limestone is fossiliferous with sparse, vuggy topography. The dolomite contains shale clasts with fossil fragments and calcite-filled vugs (Swinford, personal communication).

Hydrogeology

Ground water occurence in Greene County is somewhat evenly divided between the glacial unconsolidated aquifers and bedrock aquifers. Sand and gravel aquifers are concentrated in the western half of Greene County. Bedrock aquifers are distributed across the county.

The glacial aquifers vary from deep, outwash-filled buried valleys to sand and gravel interbedded in glacial till in end moraines.

An extensive network of buried valleys is present in Greene County (Richards et al., 1973). Most of these valleys have at least some coarse material, but they may also have silts, clays and glacial tills. Outwash occurs in some buried valleys, some current river valleys, and as an outwash plain west of Xenia.

The thickest sequences of outwash are generally found in the current course of the Mad River, portions of the Beavercreek River Valley and some portions of the Little Miami River. The outwash deposits in direct communication with the Mad River and the Little Miami River have the potential to produce up to 1000 gallons per minute to properly constructed large diameter wells (Schmidt, 1991). Outwash deposits not directly connected to a surface stream are still capable of large yields in areas where the deposits are coarse and thick.

In western Greene County areas of low-yielding sand and gravel are interbedded with thicker sequences of glacial till. These low-yielding aquifers overlie non-water bearing limestone and shale. The lowest yield for sand and gravel deposits as rated by Schmidt (1991) was the potential for 3 gallons per minute to properly constructed wells. Sand and gravel may be interbedded in glacial till in the morainal areas. Better yields are obtained where the deposits are sufficiently thick and coarse.

The bedrock aquifers are Silurian-aged limestones and dolomites in the eastern half of the county, and Ordovician-aged limestones, dolomites, and shales in the western half of the county.

The Silurian Limestones and Dolomites will yield sufficient water for farm and residential supplies. Movement of water through the bedrock is via a fracture system. Water travels mainly through the joints, fractures, and bedding planes of the rock with little movement through the matrix of the rock.

The Ordovician bedrock is present in the western half of the county and at the bottom of the deep buried drainage channels. In areas where clay-rich glacial material overlay the Ordovician bedrock, well yields are very low with some dry holes present. The Ordovician bedrock, which is found throughout southwestern Ohio, yields so little water it is considered a non-water bearing unit.

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APPENDIX A

DESCRIPTION OF THE LOGIC IN FACTOR SELECTION

Depth to Water

Depth to water values for Greene County were based on water well data on file at the Ohio Department of Natural Resources, Division of Water, Water Resources Section; Kaser (1962); Norris et al. (1956); Schalk (1987); United States Geologic Survey topographic maps; Ohio Department of Natural Resources (1972); and direct field observations. Static water levels, recorded on water well logs, were the main source of depth to water data.

All Greene County aquifers were determined to be unconfined or semi-confined. However, the DRASTIC system recognizes only confined and unconfined aquifers. Because the semi-confined aquifers in Greene County more closely resemble unconfined conditions rather than confined conditions, all aquifers in the county were rated as unconfined.

Water levels in the uplands region in the setting Glacial Till Over Bedded Sedimentary Rock (7Aa) ranged from 5-15 feet (DRASTIC rating of 9) to 50-75 feet (3) below the surface. The depths were controlled by the thickness of the overlying glacial material and regional hydrogeology. The relatively large depth to water numbers in the setting were also controlled by the steep topography of the settings.

In areas with Glacial Till Over Limestone (7Ac), water depths varied from 0-5 feet (10) to 30-50 feet (5). The lower depth to water ratings are found in locations where the bedrock surface is shallow.

The ratings for Sand and Gravel Interbedded in Glacial Till ranged from 0-5 feet (10) to 50-75 feet (3). Shallow to moderate depth to water values occur in areas of ground moraine. Sand and gravel deposits adjacent to valleys and under semi-confined conditions also merit shallow depth to water values. The areas where end moraines cover buried valley deposits, showing an increasing amount of glacial till present, and subsequently the depth to water values are large.

Outwash deposits (7Ba and 7Bb) had depth to water values ranging from 5-15 feet (10) to 30-50 feet (5). Since these deposits are found in the valleys, a shallow depth to water is expected. The setting where depth to water was rated as a (5) occurred in areas where glacial till covered the outwash deposits.

The depth to water in the Buried Valley setting (7D) ranged from 0-5 feet (10) to 75-100 feet (2). The wide variability in this setting is attributable to the buried valley setting being used in morainal areas as well as current river valleys with their shallow water tables. Water levels in some buried valley settings show the influence of semi-confining conditions.

Settings 7Ec, 7Ed, and 7Ee are alluvium over bedrock, sand and gravel, and outwash, respectively. The depth to water values were either 5-15 feet (9) or 15-30 feet (7). In alluvial settings, the shallow depth to water is largely controlled by river stage.

Net Recharge

The values used for net recharge were determined by using information from the following references: Feulner (1960 and 1961), Goldthwait et al. (1961), Harstein (1991), Jones (1992 and 1995), Koltun (1994), Norris et al. (1956), Quinn and Goldthwait (1979), Sheets and Yost (1994), and Vormelker et al. (1995). Net recharge is best defined as the amount of water that replenishes the aquifer system. The average value for recharge state-wide is approximately six inches per year (Pettyjohn and Henning, 1979). Precipitation minus runoff and evapotranspiration by plants accounts for the net recharge to the aquifer. The factors that control the amount of recharge are soil composition, slope, depth to water, and the vadose material above the aquifer. Permeable soils, such as sandy loams, will increase the recharge of the aquifer by allowing precipitation to infiltrate the surface instead of ponding or running off. The slope of the land controls how long precipitation is on the surface, enabling it to infiltrate into the ground water supply. Flat-lying ground has greater recharge rates than highly sloping terrain. The depth to water also influences the rating of recharge rates. A shallow water table will be rated higher for recharge than those areas with a deep depth to water. If the soils and vadose materials are very permeable, recharge rates will be higher. Areas with thick, clay-rich glacial till have lower recharge rates. The number and size of fractures in the glacial till and in the bedrock also influence rates of recharge.

The Glacial Till Over Bedded Sedimentary Rock setting (7Aa) has recharge values of 2-4 inches per year (in/yr) (3) and 4-7 in/yr (6). Both values reflect the greater depth to water, impervious soils, and the restricting material that is found in the vadose zones in this setting.

The Glacial Till Over Limestone setting (7Ac) has recharge values ranging from 2-4 in/yr (3) to 4-7 in/yr (6). The 2-4 in/yr settings occur mainly in upland areas where deep limestone occurs with higher depth to water values. The 4-7 in/yr values occur where the vadose zone is composed of sand and gravel and the depth to water is very shallow.

The Outwash settings (7Ba and 7Bc) have depth to water values ranging from 4-7 in/yr (6) to 7-10 in/yr (8). Sheets and Yost (1994) report recharge rates of 11 to 21 inches per year in the Mad River. Low recharge values were recorded in areas where the outwash was buried under a significant amount of glacial till. The high recharge values occur where the water table is shallow, the soil type is sandy loam, and the vadose zone is mainly sand and gravel.

Values of 2-4 in/yr (3) and 4-7 in/yr (6) are found in the Sand and Gravel Interbedded in Glacial Till setting (7Af). Slope, depth to water, and materials composing the vadose zone controlled the ratings.

Recharge rates within the Buried Valley setting (7D) varied greatly. These rates ranged from 2-4 in/yr (3) in the uplands areas with large slopes and greater depth to water values, to 10+ in/yr (9) in flat-lying outwash valleys with shallow depths to water and sandy loam or peat soils at the surface.

The alluvial settings 7Ec, 7Ed, and 7Ee all had recharge rates ranging from 2-4 in/yr (3) to 7-10 in/yr (8). Low ratings occurred in areas where thick glacial till is present. Higher ratings reflect the shallow water tables, flat topography, and the relatively permeable nature of the soils and vadose zone materials. Where shallow bedrock was encountered in an alluvial setting, fracturing of the upper portion of the bedrock surface was assumed.

Aquifer Media

Aquifer media was evaluated primarily from water well logs on file at the Ohio Department of Natural Resources, Division of Water. Additional information was contributed by Agoston (1990); Blyskum (1983); Dumouchelle et al. (1993); Dumouchelle and deRoche (1991); Feulner (1960 and 1961); Hammond (1986); Jones (1992 and 1995); Miami Valley Regional Planning (1990); Norris et al. (1956); Orton (1874); Quinn and Goldthwait (1979); Schmidt (1982, 1985 and 1991); Shaver (1989); Shrake (1993a,b,c,d); Shrake and Swinford (1993a and b); Shrake, Swinford, and Bunner (1993a,b); Struble (1987a,b); Vormelker et al. (1995); and Walton and Scudder (1960).

The aquifer rating for Glacial Till Over Bedded Sedimentary Rock (7Aa) was a three (3). This reflects the poor water-producing capacity of the Ordovician bedrock.

The Glacial Till Over Limestone setting (7Ac) recieved ratings of (4), (5), and (6), as the limestone was the best bedrock aquifer in the county. Lower rated areas were in the Lower Silurian Brassfield Formation. The areas given ratings of (5) or (6) were high in the stratigraphic section. Most bedrock wells are not cased deeply in the rock and the upper surface is fractured and weathered, producing a zone of higher porosity and permeability.

Sand and Gravel Interbedded in Glacial Till (7Af) was rated (5), (6), (7), and (8). Variations were based on well yields and thickness of the deposits.

Outwash (7Ba and 7Bc) has ratings of (7), (8), and (9). All outwash aquifers were high yielding, but the largest DRASTIC ratings were given when the aquifer was in direct connection with a surface stream.

Buried Valleys (7D) have ratings of (4),(5),(6),(7),(8), and (9). Low values for sand and gravel were found in the uplands versus the high values recorded in the outwash-filled valleys.

The Alluvial aquifers (7Ec) were rated (3), (5), and (6) for the limestone, and (4) and (6) for the sand and gravel aquifers.

Soils

The information used for soil analysis was the Soil Survey for Greene County (Garner and Ritchie, 1978). Texture, organic content, permeability, and shrink/swell potential were utilized to give a DRASTIC rating to the first six feet of the soil profile. Table 11 lists the soil types encountered in Greene County and gives information on the soils' parent material or setting and the corresponding DRASTIC index.

Topography

Topography was evaluated using 7-1/2 minute topographic quadrangle maps. Topography was then converted into slope percentages which were used for the rating process.

Impact of the Vadose Zone Media

The vadose zone is the unsaturated layer where any water present is at less than one atmosphere of pressure and is held in place by capillary action. The vadose zone was analyzed by the use of water well records on file with the Ohio Department of Natural Resources, Division of Water; (Schmidt, 1982, 1985, and 1991); Evers (1991); Feulner (1960); Goldthwait et al. (1961); Jones (1992 and 1995); Norris et al. (1956); Quinn and Goldthwaith (1979); Struble (1987a,b); Vormelker et al. (1995); and field observations.

Table 11. Greene County Soils

Soil Name	DRASTIC Rating	Soil Media
Algiers	4	silt loam
Birkbeck	4	silt loam
Brookston	3	clay loam
Casco	9	sand
Celina	3	clay loam
Crosby	3	clay loam
Edenton	3	clay loam
Eel	4	silt loam
Eldean	9	sand
Fairmount	4	silt loam
Fincastle	3	clay loam
Genesee	5	loam
Linwood	8	peat
Miami	3	clay loam
Miami-Casco	6	sandy loam
Miami-Eldean	6	sandy loam
Miami-Hennepin	3	clay loam
Millsdale	7	shrink/swell clay
Milton	4	silt loam
Ockley	4	silt loam
Odell	4	silt loam
Patton	3	clay loam
Ragsdale	3	clay loam
Randolph	7	shrink/swell clay
Raub	3	clay loam
Reeseville	4	silt loam
Ritchey	10	absent
Ross	5	loam
Rush	4	silt loam
Russell	4	silt loam
Russell-Miami	4	silt loam
Sleeth	4	silt loam
Sloan	4	silt loam
Thackery	4	silt loam
Urban	4	silt loam
Warsaw	4	silt loam
Wea	6	sandy loam
Westland	4	silt loam
Westland-Urban	6	sandy loam
Xenia	4	silt loam

Vadose Zone values for Greene County ranged from (3) to (8). Glacial till, where used as the vadose zone, was rated as a (3), (4), (5), or (6). A rating of (3) was given in areas with a large thickness of clay-rich till without the presence of sand seams. The ratings of (4), (5), and (6) were assigned to areas with variable sized sand zones present within the till. Vadose zones containing sand and gravel with significant silt and clay were rated (4), (5), (6), and (7). The higher- rated vadose zones were in areas where sand and gravel was predominate with very little fine-grained material present. Sand and gravel vadose materials were assigned ratings from (4) to (8). These vadose deposits were determined to be a little cleaner than the sand and gravel with significant silt and clay. Ratings of (7) and (8) were given in the coarse outwash areas of the county. Ratings for areas where limestone and shale were the vadose materials varied from (3) to (6). A rating of (6) was given when the bedrock was highly fractured or when the vadose zone was very thin.

Hydraulic Conductivity

Hydraulic conductivity data were evaluated using Dumouchelle et al. (1993), Driscoll (1986), Fetter (1988), Feulner (1960 and 1961), Jones (1992 and 1995), Quinn (1979), Richards (1973), Schmidt (1985), Sheets and Yost (1994), Stout (1943), Struble (1987a,b), Vormelker et al. (1995), and Walton and Scudder (1960).

Hydraulic conductivity is the ability of an aquifer media to transmit water. This property is dependent on the nature of the aquifer material. The lowest hydraulic conductivity values were in (7Aa), the interbedded limestone and shale settings, with conductivity values of 1-100 gallons per day per foot squared (gpd/ft2); they were given rating of (1). The Silurian limestones and dolomites (7Ac and 7Ec) were given conductivity values of 1-100 gpd/ft2 with a rating of (1), to 700-1000 gpd/ft2 with a rating of (6). The sand and gravel deposits had a wide variety of conductivity values in Greene County. The sand and gravel varied from thin isolated lenses to thick, areal extensive outwash deposits. The conductivity values range from 100-300 gpd/ft2 with a rating of (2), to 2000+ gpd/ft2 with a rating of (10).

APPENDIX B

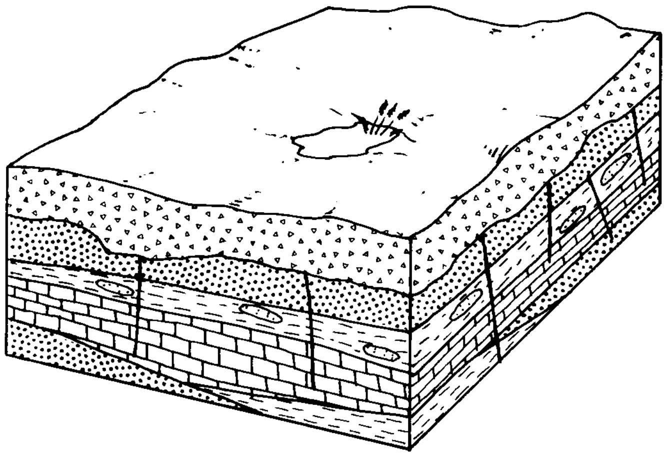
DESCRIPTION OF HYDROGEOLOGIC SETTINGS AND CHARTS

Ground water pollution potential mapping in Greene County resulted in the identification of six 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 12. Computed pollution potential indexes for Greene County range from 71 to 204.

Table 12. Hydrogeologic Settings Mapped in Greene County, Ohio

Hydrogeologic Settings	Range of GWPP Indexes	Number of Index Calculations
7Aa - Glacial Till Over Bedded Sedimentary Rocks	73-139	60
7Ac - Glacial Till Over Limestone	88-156	73
7Af - Sand and Gravel Interbedded in Glacial Till	76-145	61
7Ba - Outwash	136-188	11
7Bb - Alluvium over Bedded Sedimentary Rocks	111	1
7D - Buried Valley	71-204	111
7Ec - River Alluvium Over Sedimentary Rocks	109-148	19
7Ed - River Alluvium Over Glacial Till	102-153	15
7Ee - River Alluvium Over Outwash	175-192	2

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.



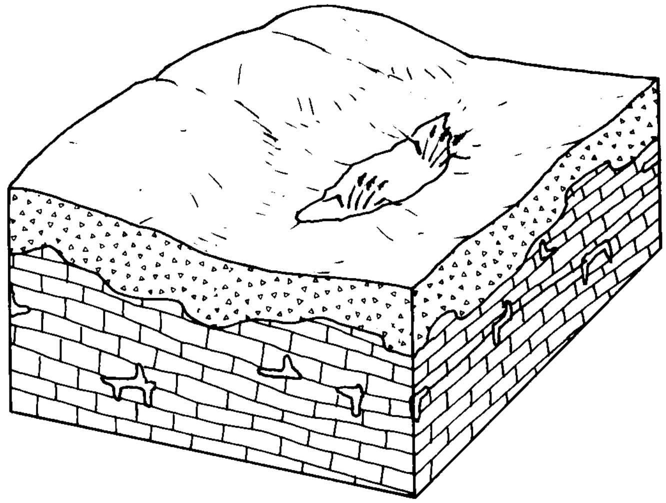
7Aa Till Over Bedded Sedimentary Rock

This hydrogeologic setting is characterized by moderate relief and flat-lying, fractured sedimentary rock. The underlying bedrock consists of thick sequences of Ordovician shale interbedded with thin layers of limestone. These sedimentary rock units are covered by varying thicknesses of glacial till. The till layer consists of unsorted deposits of interbedded clay, silt, and sand. Although ground water occurs in both the glacial deposits and the fractured bedrock, bedrock is the principal aquifer. The main source of recharge to the bedrock aquifer is from the overlying glacial till. This recharge is low to moderate due to the impermeable nature of the till and soils. Soils are clay loam. Depth to water varies, depending on glacial till thickness, but is between 5–75 feet.

The GWPP index values for the hydrogeologic setting of Till Over Bedded Sedimentary Rock range from 73 to 139 with the total number of GWPP index calculations equaling 60.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Aa1	15-30	2-4	Limestone/Shale	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	1-100	102	128
7Aa2	30-50	2-4	Limestone/Shale	Silty Loam	6-12	Sand & Gravel w/Silt & Clay	1-100	87	103
7Aa3	50-75	2-4	Limestone/Shale	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	1-100	80	103
7Aa4	30-50	2-4	Limestone/Shale	Clay Loam	0-2	Silt and Clay	1-100	80	105
7Aa5	15-30	2-4	Limestone/Shale	Clay Loam	0-2	Silt and Clay	1-100	90	115
7Aa6	30-50	2-4	Limestone/Shale	Loam	0-2	Silt and Clay	1-100	84	115
7Aa7	30-50	2-4	Limestone/Shale	Clay Loam	6-12	Silt and Clay	1-100	75	90
7Aa8	15-30	2-4	Limestone/Shale	Clay Loam	2-6	Silt and Clay	1-100	89	112
7Aa9	30-50	2-4	Limestone/Shale	Sand	6-12	Silt and Clay	1-100	87	120
7Aa10	5-15	4-7	Limestone/Shale	Clay Loam	6-12	Sand & Gravel w/Silt & Clay	1-100	117	130

Setting	Depth to Water	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Aa11	5-15	4-7	Limestone/Shale	Sand	6-12	Silt and Clay	1-100	119	152
7Aa12	15-30	2-4	Limestone/Shale	Silty Loam	2-6	Limestone/Shale	1-100	101	125
7Aa13	15-30	2-4	Limestone/Shale	Thin or Absent	2-6	Limestone/Shale	1-100	113	155
7Aa14	15-30	2-4	Limestone/Shale	Clay Loam	6-12	Sand & Gravel w/Silt & Clay	1-100	95	108
7Aa15	30-50	2-4	Limestone/Shale	Clay Loam	6-12	Sand & Gravel w/Silt & Clay	1-100	85	98
7Aa16	15-30	2-4	Limestone/Shale	Clay Loam	0-2	Sand and Gravel	1-100	105	127
7Aa17	5-15	2-4	Limestone/Shale	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	1-100	105	129
7Aa18	15-30	2-4	Limestone/Shale	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	1-100	95	119
7Aa19	15-30	2-4	Limestone/Shale	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	1-100	94	116
7Aa20	30-50	4-7	Limestone/Shale	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	1-100	107	129
7Aa21	15-30	2-4	Limestone/Shale	Clay Loam	2-6	Till	1-100	94	116
7Aa22	15-30	2-4	Limestone/Shale	Silty Loam	0-2	Till	1-100	97	124
7Aa23	15-30	2-4	Limestone/Shale	Sand	0-2	Till	1-100	107	149
7Aa24	15-30	2-4	Limestone/Shale	Clay Loam	12-18	Till	1-100	88	98
7Aa25	15-30	2-4	Limestone/Shale	Clay Loam	6-12	Till	1-100	90	104
7Aa26	5-15	4-7	Limestone/Shale	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	1-100	127	149
7Aa27	15-30	4-7	Limestone/Shale	Clay Loam	18+	Limestone/Shale	1-100	108	112
7Aa28	15-30	2-4	Limestone/Shale	Clay Loam	6-12	Limestone/Shale	1-100	85	100
7Aa29	30-50	2-4	Limestone/Shale	Silty Loam	0-2	Till	1-100	87	114
7Aa30	5-15	2-4	Limestone/Shale	Clay Loam	0-2	Till	1-100	105	129
7Aa31	15-30	2-4	Limestone/Shale	Clay Loam	2-6	Till	1-100	94	116
7Aa32	30-50	2-4	Limestone/Shale	Clay Loam	2-6	Till	1-100	84	106
7Aa33	15-30	2-4	Limestone/Shale	Clay Loam	6-12	Till	1-100	90	104
7Aa34	5-15	2-4	Limestone/Shale	Clay Loam	6-12	Till	1-100	100	114
7Aa35	5-15	2-4	Limestone/Shale	Silty Loam	0-2	Till	1-100	107	134
7Aa36	15-30	2-4	Limestone/Shale	Sand	2-6	Till	1-100	106	146
7Aa37	50-75	2-4	Limestone/Shale	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	1-100	82	108
7Aa38	15-30	2-4	Limestone/Shale	Silty Loam	0-2	Limestone/Shale	1-100	102	128
7Aa39	15-30	2-4	Limestone/Shale	Silty Loam	18+	Limestone/Shale	1-100	93	101
7Aa40	50-75	2-4	Limestone/Shale	Silty Loam	18+	Sand & Gravel w/Silt & Clay	1-100	73	81
7Aa41	15-30	2-4	Limestone/Shale	Clay Loam	6-12	Sand & Gravel w/Silt & Clay	1-100	100	112
7Aa43	15-30	2-4	Limestone/Shale	Clay Loam	12-18	Sand & Gravel w/Silt & Clay	1-100	98	106
7Aa44	15-30	2-4	Limestone/Shale	Silty Loam	2-6	Sand & Gravel w/Silt & Clay	1-100	106	129
7Aa45	15-30	2-4	Limestone/Shale	Clay Loam	0-2	Silt and Clay	1-100	95	119
7Aa46	15-30	2-4	Limestone/Shale	Clay Loam	2-6	Silt and Clay	1-100	94	116
7Aa47	15-30	2-4	Limestone/Shale	Clay Loam	12-18	Till	1-100	83	94
7Aa48	15-30	2-4	Limestone/Shale	Sand	12-18	Till	1-100	95	124
7Aa49	15-30	2-4	Limestone/Shale	Silty Loam	6-12	Silt and Clay	1-100	92	109
7Aa50	15-30	2-4	Limestone/Shale	Sandy Loam	6-12	Silt and Clay	1-100	96	119
7Aa51	5-15	2-4	Limestone/Shale	Clay Loam	18+	Till	1-100	96	102
7Aa52	5-15	2-4	Limestone/Shale	Sandy Loam	12-18	Till	1-100	104	123
7Aa53	5-15	2-4	Limestone/Shale	Sandy Loam	6-12	Till	1-100	106	129
7Aa54	30-50	2-4	Limestone/Shale	Clay Loam	12-18	Till	1-100	78	88
7Aa55	15-30	2-4	Limestone/Shale	Sandy Loam	2-6	Silt and Clay	1-100	95	127
7Aa56	15-30	2-4	Limestone/Shale	Clay Loam	6-12	Sand & Gravel w/Silt & Clay	1-100	90	104
7Aa57	15-30	2-4	Limestone/Shale	Silty Loam	2-6	Sand & Gravel w/Silt & Clay	1-100	96	121
7Aa58	15-30	2-4	Limestone/Shale	Clay Loam	6-12	Till	1-100	85	100
7Aa59	30-50	2-4	Limestone/Shale	Clay Loam	6-12	Till	1-100	80	94
7Aa60	5-15	4-7	Limestone/Shale	Sand	0-2	Till	1-100	139	179



7Ac Glacial Till Over Limestone

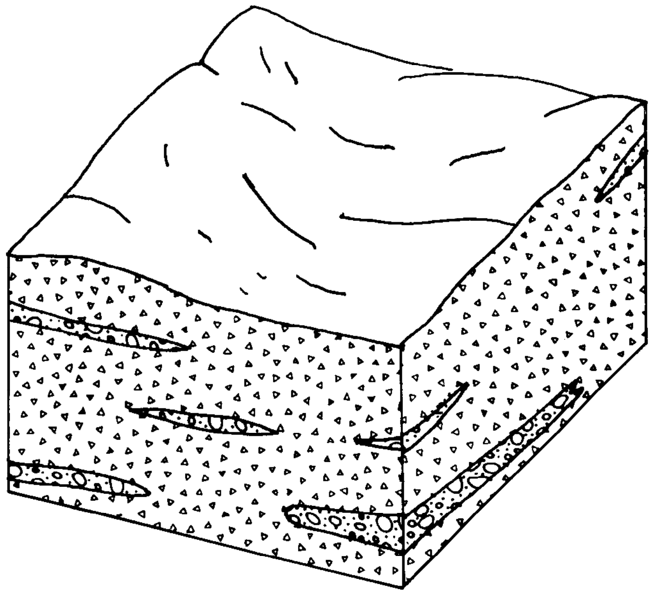
This hydrogeologic setting is characterized by flat and rolling topography and limestone bedrock covered by varying thicknesses of glacial till. The till consists primarily of clay with varying amounts of silt, sand, and gravel. Sand and gravel lenses within the till are numerous but are too thin to constitute an aquifer. The limestone bedrock serves as the aquifer in this setting. Ground water occurs in fractures and solution channels within the formation. The limestone is in direct hydraulic connection with the glacial till and precipitation infiltrating through the till serves as a source of recharge for the underlying limestone. Depth to water is extremely variable, depending in part on the thickness of the glacial till. Soils are typically clay loam and depth to water generally ranges from 5 to 50 feet.

The GWPP index values for the hydrogeologic setting of Glacial Till Over Limestone range from 88 to 156 with the total number of GWPP index calculations equaling 73.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Ac1	15-30	4-7	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	129	147
7Ac2	15-30	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	132	155
7Ac3	15-30	4-7	Limestone	Sand	0-2	Sand & Gravel w/Silt & Clay	300-700	142	180
7Ac4	15-30	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	138	159
7Ac5	15-30	4-7	Limestone	Silty Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	131	152
7Ac6	5-15	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	140	160
7Ac7	5-15	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	148	169
7Ac8	5-15	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	146	164
7Ac9	0-5	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	153	174
7Ac10	0-5	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	151	169
7Ac11	5-15	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	148	169
7Ac12	5-15	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	142	165
7Ac13	0-5	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	145	165
7Ac14	15-30	4-7	Limestone	Silty Loam	0-2	Till	700-1000	138	159

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Ac15	15-30	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	136	154
7Ac16	30-50	4-7	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	700-1000	125	141
7Ac17	30-50	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	126	144
7Ac18	15-30	4-7	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	700-1000	135	151
7Ac19	5-15	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	146	164
7Ac20	30-50	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	126	144
7Ac21	30-50	4-7	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	700-1000	125	141
7Ac22	0-5	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	156	173
7Ac23	5-15	4-7	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	700-1000	145	161
7Ac24	5-15	2-4	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	128	148
7Ac25	15-30	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	130	150
7Ac26	30-50	2-4	Limestone	Clay Loam	2-6	Silt and Clay	300-700	94	114
7Ac27	5-15	4-7	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	139	157
7Ac28	30-50	2-4	Limestone	Clay Loam	6-12	Silt and Clay	300-700	90	102
7Ac29	15-30	2-4	Limestone	Clay Loam	0-2	Silt and Clay	300-700	105	127
7Ac30	5-15	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	137	157
7Ac31	15-30	4-7	Limestone	Clay Loam	0-2	Silt and Clay	300-700	117	139
7Ac32	15-30	2-4	Limestone	Clay Loam	2-6	Silt and Clay	300-700	104	124
7Ac33	15-30	4-7	Limestone	Silty Loam	2-6	Sand & Gravel w/Silt & Clay	700-1000	137	156
7Ac34	15-30	4-7	Limestone	Clay Loam	0-2	Silt and Clay	300-700	120	142
7Ac35	5-15	4-7	Limestone	Clay Loam	0-2	Silt and Clay	300-700	127	149
7Ac36	5-15	4-7	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	100-300	133	153
7Ac37	15-30	2-4	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	100-300	108	128
7Ac38	30-50	2-4	Limestone	Silty Loam	2-6	Silt and Clay	100-300	90	115
7Ac39	30-50	2-4	Limestone	Clay Loam	2-6	Silt and Clay	100-300	88	110
7Ac40	15-30	4-7	Limestone	Shrink-swell (Aggregated) Clay	0-2	Sand & Gravel w/Silt & Clay	700-1000	144	174
7Ac41	15-30	2-4	Limestone	Clay Loam	2-6	Silt and Clay	100-300	98	120
7Ac42	15-30	4-7	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	124	143
7Ac43	15-30	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	127	151
7Ac44	15-30	4-7	Limestone	Sand	12-18	Limestone/Shale	700-1000	146	167
7Ac45	15-30	4-7	Limestone	Silty Loam	18+	Limestone/Shale	700-1000	134	136
7Ac46	30-50	4-7	Limestone	Sand	2-6	Sand & Gravel w/Silt & Clay	700-1000	142	175
7Ac47	15-30	4-7	Limestone	Silty Loam	0-2	Limestone	300-700	129	152
7Ac48	15-30	4-7	Limestone	Silty Loam	0-2	Limestone	700-1000	143	163
7Ac49	30-50	2-4	Limestone	Clay Loam	0-2	Limestone	100-300	104	125
7Ac50	30-50	2-4	Limestone	Sand	0-2	Limestone	100-300	116	155
7Ac51	30-50	4-7	Limestone	Thin or Absent	2-6	Limestone	100-300	129	169
7Ac52	15-30	4-7	Limestone	Thin or Absent	18+	Limestone/Shale	700-1000	146	166
7Ac53	15-30	2-4	Limestone	Silty Loam	2-6	Silt and Clay	100-300	100	125
7Ac54	15-30	4-7	Limestone	Silty Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	126	148
7Ac55	15-30	4-7	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	126	144
7Ac56	30-50	4-7	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	116	134
7Ac57	15-30	4-7	Limestone	Clay Loam	0-2	Sand and Gravel	300-700	132	151
7Ac58	15-30	4-7	Limestone	Sandy Loam	0-2	Sand and Gravel	300-700	138	166
7Ac59	15-30	4-7	Limestone	Silty Loam	0-2	Sand and Gravel	300-700	134	156
7Ac60	30-50	4-7	Limestone	Clay Loam	2-6	Limestone	300-700	121	138
7Ac61	30-50	4-7	Limestone	Clay Loam	0-2	Limestone	300-700	122	141
7Ac62	30-50	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	131	148

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Ac63	30-50	4-7	Limestone	Sand	0-2	Sand & Gravel w/Silt & Clay	700-1000	143	178
7Ac64	15-30	2-4	Limestone	Clay Loam	18+	Sand & Gravel w/Silt & Clay	700-1000	115	115
7Ac65	15-30	2-4	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	101	124
7Ac66	15-30	2-4	Limestone	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	100-300	105	125
7Ac67	15-30	4-7	Limestone	Sand	0-2	Sand & Gravel w/Silt & Clay	700-1000	148	184
7Ac68	5-15	4-7	Limestone	Sand	6-12	Sand & Gravel w/Silt & Clay	700-1000	153	179
7Ac69	15-30	4-7	Limestone	Clay Loam	0-2	Till	100-300	119	142
7Ac70	15-30	4-7	Limestone	Clay Loam	2-6	Till	1-100	109	131
7Ac71	15-30	4-7	Limestone	Clay Loam	2-6	Till	300-700	124	143
7Ac72	15-30	4-7	Limestone	Clay Loam	6-12	Till	100-300	108	121
7Ac73	15-30	4-7	Limestone	Clay Loam	0-2	Till	100-300	113	136



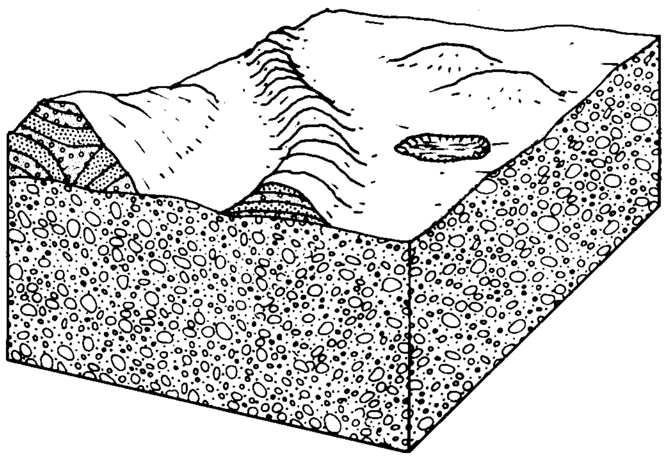
7Af Sand and Gravel Interbedded in Glacial Till

This hydrogeologic setting is characterized by low to moderate relief and sand and gravel deposits interbedded in glacial till. The till is composed primarily of clay with varying amounts of unsorted silt, sand, and gravel. The sand and gravel may be relatively thin and discontinuous, lens-shaped bodies, or thick layers which cover a large area. The thick units are usually confined to common horizons within the till. Ground water occurs in both the till and the sand and gravel; however, the sand and gravel serves as the principal aquifer. Recharge to the sand and gravel is primarily due to infiltration of precipitation through the till. Depth to water is highly variable, but on average ranges from 5 to 50 feet. Soils are typically described as clay loams.

The GWPP index values for the hydrogeologic setting of Sand and Gravel Interbedded in Glacial Till range from 76 to 145 with the total number of GWPP index calculations equaling 61.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Af1	15-30	4-7	Sand and Gravel	Loam	0-2	Till	300-700	129	156
7Af2	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Till	300-700	107	128
7Af3	15-30	2-4	Sand and Gravel	Clay Loam	2-6	Till	100-300	100	121
7Af4	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	132	155
7Af5	15-30	4-7	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	130	150
7Af6	5-15	4-7	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	140	160
7Af7	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Till	100-300	101	124
7Af8	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Till	300-700	107	128
7Af9	5-15	4-7	Sand and Gravel	Clay Loam	0-2	Till	300-700	140	160
7Af10	5-15	2-4	Sand and Gravel	Clay Loam	0-2	Till	300-700	122	142

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Af11	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	107	128
7Af12	15-30	2-4	Sand and Gravel	Clay Loam	2-6	Till	300-700	106	125
7Af13	15-30	4-7	Sand and Gravel	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	124	143
7Af14	15-30	4-7	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	125	146
7Af15	15-30	4-7	Sand and Gravel	Sand	0-2	Sand & Gravel w/Silt & Clay	300-700	137	176
7Af16	15-30	4-7	Sand and Gravel	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	129	147
7Af17	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	132	155
7Af18	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	142	165
7Af19	5-15	4-7	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	128	150
7Af20	5-15	4-7	Sand and Gravel	Clay Loam	0-2	Silt and Clay	100-300	118	142
7Af21	5-15	4-7	Sand and Gravel	Clay Loam	2-6	Silt and Clay	100-300	117	139
7Af22	5-15	4-7	Sand and Gravel	Silty Loam	2-6	Silt and Clay	100-300	119	144
7Af23	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Silt and Clay	100-300	120	147
7Af24	5-15	4-7	Sand and Gravel	Loam	2-6	Silt and Clay	100-300	121	149
7Af25	0-5	2-4	Sand and Gravel	Silty Loam	0-2	Till	100-300	113	140
7Af26	15-30	4-7	Sand and Gravel	Loam	2-6	Sand & Gravel w/Silt & Clay	100-300	121	147
7Af27	15-30	4-7	Sand and Gravel	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	100-300	117	137
7Af29	50-75	2-4	Sand and Gravel	Clay Loam	0-2	Silt and Clay	100-300	76	100
7Af30	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Silt and Clay	100-300	96	120
7Af31	15-30	2-4	Sand and Gravel	Silty Loam	18+	Sand & Gravel w/Silt & Clay	300-700	105	110
7Af32	30-50	2-4	Sand and Gravel	Clay Loam	0-2	Silt and Clay	100-300	86	110
7Af33	15-30	2-4	Sand and Gravel	Loam	2-6	Silt and Clay	100-300	99	127
7Af34	15-30	2-4	Sand and Gravel	Clay Loam	2-6	Silt and Clay	100-300	95	117
7Af35	5-15	2-4	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	118	143
7Af36	0-5	4-7	Sand and Gravel	Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	145	168
7Af37	0-5	4-7	Sand and Gravel	Silty Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	143	163
7Af38	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Silt and Clay	300-700	102	124
7Af39	15-30	2-4	Sand and Gravel	Clay Loam	2-6	Silt and Clay	300-700	101	121
7Af40	30-50	2-4	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	104	127
7Af41	15-30	4-7	Sand and Gravel	Sand	18+	Sand & Gravel w/Silt & Clay	300-700	133	153
7Af42	30-50	2-4	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	97	118
7Af43	30-50	4-7	Sand and Gravel	Clay Loam	6-12	Sand & Gravel w/Silt & Clay	300-700	115	125
7Af44	15-30	4-7	Sand and Gravel	Clay Loam	12-18	Sand & Gravel w/Silt & Clay	300-700	123	129
7Af45	15-30	4-7	Sand and Gravel	Clay Loam	0-2	Till	300-700	125	146
7Af46	15-30	4-7	Sand and Gravel	Peat	2-6	Sand & Gravel w/Silt & Clay	300-700	139	172
7Af47	15-30	4-7	Sand and Gravel	Sandy Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	135	162
7Af48	15-30	4-7	Sand and Gravel	Sand	2-6	Sand & Gravel w/Silt & Clay	300-700	141	177
7Af49	15-30	4-7	Sand and Gravel	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	129	147
7Af50	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Till	300-700	121	145
7Af51	15-30	4-7	Sand and Gravel	Silty Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	131	152
7Af54	15-30	4-7	Sand and Gravel	Silty Loam	2-6	Till	300-700	120	142
7Af55	30-50	2-4	Sand and Gravel	Sand	12-18	Till	300-700	102	127
7Af56	15-30	4-7	Sand and Gravel	Sand	0-2	Sand and Gravel	300-700	141	178
7Af57	30-50	2-4	Sand and Gravel	Sand	6-12	Till	300-700	104	133
7Af58	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	111	132
7Af59	15-30	4-7	Sand and Gravel	Clay Loam	0-2	Till	100-300	114	138
7Af60	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	138	159
7Af61	30-50	4-7	Sand and Gravel	Sandy Loam	18+	Sand & Gravel w/Silt & Clay	300-700	117	128

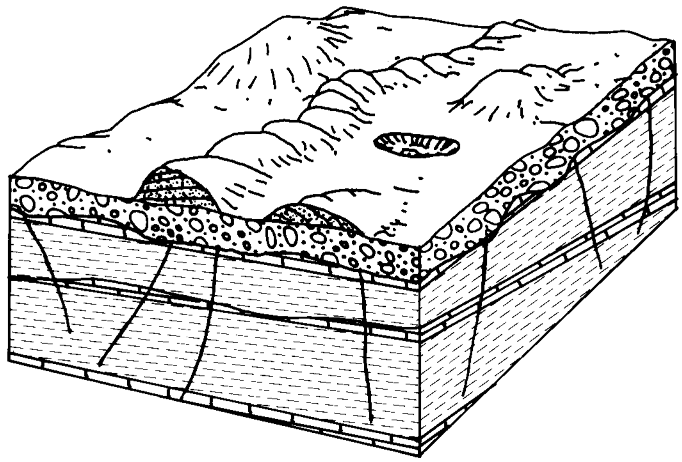


7Ba Outwash

This hydrogeologic setting is characterized by moderate topography and varying thicknesses of outwash. This setting includes both outwash plains and terraces. Kames are also included in this setting. The outwash consists of water-washed deposits of sand and gravel which serve as the principal aquifer. Soils are typically sandy loam and permeable. Recharge to the sand and gravel is relatively high. The outwash also serves as a source of recharge to the underlying bedrock. Depth to water is generally less than 30 feet.

The GWPP index values for the hydrogeologic setting of Outwash range from 136 to 188 with the total number of GWPP index calculations equaling 11.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topogr aphy	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Ba1	15-30	4-7	Sand and Gravel	Sand	2-6	Sand and Gravel	300-700	146	181
7Ba2	15-30	4-7	Sand and Gravel	Sand	12-18	Sand & Gravel w/Silt & Clay	700-1000	152	173
7Ba3	5-15	7-10	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	1000-2000	178	195
7Ba4	5-15	7-10	Sand and Gravel	Sand	0-2	Sand and Gravel	1000-2000	188	220
7Ba5	5-15	7-10	Sand and Gravel	Loam	0-2	Sand and Gravel	1000-2000	180	200
7Ba6	5-15	7-10	Sand and Gravel	Loam	0-2	Sand and Gravel	1000-2000	185	204
7Ba7	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	146	166
7Ba8	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	1000-2000	152	170
7Ba9	15-30	4-7	Sand and Gravel	Sand	0-2	Sand & Gravel w/Silt & Clay	1000-2000	162	195
7Ba10	15-30	4-7	Sand and Gravel	Sand	6-12	Sand & Gravel w/Silt & Clay	1000-2000	157	180
7Ba11	30-50	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	136	156

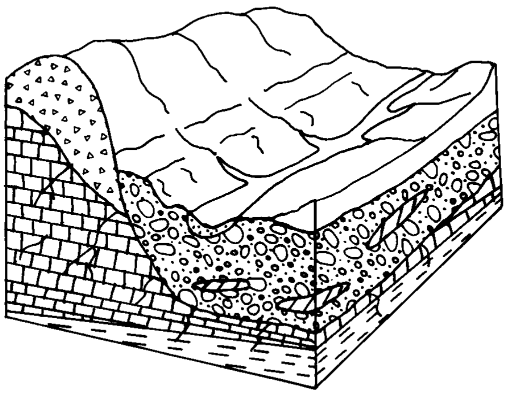


7Bb Outwash Over Bedded Sedimentary Rock

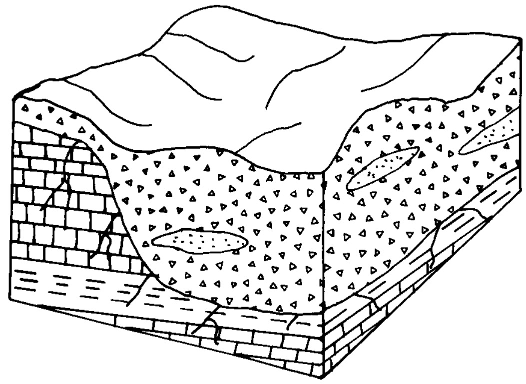
This setting is characterized by flat-lying sedimentary rocks consisting of interbedded limestone and shales covered by outwash deposits. The outwash of this setting consists primarily of sand and gravel occasionally containing interbedded deposits of till or lacustrine clays. Ground water is obtained from the bedrock. Infiltration of precipitation serves as the primary source of recharge to the aquifer. Recharge is moderate to high. Depth to water is variable and depends in part on the thickness of the outwash. Soils are variable but typically permeable, ranging from loam to sandy loam. Relief is also variable ranging from low to steep.

The GWPP index value for the hydrogeologic setting of Outwash Over Bedded Sedimentary Rock is 111 with the total number of GWPP index calculations equaling 1.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Bb1	15-30	4-7	Limestone/ Shale	Loam	0-2	Sand and Gravel	1-100	111	141



(a)



(b)

7D Buried Valley

This hydrogeologic setting varied considerably across Greene County. The buried valleys were created by pre-glacial or interglacial rivers which downcut deeply into the bedrock. The differing glacial deposits filling these valleys can be best illustrated by describing the two common forms or types mapped within Greene County.

One common form of buried valley deposits (Block Diagram a) is best exemplified by the Mad River Valley. The valley is occupied by a modern river and floodplain containing abundant outwash and kame deposits, and is easy to distinguish from the surrounding till and bedrock uplands. The depth to water is usually less than 30 feet. The upper portion of the valley commonly contains 50 to 100 feet of sand and gravel outwash with minor till or fine lacustrine deposits. Yields over 500 gpm are possible from properly constructed wells. Soils are typically loams or sandy loams. The streams are usually in direct hydraulic connection with the aquifer. Recharge is typically high.

The other common form of buried valley (Block Diagram b) is best exemplified by buried valleys in eastern Greene County. These valleys are typically overlain by end moraines, and the rolling topography makes it difficult to distinguish the valleys from surrounding areas. They contain either intermittent steams or no streams at all. The aquifer consists of thin lenses of sand and gravel interbedded in very thick sequences of fine-grained till and lacustrine deposits. Yields are commonly less than 25 gpm. Soils are typically clay loams. Depth to water is typically greater than 50 feet. Recharge is generally moderate to low. GWPP index values for these settings are usually less than 120 and are often less than 100.

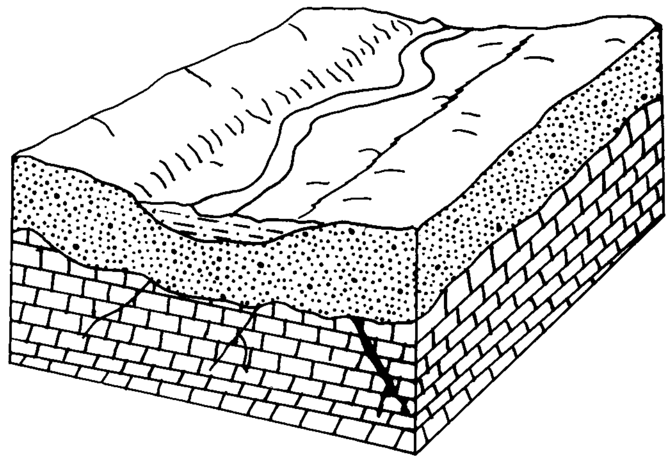
The GWPP index values for the hydrogeologic setting Buried Valley range from 71 to 204 with the total number of GWPP index calculations equaling 112.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7D1	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	101	124
7D2	0-5	4-7	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	128	151
7D3	0-5	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	130	156

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7D4	0-5	4-7	Sand and Gravel	Sand	0-2	Sand & Gravel w/Silt & Clay	100-300	140	181
7D5	0-5	4-7	Sand and Gravel	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	100-300	127	148
7D6	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Till	100-300	101	124
7D7	5-15	2-4	Sand and Gravel	Clay Loam	0-2	Till	100-300	111	134
Omitted									
7D9	0-5	4-7	Sand and Gravel	Loam	2-6	Sand & Gravel w/Silt & Clay	100-300	136	162
7D10	0-5	4-7	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	133	155
7D11	50-75	2-4	Sand and Gravel	Silty Loam	6-12	Silt and Clay	100-300	73	90
7D12	5-15	4-7	Sand and Gravel	Clay Loam	0-2	Silt and Clay	100-300	118	142
7D13	5-15	4-7	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	128	150
7D14	50-75	2-4	Sand and Gravel	Clay Loam	0-2	Silt and Clay	100-300	76	100
7D15	50-75	2-4	Sand and Gravel	Silty Loam	2-6	Silt and Clay	100-300	77	102
7D16	30-50	2-4	Sand and Gravel	Clay Loam	0-2	Silt and Clay	100-300	86	110
7D17	50-75	2-4	Sand and Gravel	Silty Loam	0-2	Silt and Clay	100-300	78	105
7D18	15-30	2-4	Sand and Gravel	Clay Loam	2-6	Silt and Clay	100-300	95	117
7D19	30-50	2-4	Sand and Gravel	Silty Loam	0-2	Silt and Clay	100-300	88	115
7D20	30-50	2-4	Sand and Gravel	Loam	2-6	Silt and Clay	100-300	89	117
7D21	30-50	2-4	Sand and Gravel	Silty Loam	2-6	Silt and Clay	100-300	87	112
7D22	15-30	2-4	Sand and Gravel	Silty Loam	0-2	Silt and Clay	100-300	98	125
7D23	15-30	2-4	Sand and Gravel	Silty Loam	2-6	Silt and Clay	100-300	97	122
7D24	5-15	2-4	Sand and Gravel	Clay Loam	2-6	Silt and Clay	100-300	105	127
7D25	15-30	2-4	Sand and Gravel	Silty Loam	2-6	Till	300-700	108	130
7D26	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Silt and Clay	100-300	96	120
7D27	30-50	2-4	Sand and Gravel	Clay Loam	2-6	Silt and Clay	100-300	85	107
7D28	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	127	151
7D29	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Silt and Clay	300-700	108	130
7D30	15-30	4-7	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	136	154
7D31	15-30	2-4	Sand and Gravel	Clay Loam	6-12	Till	700-1000	119	127
7D32	15-30	4-7	Sand and Gravel	Clay Loam	0-2	Till	700-1000	136	154
7D33	15-30	4-7	Sand and Gravel	Sand	0-2	Sand & Gravel w/Silt & Clay	300-700	142	180
7D34	50-75	2-4	Sand and Gravel	Clay Loam	2-6	Till	700-1000	103	119
7D35	75-100	2-4	Sand and Gravel	Clay Loam	0-2	Till	700-1000	99	117
7D36	75-100	2-4	Sand and Gravel	Sand	0-2	Till	700-1000	111	147
7D37	75-100	2-4	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	99	117
7D38	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	153	173
7D39	15-30	2-4	Sand and Gravel	Sand	6-12	Silt and Clay	300-700	114	143
7D40	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Silt and Clay	300-700	107	128
7D41	5-15	4-7	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	155	178
7D42	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	132	155
7D43	15-30	4-7	Sand and Gravel	Silty Loam	18+	Sand & Gravel w/Silt & Clay	300-700	123	128

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7D44	15-30	4-7	Sand and Gravel	Sand	0-2	Sand & Gravel w/Silt & Clay	300-700	142	180
7D45	15-30	4-7	Sand and Gravel	Sand	12-18	Sand & Gravel w/Silt & Clay	300-700	135	159
7D46	5-15	7-10	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	1000-2000	183	199
7D47	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	700-1000	153	173
7D48	30-50	2-4	Sand and Gravel	Sand	12-18	Till	300-700	102	127
7D49	15-30	4-7	Sand and Gravel	Sand	0-2	Sand & Gravel w/Silt & Clay	700-1000	143	180
7D50	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	133	155
7D51	5-15	7-10	Sand and Gravel	Sandy Loam	0-2	Sand and Gravel	1000-2000	187	209
7D52	5-15	2-4	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	1000-2000	167	183
7D53	5-15	7-10	Sand and Gravel	Loam	0-2	Sand and Gravel	1000-2000	188	207
7D54	5-15	7-10	Sand and Gravel	Sand	0-2	Sand and Gravel	1000-2000	193	224
7D55	5-15	7-10	Sand and Gravel	Peat	0-2	Sand and Gravel	1000-2000	191	219
7D56	50-75	4-7	Sand and Gravel	Sand	18+	Sand & Gravel w/Silt & Clay	300-700	113	133
7D57	15-30	2-4	Sand and Gravel	Silty Loam	0-2	Till	300-700	109	133
7D58	75-100	2-4	Sand and Gravel	Clay Loam	18+	Till	300-700	73	76
7D59	30-50	2-4	Sand and Gravel	Clay Loam	18+	Till	300-700	88	91
7D60	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	148	169
7D61	50-75	2-4	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	94	117
7D62	30-50	4-7	Sand and Gravel	Silty Loam	0-2	Till	300-700	117	141
7D63	15-30	7-10	Sand and Gravel	Sandy Loam	0-2	Sand and Gravel	1000-2000	177	199
7D64	15-30	7-10	Sand and Gravel	Sandy Loam	0-2	Sand & Gravel w/Silt & Clay	1000-2000	167	191
7D65	5-15	7-10	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	163	186
7D66	5-15	4-7	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	147	171
7D67	15-30	2-4	Sand and Gravel	Sand	2-6	Till	300-700	118	155
7D68	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	300-700	134	156
7D69	5-15	4-7	Limestone/Shale	Loam	0-2	Sand & Gravel w/Silt & Clay	1-100	131	159
7D70	0-5	4-7	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	137	165
7D71	5-15	4-7	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	100-300	132	160
7D72	15-30	2-4	Sand and Gravel	Clay Loam	6-12	Silt and Clay	100-300	91	105
7D73	50-75	2-4	Sand and Gravel	Clay Loam	6-12	Till	100-300	71	85
7D74	15-30	4-7	Sand and Gravel	Loam	0-2	Till	300-700	129	156
7D75	15-30	7-10	Sand and Gravel	Sand	0-2	Sand & Gravel w/Silt & Clay	700-1000	164	199
7D76	15-30	2-4	Sand and Gravel	Sand	6-12	Sand & Gravel w/Silt & Clay	300-700	124	151
7D77	15-30	2-4	Sand and Gravel	Clay Loam	18+	Till	300-700	98	101
7D79	5-15	7-10	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	1000-2000	180	200
7D80	5-15	7-10	Sand and Gravel	Sand	0-2	Sand & Gravel w/Silt & Clay	1000-2000	188	220
7D81	5-15	7-10	Sand and Gravel	Peat	0-2	Sand & Gravel w/Silt & Clay	1000-2000	186	215
7D82	15-30	2-4	Sand and Gravel	Clay Loam	2-6	Till	700-1000	113	131

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7D83	15-30	2-4	Sand and Gravel	Sand	12-18	Till	300-700	112	137
7D84	50-75	2-4	Sand and Gravel	Sand	2-6	Till	300-700	98	135
7D85	50-75	2-4	Sand and Gravel	Clay Loam	0-2	Till	300-700	87	108
7D86	50-75	2-4	Sand and Gravel	Sandy Loam	12-18	Sand & Gravel w/Silt & Clay	300-700	97	112
7D87	50-75	2-4	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	99	125
7D88	15-30	4-7	Sand and Gravel	Sandy Loam	6-12	Sand & Gravel w/Silt & Clay	300-700	131	150
7D89	5-15	7-10	Sand and Gravel	Sand	0-2	Sand and Gravel	1000-2000	196	227
7D90	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	153	173
7D91	5-15	7-10	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	1000-2000	186	202
7D92	0-5	7-10	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	2000+	197	211
7D93	15-30	4-7	Sand and Gravel	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	129	147
7D94	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	138	159
7D95	30-50	2-4	Sand and Gravel	Clay Loam	12-18	Till	100-300	84	93
7D96	50-75	2-4	Sand and Gravel	Clay Loam	0-2	Till	100-300	81	104
7D97	15-30	2-4	Sand and Gravel	Clay Loam	0-2	Till	700-1000	114	134
7D98	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	143	163
7D99	50-75	4-7	Sand and Gravel	Clay Loam	6-12	Till	700-1000	106	115
7D100	50-75	2-4	Sand and Gravel	Clay Loam	6-12	Till	100-300	76	89
7D101	50-75	2-4	Sand and Gravel	Clay Loam	0-2	Till	100-300	81	104
7D102	5-15	10+	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	2000+	196	210
7D103	5-15	10+	Sand and Gravel	Peat	0-2	Sand and Gravel	2000+	204	230
7D104	5-15	10+	Sand and Gravel	Sandy Loam	0-2	Sand and Gravel	2000+	200	220
7D105	5-15	7-10	Sand and Gravel	Clay Loam	0-2	Sand and Gravel	1000-2000	181	194
7D106	5-15	7-10	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	1000-2000	183	199
7D107	5-15	7-10	Sand and Gravel	Sand	0-2	Sand and Gravel	1000-2000	193	224
7D108	5-15	7-10	Sand and Gravel	Loam	0-2	Sand and Gravel	700-1000	163	186
7D109	30-50	4-7	Sand and Gravel	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	119	137
7D110	50-75	2-4	Sand and Gravel	Clay Loam	2-6	Sand & Gravel w/Silt & Clay	300-700	97	115
7D111	15-30	4-7	Sand and Gravel	Clay Loam	12-18	Sand & Gravel w/Silt & Clay	300-700	117	123
7D112	50-75	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	126	146

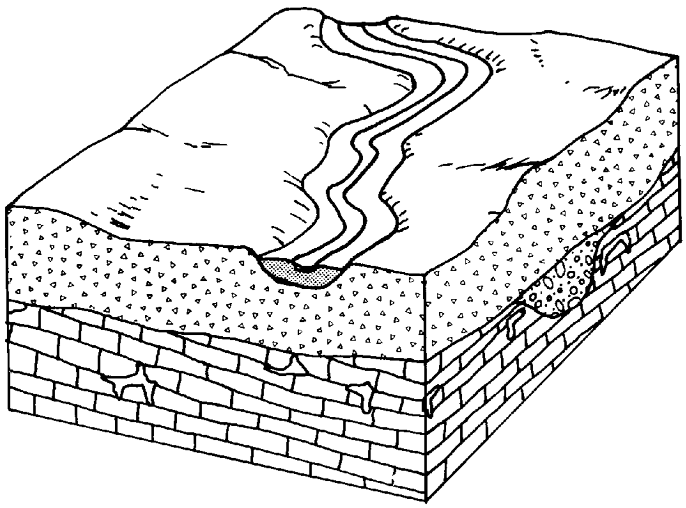


7Ec Alluvium Over Sedimentary Rock

This hydrogeologic setting is characterized by low relief with thin to moderate thicknesses of modern, stream-deposited alluvium. The alluvium is composed of silt, sand, clay, and minor gravel. Depth to water is shallow, and the stream is usually in hydraulic connection with the alluvial deposits. The alluvial deposits are underlain by limestone. These rocks are described in the 7Ac setting. The underlying fractured limestone serves as the aquifer in this setting. The alluvial deposits serve as a source of recharge to the limestone. Soils are variable. Recharge is moderate to high due to the shallow depth to water, flat topography, and the moderately permeable nature of the alluvium.

The GWPP index values for the hydrogeologic setting Alluvium Over Sedimentary Rock range from 109 to 148 with the total number of GWPP calculations equaling 19.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Ec1	15-30	2-4	Limestone	Silty Loam	0-2	Till	300-700	115	139
7Ec2	5-15	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-7000	142	165
7Ec3	5-15	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	148	169
7Ec4	15-30	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	138	159
7Ec5	15-30	4-7	Limestone	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	700-1000	136	154
7Ec6	15-30	4-7	Limestone	Silty Loam	0-2	Sand and Gravel	300-700	134	156
7Ec7	5-15	4-7	Limestone/Shale	Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	135	161
7Ec8	5-15	4-7	Limestone	Silty Loam	0-2	Limestone	300-700	147	169
7Ec9	5-15	4-7	Limestone	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	137	161
7Ec10	5-15	4-7	Limestone/Shale	Silty Loam	0-2	Limestone	700-1000	144	164
7Ec11	15-30	4-7	Limestone	Loam	0-2	Limestone/Shale	700-1000	145	168
7Ec12	5-15	4-7	Limestone/Shale	Loam	0-2	Sand & Gravel w/Silt & Clay	1-100	131	159
7Ec13	15-30	4-7	Limestone/Shale	Loam	6-12	Sand & Gravel w/Silt & Clay	1-100	111	130
7Ec14	15-30	4-7	Limestone/Shale	Silty Loam	6-12	Sand & Gravel w/Silt & Clay	1-100	109	125
7Ec15	5-15	4-7	Limestone/Shale	Loam	0-2	Till	1-100	116	147
7Ec16	5-15	4-7	Limestone/Shale	Silty Loam	0-2	Till	300-700	128	152
7Ec17	5-15	4-7	Limestone/Shale	Silty Loam	0-2	Silt and Clay	1-100	124	150
7Ec18	15-30	4-7	Limestone/Shale	Silty Loam	0-2	Silt and Clay	1-100	109	136
7Ec19	15-30	4-7	Limestone	Silty Loam	0-2	Limestone	700-1000	143	163

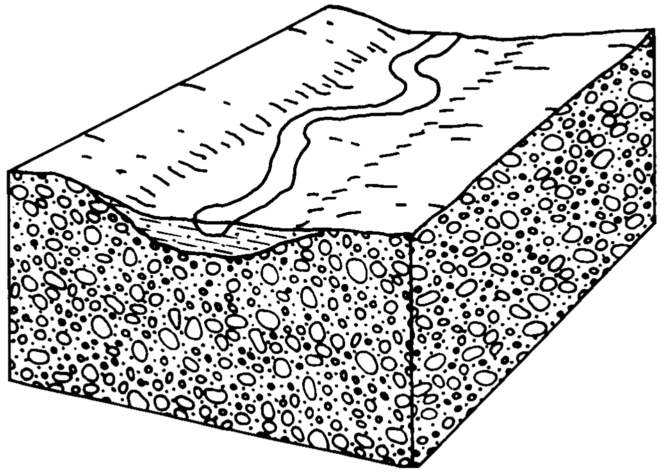


7Ed Alluvium Over Glacial Till

This hydrogeologic setting is characterized by flat-lying topography with surficial deposits of present-day, stream-deposited alluvium confined to modern floodplains in upland areas. The alluvium is composed of silt, sand, gravel, and clay that is deposited directly over the glacial till. Sand and gravel lenses within the till serve as the aquifer in this hydrogeologic setting. Depth to water is typically shallow and the overlying stream is usually in hydraulic contact with the aquifer material. The underlying till is described in setting 7Af. Soils are typically loams or silt loams.

The GWPP index values for the hydrogeologic setting of Alluvium Over Glacial Till range from 102 to 153 with the total number of GWPP index calculations equaling 15.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Ed1	15-30	2-4	Sand and Gravel	Silty Loam	2-6	Till	100-300	102	126
7Ed2	15-30	4-7	Sand and Gravel	Clay Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	125	146
7Ed3	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	137	161
7Ed4	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	132	155
7Ed5	5-15	4-7	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	149	174
7Ed6	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Silt and Clay	700-1000	153	173
7Ed7	15-30	4-7	Sand and Gravel	Silty Loam	0-2	Till	300-700	121	145
7Ed8	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Till	300-700	147	169
7Ed9	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Silt and Clay	300-700	131	155
7Ed10	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	700-1000	153	173
7Ed11	5-15	4-7	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	138	164
7Ed12	5-15	4-7	Sand and Gravel	Peat	0-2	Sand & Gravel w/Silt & Clay	300-700	150	185
7Ed13	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	136	159
7Ed14	5-15	4-7	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	133	160
7Ed15	5-15	4-7	Sand and Gravel	Silty Loam	0-2	Sand & Gravel w/Silt & Clay	300-700	131	155



7Ee - Alluvium Over Outwash

This hydrogeologic setting is characterized by low relief with thin to moderate thicknesses of modern, stream-deposited alluvium overlying outwash. The alluvium is composed of silt, sand, gravel, and clay. The underlying outwash serves as the aquifer. The depth to the water table is shallow and the stream may be in hydraulic connection with the alluvial deposits. Soils are typically silty or sandy loams. The underlying outwash is described in setting 7Ba. The alluvial deposits serve as a source of recharge for the outwash. Recharge is high.

The GWPP index values for the hydrogeologic setting of Alluvium Over Outwash range from 175 to 192 with the total number of GWPP index calculations equaling 2.

Setting	Depth to Water (feet)	Recharge (In/Yr)	Aquifer Media	Soil Media	Topography	Vadose Zone Media	Hydraulic Conductivity	Rating	Pest Rating
7Ee1	5-15	7-10	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	1000-2000	175	196
7Ee1	5-15	7-10	Sand and Gravel	Loam	0-2	Sand & Gravel w/Silt & Clay	1000-2000	175	196
7Ee2	5-15	7-10	Sand and Gravel	Silty Loam	0-2	Sand and Gravel	2000+	192	206

ERRATUM
GREENE COUNTY

Changes to Map and Report:

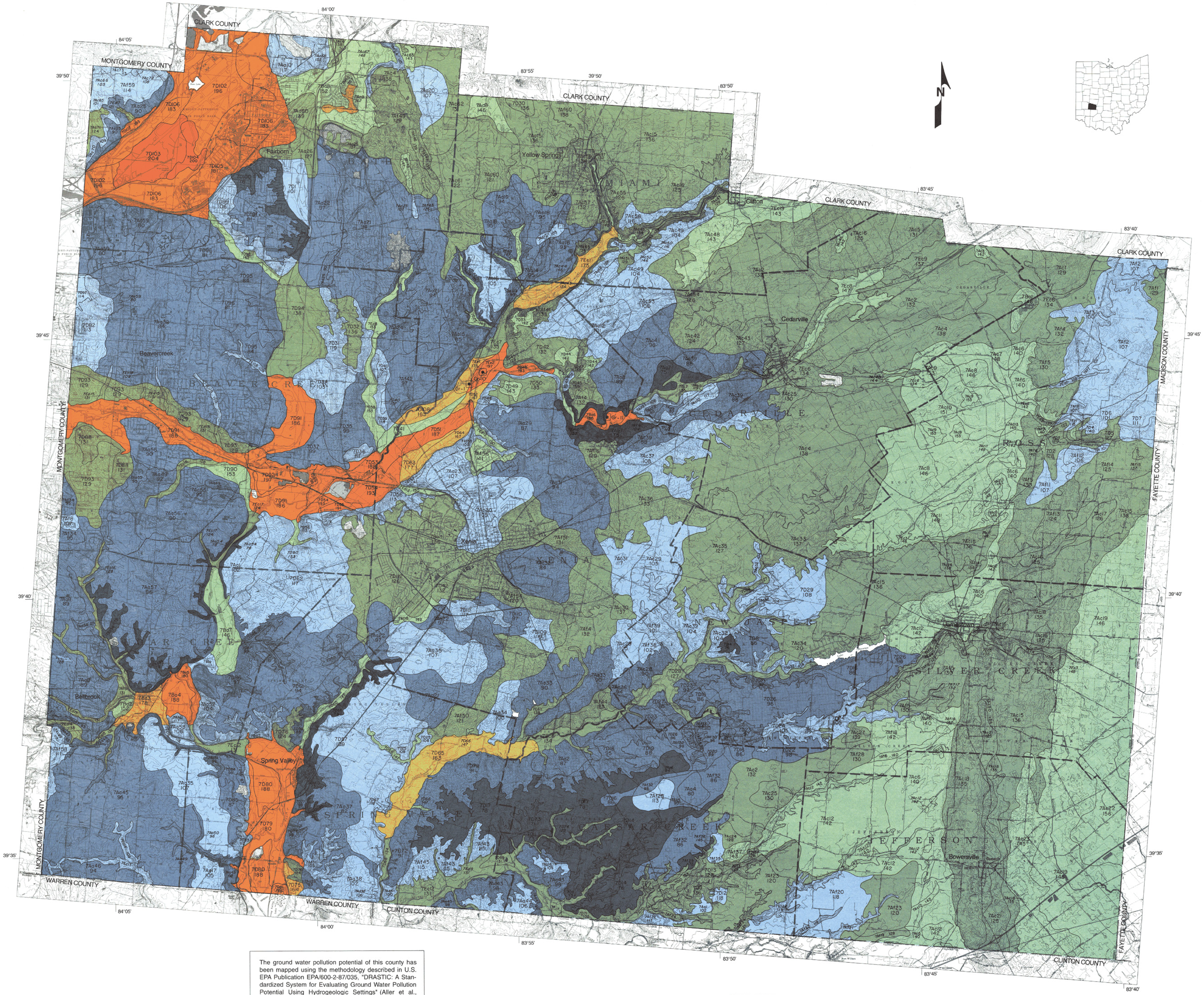
The following settings have been omited from both the map and report setting tables:

7Af28 and 7D 8.

Ground Water Pollution Potential of GREENE COUNTY

by

Wayne Jones



Miles: 1 0 1 2

Kilometers: 1 0 1 2

CONTOUR INTERVAL 5 OR 10 FEET

County Line

Township Line

Incorporated City Limit

Description of Map Symbols

Hydrogeologic Region — **7Ad6** — Hydrogeologic Setting

98 — Relative Pollution Potential

Observation Well Site *

Gravel Pit / Quarry

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

Pollution Potential Index Range

Higher	200+
	180 - 199
	160 - 179
	140 - 159
to	120 - 139
	100 - 119
	80 - 99
Lower	< 79

Hydrogeologic Settings

- 7Aa – Glacial Till Over Bedded Sedimentary Rocks
- 7Ac – Glacial Till Over Limestone
- 7Af – Sand and Gravel Interbedded in Glacial Till
- 7Ba – Outwash
- 7Bb – Outwash Over Bedded Sedimentary Rock
- 7D – Buried Valley
- 7Ec – Alluvium Over Bedded Sedimentary Rocks
- 7Ed – Alluvium Over Glacial Till
- 7Ee – Alluvium Over Outwash

A more detailed description of the hydrogeologic settings and the evaluation of the pollution potential may be found in the publication "Ground Water Pollution Potential of Greene County," GWPP Report No. 30, Ohio Department of Natural Resources, Division of Water.

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

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J. Gerrie McCall, Cartographer

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George V. Voinovich
Governor
Donald C. Anderson
Director