395

G-000-101.19

PETITION FOR SOLE SOURCE AQUIFER DESIGNATION OF THE GREAT MIAMI BURIED VALLEY AQUIFER SYSTEM IN BUTLER, CLERMONT, HAMILTON AND WARREN COUNTIES, OHIO

03/01/88

COUNCIL GVMTS
114
PETITION

[redacted]

395

PETITION FOR

SOLE SOURCE AQUIFER DESIGNATION OF THE GREAT MIAMI BURIED VALLEY AQUIFER SYSTEM

IN BUTLER, CLERMONT, HAMILTON AND WARREN COUNTIES, OHIO

OHIO-KENTUCKY-INDIANA REGIONAL COUNCIL OF GOVERNMENTS
801-B W. EIGHTH ST. - SUITE 400, CINCINNATI, OHIO 45203

1988
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PETITION FOR
SOLE SOURCE AQUIFER DESIGNATION OF THE
GREAT MIAMI BURIED VALLEY AQUIFER SYSTEM
IN BUTLER, CLERMONT, HAMILTON AND WARREN COUNTIES, OHIO

MARCH, 1988

Prepared by

Ohio-Kentucky-Indiana Regional
Council of Governments
801-B West Eighth Street, Suite 400
Cincinnati, Ohio 45203

Note: This document expands a petition already prepared and submitted by the Miami Valley Regional Planning Commission in Dayton, Ohio. In the text, **bold** type face distinguishes passages that have been supplemented by OKI.

January 1989

ERRATA SHEET FOR
PETITION FOR
SOLE SOURCE AQUIFER DESIGNATION OF THE
GREAT MIAMI BURIED VALLEY AQUIFER SYSTEM
IN BUTLER, CLERMONT, HAMILTON AND WARREN
COUNTIES, OHIO
(prepared by the Ohio-Kentucky-Indiana Regional Council of Governments in response to review comments made by the Ohio Environmental Protection Agency)

NOTE: Revisions to the original report are typed below in **bold** print.

Page 6, first paragraph, second sentence:
Neither these nor any other public water supplies within the counties that contain the proposed Sole Source Aquifer could be considered as a replacement for the 210.9 million gallons **per day** (mgd) of groundwater supplied by the Buried Valley Aquifer System within the requested area.

Page 10, 2nd paragraph, third sentence:
A **minimum contaminant level goal** of zero has been exceeded in a second well....

Page 10, footnote, first sentence:
1,1,1- trichloroethylene was recorded at 257 ppb (proposed secondary standard and **minimum contaminant level goal** are 300 ppb and 200 ppb, respectively).

Page 11, first paragraph, second sentence:
Benzene, for example, has been recorded at 4.5 ppb, which is below the proposed maximum contamination level of 5 ppb but above the **minimum contaminant level goal** of zero.

Page 23, first paragraph, last sentence:
The information collected **by OKI** was tabulated and appears in Table 3.2.

Page 25, third column:
The Cincinnati aquifer service area population should be **287,134** instead of 287,194.

Page 27:
The following footnotes should be added below "Grand Totals":
+Location of business office for extensive rural water system.
++Withdrawn from Ohio River Aquifer.

Page 38, third paragraph, first sentence:
In this section, groundwater from bedrock areas surrounding the proposed Sole Source Aquifer is **considered as** a potential source of drinking water.

Page 49, first paragraph, first sentence:
The Buried Valley Aquifer System associated with the Great Miami and Little Miami Rivers **and the Mill Creek** lies entirely within....

Page 50, first paragraph, Class 1 and 2 aquifer references:
To further clarify this paragraph, the reader should note that **Class 1 areas yield more than 100 gpm., Class 2 areas yield less than 100 gpm.**

Page 56, second paragraph, third sentence:
They are usually 100 to 200 **thick**, although they can be up to 400 feet **thick.**

Page 73, first paragraph, first sentence:
Groundwater withdrawal for public water supplies within the Buried Valley Aquifer System totals **207.099** mgd....

Page 73, second paragraph, second sentence:
Non-community **public** water supply systems that provide drinking water....

Page 74:
The following footnote should be added at the bottom of the table:
NOTE: Groundwater withdrawals presented in this table are not primarily for drinking water use.

Page 80, section heading:
3. **Natural** and Human Induced Aquifer Recharge

TABLE OF CONTENTS

	Page
CHAPTER I. PETITION IDENTIFYING INFORMATION	1
CHAPTER II. NARRATIVE: GENERAL INFORMATION	4
A. General Location of the Aquifer	4
B. Groundwater Dependency on the Aquifer	4
C. Availability of Other Public Water Supplies	6
D. Reasons For Interest in SSA Designation	6
E. Aquifer Vulnerability And Potential Health Threat	7
F. Aquifer Water Quality	12
G. Relationship of the Petitioner to the Purveyors of Water Supply	12
References	18
CHAPTER III. SOLE OR PRINCIPAL DETERMINATION	19
A. Aquifer Service Area	19
1. Description of the Aquifer Service Area	19
2. Map of the Aquifer Service Area	19
B. Population	21
1. Entire Population within the Aquifer Service Area	21
2. Population within the Aquifer Service Area That Is Actually Served by the Proposed Sole Source Aquifer	21
C. Current Sources of Drinking Water	21
1. Current Drinking Water Sources Matrix	21
2. Description of Each Current Source	21
a. Public water supply	23
b. Private water supply (domestic wells)	28

Page

3. Seasonal Variations 31

4. Actual Use Versus Potential Capacity 32

5. Why the Source Is Not Used to Its Full Capacity . 32

D. Potential Alternative Sources of Drinking Water . . . 33

1. Alternative Drinking Water Sources Matrix 33

For Current Source - Existing Surface Water Systems

2. Description. 35

3. Why Source Not Currently in Use 35

4. Legal or Institutional Constraints. 35

5. Estimated Daily Supply 36

6. What Is Necessary to Transfer to This Source. . . 36

7. Estimated Cost. 36

8. Economic Feasibility 37

For Alternative Source 1 - Bedrock Wells

2. Description. 38

3. Why Source Not Currently in Use 39

4. Legal or Institutional Constraints. 39

5. Estimated Daily Supply 39

6. What Is Necessary to Transfer to This Source. . . 41

7. Estimated Cost. 41

8. Economic Feasibility 41

For Alternative Source 2 - Existing Surface Water Impoundments

2. Description. 42

3. Why Source Not Currently in Use 44

4. Legal or Institutional Constraints. 45

5. Estimated Daily Supply 45

Page

6. What Is Necessary to Transfer to This Source . . . 46

7. Estimated Cost 46

8. Economic Feasibiilty. 46

References. 48

CHAPTER IV. HYDROGEOLOGICAL DATA 49

A. The Aquifer and Its Location 49

1. Description of Locale, Topography, Climate, Geology and Groundwater 49

2. Topographic Map of Aquifer Location 50

3. Aquifer's Hydrology and Hydrogeology 53

a. Aquifer and non-aquifer units 53

b. Geologic cross sections 56

c. Aquifer characteristics 56

4. Groundwater Withdrawal from the Aquifer. 73

a. Wells (drinking, irrigation, industrial). 73

b. Springs 76

c. Stream baseflow 76

d. Potentiometric surface map 76

B. Recharge Area. 77

1. Topographic Map of Recharge Area. 77

2. Methods Used to Determine Recharge Area 77

3. Natural and Human-Induced Aquifer Recharge . . . 80

C. Streamflow Source Area 87

1. Topographic Map of Streamflow Source Area . . . 87

2. Methods Used to Determine Streamflow Contribution 89

3. Streamflow Characteristics 89

Page

D. Designated Area 90

E. Project Review Area 90

References 94

Appendix A. Resolutions and Letters of Support

Appendix B. Construction of ODNR Ground-Water Resources Maps - Letter from Michael Hallfrisch

LIST OF TABLES

Table		Page
2.1	Groundwater Quality of the Buried Valley Aquifer at Selected Locations	13
2.2	Water Purveyor Status of Ohio Jurisdictions Represented on the OKI Board of Trustees	16
3.1	Current Drinking Water Sources for the Aquifer Service Area	22
3.2	Summary Data for Public Drinking Water Systems for the OKI Portion of the Aquifer Service Area	24
3.3	Current Private Drinking Water Population and Use	30
3.4	Alternative Drinking Water Sources	34
3.5	Potential Water Supply from Bedrock Wells	40
4.1	Stratigraphic Sequence for Clark, Greene and Montgomery Counties	55
4.2	Characteristics of the Buried Valley Aquifer at Selected Locations	58
4.3	Known Groundwater Withdrawals for Non-Community Use	74
4.4	Estimates of Groundwater Withdrawals (mgd) for Industrial Use--OKI Planning Area	75
4.5	Estimated Induced Infiltration from Streambeds Overlaying the Buried Valley Aquifer System	81
4.6	Unlined Industrial and Municipal Surface Impoundments Overlaying the Great Miami Aquifer System	84
4.7	Class V Injection Wells in the Aquifer Recharge Area	85
4.8	Single-Family Dwelling Waste Disposal Dry Wells ("Exempt") in the Aquifer Recharge Area	86
4.9	Summary Data on Losing and Gaining Streams in the Aquifer Recharge Area	91

LIST OF FIGURES AND PLATES

Figure		Page
2.1	Buried Valley Aquifer Vicinity Map	5
2.2	Location Index for Water Quality Indicators	14
3.1	Location Index for County Topographic Maps with Selected Data for Sole Source Aquifer Petition (Plates 1-9, MVRPC and Plates 1-4, OKI)	20
3.2	Locations of Reservoirs within the OKI Planning Area	43
4.1	Buried Valley Aquifer System	51
4.2	Location Index for Cross Section and Aquifer Characteristics	57
4.3	Cross Section at Mad River in Champaign County, A - A'	60
4.4	Cross Section at Stillwater River in Miami County, B - B'	61
4.5	Cross Section at Great Miami River in Miami County, C - C'	62
4.6	Cross Section at Great Miami River in Northern Montgomery County, D - D'	63
4.7	Cross Section at Mad River in Montgomery County, E - E'	64
4.8	Cross Section in Southern Greene County, F - F'	65
4.9	Cross Section at Great Miami River in Southern Montgomery County, G - G'	66
4.10	Cross Section at Seven Mile Creek in Preble County, H - H'	67
4.11	Cross Section at Great Miami River in Northern Butler County, I - I'	68
4.12	Cross Section at Great Miami River in Southern Butler County, J - J'	69
4.13	Longitudinal Cross Section. County Well Field to Huffman Dam in Montgomery County, K - K'	70
4.14	Cross Section of the Mill Creek Valley at Wyoming, Lockland and Reading in Hamilton County, L - L'	71

Figure		Page
4.15	Cross Section of the Little Miami Valley at Its Confluence with the Ohio River Valley in Hamilton County, M - M'. . . .	72
4.16	Surface Drainage of the Great Miami/Little Miami/ Mill Creek Basins - Gaining and Losing Streams.	88
4.17	Proposed Designated and Project Review Area (MVRPC)	92
4.18	OKI's Proposed Designated/Project Review Area.	93
Plate*		
1	Sole Source Aquifer Project Review Area-Butler County	
2	Sole Source Aquifer Project Review Area-Warren County	
3	Sole Source Aquifer Project Review Area-Hamilton County	
4	Sole Source Aquifer Project Review Area-Clermont County	

*Rear pocket of petition

CHAPTER I

PETITIONER IDENTIFYING INFORMATION

Aquifer

Name: Great Miami Buried Valley Aquifer System

Location: Southwestern Ohio

Petitioner

Name: Ohio-Kentucky-Indiana Regional Council of Governments

Address: 801-B West Eighth Street, Suite 400
Cincinnati, Ohio 45203

Phone Number: (513) 621-7060

Responsible Person

Name: A. H. Hessling, Executive Director, OKI

Contact

Name: Lorna Harrell, Environmental Planner, OKI

Phone Number: (513) 621-7060

The Ohio-Kentucky-Indiana Regional Council of Governments (OKI) is a metropolitan planning organization serving 194 units of local government in the Greater Cincinnati region, with a planning area that includes eight counties: Butler, Clermont, Hamilton, and Warren Counties in Ohio; Boone, Campbell, and Kenton Counties in Kentucky, and Dearborn County in Indiana. Providing a mechanism to coordinate the activities of all these governments is a primary function of OKI's planning programs. OKI is governed by a 103-member board of trustees composed primarily of local elected officials, representing counties, municipalities, and townships in the regional planning area. At least two-thirds of the trustees must be elected officials, and the trustees in turn select 25 of their number to constitute an Executive Committee which makes policy decisions for the organization.

With a history of water quality management planning dating back to 1974, OKI has also long been aware of the need to protect the region's groundwater resources. This need is especially obvious in the Ohio portion of the OKI region, because an important buried valley aquifer system extends throughout much of southwestern Ohio. This aquifer system is associated primarily with the Great Miami River basin, but also extends to the smaller basins of the Little Miami River and Mill Creek, and provides a crucial source of water supply for many citizens and industries in several Ohio counties. For that reason, OKI welcomes the opportunity to seek Sole Source Aquifer Designation for that portion of this system in the OKI region, as described in the following petition.

In taking this action, it should be noted that OKI is essentially expanding a petition that has already been submitted by the Miami Valley Regional Planning Commission located in Dayton, Ohio, because some portions of this aquifer system are located in that organization's planning area and other portions are located in the Ohio counties served by OKI, i.e., Butler, Clermont, Hamilton and Warren Counties. This additional submittal, moreover, is a result of discussions among numerous local elected officials in OKI's planning area, who want their communities to receive the benefits of Sole Source Aquifer Designation through the agency (OKI) that already responds to them about other regional issues. As previously noted, OKI's structure is built upon the direct participation of local governments in decision-making, as exemplified by the composition of its Board of Trustees and of its Executive Committee, which meets monthly to consider policies and programs for a variety of regional concerns.

Accordingly, after extensive discussions in the spring of 1987 about the significance of Sole Source Aquifer Designation, the Executive Committee resolved unanimously that OKI should pursue this designation on behalf of the local governments in its planning area. A copy of this April 9, 1987 resolution is presented in Appendix A of this petition, along with additional supporting resolutions that were forwarded to OKI from the Butler County Board of Commissioners, the City of Hamilton, the Village of Monroe, the City of Trenton, and the Water Association, a rural water cooperative headquartered in Butler County.

CHAPTER II

NARRATIVE: GENERAL INFORMATION

A. General Location of the Aquifer

The aquifer is located in southwestern Ohio as shown on the vicinity map* (Figure 2.1). The Buried Valley Aquifer System map (Figure 4.1 on page 51) illustrates the location of the network of buried valley aquifers. This network is within the Great Miami, Little Miami, and Mill Creek basins of Ohio and is one of the most extensive buried valley aquifer systems in North America. The system underlies all or portions of thirteen Ohio counties, extending in the north from Logan County, southwest to the Ohio River and from the Ohio-Indiana border east to Champaign, Clark, and Greene Counties **in MVRPC's planning area and Warren and Clermont Counties in OKI's planning area.**

B. Ground Water Dependency on the Aquifer

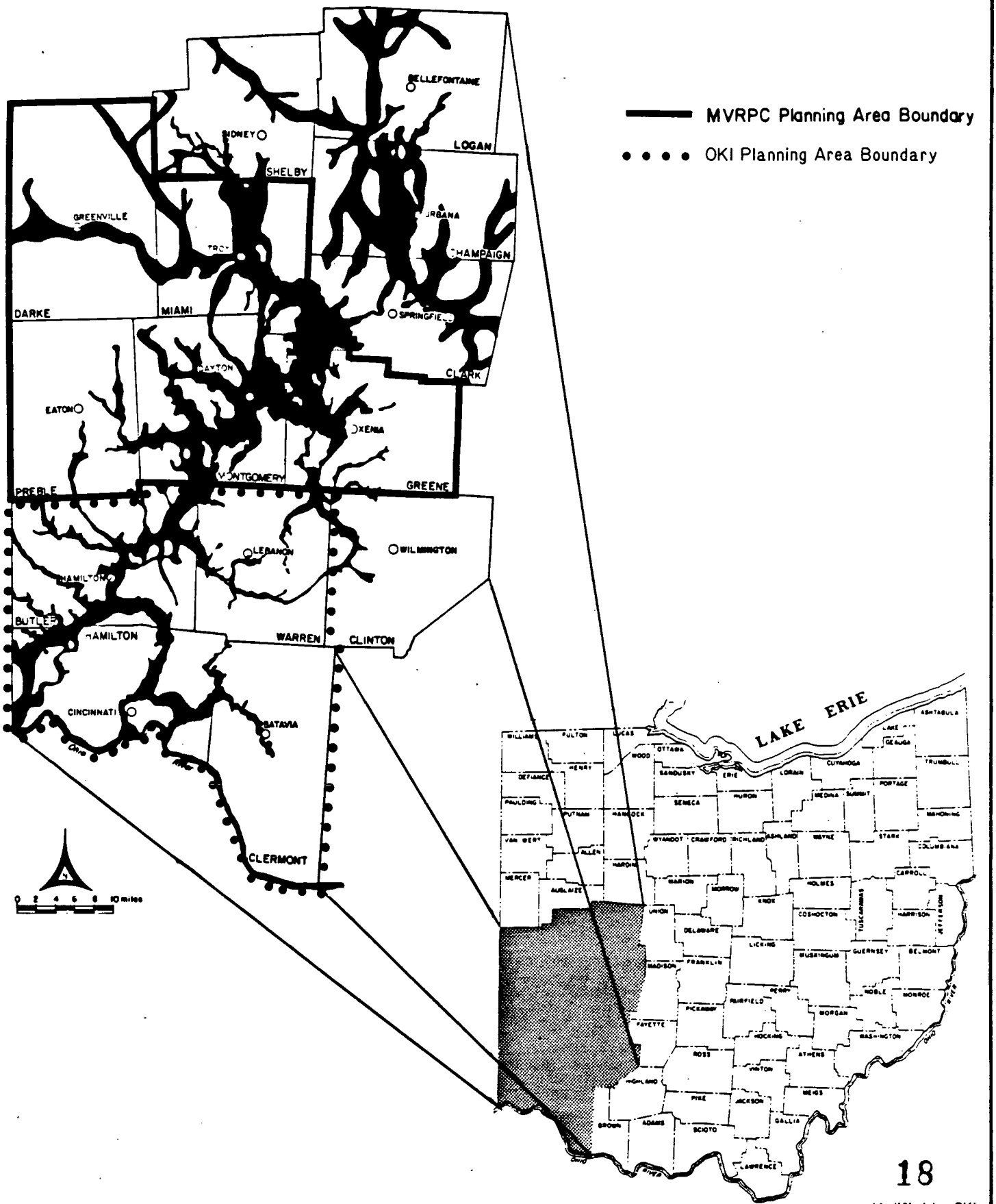
The total population in the proposed Sole Source Aquifer area is estimated to be **1,738,857 (927,381 - MVRPC area, 811,476 - OKI area).** These figures were derived from 1980 U.S. Census data and information provided by public water supply purveyors. Within the proposed area, the population dependent on groundwater from the Buried Valley Aquifer System is estimated to be **1,567,145 (897,631 - MVRPC area, 669,514 - OKI area), or 90% of the population (97% - MVRPC area, 83% - OKI area).**

***The Great Miami River aquifer system also encompasses the buried valley aquifer network underlying the Whitewater River system in Indiana, which may in fact be further interconnected with other aquifer networks underlying other river basins. Indiana's Department of Natural Resources is currently mapping the Whitewater River's aquifer system, and Indiana's Department of Environmental Management is planning to subsequently prepare a petition requesting the aquifer's designation as a "sole source." This petition, therefore, addresses the aquifer system underlying the Whitewater River for only the Ohio portion, with the understanding that the Indiana portion will be addressed in a subsequent petition to be submitted in the near future.**

FIGURE 2.1

395

BURIED VALLEY AQUIFER VICINITY MAP



Prepared By: Miami Valley Regional Planning Commission

Modified by OKI

C. Availability of Other Public Water Supplies

Within the area served by the proposed Sole Source Aquifer, only four public water supply purveyors do not rely on the Buried Valley Aquifer System for their supplies. Neither these nor any other public water supplies within the counties that contain the proposed Sole Source Aquifer could be considered as a replacement for the 210.9 million gallons a day (mgd) of groundwater supplied by the Buried Valley Aquifer System within the requested area.

D. Reasons For Interest in SSA Designation

The ready availability of good quality groundwater has historically played a major role in the development of areas overlying the buried valley aquifer. A continuously developed corridor, much of it highly industrialized, extends from north of the city of Dayton south to Cincinnati and the Ohio River. Protection and management of the underlying aquifer from the effects of existing and future development is essential. This is needed to sustain the economic growth of the area and to safeguard the public health. The industrial and municipal water supply in the Dayton metropolitan area, for instance, is one of the largest in the United States where the entire supply is drawn from groundwater. In Ohio, Montgomery County leads the State in groundwater usage at 134 mgd (Eberle and McClure, 1980), more than double the amount of the next largest user. Management of the resource, however, has fallen far behind its utilization, and users are faced with the prospect of both chronic long-term degradation of water quality and local areas of acute contamination that threaten some water supplies.

MVRPC and OKI are the two Designated Planning Agencies (DPA) for water quality in the area in which the Great Miami Buried Valley Aquifer System is located. MVRPC is the designated agency for the Miami Valley Region of Southwestern Ohio (Darke, Greene, Miami, Montgomery, and Preble Counties). OKI is the designated agency for an area that includes one county in Indiana, three counties in Kentucky, and four counties in Ohio (including Butler, Clermont, Hamilton, and Warren in the area proposed for "Sole Source" designation).

As designated planning agencies, MVRPC and OKI are responsible for developing and administering regional Areawide Water Quality Management Plans (AWQMP). As a part of their water quality management responsibilities, each agency is developing an aquifer protection and management program. There is a need for an effective management plan and program for the aquifer. In the region served by MVRPC, this need is critical because the population, and the industrial base that supports it, are almost entirely dependent upon this water resource. In the region served by OKI, the aquifer is widely used as a source of domestic water supply, particularly in Butler County, and is a critical resource for many of the area's major industries. U.S. EPA's Sole Source Aquifer designation will assist in increasing local awareness of groundwater dependency and is an essential early step in developing a protection and management program for this irreplaceable resource.

E. Aquifer Vulnerability and Potential Health Threat

Because of the hydrogeology of the aquifer -- highly permeable sand and gravel deposits within confining borders of bedrock - it is extremely vulnerable to contamination from sources that lie within (e.g., injection wells) and above it and its recharge

zones. The land directly above and adjacent to the aquifer is intensively urbanized in many areas with land uses that include public, commercial, industrial, and residential. These land uses have many associated activities that have the potential to contaminate the aquifer. Less urbanized areas are subject to contamination from agricultural practices, on-site wastewater treatment and disposal systems, sludge disposal, and other activities. **In addition, waste storage sites pose a potential threat, including leakage from hazardous waste storage and processing, sludge disposal, gravel pits and other sites used as landfills.** Contamination of the aquifer from various sources has already occurred, and water supplies in some areas have been rendered unusable.

In the MVRPC area in 1984, for example, levels of TCE (trichloroethylene) as high as 508 ppb forced abandonment of a well serving Sunny Acres Mobile Home Park in Harrison Township, Montgomery County. Elevated levels of other SVOCs (synthetic volatile organic compounds) were detected in additional private and public wells in the Sunny Acres area.

A 1985 Ohio EPA analysis of the City of Dayton's well water and tap water revealed SVOCs in concentrations exceeding the RMCLs (recommended maximum contamination levels). These findings prompted a letter from Paul Flanigan, Acting Deputy Director of Water Programs for Ohio EPA, to William Zilli, Director of Water for the City of Dayton, stating that, "The Dayton well field has one of the widest varieties of organic constituents observed to date in the Ohio EPA's ongoing survey of public water supplies." Further, the letter recommended that, "the city respond immediately through investigation and corrective measures rather than to delay pending promulgation of [federal] regulations."

While the recent discovery of SVOCs in the City of Dayton's well fields serves to illustrate the significant public health hazards that result from aquifer contamination, the threat **in the MVRPC area** is not limited to Dayton. Studies carried out south of Dayton in the City of Moraine revealed the presence of both priority pollutant metals and organic chemicals in the vicinity of a Montgomery County well field. In Miami County, north of Dayton, private wells in the city of Troy have been abandoned due to levels of nitrates above the allowable limit of 10 mg/l (as N) and high levels of lead, arsenic, and mercury. East of Dayton in Greene County's City of Beavercreek, the discovery of vinyl chloride in a number of private wells forced residents to start using bottled water. Superfund moneys were eventually released by U.S. EPA to pay for extension of the public water system into the affected area.

Within the OKI area, instances of groundwater contamination have been reported in each of the four counties. In Butler County, a groundwater plume containing VOCs and several inorganic compounds in excess of EPA's drinking water standards is moving westward and downward from the former site of Chem-Dyne, Inc., in the City of Hamilton. Although contamination is primarily confined to the upper 4-6 feet of the aquifer's water table, contaminants have been identified at a depth of 65 feet. The source of contamination is Chem-Dyne's former storage of 300,000 gallons of bulk waste and 30,000 drums of chemical waste, which included pesticides, solvents, PCB's, and heavy metals. The surface source of groundwater contamination was cleaned up through a Superfund contract, and a groundwater pumping and treatment system is in place. The city's wells, which are four and a half miles southwest of the Chem-Dyne site, are under no immediate threat.

In another incident of groundwater contamination in Butler County, the two wells in the Village of Seven Miles have recorded VOC levels of 55.9 ppb and 88.0 ppb (June, 1987). These levels exceed the proposed standard of 5.0 ppb. While the Village is looking for a new site for a well field, residents have been warned to boil their drinking water.

In Clermont County, the City of Milford has closed one of its wells this past year and has recorded an increase in contaminants in its other two wells. Samples from the closed well contained four chemical compounds at levels that exceed proposed primary or secondary standards.* A proposed secondary standard of zero has been exceeded in a second well for trichloroethylene (3.5 ppb) and 1, 2- dichloroethane (1.4 ppb) and in a third well for trichloroethylene (0.5 ppb). The source of contamination has not been identified.

In Hamilton County, uranium concentrations above background levels have been recorded at onsite wells at the U.S. Department of Energy's Feed Materials Production Center (FMPC) near Fernald and at three wells within a half mile to the south. The source of elevated uranium levels has been attributed to onsite runoff from the FMPC, which produces purified uranium and uranium compounds, and to leakage from FMPC storage pits. The U.S. and Ohio Environmental Protection Agencies are negotiating with the U.S. Department of Energy to perform a remedial investigative/feasibility study of the entire site to determine the extent and source of contamination.

*1, 1, 1- trichlorethylene was recorded at 257 ppb (proposed primary and secondary standards are 300 ppb and 200 ppb respectively). Levels of trichlorethylene (24.5 ppb), 1, 2- dichloroethane (14.8 ppb), and 1, 1- dichloroethylene (12.4 ppb) all exceeded their proposed primary standard of 5 ppb. Levels of tetrachloroethylene (for which there are no standards at present) also were elevated (26.9 ppb).

Also in Hamilton County, several chemical compounds have been recorded in the City of Reading's wells at levels that exceed proposed standards. Benzene, for example, has been recorded at 4.5 ppb, which is below the proposed maximum contamination level of 5 ppb but above the proposed secondary standard of zero. During 1985, four of Reading's twelve wells were closed temporarily. One continuing source of contamination is Pristine, Inc., where leakage has occurred from a liquid waste incinerator and from drums and tanks storing 350,000 gallons of chemicals. Although some of the drums and contaminated soil have been removed, the U.S. EPA is continuing negotiations with the responsible parties for clean-up of the 2.5 acre site.

At New Baltimore in Hamilton County, fourteen wells in 1985 were found to be contaminated with nitrates attributed to residential septic systems. The affected households were notified and advised to obtain additional laboratory tests for their drinking water.

In Warren County, nitrates from residential septic systems have been a source of contamination to residential wells in Carlisle for several years. The recent installation of sewers in the area has mitigated this contamination, but elevated nitrate levels in the groundwater are expected to persist for a long time.

The significant hazard to public health that these recent contamination examples represent results from the following factors: intense development will continue to occur in the area overlying and adjacent to the aquifer; and the aquifer is a sand and gravel, non-isolated, interconnected system that is highy vulnerable to contamination from above and is subject to lateral contamination spreading because of natural groundwater movement and movement induced by production wells.

F. Aquifer Water Quality

The highly productive Buried Valley Aquifer is also highly developed and requires artificial recharge in many areas to maintain a high rate of withdrawal. The water quality of this highly developed, artificially recharged aquifer is susceptible to rapid degradation; however, the natural groundwater quality is generally good and meets primary drinking water standards in most areas (Pennino, 1984) although the typically hard water may have high iron concentrations (OEPA, 1981 and Spieker, 1968). Inorganic water quality data are presented in Table 2.1. The corresponding sampling locations are shown on Figure 2.2. The concentrations of iron or manganese are greater where more clay is present in the aquifer. Sulfate concentrations vary and are believed to reflect local aquifer recharge from river infiltration or from the proximity of areas used for coal storage or coal ash disposal (OEPA, 1981). A study of Pennino (1984) revealed a statistically significant increase in sodium and chloride in the buried valley surrounding the Upper Mad River. This could be due to increased use and storage of road salt, increased sewage discharges, solid waste disposal, or agricultural runoff. In general, concentrations of all chemical parameters have increased gradually over the past 40 years.

G. Relationship of the Petitioner to the Purveyors of the Water Supply

The Miami Valley Regional Planning Commission (MVRPC) **and the Ohio-Kentucky-Indiana Regional Council of Governments (OKI),** are the two organizations making formal application for Sole Source Aquifer Designation, as previously explained in Chapter 1. **Both agencies have** water quality planning responsibilities within their respective regions.

TABLE 2.1
GROUNDWATER QUALITY OF THE BURIED VALLEY AQUIFER AT SELECTED LOCATIONS

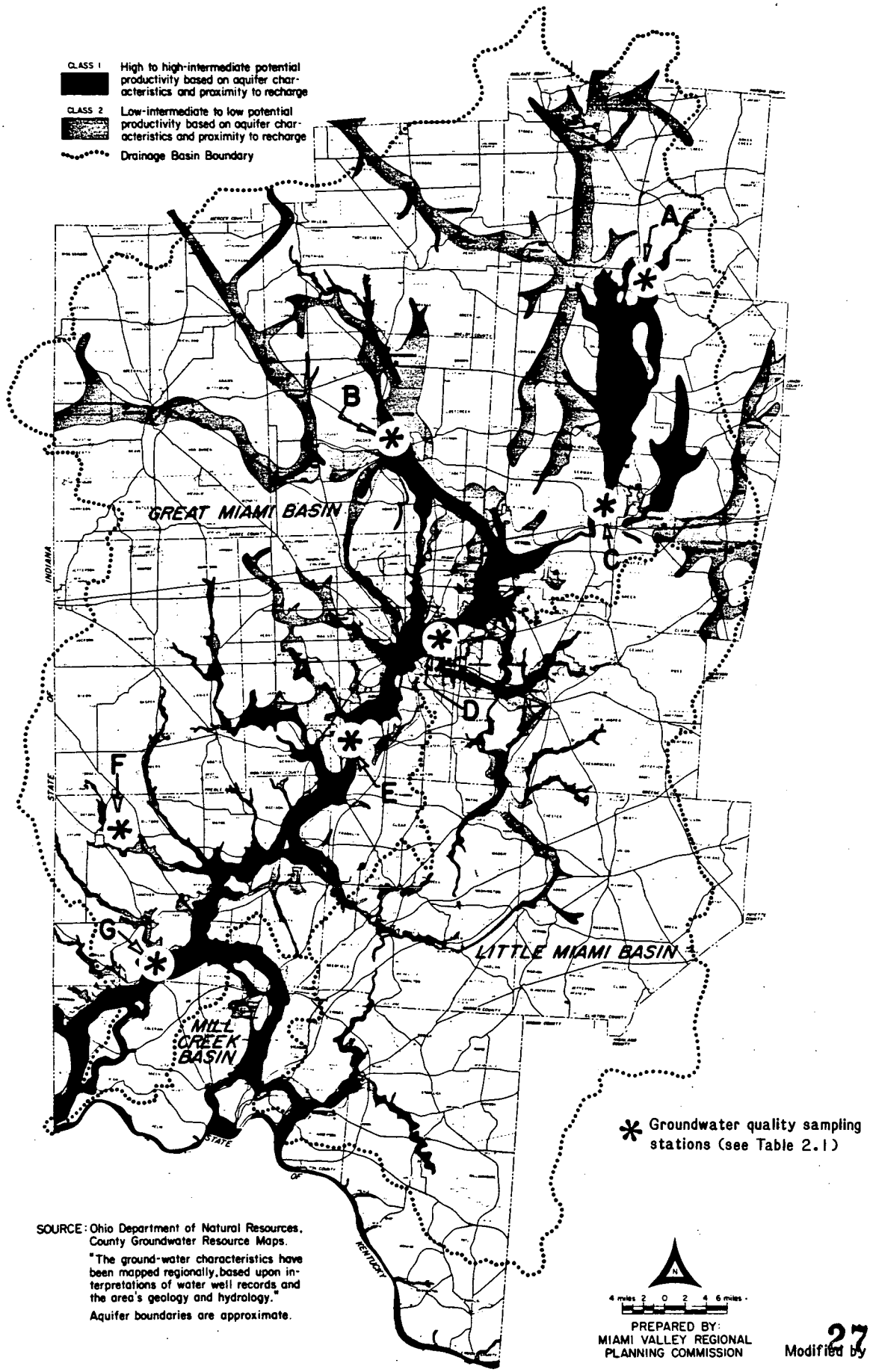
Code	County (Location)	Month/Year	pH	Total Dissolved Solids (mg/l)	Sodium (mg/l)	Chloride (mg/l)	Sulfate (mg/l)	Iron (mg/l)	Manganese (mg/l)	
A	Logan (West Liberty)	3/40	7.2	394	-	3	-	.7	.02	*
		12/50	7.7	395	-	3	-	1.05	.05	*
		1/61	7.4	412	3	ND	-	1.5	.05	*
		11/70	7.7	469	6	7	65	.58	.03	*
		6/79	-	451	ND	ND	74	.97	.03	*
		/86	-	522	4	11	76	1.10	-	**
B	Miami (Troy)	4/43	7.3	386	-	8	-	.25	.05	*
		4/53	7.4	406	-	8	-	.8	.08	*
		1/64	7.5	400	19	17	-	.6	.1	*
		1/71	7.5	386	21	17	39	1.18	.03	*
		7/77	7.9	-	19	19	60	5.1	.05	*
		/86	7.5	440	20	-	56	1.45	-	**
C	Clark (Springfield)	11/46	7.6	412	-	5	-	ND	.02	*
		12/53	7.8	436	-	6	-	.01	ND	*
		2/64	7.6	571	7	12	-	1.7	.5	*
		12/73	7.6	-	12	21	85	.3	.2	*
		5/86	7.9	470	11	22	75	.33	-	**
D	Montgomery (Dayton, Mad River)	9/48	7.4	433	-	11	-	.17	.01	*
		11/56	7.4	584	-	29	-	1.0	.45	*
		11/66	7.5	474	19	28	81	.1	-	*
		3/76	7.4	-	20	35	71	.37	.03	*
		5/86	7.7	532	19	39	61	2.33	-	**
E	Montgomery (Miamisburg)	2/46	7.2	440	-	11	-	.05	ND	*
		1/58	7.2	502	-	54	-	.05	ND	*
		11/65	7.2	530	43	79	-	ND	ND	*
		10/77	8.0	531	42	69	72	.13	.13	*
		5/86	8.0	560	11	71	57	ND	-	**
F	Butler (Oxford)	10/41	7.3	442	-	10	-	.6	.07	*
		11/52	7.7	436	-	6	-	.45	.17	*
		10/64	7.4	330	7	13	-	.2	.1	*
		12/75	7.7	-	10	22	85	.58	.04	*
		5/86	7.5	500	12	26	73	ND	-	**
G	Hamilton-Butler (SW Ohio Water Co.)	1/65	7.4	389	8.6	16	64	.09	.17	*
		10/56	7.3	370	4.5	7.5	52	.02	.15	*
		11/75	7.0	350	-	35	69	.1	.26	*
		5/86	7.6	450	25	47	67	.06	-	**

* Ground Water Quality of the Great Miami Valley Aquifer, Ohio EPA, 1981.
** Ambient Ground Water Quality Sampling Program, Ohio EPA Southwest District Office (unpublished)

FIGURE 2.2

LOCATION INDEX FOR WATER QUALITY INDICATORS

395



SOURCE: Ohio Department of Natural Resources, County Groundwater Resource Maps.

"The ground-water characteristics have been mapped regionally, based upon interpretations of water well records and the area's geology and hydrology."

Aquifer boundaries are approximate.

Modified by OKI

MVRPC is currently undertaking development of a regional groundwater management plan. OKI is in the process of identifying potential pollution sources, collecting and assessing groundwater monitoring data, and establishing a public forum for the purpose of developing groundwater management and protection strategies.

As indicated in the first chapter, OKI is structured so that a majority of its board members are local elected officials representing governmental jurisdictions in the region; in turn, many of these jurisdictions are also water purveyors for their citizens. As previously noted, the OKI Executive Committee has resolved to pursue sole source designation for increased protection of the aquifer system. Their resolution can be found in Appendix A along with others from individual communities and from a rural water cooperative (i.e., purveyor). For further clarification of this relationship, Table 2.2 lists the Ohio jurisdictions represented on OKI's Board of Trustees, indicates which are also water purveyors, and, specifically, which use groundwater from the aquifer system being proposed for sole source designation.

TABLE 2.2

WATER PURVEYOR STATUS OF OHIO JURISDICTIONS REPRESENTED*

ON THE OKI BOARD OF TRUSTEES

Jurisdiction	Water Purveyor	Supplied from Proposed SSA
Butler County	X	X
City of Fairfield	X	X
City of Hamilton	X	X
City of Middletown	X	X
City of Oxford	X	X
City of Trenton	X	X
Clermont County	X	X
City of Milford	X	X
City of Blue Ash		
City of Cheviot		
City of Cincinnati	X	X
City of Deer Park		
City of Forest Park		
City of Harrison	X	X
City of Indian Hill	X	X
City of Lincoln Heights		
City of Loveland	X	X
City of Madeira		
City of Montgomery		
City of Mt. Healthy		
City of North College Hill		
City of Norwood	X	X
City of Reading	X	X

*Villages and townships are represented on the OKI Board as classes of jurisdictions rather than individual jurisdictions, and thus are not listed individually in this table.

Jurisdiction	Water Purveyor	Supplied from Proposed SSA
City of St. Bernard		
City of Sharonville		
City of Silverton		
City of Springdale		
City of Wyoming	X	X
Warren County	X	X
City of Franklin	X	X
City of Lebanon	X	X
City of Mason	X	X
City of Springboro	X	X

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CHAPTER III

SOLE OR PRINCIPAL DETERMINATION

A. Aquifer Service Area

1. Description of the Aquifer Service Area

The aquifer service area encompasses the aquifer and the areas served by public water supply purveyors that use the proposed Sole Source Aquifer. **In the MVRPC area,** maps were sent to each public water supply purveyor with a request for them to outline their service areas. Most maps were returned; in some cases, visits were necessary to obtain service area maps. The service areas include major portions of Champaign, Clark, Greene, Miami, and Montgomery Counties and smaller portions of Darke, Logan, Preble, and Shelby Counties. **Similarly, the delineations of water service areas in the OKI region were based on information provided by water suppliers. The water service areas which use the proposed Sole Source Aquifer include most of Butler, Hamilton, and Warren Counties and a smaller portion of Clermont County.**

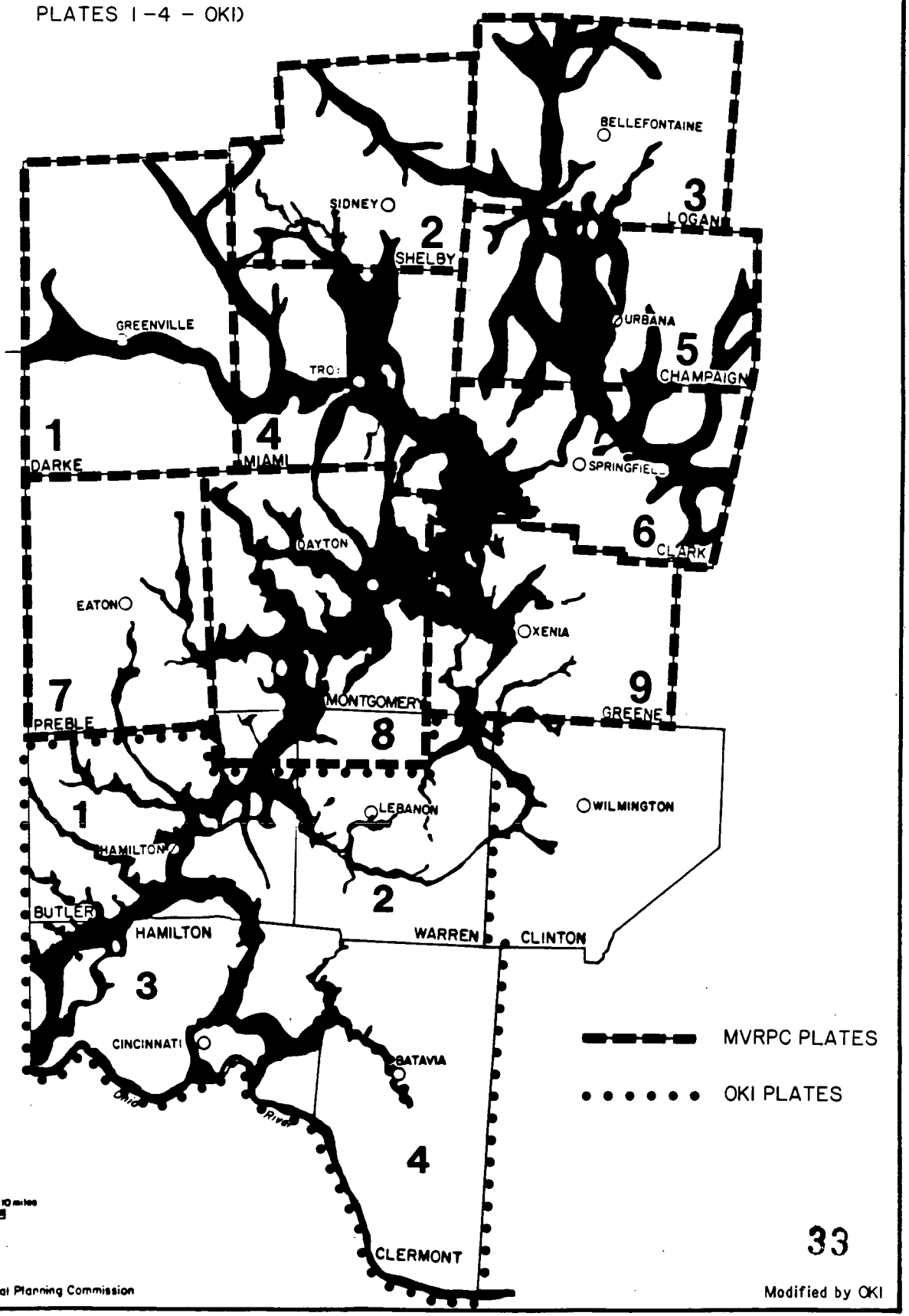
2. Map of the Aquifer Service Area

The County Topographic Maps (Plates 1-9, **MVRPC petition and OKI Plates 1-4)** display the boundaries of the aquifer and the public water supply service areas. These two units compose the aquifer service area. A location index for these plates is presented in Figure 3.1.

FIGURE 3.1

395

LOCATION INDEX FOR
COUNTY TOPOGRAPHIC MAPS WITH SELECTED DATA FOR
SOLE SOURCE AQUIFER PETITION (PLATES 1-9 - MVRPC and PLATES 1-4 - OKI)



33

Prepared By: Miami Valley Regional Planning Commission

Modified by OKI

B. Population

1. Entire population within the Aquifer Service Area: **1,738,857 (927,381 - MVRPC area, 811,476 - OKI area).**

2. Population within the Aquifer Service Area that is actually served by the proposed Sole Source Aquifer: **1,567,145 (897,631 - MVRPC area, 669,514 - OKI area).**

C. Current Sources of Drinking Water

1. Current Drinking Water Sources Matrix

The current drinking water sources matrix is presented in Table 3.1.

2. Description of Each Current Source

Approximately eighty-five percent of the public water supply **(97 percent - MVRPC area, 73 percent - OKI area)** and 100% of the private water supply in the proposed Sole Source Aquifer area comes from the Buried Valley Aquifer System. The current sources and methods used for calculating the percentages presented in the matrix (Table 3.1) are discussed below. As directed by the Petitioner Guidance, the narrative description of each current source does not include a description of the proposed Sole Source Aquifer.

TABLE 3.1

CURRENT DRINKING WATER SOURCES FOR THE AQUIFER SERVICE AREA

SOURCE \ USE	PUBLIC WATER SUPPLY (COMMUNITY AND NON-COMMUNITY)	PRIVATE AND OTHER	TOTAL
Petitioned Aquifer	207.099 mgd (73.008 - OKI 134.091 - MVRPC 85%)	3.799 mgd (0.963 - OKI 2.836 - MVRPC 2%)	210.898 mgd 87%
Other Aquifers	0.017 mgd (0.017 - OKI 0 - MVRPC < 0.1%)	0	0.017 mgd < 0.1%
Surface Water	31.627 mgd (27.180 - OKI 4.447 - MVRPC 13%)	0	31.627 mgd 13%
Transported from the Outside	0	0	0
Total	238.743 mgd (100.205 - OKI 138.538 - MVRPC 98%)	3.799 mgd 2%	242.542 mgd 100%

a. Public water supply

To determine the amount of water supplied by the public water supply purveyors within the proposed Sole Source Aquifer area, each public water supplier listed on Ohio EPA's comprehensive data sheets (Model State Inventory System) was sent a questionnaire **(MVRPC) or contacted by phone (OKI). The goal of the survey was to update** information regarding the source of the water supplied, the population served, the average daily supply, water service area, seasonal variations, and the potential capacity of the existing systems. **The MVRPC** questionnaires were returned by 60% of the public water supply purveyors. Information for all remaining water supply purveyors was obtained from Ohio EPA files and by telephone calls and site visits to water plant managers. The information collected by OKI was tabulated and appears in Table 3.2.

In the MVRPC area, only two public water systems within the proposed Sole Source Aquifer area rely on surface water: Piqua (Miami County) and Greenville (Darke County). These systems provide 4.447 million gallons per day (mgd) or about 3% of the water supply **in the MVRPC area).**

The City of Piqua is the largest supplier of surface water (2.647 mgd) **in the MVRPC area.** This water system has three intakes: the Piqua Hydraulic Canal, which is connected to the Great Miami River; the Great Miami River; and a gravel pit. The water plant manager noted on the questionnaire that, "The City of Piqua got 59 percent of its water in 1986 from a gravel pit. Part of the water in the gravel pit is from a shallow aquifer." This indicates that reliance on water from the Buried Valley Aquifer System is so widespread that even "surface water" suppliers acknowledge their use of this source.

Table 3.2
Summary Data for Public Drinking Water Systems for the OKI Portion of the Aquifer Service Area

County	Name	Township	Population	Average Withdrawn (mgd) Ground Water	Surface Water	Total	Maximum Production (mgd)	% Purchased
Butler	Airway MHP	St. Clair	150	0.019	0	0.019	0.019	0
	Butler County	Hamilton, City of	46,377	pur	pur	pur		100
	C&M Miami MHP	Ross	40	0.005	0	0.005	0.005	0
	Catalina MHP	Madison	1,000	0.092	0	0.092	0.092	0
	Edgewood MHP	Wayne	65	0.005	0	0.005	0.005	0
	Fairfield	Fairfield	32,000	3.300	0	3.300	8.000	0
	Green Tree Apts.	Ross	71	0.007	0	0.007	0.007	0
	Hamilton	Hamilton, City of	67,001	13.960	0	13.960	27.000	0
	Jackson Road MHP	St. Clair	210	0.015	0	0.015	0.015	0
	Linda Park MHP	St. Clair	187	0.015	0	0.015	0.015	0
	Middletown	Middletown, City of	75,000	12.000	0	12.000	20.000	0
	Monroe	Lemon	5,300	0.751	0	0.751	1.500	0
	New Miami	St. Clair	4,250	0.300	0	0.300	1.400	0
	Oxford	Oxford	22,500	2.100	0	2.100	2.100	0
	Seven Mile	St. Clair, Wayne	841	0.088	0	0.088	2.592	0
	Suburban MHP	Ross	180	0.020	0	0.020	0.020	0
	The Water Association	Hanover	23,500	1.830	0	1.830	3.600	0
	Trail - Otel MHP	Fairfield	150	0.018	0	0.018	0.018	0
	Trenton	Trenton, City of	6,401	0.588	0	0.588	1.000	0
	Village MHP	Hanover	50	0.005	0	0.005	0.005	0
	Walnut Grove MHP	Lemon	72	0.020	0	0.020	0.020	0
	Woodland Manor Nursing Home	Milford	48	0.008	0	0.008	0.008	0
		TOTALS	285,393	35.15	0	35.146	67.421	

Table 3.2 (continued)
Summary Data for Public Drinking Water Systems for the OKI Portion of the Aquifer Service Area

County	Name	Township	Population	Average Withdrawn (mgd) Ground Water	Surface Water	Total	Maximum Production (mgd)	% Purchased
Clermont	Batavia	Batavia	1,900		0.180	0.180	0.800	0
	Clermont Co. MGS Subdistrict	Goshen, Miami, Stonelick	33,750	1.650	0.000	1.650	1.650	0
	Clermont Co. PUB Subdistrict	Batavia, Miami, Stonelick	341	0.017 ††	0.000	0.017	0.017	0
	Lake Remington MHP	Miami	170	0.012	0.000	0.012	0.012	0
	Milford	Milford, City of	6,200	0.560	0.000	0.560	1.368	0
		TOTALS	42,361	2.239	0.180	2.419	3.847	
Hamilton	Arlington Heights	Arlington Heights Village of	1,100		0.185 (pur)	0.185	0.185	100
	Branch Hill MHP	Crosby	350	0.028	0.000	0.028	0.028	0
	Candlelight MHP	Harrison	60	0.003	0.000	0.003	0.003	0
	Cincinnati	Cincinnati, City of	287,194 170,721 - GW 116,413 - SW	15.000	22.815	37.815	37.815	0
	Cleves	Miami	4,325	0.640	0.000	0.640	1.350	0
	Dry Fork MHP	Whitewater	180	0.012	0.000	0.012	0.012	0
	Glendale	Glendale, Village of	2,000	0.388	0.000	0.388	0.760	0
	Harrison	Harrison	6,700	0.762	0.000	0.762	2.592	100
	Harrison Township Water Corp	Harrison	1,080			0.000		0
	Haven Park West MH	Crosby	300	0.012	0.000	0.012	0.012	0
	Indian Hill	Indian Hill, City of	15,000	2.113	0.000	2.113	4.000	0
	Lockland	Lockland, Village of	4,300	1.020	0.000	1.020	1.020	0
	Loveland	Loveland, City of	10,400	1.700	0.000	1.700	1.700	
	Maple Leaf MHP	Harrison	100	0.010	0.000	0.010	0.010	

Table 3.2 (continued)
Summary Data for Public Drinking Water Systems for the OKI Portion of the Aquifer Service Area

County	Name	Township	Population	Average Withdrawn (mgd) Ground Water	Surface Water	Total	Maximum Production (mgd)	% Purchased
Hamilton continued	Martins MHP	Whitewater	128	0.009	0.000	0.009	0.009	0
	Norwood	Norwood, City of	22,148		4.000 (pur)	4.000	4.000	100
	Reading	Reading, City of	12,800	1.620	0.000	1.620	2.800	0
	Red Wood MHP	Whitewater	90	0.007	0.000	0.007	0.007	0
	Rolling Acres MHP	Harrison	580	0.060	0.000	0.060	0.060	0
	Twightwee Welfare Corp.	Symmes	80	0.007	0.000	0.007	0.007	0
	Westbrook Village	Whitewater	450	0.032	0.000	0.032	0.320	0
	Wyoming	Wyoming, City of	9,700	1.500	0.000	1.500	2.000	0
		TOTALS	379,065	24.92	27.000	51.923	58.690	
Warren	Caesar's Lake MHP	Wayne	115	0.008	0	0.008	0.008	0
	Carlisle Manor Health Center	Franklin	41	0.005	0	0.005	0.005	0
	Corwin	Wayne	100	pur.		pur.	0.000	100
	Dakin Mobile Estate	Wayne	196	0.010	0	0.010	0.010	0
	Dubois Condominium	Franklin	650	0.058	0	0.058	0.058	0
	Franklin	Franklin	10,500	2.100	0	2.100	4.600	0
	Harlan-Eastfork Water System	Salem	13,475	1.000	0	1.000	1.000	0
	Lebanon	Lebanon, City of	10,000	1.110	0	1.110	3.000	0
	Mason	Deerfield	10,600	1.100	0	1.100	2.000	0
	Morrow	Salem	2,200	0.256	0	0.256	0.256	0
	Ohio Cr./Lebanon Corr. Inst.	Turtle Creek	2,500	0.986	0	0.986	0.986	0
	Otterbein Home	Turtle Creek	735	0.075	0	0.075	0.075	0
	Shadow Lake Village MHP	Turtle Creek	600	0.035	0	0.035	0.035	0

Table 3.2 (continued)
Summary Data for Public Drinking Water Systems for the OKI Portion of the Aquifer Service Area

County	Name	Township	Population	Average Withdrawn (mgd) Ground Water	Surface Water	Total	Maximum Production (mgd)	% Purchased
Warren continued	South Lebanon	Union, Hamilton	3,600	0.400	0	0.400	0.500	0
	Springboro	Clear Creek, Franklin	5,400	0.700	0	0.700	1.400	4
	Warren County	Lebanon, City of	22,591	2.550	0	2.550	2.550	12.7
	Waynesville	Wayne	2,100	0.324	0	0.324	0.790	0
		Totals	85,403	10.717	0	10.717	17.273	
	Grand Totals		792,222	73.025	27.180	100.205	147.231	

The Greenville Water System has two sources of water, Greenville Creek and a well field on the southwestern side of the City. The creek supplies 70 percent (1.8 mgd) of the water to the City. The water plant manager reports that surface water and groundwater are blended during the winter to raise the water temperature and to keep pipes from freezing. Due to surrounding agricultural land use, Greenville Creek is not suitable for water supply during periods of high run-off following storm events. Greenville relies solely on groundwater when these conditions prevail.

In the OKI area, three public water systems within the proposed Sole Source Aquifer area rely exclusively on surface water: Batavia (Clermont County), Arlington Heights (Hamilton County), and Norwood (Hamilton County). The Batavia system provides 0.180 mgd, with its intake on the East Fork of the Little Miami River. The Village of Arlington Heights and City of Norwood uses 0.185 mgd and 4 mgd, respectively, all of which is purchased from the City of Cincinnati.

The City of Cincinnati uses surface water from the Ohio River and groundwater from a well field located in southern Butler County near the City of Fairfield. As Table 3.2 indicates, the average groundwater withdrawal of 15 mgd supplies a population of 170,721. A new pumping facility planned for 1989 will boost the city's groundwater withdrawal to 35 mgd. Another 116,473 people within the Cincinnati service area reside over the aquifer, but are served by an estimated 22.8 mgd of surface water.

b. Private water supply (domestic wells)

The private water supply accounts for the households within the area of the Buried Valley Aquifer System that are not served by a public water system. The water

supply for these households is exclusively groundwater, as confirmed by several County Health Departments (Champaign, Darke, Greene, and **Hamilton**). Well logs on file at the Ohio Department of Natural Resources indicate that within the proposed Sole Source Aquifer area, these supplies come from sand and gravel aquifers, in other words, principally from the Buried Valley Aquifer System. The total population for the proposed designated area that is served by domestic wells is **75,964 (56,710 - MVRPC area; 19,254 - OKI area.) Water use is estimated to be 3.799 mgd (2.836 mgd - MVRPC area; 0.963 - OKI area).**

Table 3.3 is a tabulation of each township's population that is served by domestic wells within the proposed Sole Source Aquifer area. **In the MVRPC area,** estimates of the population served by domestic wells were based on township population figures given in the 1980 census. Populations for unincorporated areas that are served by public water supplies were subtracted from township populations. The resulting number was multiplied by the percent of the area in the township that is over the aquifer and not served by a public water system. The procedure for calculating the population served in each township was complicated when public water supply systems crossed township lines. When this occurred, the townships affected were considered as a group. **In the OKI area, populations served by domestic wells were estimated by counting houses in areas overlying the aquifer but not served by public water systems. House counts were then multiplied by average household size by township as determined by the 1980 census.**

Water use estimates for the population served by domestic wells were derived by multiplying the population by 50 gallons/day, an average water use figure provided by the Ohio EPA, Southwest District Office, Division of Public Water Supply.

TABLE 33

CURRENT PRIVATE DRINKING WATER POPULATION AND USE

COUNTY	TOWNSHIP	POPULATION	WATER USED (MGD)
Butler	Fairfield	207	
	Union	260	
	Hamilton (City of)	18	
	St. Clair	912	
	Ross	1898	
	Lemon	250	
	Oxford	77	
	Wayne	509	
	Madison	2907	
	TOTAL	7038	0.352
Clermont	Batavia	59	
	Stonelick	25	
	Union	119	
	Miami	601	
	TOTAL	804	0.040
Hamilton	Harrison	2154	
	Crosby	1611	
	Whitewater	705	
	Symmes	100	
	TOTAL	4570	0.229
Warren	Franklin	5336	
	Turtle Creek	300	
	Union	259	
	Wayne	823	
	Salem	93	
	Hamilton	29	
	Massie	2	
	TOTAL	6842	0.342
	GRAND TOTAL	**19,254**	**0.963**

3. Seasonal Variations

Most water systems, surface and groundwater, do not experience any significant seasonal variation in the amount the provide. **In the MVRPC area,** two water system managers reported that they provide slightly more water in the summer than in the winter. **In the OKI area, water system managers generally have reported that they provide slightly more water during summer than winter.**

In the MVRPC area, two public water supply systems have more significant seasonal variations. Greenville, as discussed previously, relies solely on groundwater during storm events that flush agricultural run-off into the stream that serves as its primary source of drinking water. The second supplier with significant variation is the Montgomery County Greater Moraine Sanitary District. Montgomery County and the City of Dayton have recently entered into an agreement for the City to provide water for the County system. As a result, the City's services population increased by approximately 40%. The City provided water to the expanded area until a large fire at a warehouse near the wellfield in Spring, 1987 caused several wells to be taken out of production. Because the City was no longer able to meet the demands of the Greater Moraine Sanitary District, some county wells that previously had served the area were returned to use. It is anticipated that the County may have to provide some of its own water every summer until a new City wellfield is constructed. However, it must be emphasized that no one is certain about the use of the County wells in future years.

In the OKI area, a serious seasonal water supply problem has developed in the City of Oxford in Butler County. The arrival of the students at Miami University each fall

increases the water service area's population by almost 70 percent, and the higher water demand coincides with a period of low natural recharge to the supply aquifer. Recently, increasing student enrollments and periods of droughts have exacerbated the problem. During Fall 1987, the shortage became especially acute, prompting the city council to ban all unnecessary water use through at least February 2, 1988. As a long-range solution to these shortages, the City of Oxford plans to develop a new well field which may be in use by Fall 1988.

Because of low recharge during 1987, the Clermont County Sewer and Water District supplemented their supply with water purchased from the interconnecting Harlan-East Fork Water System. This and other similar situations have been temporary and are not anticipated to recur annually.

4. Actual Use Versus Potential Capacity

Most water systems are designed to accommodate potential growth in the areas they serve as well as to provide back-up or emergency supplies if part of the system becomes inoperable. The maximum capacity for groundwater systems is 401.566 mgd (281.799 mgd - MVRPC area, 119.767 mgd - OKI area). Actual use is 207.099 mgd (134.091 mgd - MVRPC area, 73.008 mgd - OKI area). For surface water systems, the maximum capacity is 41.40 mgd (13.60 mgd - MVRPC area, 27.80 mgd - OKI area) and actual use is 31.63 mgd (4.45 mgd - MVRPC area, 27.18 - OKI area).

5. Why the Source Is Not Used to Its Full Capacity

The predominant reason why the groundwater and surface water sources are not used to their full capacities is that the water systems simply can provide more water than

is needed. Some water systems have reserve wells or extra capacity for emergency supply. A few water supply managers pointed out that as they are upgrading their systems, various portions of their systems may be shut down at different times. The additional capacity is needed and used on an irregular basis, especially during system repair. In the MVRPC area, Montgomery County has a large amount of additional capacity because its three well fields have recently been taken out of service. The use of the well fields was discontinued primarily because a treatment plant was needed and it was less expensive to interconnect with the City of Dayton.

D. Potential Alternative Sources of Drinking Water

In this section, potential alternative sources of drinking water are considered. Although various political jurisdictions are mentioned, potential alternative water sources have been evaluated primarily from a regional perspective.

1. Alternative Drinking Water Sources Matrix

Table 3.4 corresponds to Exhibit 3-5 in the Petitioner Guidance. The "Petitioned Aquifer Supply" is the amount of drinking water currently supplied by the Buried Valley Aquifer System in the OKI planning area. Only existing surface water supplies are included in the increment available from current sources.

The matrix indicates that alternative water sources would supply less water than presently is withdrawn from the petitioned aquifer in the OKI planning area. However, because the alternative sources total is almost equal to the "Petitioned Aquifer Supply,"

TABLE 3.4

ALTERNATIVE DRINKING WATER SOURCES

(A) PETITIONED AQUIFER SUPPLY 73,008,000 gpd

SOURCE	ESTIMATED DAILY SUPPLY
(B) Increment from Existing Surface Water Systems	600,000
(C) Alternative Source 1 - Bedrock Wells	- 0 -
(D) Alternative Source 2 - Existing Impoundments	< 72,000,000
	(E) Total < 72,600,000

the alternative sources have received further evaluation according to the steps presented in the Petitioner Guidance.

For Current Source - Existing Surface Water Systems

2. Description

In the OKI area, there are two existing surface water systems that could provide alternative sources of drinking water if the Buried Valley Aquifer System became unusable. The systems belong to the City of Cincinnati in Hamilton County and the Village of Batavia in Clermont County. Their water intakes and current service areas are shown on Plates 3 and 4.

3. Why Source Not Currently in Use

Both sources are currently in use.

4. Legal or Institutional Constraints

No specific constraints to expansion have been identified at this time. Expansion of the larger, more intricate Cincinnati system, however, would be expected to be more complicated than expansion of the smaller Batavia system.

5. Estimated Daily Supply

The Batavia water system is capable of supplying 0.8 mgd which is approximately 0.6 mgd more than it currently provides on an average day. Theoretically, this surplus would be available to the surrounding Clermont County water service area (Plate 4).

Approximately 35 mgd more surface water could be supplied by the Cincinnati system than is provided currently. If the aquifer were to become contaminated, 15 mgd surface water would be necessary to supply Cincinnati customers now served by groundwater. The remaining 20 mgd surplus could be available for distribution to other areas.

6. What Is Necessary to Transfer to These Sources

For both systems, water distribution lines from the current service areas to surrounding areas would be needed. Expanding Batavia's service area also would require construction of a lift station. The City of Cincinnati's plants also would require modification for water treatment, if the system could not rely on groundwater for part of its supply.

7. Estimated Cost

Expansion costs would include 1) operation, maintenance, and treatment costs and 2) installation costs of new water lines. Annual O&M/treatment costs should be similar to current residential customer costs which are $192.00 for Batavia, $128.16 for Clermont County and $102.10 for Cincinnati*. Estimates of average costs per mile of water

*Based on water usage of 9600 cubic feet/year.

distribution lines were $135,000 to $160,000 for the Batavia system expansion (10-inch lines) and $660,000 to $792,000 for the more urbanized Cincinnati system expansion (24-inch lines).

8. Economic Feasibility

The threshold for the economic feasibility of using a potential water source is defined in the Petitioner Guidance as 0.4 to 0.6 percent of the mean household income of an area. Applying this factor to the mean annual income for the Batavia area ($21,373 as reported in 1980 Census data for Clermont County) yielded an annual threshold range of $85.50 to $128.24. Because current household water costs already exceed this range, adding the cost of new water lines would make expansion of the service area economically infeasible.

Applying the 0.4 to 0.6 percent factor to Cincinnati's mean annual income ($27,195 as reported in 1980 Census data for Hamilton County) yielded an annual threshold range of $108.78 to $163.17. The average annual household cost ($102.10) is below the lower limit. Because of the complexity of expanding the Cincinnati system within Hamilton County or possibly north into Butler County, it would be difficult to accurately estimate miles of water line needed. However, the high cost of line installation in urban areas combined with current O&M Treatment costs could approach or exceed the economic threshold range.

A realistic assessment of expanding the Cincinnati surface water service area would involve analyzing complex variables in a process that exceeds the scope of this petition. From a perspective of future demographic growth and development, supplying surface water to areas currently served by groundwater may not be a viable option. The faster growth of eastern Hamilton County which relies primarily on surface water compared to the slower growth of western Hamilton County which relies on groundwater is likely to create a higher water demand, thus reducing or eliminating the surface water supply available to additional areas.

Because the increment from the Cincinnati water system is uncertain, only the 0.6 mgd increment from the Batavia water system has been added to line B of Table 3.4

For Alternative Source 1 - Bedrock Wells

2. Description

In this section, groundwater from bedrock areas surrounding the proposed Sole Source Aquifer is considered as a potential source of drinking water. Ground-Water Resources Maps prepared by the Ohio Department of Natural Resources (ODNR) indicate that well yields in bedrock areas of Butler, Clermont, Hamilton and Warren Counties are extremely low (Schmidt, 1986, Walker, 1986 a, b and c). Bedrock generally consists of interbedded plastic shales and thin limestone layers covered with clayey glacial till.

3. Why Source Not Currently in Use

Because of the region's historical development along river corridors and the abundant good quality water available from the Buried Valley Aquifer System, the use of relatively low yielding bedrock wells has not been considered for public drinking water. Current sources have been more than sufficient in meeting water needs.

4. Legal or Institutional Constraints

No specific constraints have been identified at this time. It is assumed that farm land would have to be procured for this purpose. Legal constraints may be encountered by communities seeking to acquire land or control land use for wellhead protection beyond their jurisdictions.

5. Estimated Daily Supply

The average yield and depth of bedrock wells in each county was calculated from bedrock well data shown on the ODNR Ground-water Resources maps. This approach was validated by the fact that well sites mapped are considered typical for the area shown. Table 3.5 summarizes yield data by county and also includes the number of wells that would be needed to replace the groundwater now supplied by the Buried Valley Aquifer in each county. These numbers range from 1,187 wells in Clermont County to 28,714 wells in Butler County.

TABLE 3.5

POTENTIAL WATER SUPPLY FROM BEDROCK WELLS

County	Avg. Yield (gpm)[a]	Max. Yield (gpm)	Water Supplied by SSA (mgd)	No. Wells Required
Butler	0.85	10	35.146	28,714
Clermont	0.98	5	2.222	1,187
Hamilton	1.40	5	24.923	17,661
Warren	1.30	10	10.717	5,316

[a]Average and maximum yields determined from 1986 County Ground-Water Resources Maps, Ohio Department of Natural Resources, Division of Water.

Sustained yields over a long period of time would require continuing recharge to the bedrock. Because the area is not recharged by major streams, recharge from precipitation would be required to sustain water withdrawal. However, the low hydraulic conductivities of the overlying clay and glacial till limit potential recharge.

6. What Is Necessary to Transfer to This Source

A large number of bedrock wells would have to be constructed and connected with existing water treatment facilities and distribution systems. The highly mineralized bedrock well water may require treatment beyond that which is currently provided.

7. Estimated Cost

The estimated installation of a new well, based upon current figures provided by Moody's of Dayton, Inc., includes $10,500 for a pump, $3,800 for a pumping test and $50 per foot for drilling and installation of partial casing. Depending upon well depth, total estimated costs per well range from $18,025 in Butler County to $18,825 in Warren County.

8. Economic Feasibility

Because of the large number of wells required to provide an alternative water supply, the well installation costs alone make this alternative infeasible. Adding the cost

of distribution lines and O&M costs of such an extensive system further elevates the cost beyond economic feasibility.

Bedrock wells, therefore, do not provide a viable alternative (See Table 3.4, line C).

For Alternative Source 2 - Existing Surface Water Impoundments

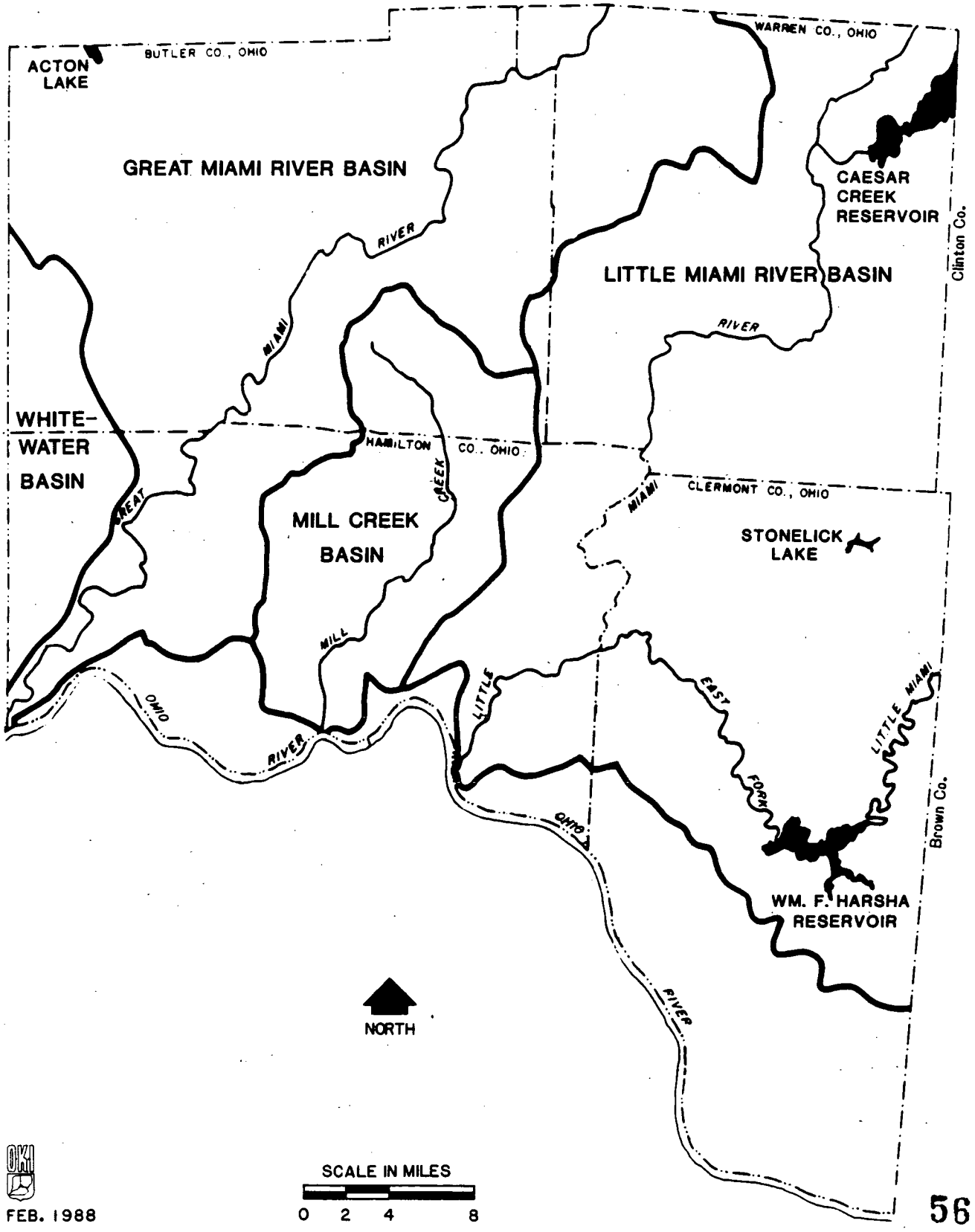
2. Description

Within the OKI area, there are two existing reservoirs which have been developed by the U.S. Army Corps of Engineers and have been designed to provide public water supply. These are 2,830-acre Caesar Creek Reservoir in northwestern Warren County and 2,160-acre William F. Harsha Reservoir (also known as East Fork Lake) in central Clermont County. A smaller impoundment, Acton Lake, lies primarily in Preble County but includes 200 acres in Butler County. Although designed as a recreational impoundment, Acton Lake waters have supplemented water supply to the city of Oxford during recent water emergencies. Stonelick Lake, a 181-acre recreational impoundment in northwestern Clermont County, is not designated for use as a public water supply. Since its construction during the 1950's, sediment has reduced its original 25 foot depth by more than half, impairing even recreational use.

Figure 3.2 illustrates the locations of these reservoirs within the OKI planning area. All four reservoirs are within the Ohio state park system.

FIGURE 3.2

LOCATION OF RESERVOIRS in the OKI PLANNING AREA



FEB. 1988

In considering the use of surface water impoundments to replace groundwater from the aquifer, the hydraulic connection between the aquifer and surface waters is important. The locations of reservoirs with respect to potential contamination sources also is important. The reservoirs shown in Figure 3.2 are in predominantly rural areas upstream from the more heavily populated and industrialized corridors within the OKI area.

3. Why Source Not Currently in Use

Groundwater from the Buried Valley Aquifer and surface water from the Ohio River generally have been sufficient in supplying the area's water needs. More recently, however, increasing consideration has been given to surface impoundments as alternative water sources. Periodic water shortages and expanding populations have underscored the need to develop alternative supplies. As mentioned previously, low annual recharge to the aquifer has caused groundwater shortages in the City of Oxford which were alleviated temporarily by releasing surface water from Acton Lake. In Clermont County, the public water supply available in Harsha Reservoir is now considered as a long-term solution to water shortages related to drought periods and increased demand. The county plans to build a water treatment plant near Harsha Reservoir and begin withdrawing 10 mgd by 1990. Officials of the Clermont County Sewer and Water District are projecting withdrawals of 20 mgd by the year 2005.

4. Legal or Institutional Constraints

Because the Ohio Department of Natural Resources owns the public water supply rights to both Caesar Creek and Harsha Reservoirs, any water purveyor planning to withdraw surface water from either lake must first purchase water rights or make other legal arrangements with the Ohio DNR. The Clermont County Sewer and Water District intends to purchase all the water rights to Harsha Reservoir. Therefore, any other water purveyors that want to use Harsha Reservoir water would be required to negotiate with them.

As implied earlier, Acton and Stonelick Lakes, which are both managed by the Ohio DNR, are considered too small for public water supply. During Oxford's water emergencies, supplemental water releases from Acton Lake have never occurred for more than four days.

5. Estimated Daily Supply

Information provided by the U.S. Army Corps of Engineers' District Office in Louisville indicates that Caesar Creek and Harsha Reservoirs are capable of providing 37 mgd and 35 mgd, respectively, for public water supply. The combined dependable water volume from both reservoirs therefore totals 72 mgd.

6. What is Necessary to Transfer to This Source

Transferring to this water source would require construction of water intake structure and treatment plants at the reservoirs. Because surface water treatment is more complex than current treatment of groundwater from the Buried Valley Aquifer System, the new treatment facilities would have to provide for coagulation, flocculation and biological treatment. Major interconnections with existing waterlines would also be necessary.

7. Estimated Costs

The estimated costs of this alternative include operation and maintenance and construction costs of new treatment plants, water intake structures, and interconnects. It is assumed that construction of a water treatment plant at Caesar Creek Reservoir would be at least $10 million, the projected cost of the treatment facility at Harsha Reservoir. Similarly, estimates by the Clermont County Sewer and Water District of $264,000 per mile for interconnects (24" ductile iron pipe) would be applicable to other rural areas. Higher costs per mile would be incurred in more developed areas.

8. Economic Feasibility

Theoretically, Caesar Creek and Harsha Reservoirs are capable of supplying a large volume of water to the OKI planning area, but these potential sources are not "near" to high water demand areas (e.g. Butler County) as defined by the U.S. EPA's Petitioner Guidance.

"Near" has been defined as "being within a distance normal to the local area for tapping into a water source." Because there are no eminent plans to utilize Caesar Creek Reservoir as a public water supply, the "distance normal to the local area" has not been established. This distance, however, has been determined for Harsha Reservoir. According to the Ohio Department of Natural Resources, Division of Water, there are plans to extend pipelines as far as 5.5 miles from the reservoir.

Butler and Hamilton Counties, the counties with the greatest groundwater demand, are more than 5.5 miles from either of the two major reservoirs. Therefore, the economic feasibility of this alternative has not been considered in detail. Although Caesar Creek and Harsha Reservoirs could supply water to part of the OKI planning area, it is concluded that they are too far from the areas of greatest need to provide a total replacement source if the Buried Valley Aquifer were to become contaminated.

REFERENCES

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U.S. Bureau of the Census. 1980a. Characteristics of the Population, Number of Inhabitants.

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_____ 1986b. Ground-Water Resources of Hamilton County (map). Ohio Department of Natural Resources, Division of Water.

_____ 1986c. Ground-Water Resources of Warren County (map). Department of Natural Resources, Division of Water.

CHAPTER IV

HYDROGEOLOGICAL DATA

A. The Aquifer and Its Location

1. Description of Locale, Topography, Climate, Geology, and Groundwater

The Buried Valley Aquifer System associated with the Great Miami and Little Miami Rivers lies entirely within the till plains of the central lowland in southwestern Ohio. The region is characterized by broad valleys with relatively small streams flowing through them. The valleys are the remnants of a pre-glacial drainage system. When southwestern Ohio was covered by glacial ice, its hydrogeologic character was significantly altered. As the glaciers melted, the valleys were partially filled with outwash. The floods of meltwater carried vast quantities of glacial materials down the valleys. Changes in velocity caused deposition to range in size from coarse gravel to fine sand and even to silt and clay. Several hundred feet of glacial deposits are now on top of the original stream beds in these valleys. Many present-day streams flow in the ancient river valleys, but at much higher elevations than the original streams. For example, Mill Creek flows in the valley cut by the ancestral Ohio, and Caesars Creek follows the former Hamilton River (Henry, 1973). In other places the modern streams flow in freshly cut valleys. Some of the old valleys were abandoned as waterways (Bernhagen and Schaefer, 1947).

The buried valleys of southwest Ohio are the most productive groundwater sources in the State. In Ohio, Montgomery County leads the State in groundwater usage (Eberle and McClure, 1980). In the Class 1 buried valleys, impressive yields are often found for industrial and municipal supplies. For example, a well near the Mad River at the mouth of Buck Creek yielded 7000 gallons per minute when first developed (Norris et al., 1952). The other extreme in the Buried Valley System is exemplified by the pre-glacial Teays River Valley, a Class 2 aquifer that crosses the northeastern part of the Great Miami River basin. This 300-foot deep valley is filled mostly with silt and clay and is a poor location for wells (Todd, 1960).

Southwestern Ohio is classified as having a temperate, humid climate. Annual precipitation averages 35 to 41 inches. The average temperature is 51 - 53 degrees (ODNR, 1962).

2. Topographic Map of Aquifer Location

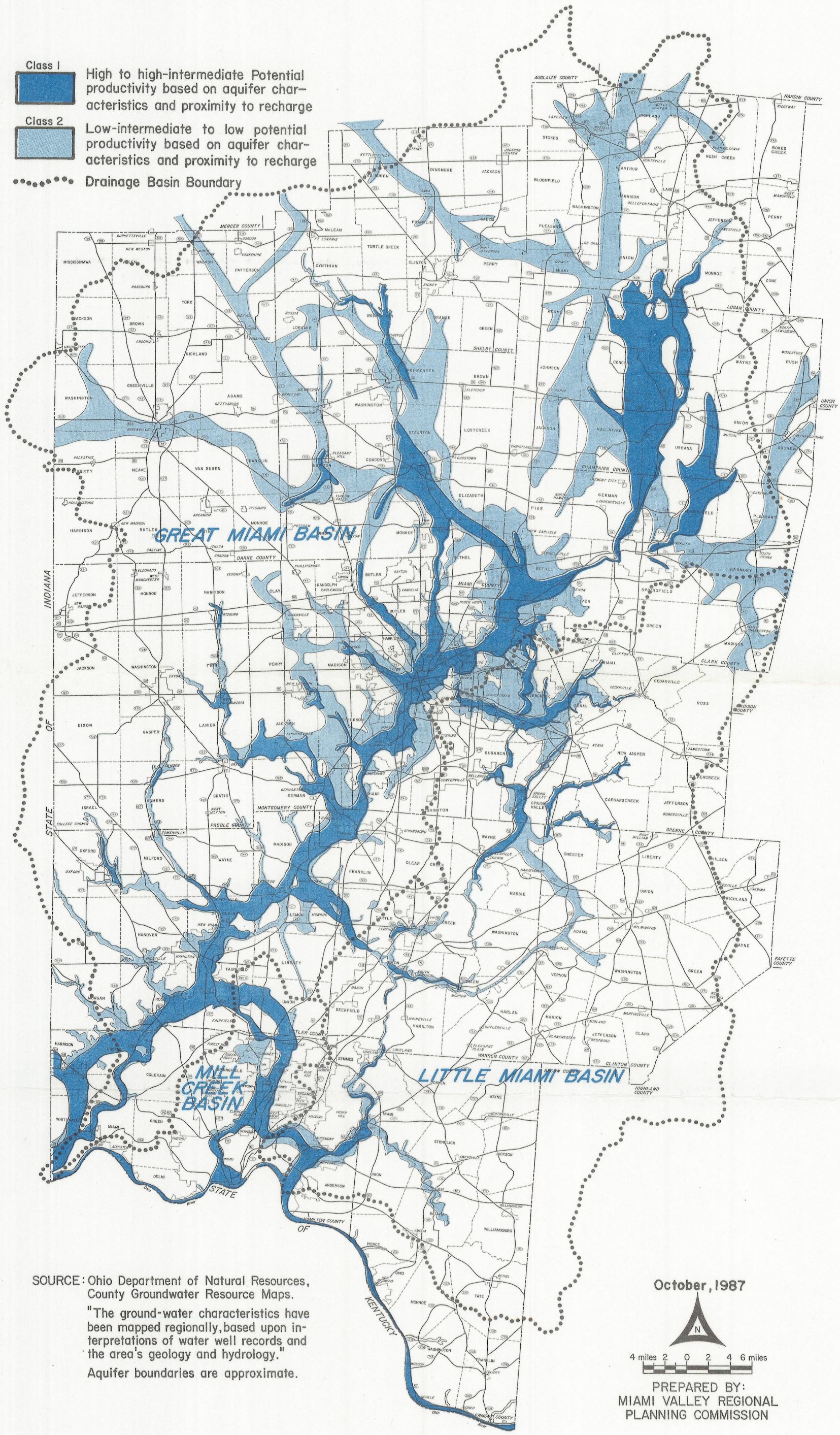
Aquifer boundaries are shown on **Figure 4.1** and on the County Topographic Maps (Plates 1-9, **MVRPC petition and OKI Plates 1-4**). Because the area of the proposed Sole Source Aquifer is large, U.S.G.S. topographic maps with a scale of 1 inch = 1 mile have been used.

The County Topographic Maps illustrate the location of the system and show the entire network of buried valley aquifers which have been divided into two classes (Class 1 and Class 2) on the basis of yield. Within the Proposed Designation Area, both classes are being petitioned for designation as the Sole Source Aquifer. The location of the buried valleys was taken from Groundwater Resources maps prepared

FIGURE 4.1

BURIED VALLEY AQUIFER SYSTEM

GREAT MIAMI/LITTLE MIAMI/MILL CREEK BASINS



SOURCE: Ohio Department of Natural Resources, County Groundwater Resource Maps.

"The ground-water characteristics have been mapped regionally, based upon interpretations of water well records and the area's geology and hydrology."

Aquifer boundaries are approximate.

October, 1987

4 miles 2 0 2 4 6 miles

PREPARED BY:
MIAMI VALLEY REGIONAL PLANNING COMMISSION

by the Ohio Department of Natural Resources (ODNR), Division of Water. An explanation of the process used by ODNR to produce the County Groundwater Resources maps was provided by Michael Hallfrisch, a hydrogeologist with ODNR's Division of Water, Groundwater Resources Section. His letter to the Miami Valley Regional Planning Commission is included in Appendix B.

The northern boundary is defined by the drainage divide between the Great Miami River Basin and the Maumee River Basin. As there have not been field studies to define the direction of flow in the northern Class 2 buried valleys, it was assumed that the groundwater divide approximates the surface water divide. However, it was found that the groundwater gradient in one segment of the mainsteam of the aquifer is toward the north. The divide appears to be located in northwest Champaign County. The potentiometric lines and data points indicating the existence of the divide are shown on MVRPC's County Topographic Maps for Champaign, Logan, and Shelby Counties. Where the groundwater divide is more precisely known, it is used to define the northern aquifer boundary. **The southern boundary of the aquifer in the MVRPC planning area is the Montgomery-Warren County line just north of the Franklin-Carlisle area.**

In the OKI planning area, the eastern and western boundaries of the Great Miami River aquifer system have been shown to stop at county lines. The aquifer presumably extends from the northeastern corner of Warren County into the northwestern corner of Clinton County, but available information is inadequate for delineating the aquifer's configuration in Clinton County.

To the west, shallow aquifers may extend into Indiana from Butler County along Indian Creek and Dry Fork and aquifers do extend into Indiana from Hamilton

County along the Whitewater and Ohio Rivers. There appears to be little data on the aquifer configuration of any of these streams. However, a description of the aquifer system of the Whitewater Basin is planned for publication in mid-1988 by the Indiana Department of Natural Resources. After it is available, a Sole Source Designation petition for the Whitewater aquifer may be prepared by the Indiana Department of Environmental Management in coordination with OKI.

Several public water supply well fields have been included in the Sole Source Aquifer Petition even though they are depicted as being outside the boundaries of the buried valley aquifer, as defined by the ODNR maps. Defining an aquifer this large necessarily results in some inaccurate boundary estimates. By examining the well logs for the well fields located just outside the line for the buried valley, it was determined that several additional public water supply areas in the MVRPC planning area should be included with the petition because their wells tap water from the Buried Valley Aquifer System. The public water supplies are the: City of Eaton (Preble County), Village of Versailles (Darke County), Village of South Vienna (Clark County), and the Village of St. Paris (Champaign County).

3. Aquifer's Hydrology and Hydrogeology

a. Aquifer and non-aquifer units

Those portions of the buried valley aquifer system for which Sole Source Designation is sought comprise the aquifer units relevant to this petition, but two other general units require discussion as potential aquifers. The first is the glacial till deposited as ground and end moraines. Till generally is not used for water supplies because

it seldom yields enough water even for domestic purposes. Occasionally, interbedded sand and gravel layers may be encountered, usually just above the surface of the bedrock. These zones can be developed for domestic use (Norris, et al., 1952). It is clear that the tills are usually non-aquifer units.

Bedrock systems are the second group of potential aquifer units. Stratigraphic sequences for Montgomery (Norris et al., 1948), Greene (Norris, 1956), and Clark (Norris, et al., 1952) Counties were combined **to describe the bedrock's water-bearing properties and its potential for use as a water supply within the area of the proposed Sole Source Aquifer (Table 4.1). The following bedrock descriptions are applicable to both the MVRPC and OKI areas:**

Silurian: Generally adequate water supplies available for farm and domestic requirements, except from the Osgood and Massie shales. Wells ordinarily yield from 5 to 15 gallons a minute. A few wells yield more than 100 gallons a minute. Water is very hard. Important spring horizons at base of system, above Massie shale, and in Springfield formation.

Ordovician (Richmond, Maysville, and Eden): Wells generally yield no water, or seldom more than 1 gallon a minute. Water in places is high in iron or salt and is hard. Where water is present it generally occurs in the top few feet of strata.

Ordovician (pre-Eden): Generally yields salt water at base.

TABLE 4.1

STRATIGRAPHIC SEQUENCE FOR CLARK, GREENE AND MONTGOMERY COUNTIES[a]

System	Group	Formation	Avg. Thickness (ft.)
Silurian	Cayuga	no data available	
	Niagara	Cedarville dolomite	75
		Springfield dolomite	14
		Euphemia dolomite	7
		Laurel dolomite	5
		Osgood calcareous shale and limestone	20
		Dayton limestone	7
	Clinton	Brassfield limestone	30
Ordovician		Richmond, Maysville, and Eden (undifferentiated)	1000
	Pre-Eden	Trenton limestone	650

[a]This sequence is applicable to the OKI planning area.

b. Geologic cross sections

Cross sections for the Buried Valley Aquifer System were obtained from US Geological Survey and Ohio Department of Natural Resources publications as well as from various consulting reports and from documents related to the MVRPC's Groundwater Management and Protection Program. Figure 4.2 depicts the locations of the cross sections. Figures 4.3 - 4.15 are transverse cross sections of the Buried Valley Aquifer System. Considerable effort was made to ensure that the transverse cross sections cover the aquifer completely and represent the variations within the aquifer system.

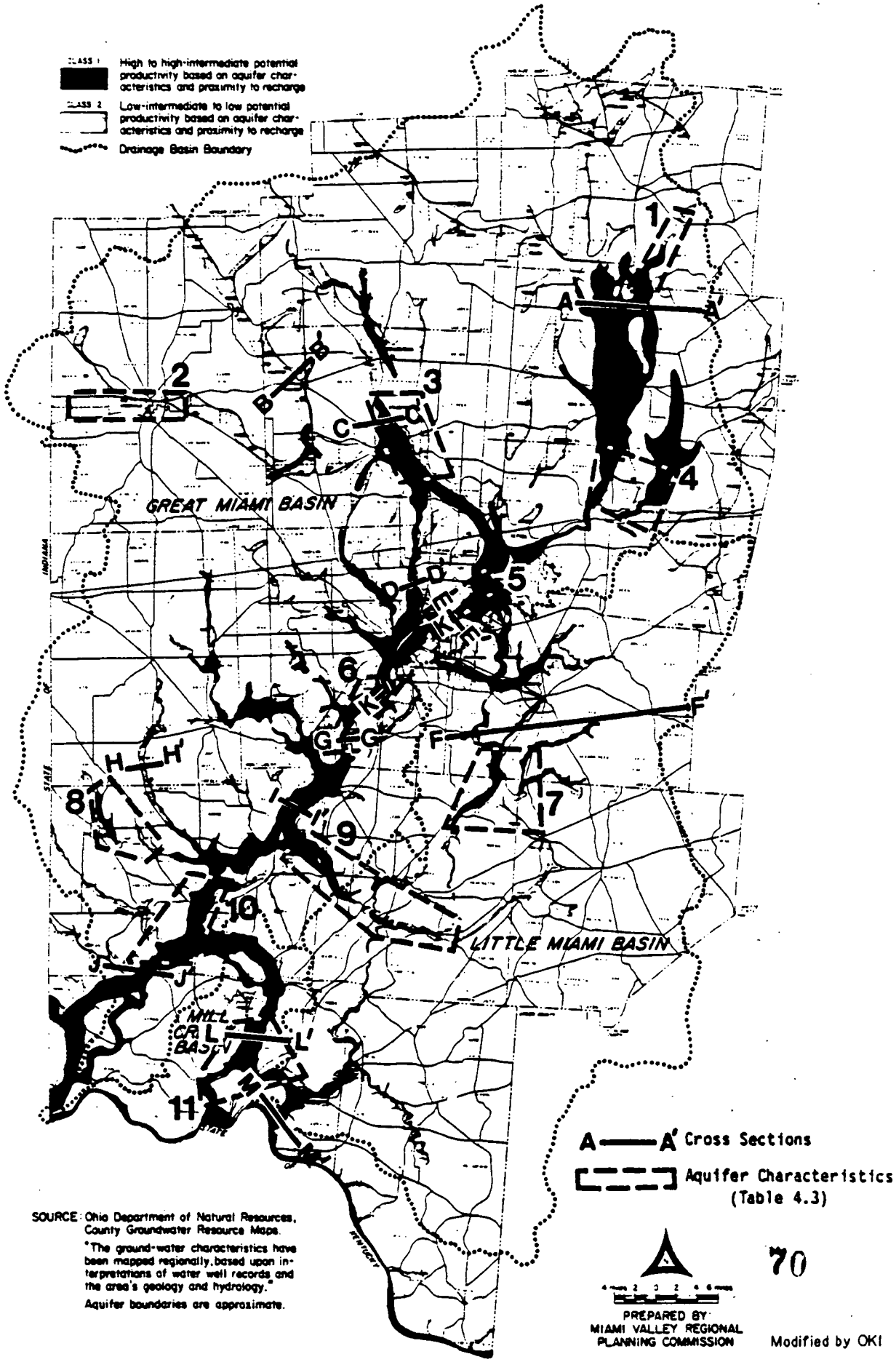
c. Aquifer characteristics

Aquifer characteristics are shown in Table 4.2 for selected sites along the buried valleys (See Figure 4.2). The valley deposits range in width from one-tenth mile to three and a half miles. They are usually 100 to 200 feet deep, although they can be up to 400 feet deep. The downward slope, or gradient, of the buried valleys ranges from 1.0 foot/mile to 8.5 feet/mile. The gradient has been reported for only a few areas, making it difficult to give an average gradient for the system. The hydraulic conductivity of the Class 1 deposits ranges from 1000 to 5500 gallons per day per square foot (gpd/ft^2); however, hydraulic conductivities greater than 3000 gpd/ft^2 are rare. Class 1 valley deposits consist of sand and gravel with some interbedded till, silt, or clay. Where more till, silt, or clay is present, the deposits have been designated Class 2. At places, the water-bearing deposits are confined by a discontinuous layer of less permeable material.

FIGURE 4.2

395

LOCATION INDEX FOR CROSS SECTIONS AND AQUIFER CHARACTERISTICS



SOURCE: Ohio Department of Natural Resources, County Groundwater Resource Maps.

"The ground-water characteristics have been mapped regionally, based upon interpretations of water well records and the area's geology and hydrology."

Aquifer boundaries are approximate.

TABLE 4.2

CHARACTERISTICS OF THE BURIED VALLEY AQUIFER AT SELECTED LOCATIONS

Code	Location	Class	Width	Depth	Gradient	Hydraulic Conductivity	Composition	References*
(1)	Southeast Logan Co. and Northeast Champaign Co.	1&2	1 to 2 1/2 miles	70 to 230 ft.	--	--	sand and gravel with interbedded silt and clay, some boulders	(1,2)
(2)	West-Central Darke Co.	2	< 1 mile	60 to 80 ft.	--	--	clay and silt with interbedded sand, some gravel	(1,2)
(3)	Southeast Miami Co.	1	1 to 3 miles	150 to 250 ft.	--	1130 gpd/ft^2	sand and gravel with interbedded clay and irregular till layers	(1,3)
(4)	North-Central Clark Co.	1&2	3 1/2 mile maximum	125 to 400 ft.	7.5 ft./mi.	5500 gpd/ft^2 (class 1)	coarse sand and gravel (class 1) or fine sand and silt (class 2)	(1,4,5)
(5)	Northeast Montgomery Co. and Northwest Greene Co.	1	1 1/2 to 3 1/2 mi.	50 to 200 ft.	--	2300 - 3500 gpd/ft^2	sand and gravel, scattered till, may be confined by extensive till layers in some places	(6,7,8,9)
(6)	South-Central Montgomery Co.	1	3/4 mi. to 2 1/2 mi.	70 to 210 ft.	1 ft./mi	1000 to 2500 gpd/ft^2	highly stratified sand and gravel, occasional thin till	(1,5,7,8,10)
(7)	Southwest Greene Co. and Northeast Warren Co.	1&2	3/4 mi. to 2 mi.	70 to >300 ft.	--	--	sand and gravel with interbedded till (class 1) thick glacial till with some sand and gravel layers (class 2)	(1,6,11,12)
(8)	Northwest Butler Co.	1&2	2 mi.	50 to 100 ft.	--	--	sand and gravel, scattered till and fine sand	(1,13)
(9)	West-Central Warren Co. and East-Central Butler Co.	1&2	1/10 to 1 mi.	80 - 290 ft.	--	--	coarse sand and gravel, some silt (class 1) till with interbedded sand (class 2)	(1,14)
(10)	Southern Butler Co.	1	2 to 3 mi.	80 - 250 ft.	5 to 8.5 ft./mi.	2500 - 3000 gpd/ft^2	sand and gravel with scattered, occasionally thick, lenses of silt and clay	(15,16,17,18)
(11)	Eastern Hamilton Co.	1	1/4 to 2 mi.	150 - 250 ft.	--	1250 gpd/ft^2	sand and gravel confined by 50 to 130 ft. of till and clay at surface	(14,15)

*See following page.

TABLE 4.2 (Continued)

CHARACTERISTICS OF THE BURIED VALLEY AQUIFER AT SELECTED LOCATIONS

LIST OF REFERENCES

1 Dames and Moore, "Hydrogeologic Survey of Ground Water Potential in Southwest Ohio," (for Ohio Department of Natural Resources, 1971-1972).

2 F. Klaer and Associates, "Hydrogeologic Survey of Ground Water Potential in Southwest Ohio," (for Ohio Department of Natural Resources, 1971).

3 P. Plummer, "Groundwater Resources near Grayson, Miami County, Ohio," Groundwater Investigations of the Great Miami River Basin (The Miami Conservancy District, 1971).

4 S.E. Norris, W.P. Cross, R.P. Goldthwait, and E.E. Sanderson, "The Water Resources of Clark County, Ohio,"Bulletin 22 (State of Ohio, Department of Natural Resources, Division of Water, 1952).

5 E.E. Norris and H.B. Eagon, "Recharge Characteristics of a Water Course Aquifer at Springfield, Ohio" (1971).

6 S.E. Norris, "The Water Resources of Greene County, Ohio," Bulletin 19 (State of Ohio, Department of Natural Resources, Division of Water, 1956).

7 S.E. Norris, W.P. Cross, and R.P. Goldthwait, "The Water Resources of Montgomery County, Ohio," Bulletin 12 (Ohio Water Resources Board, 1948).

8 W.E. Norris and A.M. Spieker, "Ground-Water Resources of the Dayton Area, Ohio," Water Supply Paper 1808 (U.S.G.S., 1966).

9 D.K. Todd, "Ground Water Resources of the Upper Great Miami River Basin and the Feasibility of Their Use for Streamflow Augmentation" (Report to the Miami Conservancy District, 1969).

10 K.F. Evans, "Water Quality of the Glacial-Outwash Aquifer in the Great Miami River Basin, Ohio," Open File Report 77-76 (U.S.G.S. Water Resources Investigations, 1977).

11 G. Henry, "Geological Investigation of a Buried Valley in the Vicinity of Dike A, Caesar Creek Reservoir, Ohio" (Thesis, Wright State University, 1973).

12 J.L. Jehn, "The Delineation of a Preglacial Buried Valley Underlying a Proposed Reservoir Complex in the Vicinity of Harveysburg, Ohio" (Thesis, Wright State University, 1973).

13 F.W. Erdmann, "Water Supply Investigation and Development of Upper Four Mile Creek - Phase I" (Dames and Moore Job No. 08296-006-17, 1981).

14 H.L. Pree, "Ground Water Resources Along Interstate Highway 71, Between Cincinnati and Harrisburg, Ohio," Information Circular No. 8 (State of Ohio Department of Natural Resources, Division of Water, 1965).

15 R.J. Bernhage and E.J. Schaefer, "Ground-Water Conditions in Butler and Hamilton Counties, Ohio, 1946," Bulletin 8 (State of Ohio, Department of Natural Resources, Division of Water, 1947)

16 G.D. Dove, "A Hydrologic Study of the Valley Fill Deposits in the Venice Area, Ohio," Technical Report No. 4, (State of Ohio, Department of Natural Resources, Division of Water, 1947).

17 R.C. Lewis, "An Investigation of the Potential Yield of the Big Bend Well Field" (Dissertation, University of Cincinnati, 1968).

18 P.M. Plummer, "Ground Water Quality in the Hamilton - New Baltimore Area, Ohio, An Assessment through 1981" (1982)

FIGURE 4.3

CROSS SECTION AT MAD RIVER IN CHAMPAIGN COUNTY, A - A'

OHIO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF WATER

OHIO WATER PLAN INVENTORY
1960

UPPER MAD RIVER BASIN

UNDERGROUND WATER RESOURCES

Prepared by ALFRED C. WALKER, Geologist,
Ohio Division of Water

GENERALIZED CROSS SECTION SHOWING GEOLOGY OF THE UPPER MAD RIVER BASIN.

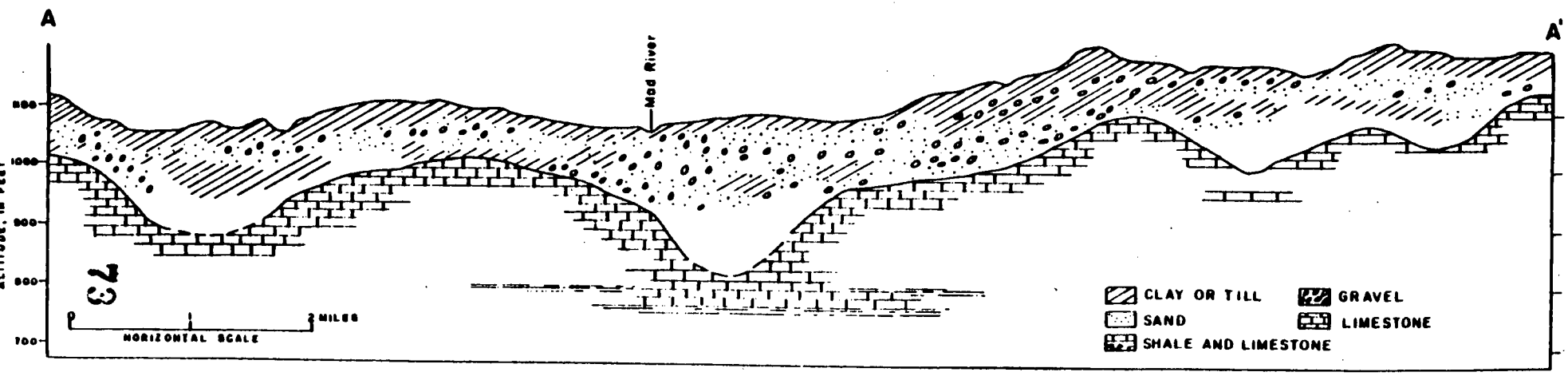
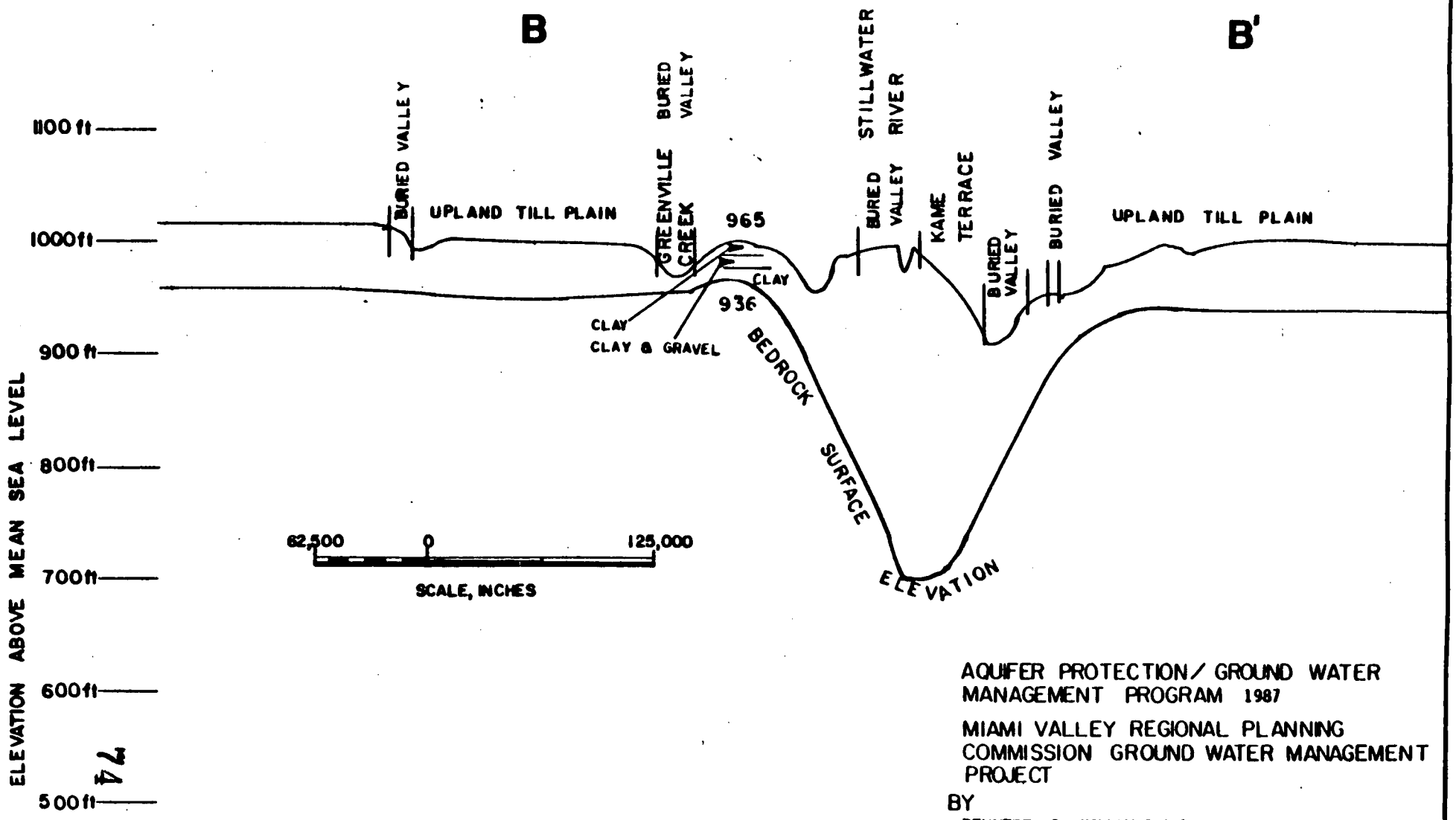


FIGURE 4.4

CROSS SECTION AT STILLWATER RIVER IN MIAMI COUNTY. B - B'



AQUIFER PROTECTION / GROUND WATER MANAGEMENT PROGRAM 1987

MIAMI VALLEY REGIONAL PLANNING COMMISSION GROUND WATER MANAGEMENT PROJECT

BY

BENNETT & WILLIAMS, INC.
CONTRONICS, INC.
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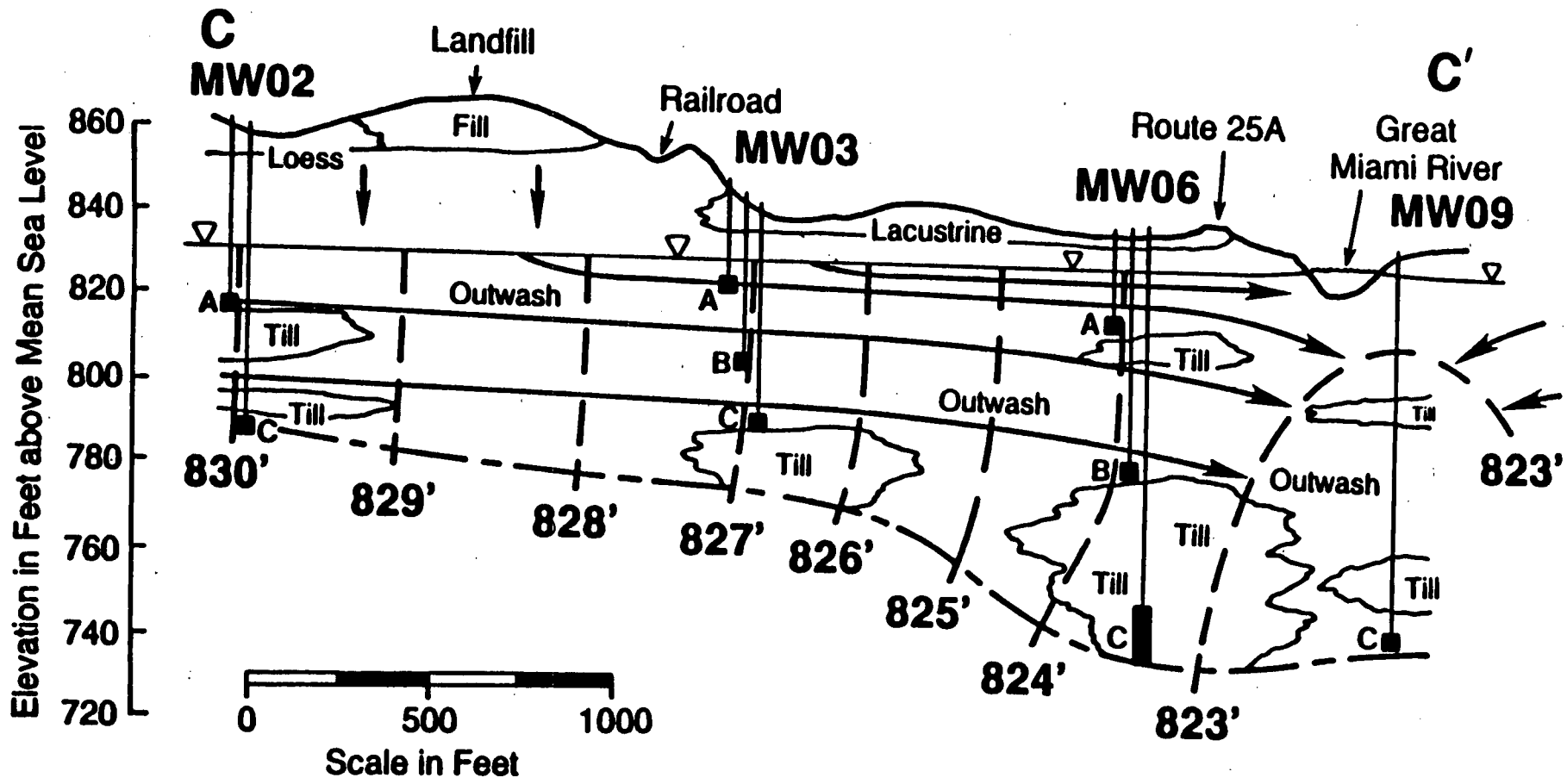
CONSERVATION RESOURCES

FIGURE 4.5

CROSS SECTION AT GREAT MIAMI RIVER IN MIAMI COUNTY. C - C'



823' Equipotential Line (feet)

75 Average groundwater head for the period May, 1985 - October 1985

Groundwater Flow Line (approximate)

Approximate Bedrock Interface

Well Screen

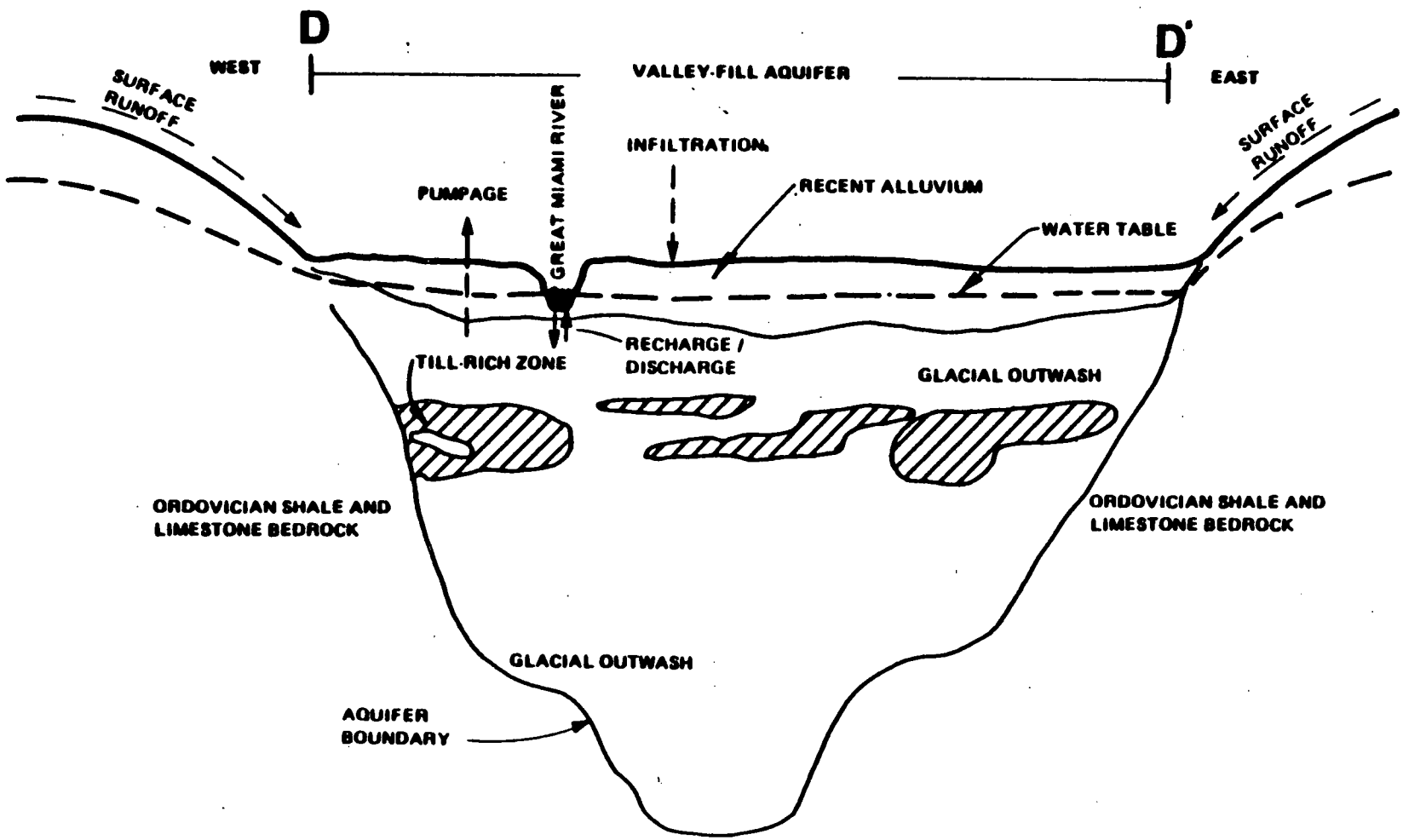
MW02 EPA Monitoring Well Number near MCI Site

Geologic Cross Section and Approximate Groundwater Flowlines near the MCI Site, Troy, Ohio

Note: Flowlines and equipotential lines are constructed using head data from the U.S. EPA Remedial Planning Investigation Report (WA113.5 LHI. 0) prepared by CH2M Hill, 1986.

FIGURE 4.6

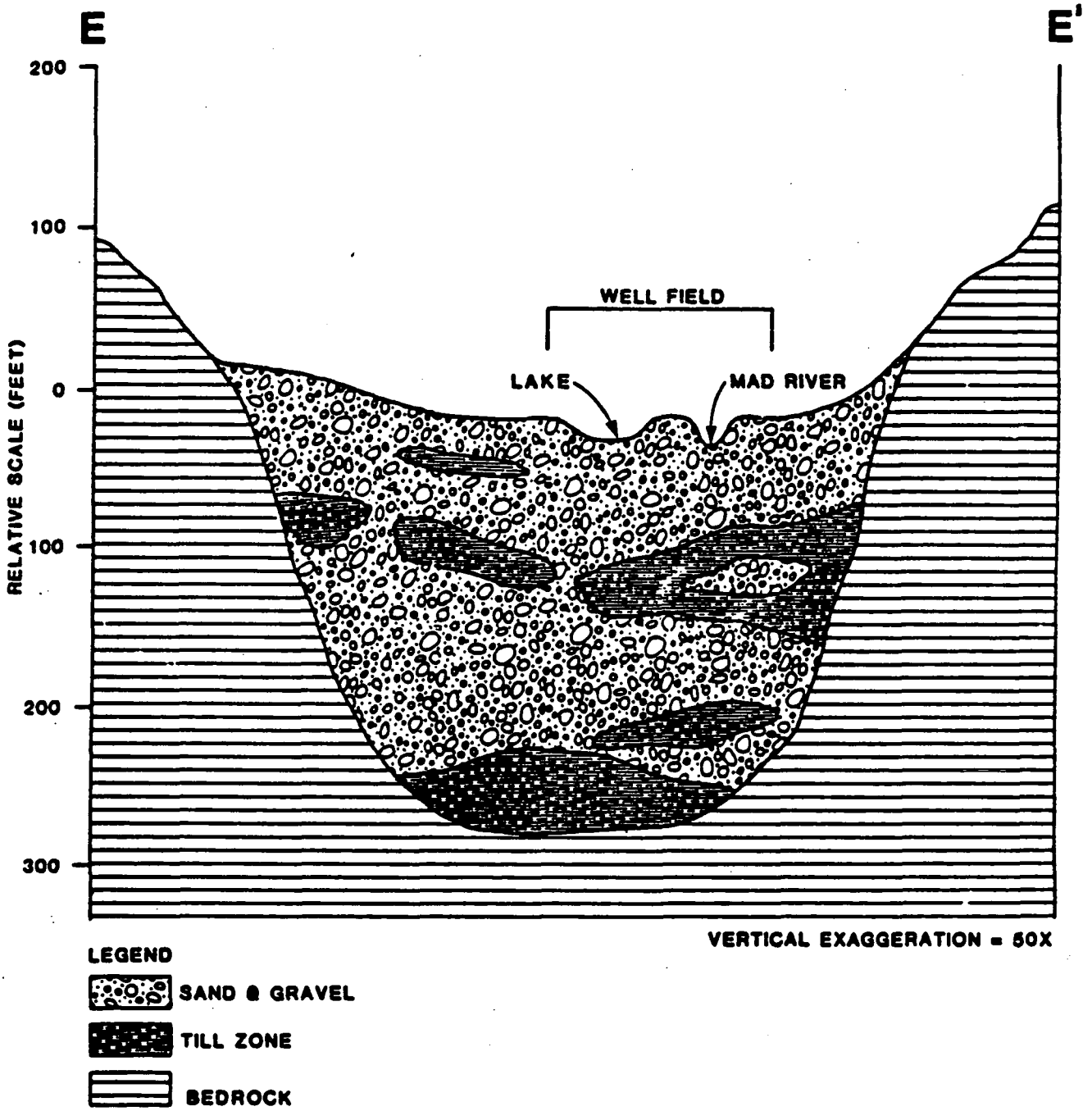
CROSS SECTION AT GREAT MIAMI RIVER IN NORTHERN MONTGOMERY COUNTY. D - D'



Prepared by CH2M HILL, INC.
August 1986

FIGURE 4.7

CROSS SECTION AT MAD RIVER IN MONTGOMERY COUNTY, E - E'



GENERALIZED HYDROGEOLOGIC CROSS SECTION

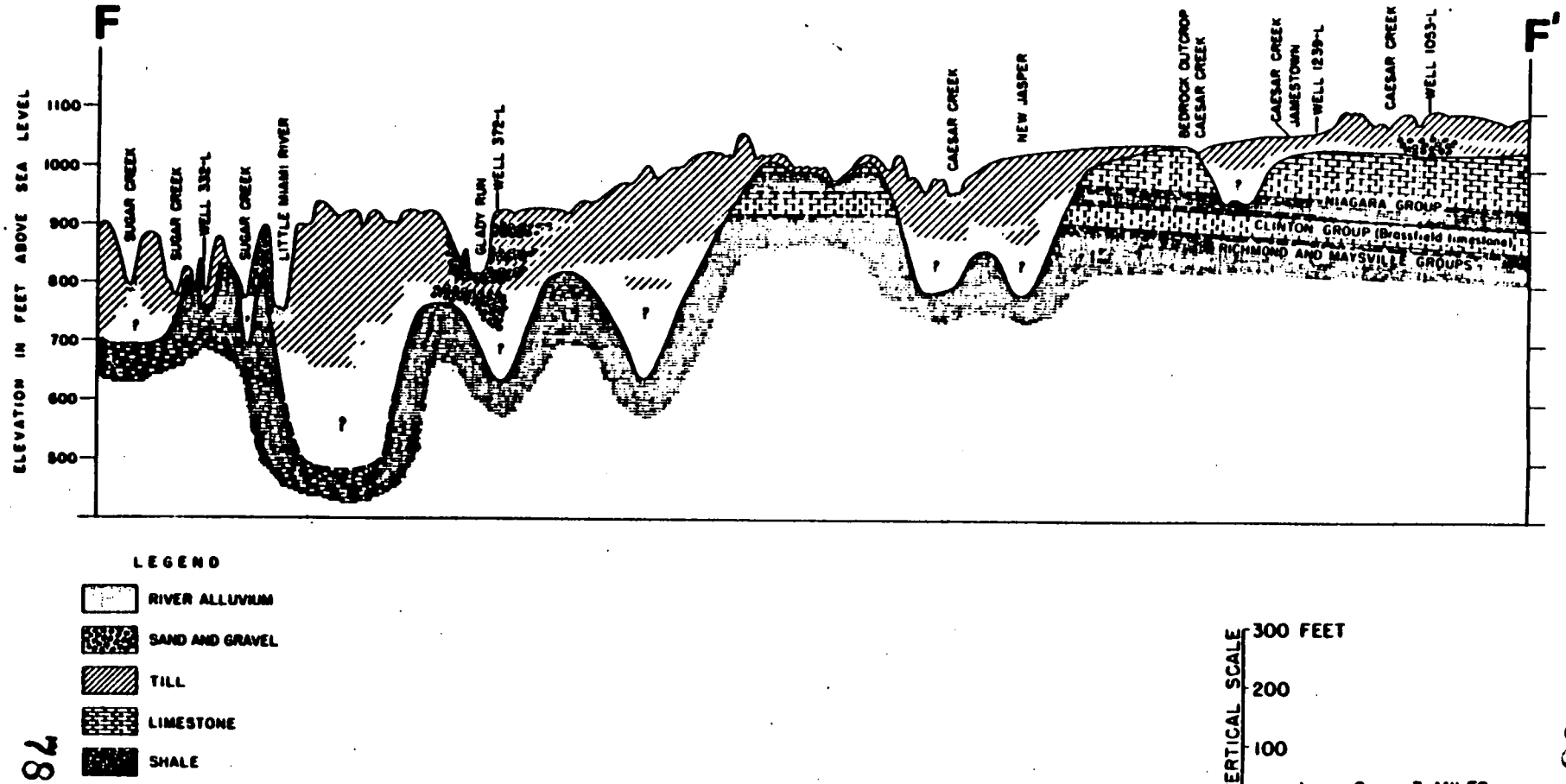
GERAGHTY & MILLER, INC.
Ground-Water Consultants

Mad River Well Field Assessment
City of Dayton
Dayton, Ohio 1987

FIGURE 4.8

CROSS SECTION IN SOUTHERN GREENE COUNTY

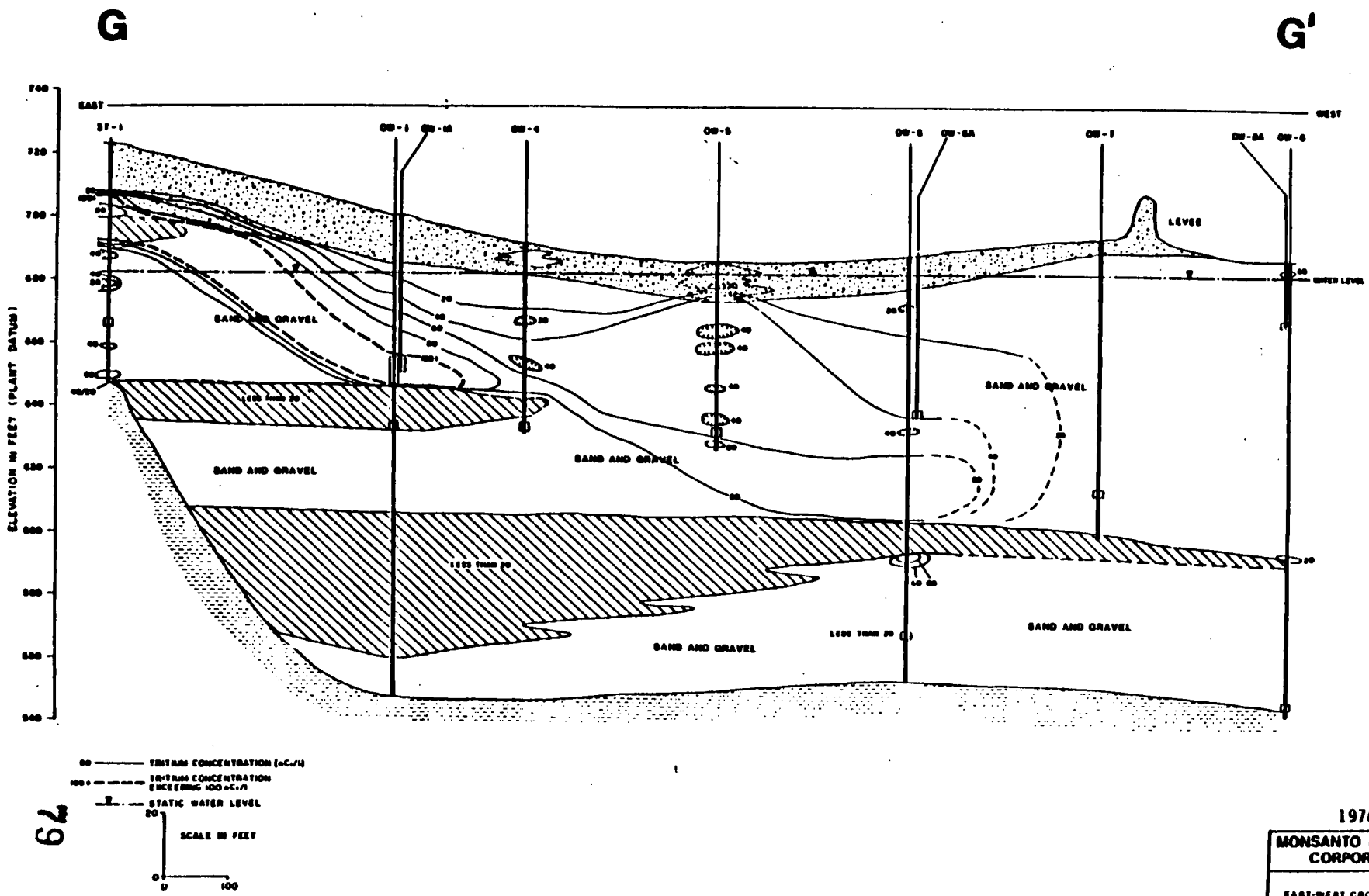
F – F'



S. E. Norris, W. P. Cross and R. P. Goldthwait. 1956. The Water Resources of Greene County, Ohio Ohio Department of Natural Resources, Division of Water, Bulletin 19.

FIGURE 4.9

CROSS SECTION AT GREAT MIAMI RIVER IN SOUTHERN MONTGOMERY COUNTY. G - G'



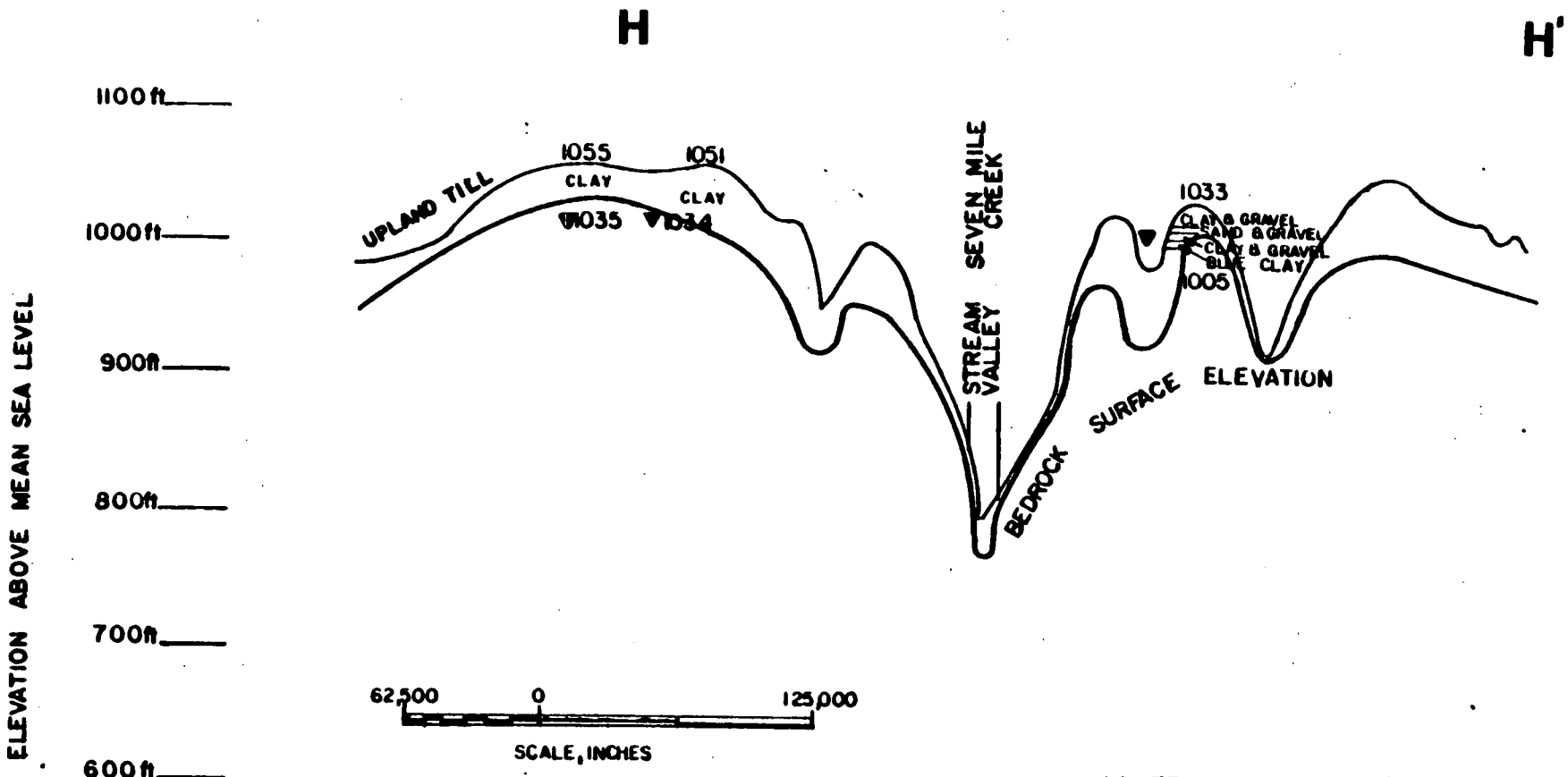
1976

MONSANTO RESEARCH CORPORATION

EAST-WEST CROSS-SECTION
SOIL DISTILLATE
TRITIUM CONCENTRATIONS
VERSUS DEPTH

FIGURE 4.10

CROSS SECTION AT SEVEN MILE CREEK IN PREBLE COUNTY. H - H'



AQUIFER PROTECTION/GROUND WATER MANAGEMENT PROGRAM 1987

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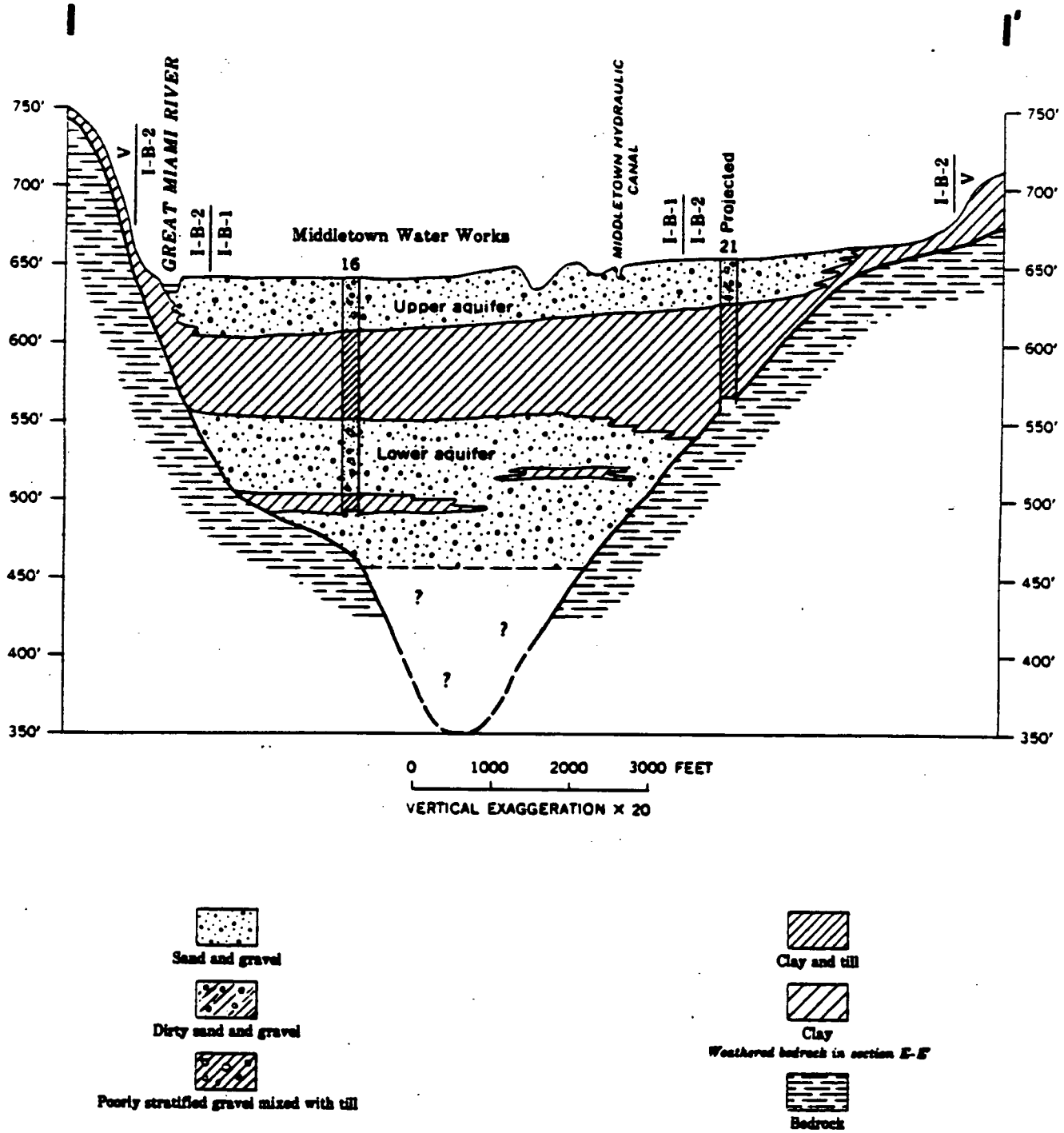
CONSERVATION RESOURCES

FIGURE 4.11

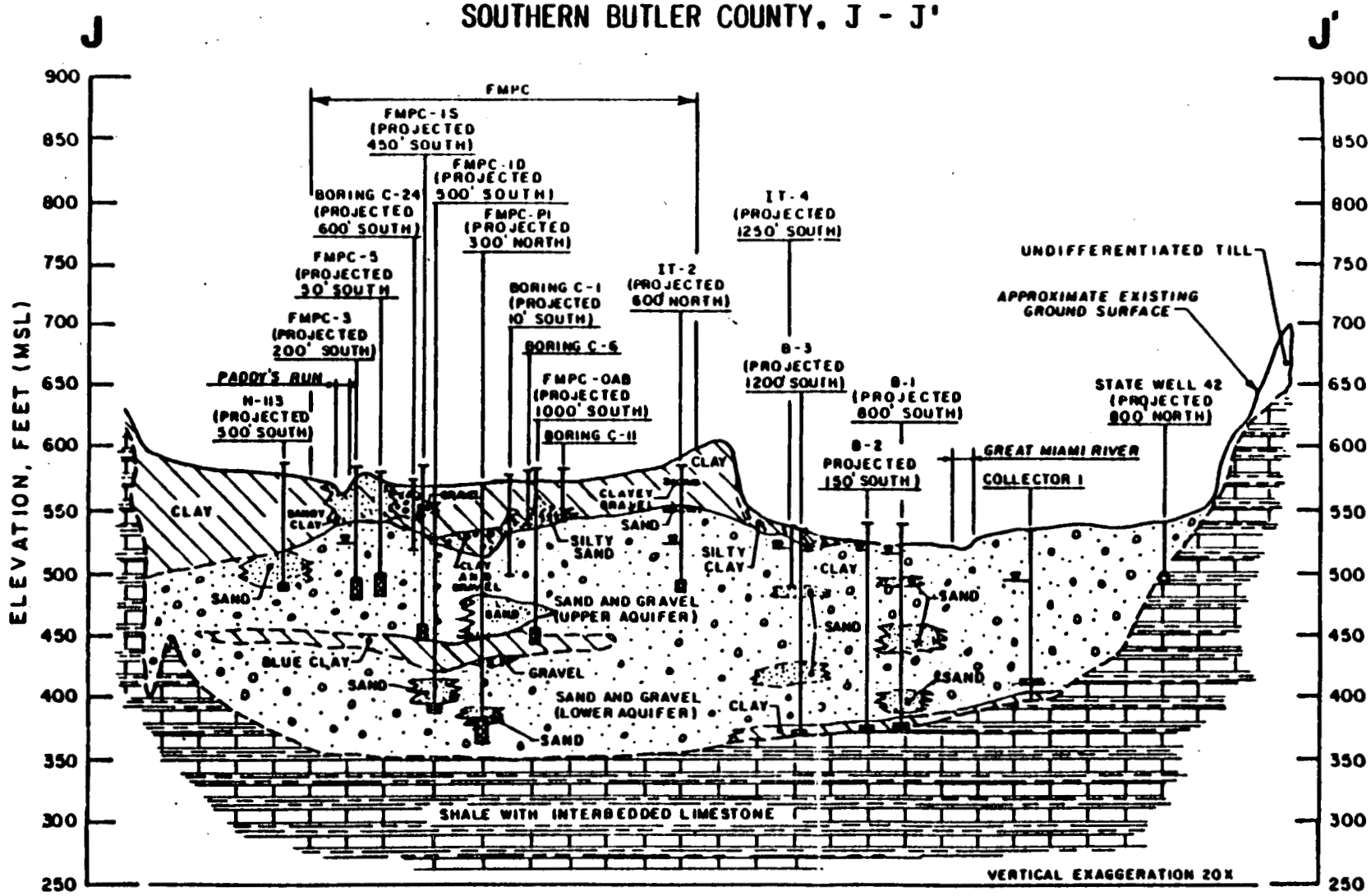
CROSS SECTION AT GREAT MIAMI RIVER IN NORTHERN BUTLER COUNTY, I - I'



A. M. Spieker. 1968. Ground Water Hydrology and Geology of the Lower Great Miami River Valley, Ohio. Geological Survey Professional Paper

FIGURE 4.12

CROSS SECTION AT GREAT MIAMI RIVER IN SOUTHERN BUTLER COUNTY, J - J'



THE BORING LOGS AND RELATED INFORMATION DEPICT SUBSURFACE CONDITIONS ONLY AT THE SPECIFIC LOCATIONS AND DATES INDICATED SOIL CONDITIONS AND WATER LEVELS AT OTHER LOCATIONS MAY DIFFER FROM CONDITIONS OCCURRING AT THESE BORING LOCATIONS ALSO THE PASSAGE OF TIME MAY RESULT IN A CHANGE IN THE CONDITIONS AT THESE BORING LOCATIONS

THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS AND IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE INDICATED

LEGEND

OPEN INTERVAL

WATER LEVELS (MEASURED 3/27/86 THRU 4/11/86)

VERTICAL SCALE

0 100 200 FEET

HORIZONTAL SCALE

0 2000 4000 FEET

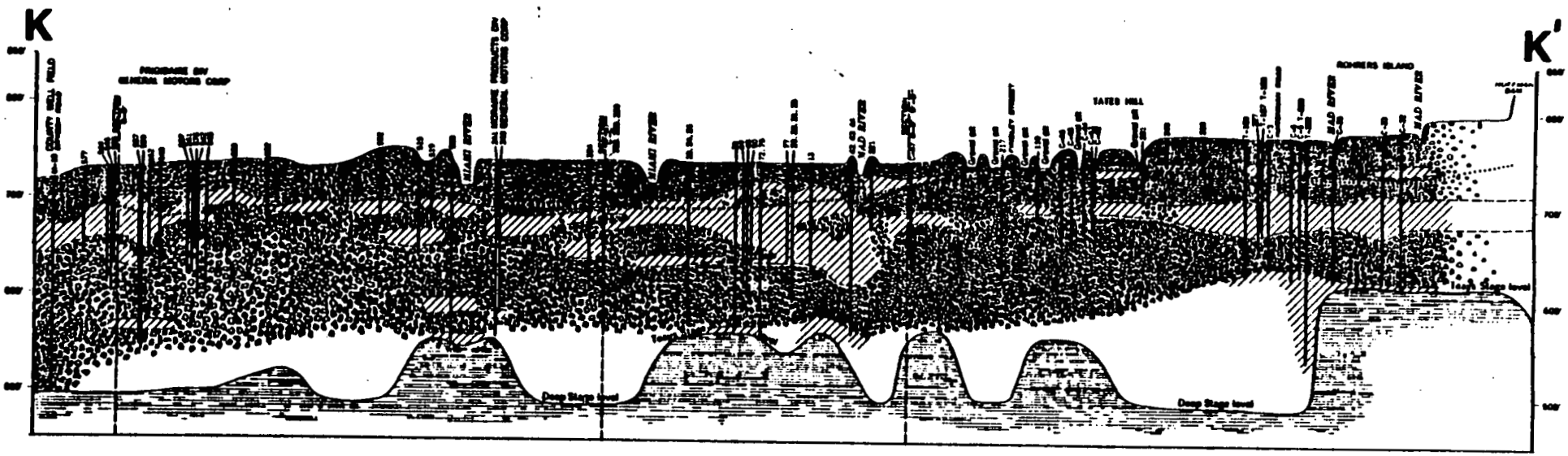
REFERENCES:

MODIFIED FROM U.S.G.S. PROFESSIONAL PAPER No. 605-A USING AVALIABLE OHIO STATE WATER WELL RECORDS, SOWC WATER WELL DATA, DAMES AND MOORE DOE, FEED MATERIALS PRODUCTION CENTER GROUND WATER STUDY TASKS A AND C REPORTS AND IT BORING LOGS.

© 1984 IT CORPORATION

FIGURE 4.13

LONGITUDINAL CROSS SECTION. COUNTY WELL FIELD TO HUFFMAN DAM IN MONTGOMERY COUNTY. K - K'



Upper aquifer
Sand and gravel deposits occurring at or near the surface; generally overlies the till-rich zone

Till-rich zone
Fairly widespread sheets, lenses, and masses of till; contains pockets and lenses of sand and gravel; occurs as a layer of low permeability and generally separates the sand and gravel deposits into an upper and a lower aquifer

Lower aquifer
Sand and gravel deposits generally occurring between the till-rich zone and bedrock; contains interbedded lenses and masses of till and clay, especially near the bedrock surface

Shale of Ordovician age with thin interbedded limestone layers

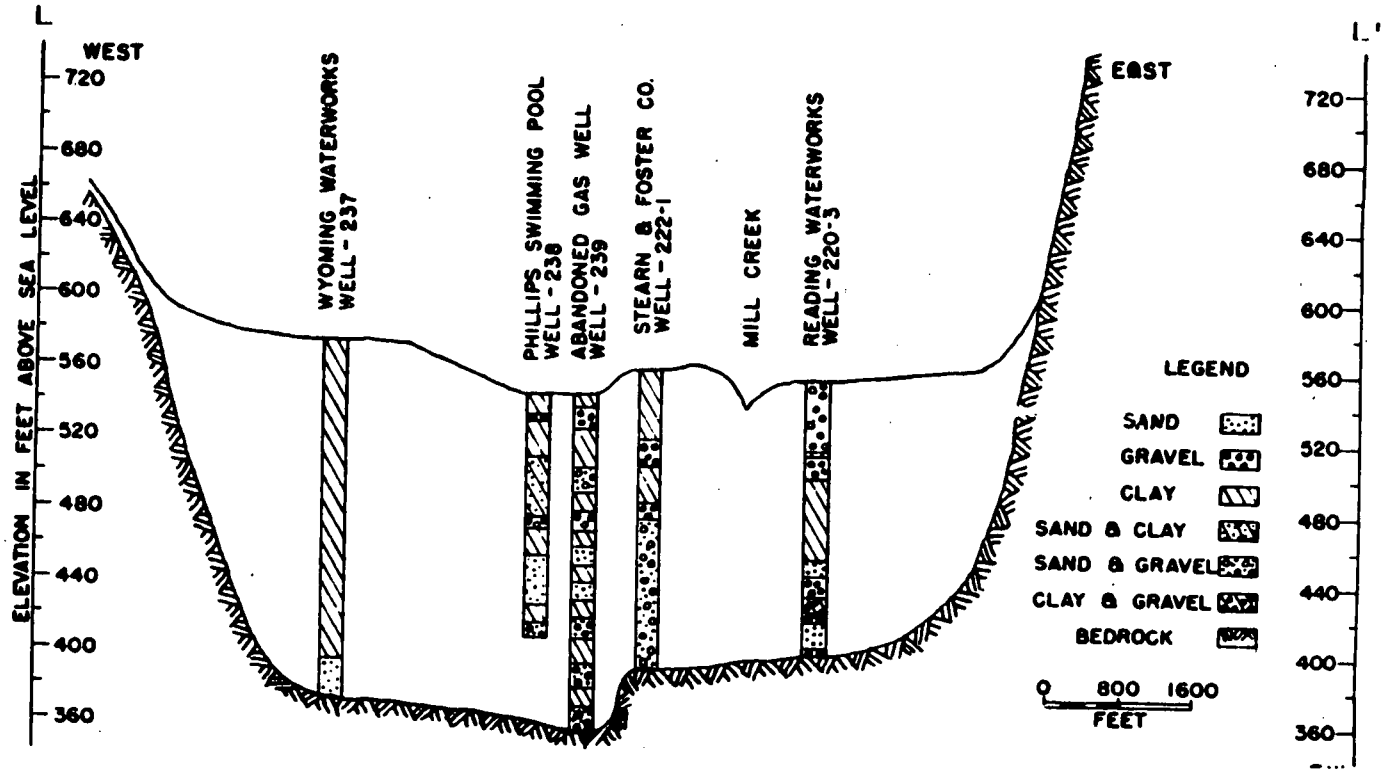
83

Reference:

Norris, S.E. and A.M. Spieker. 1966. Ground-Water Resources of the Dayton Area, Ohio. U.S. Geological Survey Water-Supply Paper 1808.

FIGURE 4.14

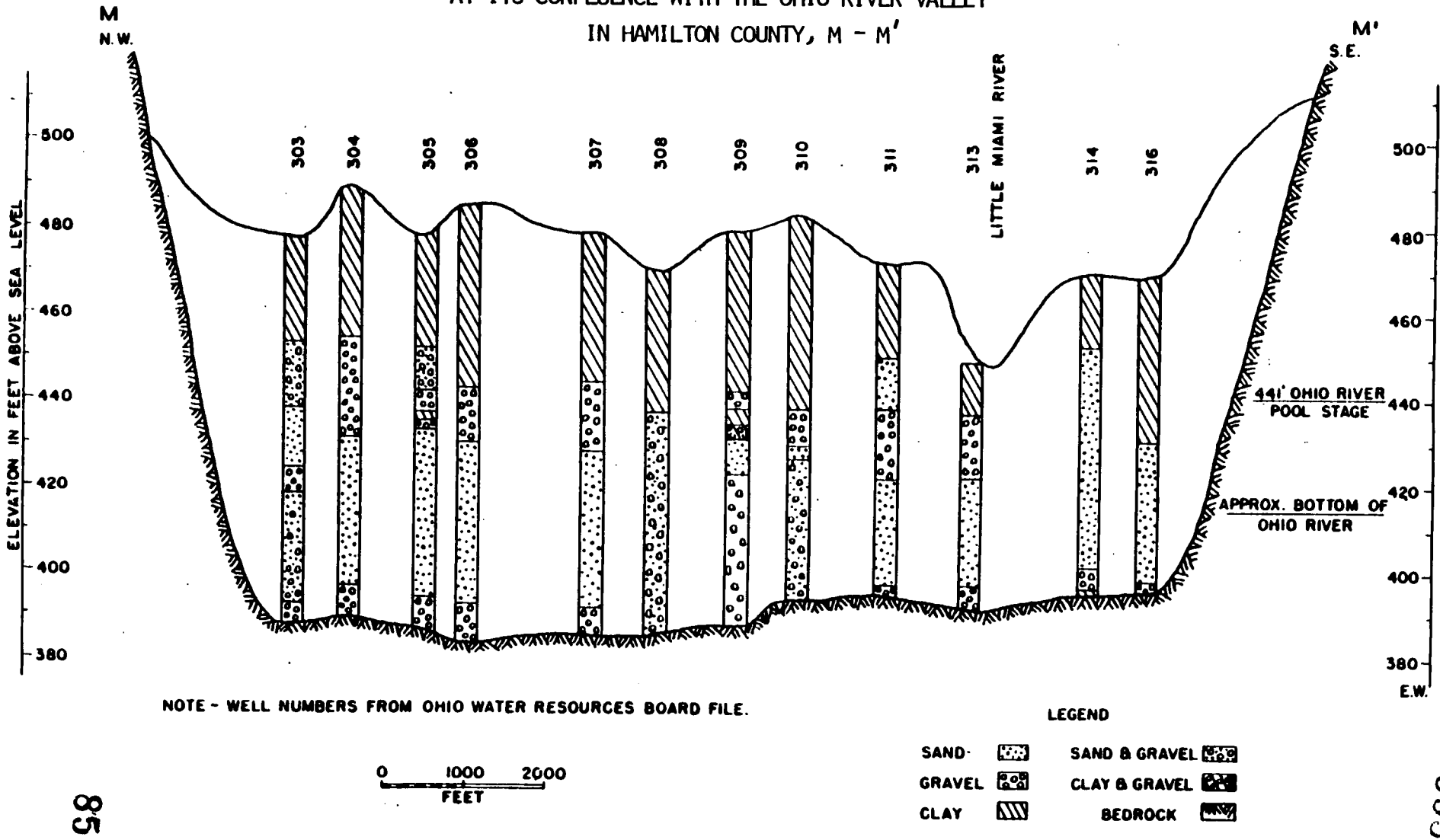
CROSS SECTION OF THE MILL CREEK VALLEY
AT WYOMING, LOCKLAND AND READING
IN HAMILTON COUNTY, L - L'



Reference:
Bernhagen, R.J. and E.J. Schaefer. 1947. Ground-water Conditions in Butler and Hamilton Counties, Ohio, 1946. Ohio Department of Natural Resources, Division of Water Bulletin 8.

FIGURE 4.15

CROSS SECTION OF THE LITTLE MIAMI VALLEY
AT ITS CONFLUENCE WITH THE OHIO RIVER VALLEY
IN HAMILTON COUNTY, M - M'



Reference:
Bernhagen, R.J. and E.J. Schaefer. 1947. Ground-water Conditions in Butler and Hamilton Counties, Ohio, 1946. Ohio Department of Natural Resources, Division of Water, Bulletin 8.

4. Groundwater Withdrawal from the Aquifer

a. Wells (drinking, irrigation, industrial)

Groundwater withdrawal for public water supplies within the Buried Valley Aquifer System totals **507.099 mgd (134.091 mgd - MVRPC area, 73.008 mgd - OKI area).** The locations of public water supply well fields are shown on the County Topographic Maps (Plates 1-9, **MVRPC petition and OKI Plates 1-4).** Withdrawal from individual public water supplies is available in Chapter III.C., Table 3.2. Withdrawal for private (domestic) use totals 3.799 **(2.836 mgd - MVRPC area, 0.963 OKI area).**

Withdrawal from wells used for irrigation and agriculture is not well known. More information is available on industrial and commercial groundwater use. Non-community water supply systems that provide drinking water to users during the daytime include schools, camps, businesses, and industries. Most of these withdrawals are less than 0.05 mgd. Withdrawals greater than this, as noted in Ohio EPA files, are presented in Table 4.3. The non-community program within Ohio EPA is just beginning and only a few surveys have been completed, making this list incomplete. Table 4.4 includes estimates of groundwater withdrawals for industrial use for counties within the OKI planning area. Other major users of groundwater include golf courses, fruit farms, and nurseries; however, there is no record of the amount of groundwater withdrawal by these users.

TABLE 4.3

KNOWN GROUNDWATER WITHDRAWALS
FOR NON-COMMUNITY USE

County	User	Amount (mgd)
Butler	Sorg Paper Company	4.000
Darke	Corning Glass Works	.225
Greene	Elano Corp.	.075
	Hilltop Basic Resources	1.096
	Morris Bean & Co.	.196
Hamilton	Cincinnati, Inc.	0.100
	Fernald Feed Materials Production Center	0.500
	General Electric Co.	5.460
	Southwestern Ohio Water Co.	16.300
Miami	B.F. Goodrich Co.	.186
	Hobart Brothers Co.	.131
	Hobart Corp.	.131
	Link Corp.	.087
	Westerville Creamery	.055
Montgomery	Chrysler	.250
	Dayton Power & Light, Hutchings Station	4.320
	Dayton Coca Cola Co.	.240
	Monsanto Research Corp.	.720
	Atlas Die Casting	.306
	Cargill, Inc.	.402
	Dayton-Walther Corp.	.493
	Dayton Air Cond. - South	2.926
	Delco Moraine	7.123
	G.M.C. - Delco Products	1.388
	Hilltop Basic Resources	.546
	Howard Paper Mills, Inc.	1.712
	Interstate Folding Boxboard	1.370
	Miami Paper Corp.	2.226
	Premier Rubber Co.	.268
	Moraine Materials	.084
	Premium Rubber Co.	.268
	Standard Register Co.	.295
	Hewitt Soap Co.	.088
	TRW Globe Motors	.079
	West Carrollton Parchment	.436
Warren	Kings Island Park	0.349
	TOTAL	54.431

SOURCE: Ohio EPA Active Non-Community Water Supply Systems 1987 files.

TABLE 4.4

ESTIMATES OF GROUNDWATER WITHDRAWALS (MGD) FOR INDUSTRIAL USE - OKI PLANNING AREA

County	Thermo-electric	Manufacturing	Total
Butler	0	23.8	23.8
Clermont	2.0	0	2.0
Hamilton	2.0	18.9	20.9
Warren	0	0.9	0.9

SOURCE: U.S. Geological Survey. Water Use in Ohio - 1980. Water-Resources Investigations Report 84-4024.

b. Springs

The buried valley occurs at a topographic low which does not present the opportunity for springs to develop. There are several noted springs at the base of certain bedrock horizons and from more permeable layers within till units, but none from the proposed Sole Source Aquifer.

c. Stream baseflow

It is normal for streams within the Buried Valley Aquifer System to be gaining; i.e., to have sustained baseflow from groundwater discharge from the aquifer. The amount of groundwater discharge to the streams is generally assumed to be equivalent to flow in the streams during periods of lowflow (Cross and Hedges, 1959). One researcher has estimated the amount of water discharged from stream underflow, which is likely to be related to stream baseflow, as 1% of the precipitation falling within the drainage basin (Renken, 1976). Stream baseflow, particularly gaining and losing streams, is also discussed later in Section C. Streamflow Source Area.

d. Potentiometric surface map

The potentiometric surface for the aquifer system is shown on the County Topographic Maps (Plates 1-9, **MVRPC petition and OKI Plates 1-4).** The surface water pathways are shown as part of the topographic map base. Groundwater flow within the buried valleys is generally from north to south and drops at an average rate of 10.7 ft/mile.

Data for the potentiometric maps were obtained from a telephone survey of public water suppliers, from reports on groundwater monitoring at various facilities, **from ODNR well logs** and from USGS data (Schindel et al., 1985 **and 1986). Because subsurface data were collected from different sources and measured over many years, the maps' contour lines represent a generalized potentiometric surface considered to be indicative of average conditions at the present time. As the maps were developed, preference was given to more recent data points.**

B. Recharge Area

1. Topographic Map of Recharge Area

The recharge area has been determined to be the land's surface overlying the Buried Valley Aquifer System. This area is shown on the County Topographic Maps (Plates 1-9, **MVRPC petition and OKI Plates 1-4).** In addition to the topography of the recharge area, natural surface water bodies and artificial recharge lagoons are shown on these maps.

2. Methods Used to Determine Recharge Area

The method used to determine the recharge area was an assessment of reports and hydrogeologic maps prepared by the Ohio Department of Natural Resources and the USGS.

Research has documented that the most significant sources of recharge to the Buried Valley Aquifer System are infiltration from surface water bodies overlying the aquifer, and infiltration of precipitation that falls on the land overlying the aquifer. A description of the methods used in this research is included in order to clarify the validity of this work. Walton and Scudder's (1960) work in the Fairborn (Greene County) area was based on a water balance equation. Groundwater discharge to and recharge from streams were estimated by stream flow measurements at several gaging stations. Work by Norris (1956 and 1966) in the Dayton area (Montgomery County) was based on well hydrographs and low flow stream measurements. The Venice area (Butler and Hamilton Counties) was examined by Dove (1961) who used a detailed map of the water table to determine where recharge was occurring. In Springfield (Clark County), Norris and Eagon (1971) measured groundwater levels in a close network of observation and production wells for several years prior to the publication of their conclusions. All of these studies conclude that when bounded by relatively impermeable glacial till and shale or limestone bedrock, the aquifer is recharged by infiltration of surface water and precipitation intersecting its surface.

Methods used by consultants to the City of Dayton include observation wells and flow models for the Miami and Mad River well fields. These studies confirm and reinforce the earlier studies cited above. The Mad River Well Field Assessment prepared by Geraghty & Miller (1987) presents a water budget for the well field. Less than 2.5% of the inflow to the well field is attributed to groundwater from the valley walls. Substantial recharge is attributed to the Mad River, lakes, and artificial recharge lagoons, whose combined contribution represents 80% of the inflow to the well field. Precipitation is estimated to contribute 6 to 10% of the

inflow. CH2M Hill's Miami Well Field Study (1986) modeled the water flow in the area of the well field north of Dayton. The report states that, "inflow of water from adjacent uplands is minimal compared to other forms of natural inflow." Here again, natural recharge from the river, recharge from the artificial lagoons, and precipitation are found to be the major contributors of water to the aquifer.

Review of the published studies has led to the determination that the area over the aquifer, as shown on the Buried Valley Aquifer System Map (Figure 4.1), is the recharge zone. This map was developed from the county Groundwater Resources maps prepared by ODNR, Division of Water. The methods used by ODNR to prepare these maps are explained in Appendix B. Confirmation of this determination came from the work on the Groundwater Management Plan for MVRPC (Bennett & Williams, 1987). Bennett & Williams' staff have prepared an aquifer recharge and sensitivity map **for the MVRPC area.** Their map depicts sensitivity categories based on the amount of recharge expected in each category. The most sensitive areas are those expected to receive the most recharge from surface water; these are directly under the Miami and Mad Rivers and their major tributaries. Bennett & Williams' description of the most sensitive area and highest recharge zone is, "Miami/Mad River main stream and major tributaries, sands and gravels 25 to 200+ feet thick, directly recharged from the surface, often induced infiltration out of the bottoms of the rivers (valley trains)." It is clear that the highest recharge category coincides with the aquifer boundaries shown on the Buried Valley Aquifer System Map (Figure 4.1).

3. Natural and Human-Induced Aquifer Recharge

The amount of aquifer recharge from precipitation was first estimated by Walton and Scudder (1960). Their calculations are used in most of the other recharge studies. Walton and Scudder used a water balance equation and measured inputs and outputs to groundwater during a period when the aquifer was being recharged. During the period of measurement, it was estimated that 11 inches of precipitation infiltrated the aquifer. (It should be noted that recharge over the buried valley system is much greater than in upland areas.) Because little recharge occurs at other times of the year, the total recharge due to precipitation was estimated to be 12 inches annually. Walton and Scudder's study was in the Fairborn area of Greene County which receives an average annual precipitation of 38 inches. Twelve inches, or 30%, of this is estimated as recharge over the aquifer area. This is confirmed by Renken's (1976) evaluation of the Four Mile-Seven Mile Creek Basin. Within the **MVRPC-OKI project area**, annual precipitation is between 35 and 41 inches (ODNR, 1962). Applying the estimate of 30%, the amount of precipitation expected to contribute to recharge is 10 to 14 inches per year. Some areas of Class 2 aquifer capped by a layer of clay-rich glacial material receive less recharge from precipitation. Pavement in urban areas promotes increased run-off and, thus, decreases the amount of recharge by precipitation.

A second form of recharge to the aquifer is infiltration from stream beds. Recharge from stream beds can be sizable, especially in locations where there is much groundwater withdrawal from production wells. Where groundwater production lowers groundwater levels below the level of the stream, induced infiltration occurs. Several researchers have identified zones where induced infiltration is occurring. The range of estimates for the amount of recharge to the aquifer from induced stream bed infiltration is given in Table 4.5.

TABLE 4.5

ESTIMATED INDUCED INFILTRATION FROM STREAMBEDS OVERLYING THE BURIED VALLEY AQUIFER SYSTEM

Streambed	County	Infiltration Rate (gal./day/ acre)	Source[a]
Hebble Creek at Wright-Patterson AFB	Greene	230,000	Walton & Scudder, 1960
Great Miami River at Venice	Butler, Hamilton	120,000	Dove, 1961
Mad River at Springfield	Clark	500,000	Norris & Eagon, 1971
Great Miami River at Dayton	Montgomery	150,000	CH2M Hill, 1986

[a]Full citations are provided in the references at the end of this chapter.

The USGS conducted a gain and loss study on the Stillwater River in Darke, Miami and Montgomery Counties (Johnson and Metzker, 1981). Two portions of the stream that were found to be losing, or contributing to recharge, are a section of Greenville Creek between Bear's Mill and Bradford in Darke County and a section of the Stillwater River between Covington and Pleasant Hill in Miami County. The communities of Bradford and Covington withdraw their water supply from the Buried Valley Aquifer near the losing streams. Although it has not been studied extensively, it is possible that their withdrawals are causing induced infiltration to the aquifer from Greenville Creek and the Stillwater River.

Where there are artificial recharge lagoons, infiltration from surface water is greatly enhanced. Norris and Spieker (1966) used the results from two periods of stream flow measurements to prepare an estimate of 1,700,000 gallons per day per acre (g/d/acre) as the recharge rate at Rohrer's Island on the Mad River near Dayton. A more recent estimate for this recharge facility by Geraghty & Miller (1987) is 780,000 g/d/acre. The Miami River recharge lagoons can contribute up to 1,400,000 g/d/acre if they are properly maintained (CH2M Hill, 1986). The locations of recharge lagoons are shown on the appropriate County Topographic Maps (Plates 1-9, MVRPC petition). **There are no recharge lagoons in the OKI area.**

Lakes, gravel pits, and other surface impoundments also contribute to aquifer recharge. An estimate of their significance in areas of induced infiltration comes from Geraghty & Miller's (1987) work on the Mad River Well Field. They report that infiltration from the lakes and gravel pits is responsible for 6,850 g/d/acre of lake bottom. The ponded, slow moving water in these water bodies allows siltation of the bottom which leads to relatively low infiltration. An inventory of surface impoundments was conducted by Ohio EPA in 1980. Data for unlined impoundments including several larger than 1 acre are presented in Table 4.6.

Injection wells also are a potential source of recharge to the aquifer. The significance of this source of recharge has not been quantified, but it is likely that these wells represent only a fraction of the total aquifer recharge. Most injection wells within the aquifer area are either Class V injection wells used for a variety of purposes such as air conditioning and heat pumps, storm water drainage, and septic systems, or are "exempt." "Exempt" wells, used in the septic systems of single-family dwellings, are not regulated. A report prepared by Malcolm Pirnie, Inc. (1986) for the Ohio EPA provides the most comprehensive survey of injection wells for the recharge area. Survey data were obtained by reviewing county health department records and from a mail survey to businesses. The resulting data are presented in Tables 4.7 and 4.8. The number and uses of Class V injection wells are shown in Table 4.7, but their locations are not available nor are all reported wells within the recharge area. The numbers of "exempt" wells within the potentially designated area are listed by township in Table 4.8.

TABLE 4.6

UNLINED INDUSTRIAL AND MUNICIPAL SURFACE IMPOUNDMENTS OVERLAYING THE GREAT MIAMI AQUIFER SYSTEM

County	Size (Acres)	Type	Owner	Location
Butler	28.7	Ind	Armco	Middletown
	13.0	Mun	City of Middletown	Middletown
	2.75	Ind	Cyanamid	Fairfield
	2.01	Ind	Armco	Middletown
	1.55	Ind	Simpson Paper	Middletown
	1.38	Ind	Armco	Middletown
Hamilton	11.02	Ind	Cincinnati Gas & Electric--Miami Fort	North Bend
	4.82	Ind	Dept. of Energy	Fernald
	4.36	Mun	Metropolitan Sewer District--Mill Creek	Cincinnati
	3.15	Ind	General Electric	Evandale
	2.70	Mun	Cincinnati, Inc.	Harrison
	2.3	Ind	Chevron Refinery	Hooven
	2.0	Ind	Pthalchem	Cincinnati
	1.84	Ind	Procter & Gamble	Cincinnati
Warren	19.0	Ind	Moraine Materials	Franklin
	5.74	Ind	Morrow Gravel Pit	Morrow

TABLE 4.7

CLASS V INJECTION WELLS IN
THE AQUIFER RECHARGE AREA

County	Storm Water	Waste Disposal (includes Septic Systems)	Cooling, Heat Pump Return
Butler	12	2	
Champaign		7	
Clark		75	
Clermont		None listed	
Greene			13
Hamilton	2		1
Logan		35	
Miami		34	1
Montgomery	407	47	39
Warren			1

SOURCE: Malcolm Pirnie, Inc. 1986. Class IV and V Injection Well Inventory for the Ohio Environmental Protection Agency.

TABLE 4.8

SINGLE-FAMILY DWELLING WASTE DISPOSAL DRY WELLS ("EXEMPT") IN THE AQUIFER RECHARGE AREA

County	Township and Number of Wells			
Butler	Fairfield	1	Ross	1
	Hanover	1		
Champaign	Adams	4	Concord	8
	Harrison	12	Jackson	22
	Johnson	7	Mad River	36
	Rush	14	Salem	77
	Union	9	Urbana	482
	Goshen	56		
Clark	Bethel	914	German	248
	Harmony	127	Madison	20
	Mad River	881	Moorefield	442
	Pike	77	Pleasant	58
	Springfield	1350		
Clermont	None listed			
Darke	None listed			
Greene	Bath	1	Beavercreek	28
	Sugarcreek	4	Xenia	4
Hamilton[a]	Columbia	Number unknown		
	Whitewater	Number unknown		
Logan	Jefferson	123	Liberty	124
	Monroe	52	Union	9
Miami	Bethel	135	Concord	253
	Elizabeth	33	Monroe	23
	Newberry	37	Newton	12
	Spring Creek	51	Staunton	112
	Union	58	Washington	58
Montgomery	Butler	55	Clay	3
	German	49	Harrison	118
	Jackson	6	Jefferson	16
	Madison	96	Mad River	174
	Miami	283	Moraine	113
	Randolph	27	Washington	225
Preble	None listed			
Shelby	Cynthian	7	Loramie	7
	Orange	7	Washington	8
Warren	None listed			

SOURCE: Malcolm Pirnie, Inc. 1986. Class IV and V Injection Well Inventory for the Ohio Environmental Protection Agency

[a]Malcolm Pirnie, Inc. (1986) lists no exempt wells for Hamilton County. However, Hamilton County Health Department officials have confirmed the presence of exempt wells in two townships, although their numbers are unknown.

C. Streamflow Source Area

1. Topographic Map of Streamflow Source Area

The streamflow source area is shown on the County Topographic Maps (Plates 1-9, **MVRPC petition and OKI Plates 1-4).** The area includes the drainage basins of the Mad, Stillwater, Great Miami, Little Miami Rivers, and the Mill Creek. Portions of steams known to be losing are shown on Figure 4.16.

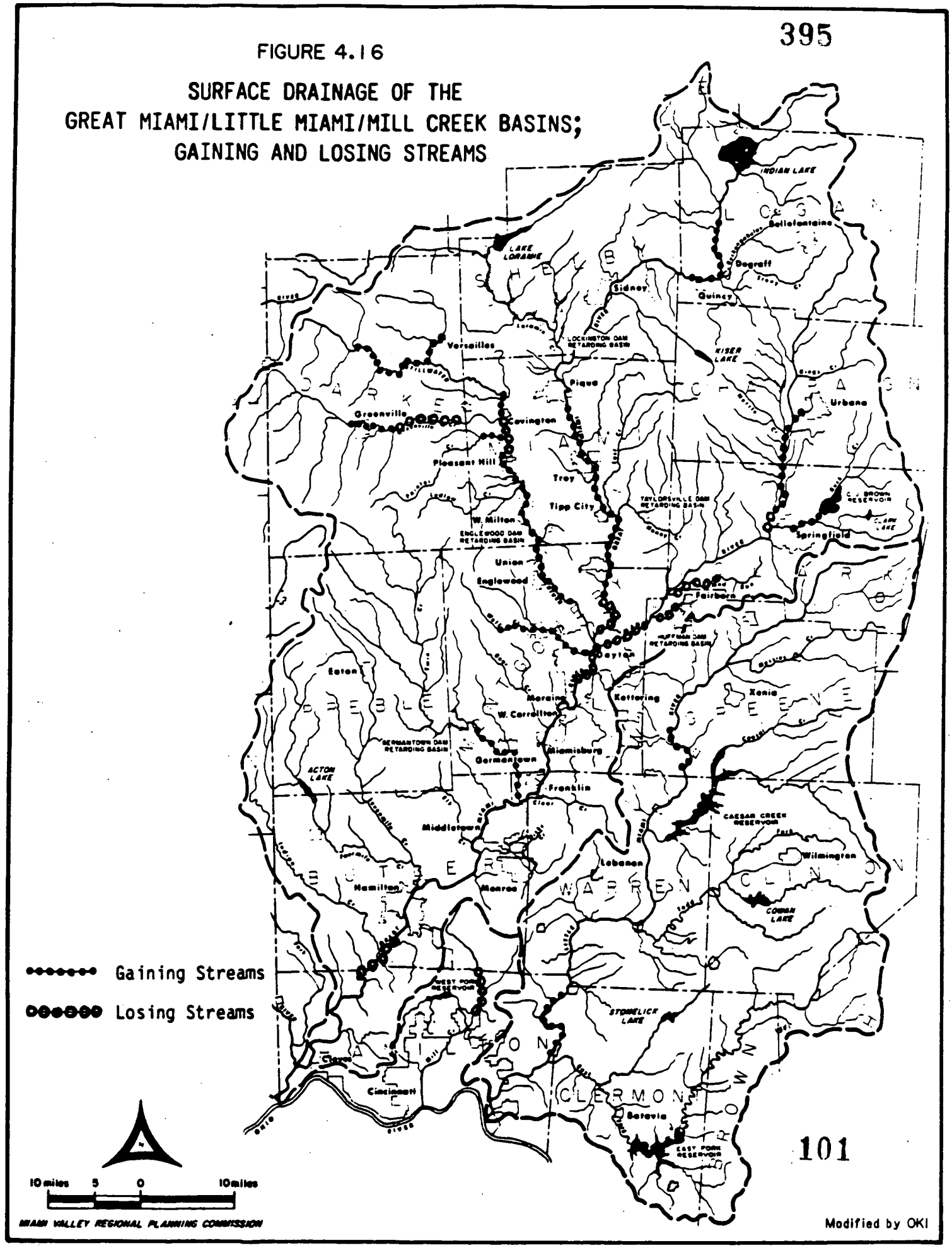
The streamflow source comprises two major basins, The Great and Little Miami Rivers, with a total drainage area of 7,140 square miles (ODNR, 1960). These basins and their surface drainage systems are shown on Figure 4.16. The Great Miami River, a major tributary of the Ohio River, begins at Indian Lake in Logan County and flows 170 miles to join the Ohio River just west of Cincinnati. Its total drainage area is 5,385 square miles, of which 3,948 are in Ohio **(705 square miles are within the OKI planning area).** Major tributaries include the Stillwater River, the Mad River, Twin Creek, and the Whitewater River.

The Little Miami River, which begins in Clark County, flows 105 miles to join the Ohio River east of Cincinnati. **Of its 1,755 square mile drainage basin, nearly half (875 square miles) is within the OKI area. Among its major tributaries** are Caesars Creek, Todd Fork and the East Fork.

395

FIGURE 4.16

SURFACE DRAINAGE OF THE
GREAT MIAMI/LITTLE MIAMI/MILL CREEK BASINS;
GAINING AND LOSING STREAMS



101

The Mill Creek Basin is a smaller drainage area surrounded by the Great and Little Miami River Basins. The Mill Creek rises in southern Butler County and flows southward 28 miles through Hamilton County to its confluence with the Ohio River in Cincinnati. Its 166 square mile drainage basin is entirely within the OKI planning area.

2. Methods Used to Determine Streamflow Contribution

The streamflow studies cited in this chapter have relied mainly on flow measurements, although some computer modeling also has been done in recent years. Low-flow indices and flow-duration curves also have been analyzed to evaluate streamflow contribution. The information gained from the study of selected portions of streams is used to make some generalizations about the entire Buried Valley Aquifer System.

3. Streamflow Characteristics

Within the Buried Valley Aquifer, losing streams are usually the result of induced infiltration while gaining streams are probably the normal condition. Most losing reaches are near centers of groundwater pumping which causes induced infiltration from streams (Table 4.5 and Figure 4.16). Some major pumping centers have not been studied, but it is expected that these centers also are areas of induced infiltration. Gaining streams are streams embedded in highly permeable glacial materials that provide for their typically high sustained flow and relatively high low-flow

indices. Data on losing and gaining portions of streams are summarized in Table 4.9. Streams known to be losing or gaining are shown on Figure 4.16.

D. Designated Area

The proposed designated area is the area contained within the aquifer boundaries, its coincident recharge area, and the aquifer's service area. This area is delineated on the County Topographic Maps (Plates 1-9, **MVRPC petition and OKI Plates 1-4).** Figures 4.17 and 4.18 are maps delineating the proposed Designated and Project Review Area in the MVRPC and OKI planning areas, respectively.

E. Project Review Area

The project review area is the same area described in Section D above. This area is illustrated on Figure 4.17 and 4.18 and on the County Topographic Maps (Plates 1-9, **MVRPC petition and OKI Plates 1-4).**

TABLE 4.9

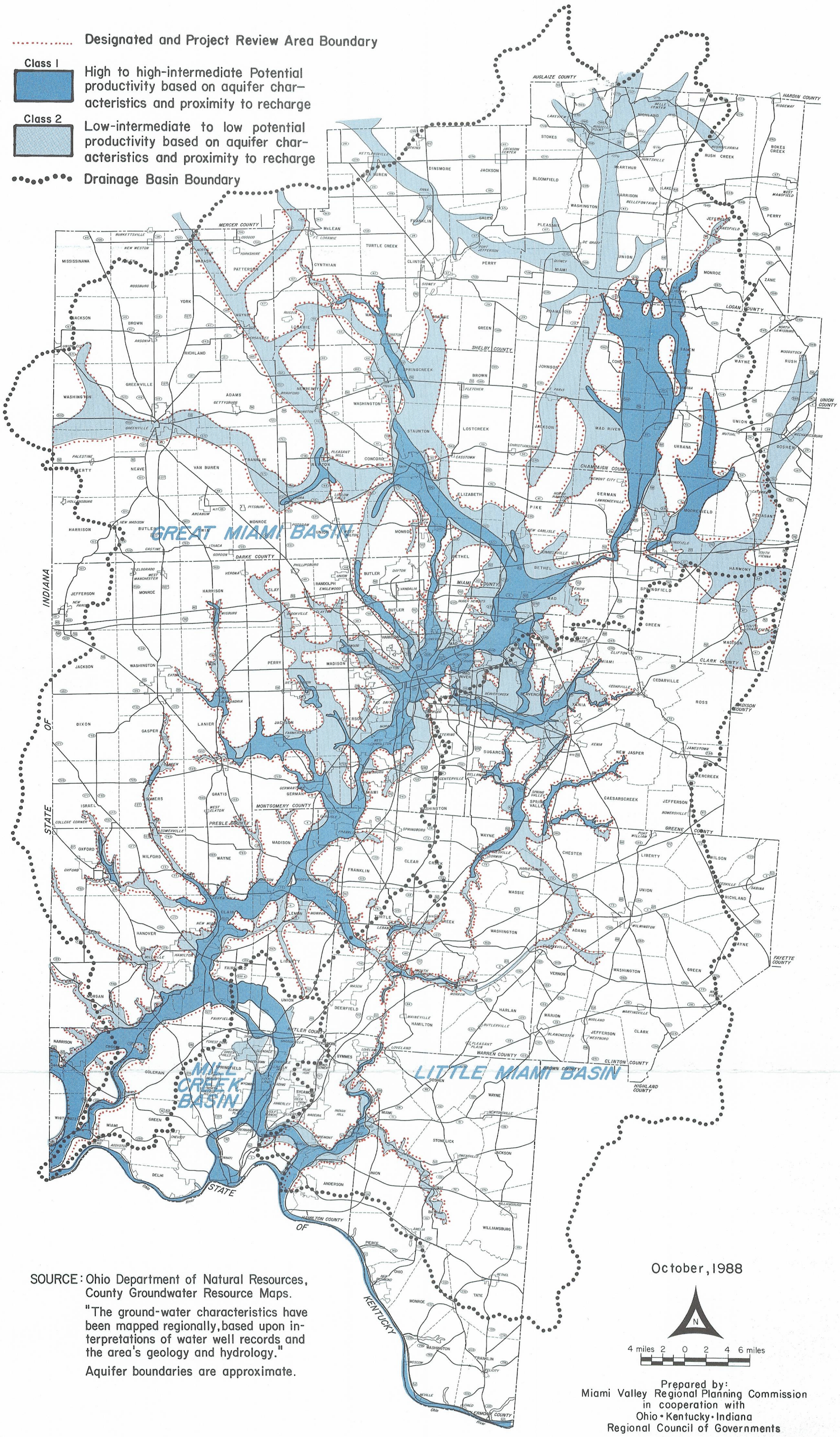
SUMMARY DATA ON LOSING AND GAINING STREAMS IN THE AQUIFER RECHARGE AREA

Source	Location	Losing/ Gaining	Type of Investigation*
CH2M Hill 1986	- Great Miami in Montgomery County	Losing	1
Cross and Hedges 1959	- Little Miami in Greene and Hamilton Counties	Gaining	2
	- Mill Creek in Hamilton County	Losing	2
	- Great Miami in Logan, Miami & Montgomery Counties	Gaining	2
	- Mad River in Champaign and Clark Counties	Gaining	2
	- Buck Creek in Clark County	Gaining	2
	- Wolf Creek in Montgomery County	Gaining	2
	- Twin Creek in Montgomery and Warren Counties	Gaining	2
Dove 1969	- Great Miami in Butler and Hamilton Counties	Losing	3
Johnson and Metzker 1981	- Stillwater in Darke, Miami & Montgomery Counties	Gaining & Losing	4
Norris, Cross, Goldthwait and Sanderson 1952	- Buck Creek in Clark County	Gaining	2
Norris and Eagon 1971	- Mad River in Clark County	Losing	3
Norris and Spieker 1966	- Great Miami in Montgomery County	Losing	5
	- Mad River in Montgomery County	Losing	5
Walton and Scudder 1960	- Hebble Creek and Mudd Run in Greene County	Losing	5

* 1 Field measurements of groundwater levels and computer modeling
2 Analysis of flow-duration curves and dry-weather indices
3 Field measurements of groundwater levels and water balance calculations
4 Field measurements of streamflow
5 Field measurements of streamflow and groundwater levels and water balance calculations

GREAT MIAMI/LITTLE MIAMI RIVER BASINS
BURIED VALLEY AQUIFER SYSTEM

SOLE SOURCE AQUIFER
DESIGNATED AND PROJECT REVIEW AREA



SOURCE: Ohio Department of Natural Resources, County Groundwater Resource Maps.

"The ground-water characteristics have been mapped regionally, based upon interpretations of water well records and the area's geology and hydrology."

Aquifer boundaries are approximate.

October, 1988

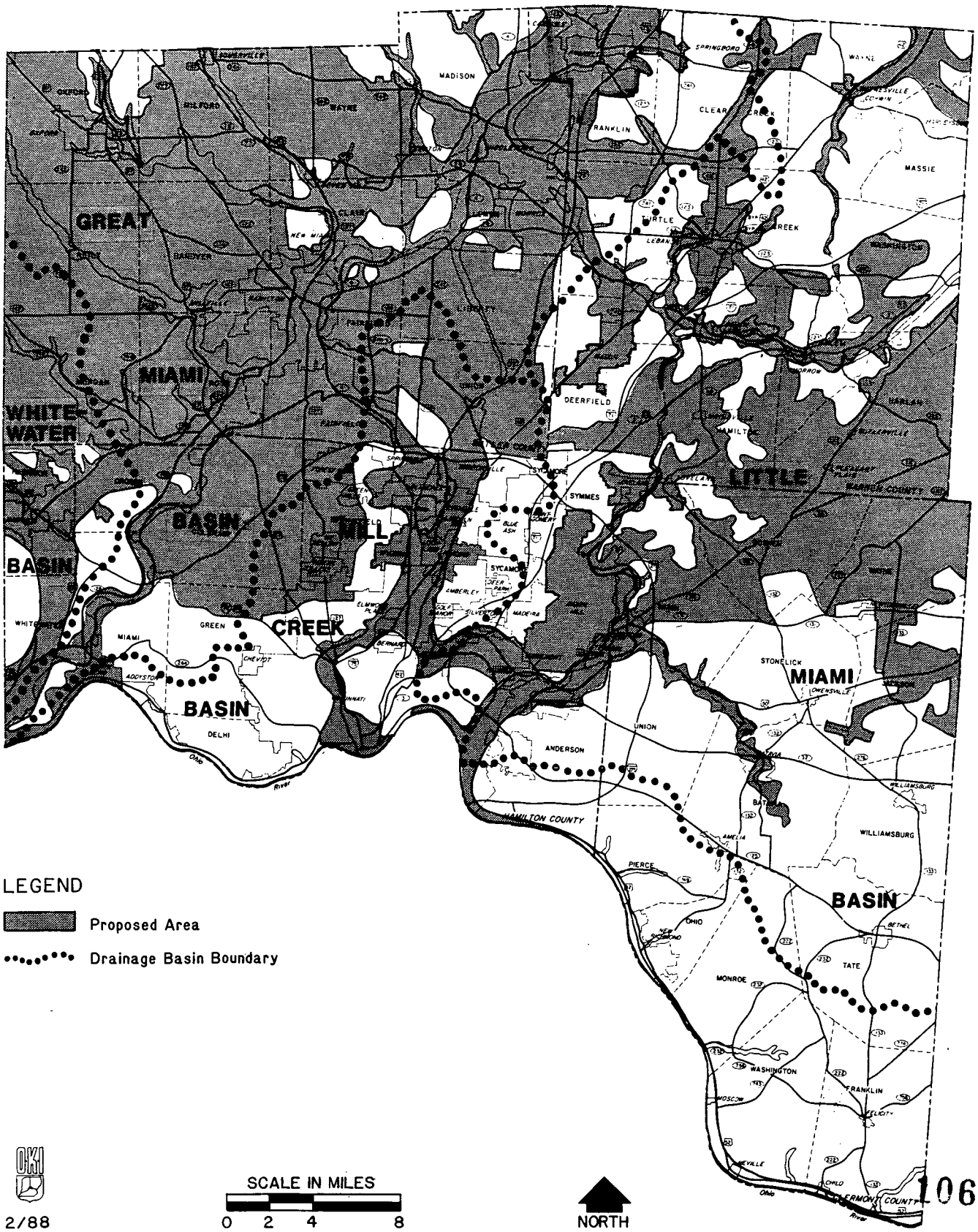
N

4 miles 2 0 2 4 6 miles

Prepared by:
Miami Valley Regional Planning Commission
in cooperation with
Ohio • Kentucky • Indiana
Regional Council of Governments

FIGURE 4.18

OKI's PROPOSED DESIGNATED/PROJECT REVIEW AREA



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APPENDIX A

Resolutions and Letters of Support

RESOLUTION OF THE OHIO-KENTUCKY-INDIANA REGIONAL COUNCIL OF GOVERNMENTS SUPPORTING SOLE SOURCE AQUIFER DESIGNATION FOR PORTIONS OF THE BURIED VALLEY AQUIFER SYSTEM OF THE GREAT MIAMI/LITTLE MIAMI BASINS

WHEREAS, the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) is the Designated Planning Agency for water quality management planning pursuant to Section 208 of the Federal Water Polluton Control Act Amendments of 1972 (P.L. 92-500) and 1977 (P.L. 95-217) for an area that includes Butler, Clermont, Hamilton, and Warren Counties in Ohio; and

WHEREAS, Butler, Clermont, Hamilton, and Warren Counties are underlain by various waterbearing geologic formations which are a major source of the area's domestic, agricultural, and industrial water supplies; and

WHEREAS, these resources include portions of the Class 1 and Class 2 buried valley aquifer system associated with the Great and Little Miami Rivers and the Mill Creek and their tributaries; and

WHEREAS, the aquifer's protection is essential to the future viability of the area's population and economy; and

WHEREAS, local governments support the need for planning and management to protect the buried valley aquifer system; and

WHEREAS, a petition has been prepared by the Miami Valley Regional Planning Commission to support the "sole source" designation of the entire aquifer, including that part of the aquifer within Butler, Clermont, Hamilton, and Warren Counties; and

WHEREAS, OKI is responsible for the preparation, maintenance, and administration of areawide management planning and programs for surface and groundwater in Butler, Clermont, Hamilton, and Warren Counties; and

WHEREAS, an affirmative decision to grant Sole Source Aquifer designation by the Administrator of the United States Environmental Protection Agency under the provisions of Section 1424(e) of the Safe Drinking Water Act of 1974 (P.L. 93-523) would strengthen local capability to manage the aquifer system by providing federal recognition of the region's social and economic dependence on its groundwater resources.

NOW, THEREFORE BE IT RESOLVED, that the Executive Committee of OKI, at its public meeting of April 9, 1987, authorizes OKI to be a co-petitioner of the petiton before the United States Environmental Protection Agency to designate the Class 1 and Class 2 buried valley aquifer system of the Great Miami/Little Miami Basins within Butler, Clermont, Hamilton, and Warren Counties as a sole source aquifer under Section 1424(e) of the Safe Drinking Water Act of 1974.

O.H. Egleston, President

jt

4/9/87

No. 87-4-584

RESOLUTION BY SHELTON 395

Resolved By the Board of County Commissioners of Butler County, Ohio, That

WHEREAS, Butler, Clermont, Hamilton, and Warren Counties in Ohio are underlain by various waterbearing geologic formations which are a major source of the area's domestic, agricultural, and industrial water supplies; and

WHEREAS, these resources include portions of the Class I and Class 2 buried valley aquifer system associated with the Great and Little Miami Rivers and the Mill Creek and their tributaries; and

WHEREAS, a petition has been prepared for the Great Miami/Little Miami aquifer system as a basis for requesting designation as a sole source under the provisions of Section 1424(e) of the Safe Drinking Water Act of 1974 (P.L. 93-523); and

WHEREAS, the aquifer's protection is essential to the future viability of this area's population and economy; and

WHEREAS, the opportunity to protect and manage the Great Miami/Little Miami aquifer system would be facilitated by its designation as a sole source aquifer; and

WHEREAS, a petition for the aquifer's designation has been prepared ty the Miami Valley Regional Planning Commission (MVRPC); and

WHEREAS, the MVRPC is the Designated Planning Agency (DPA) for water quality management planning (pursuant to Section 208 of the Federal Water Pollution Control Act Amendments of 1972 and 1977) for only five of the counties in the area to which the petition applies; and

WHEREAS, the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) is the DPA for the counties of Butler, Clermont, Hamilton, and Warren; and

WHEREAS, responsibility for the preparation, maintenance, and administration of areawide management planning and programs for surface and groundwater in Butler, Clermont, Hamilton, and Warren Counties is delegated to OKI as a DPA for water quality management planning.

NOW, THEREFORE BE IT RESOLVED that the Board of County Commissioners in the County of Butler, State of Ohio, endorses the petition before the United States Environmental Protection Agency to designate the Class I and Class 2 buried valley aquifer system of the Great Miami/Little Miami Basins as a sole source aquifer under Section 1424(e) of the Safe Drinking Water Act of 1974; and

BE IT FURTHER RESOLVED that the Board of Butler County Commissioners requests that that part of Butler, Clermont, Hamilton, and Warren Counties within the Sole Source Aquifer Boundary as defined in the petition be included in the area designated as a Sole Source Aquifer.

Mr. Logsdon seconded the above resolution and upon call of the roll, the vote resulted as follows:

Mr. Shelton Yea Mr. Logsdon Yea Mr. Combs Yea

Adopted: April 30, 1987

Attest: Diana Bradford, Clerk

C E R T I F I C A T E

I, Clerk of the Board of Butler County Commissioners, do hereby certify that the foregoing is a true and correct copy of Resolution #87-4-584 adopted by the Board of Butler County Commissioners on April 30, 1987.

Diana Bradford
Diana Bradford
Clerk of the Board

Municipal Building • 20 High Street at Monument 45011 • 1-513-868-5834

Hamilton! Ohio

OFFICE OF THE MAYOR
AND
CITY COUNCIL

May 29, 1987

Ohio-Kentucky-Indiana Regional Council
of Governments
426 East Fourth Street
Cincinnati, Ohio 45202

Gentlemen:

As directed by Hamilton City Council, I have enclosed a certified copy of Resolution No. R87-5-39 adopted by Hamilton City Council at its regular meeting on May 27, 1987.

> **RESOLUTION NO. R87-5-39:** A resolution endorsing the petition before the United States Environmental Protection Agency to designate the Class 1 and Class 2 Buried Valley Aquifer System of the Great Miami/Little Miami Basins as a sole source aquifer under Section 1424(e) of the Safe Drinking Water Act of 1974 (P. L. 93-253).

It is my understanding that you will forward this certified copy of the resolution to the United States Environmental Protection Agency.

Thank you for your assistance.

Sincerely,

Linda A. Landi

Linda A. Landi
City Clerk

LAL/

Enclosure

RESOLUTION NO. R87-5-39

A RESOLUTION ENDORSING THE PETITION BEFORE THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY TO DESIGNATE THE CLASS 1 AND CLASS 2 BURIED VALLEY AQUIFER SYSTEM OF THE GREAT MIAMI/LITTLE MIAMI BASINS AS A SOLE SOURCE AQUIFER UNDER SECTION 1424(e) OF THE SAFE DRINKING WATER ACT OF 1974 (P.L. 93-253).

WHEREAS, the Ohio Counties of Butler, Clermont, Hamilton, and Warren are underlain by various water-bearing geologic formations which are a major source of the area's domestic, agricultural, and industrial water supplies; and

WHEREAS, these resources include portions of the Class 1 and Class 2 buried valley aquifer system associated with the Great and Little Miami Rivers and Mill Creek, together with their tributaries; and

WHEREAS, a petition has been prepared for the Great Miami/Little Miami aquifer system as a basis for requesting designation as a sole source under the provisions of Section 1424(e) of the Safe Drinking Water Act of 1974 (P. L. 93-523); and

WHEREAS, the aquifer's protection is essential to the future viability of this area's population and economy, and the opportunity to protect and manage the Great Miami/Little Miami aquifer system would be facilitated by its designation as a sole source aquifer; and

WHEREAS, a petition for the aquifer's designation has been prepared by the Miami Valley Regional Planning Commission which is the Designated Planning Agency for water quality management planning (pursuant to Section 208 of the Federal Water Pollution Control Act Amendments of 1972 and 1977) for only five of the counties in the area to which the petition applies; and

WHEREAS, the Ohio-Kentucky-Indiana Regional Council of Governments is the Designated Planning Agency for the Ohio counties of Butler, Clermont, Hamilton, and Warren; and

WHEREAS, responsibility for the preparation, maintenance, and administration of area-wide management planning and programs for surface and groundwater in the aforesaid counties is delegated to the Ohio-Kentucky-Indiana Regional Council of Governments as a Designated Planning Agency for water quality management planning;

NOW, THEREFORE, BE IT RESOLVED by the Council of the City of Hamilton, Ohio:

SECTION I: That the City of Hamilton, Butler County, Ohio, hereby endorses the petition before the United States

Environmental Protection Agency to designate the Class 1 and Class 2 buried valley aquifer system of the Great Miami/Little Miami Basins as a sole source aquifer under Section 1424(e) of the Safe Drinking Water Act of 1974.

SECTION II: That the City of Hamilton, Ohio, hereby requests that those parts of the Ohio counties of Butler, Clermont, Hamilton and Warren located within the sole source aquifer boundary as defined in the aforesaid petition be included in the area designated as a sole source aquifer.

SECTION III: That the City Clerk is hereby directed to forward a certified copy of this resolution to the Ohio-Kentucky-Indiana Regional Council of Governments for transmittal to the United States Environmental Protection Agency.

SECTION IV: This resolution shall take effect and be in full force from and after the earliest period allowed by law.

PASSED: May 27, 1987

GREGORY V. JOLIVETTE
Mayor

Effective Date: Immediately

ATTEST: Linda A. Landi
City Clerk

CERTIFICATE

I hereby certify that the foregoing is a true and correct copy of Resolution No. R87-5-39, adopted by the Council of the City of Hamilton, Ohio, at its regular meeting on the 27th day of May, 1987.

Linda A. Landi
City Clerk
City of Hamilton! Ohio

EMERGENCY RESOLUTION NO. 10-87

A RESOLUTION ENDORSING THE PETITION BEFORE THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGARDING SOLE SOURCE AQUIFER DESIGNATION FOR THE GREAT MIAMI/LITTLE MIAMI BASINS AND REQUESTING INCLUSION IN THE AREA OF THE GREAT MIAMI/LITTLE MIAMI BASINS DESIGNATED AS A SOLE SOURCE AQUIFER, AND DECLARING AN EMERGENCY.

395

WHEREAS, Butler, Clermont, Hamilton and Warren Counties in Ohio are underlain by various waterbearing geologic formations which are a major source of the area's domestic, agricultural and industrial water supplies; and

WHEREAS, these resources include portions of the Class 1 and Class 2 buried valley aquifer system associated with the Great and Little Miami Rivers and the Mill Creek and their tributaries; and

WHEREAS, a petition has been prepared for the Great Miami/Little Miami aquifer system as a basis for requesting designation as a sole source under the provisions of Section 1424(e) of the Safe Drinking Water Act of 1974 (P.L. 93-523); and

WHEREAS, the aquifer's protection is essential to the future viability of this area's population and economy; and

WHEREAS, the opportunity to protect and manage the Great Miami/Little Miami aquifer system would be facilitated by its designation as a sole source aquifer; and

WHEREAS, a petition for the aquifer's designation has been prepared by the Miami Valley Regional Planning Commission (MVRPC); and

WHEREAS, the MVRPC is the Designated Planning Agency (DPA) for water quality management planning (pursuant to Section 208 of the Federal Water Pollution Control Act Amendments of 1972 and 1977) for only five of the counties in the area to which the petition applies; and

WHEREAS, the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) is the DPA for the counties of Butler, Clermont, Hamilton and Warren; and

WHEREAS, responsibility for the preparation, maintenance and administration of areawide management planning and programs for surface and groundwater in Butler, Clermont, Hamilton and Warren Counties is delegated to OKI as a DPA for water quality management planning;

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE MUNICIPALITY OF MONROE, STATE OF OHIO, THAT:

SECTION 1: The Monroe Council hereby endorses the petition before the United States Environmental Protection Agency to designate the Class 1 and Class 2 buried valley aquifer system of the Great Miami/Little Miami systems as a Sole Source Aquifer under Section 1424(e) of the Safe Drinking Water Act of 1974.

SECTION 2: The Monroe Council further requests that that part of Butler, Clermont, Hamilton and Warren Counties within the sole source aquifer boundaries, as designated in the petition, be included in the area designated as a Sole Source Aquifer with OKI as the Designated Planning Agency.

SECTION 3: This Resolution is hereby declared to be an emergency measure and necessary for the immediate preservation of the public health, safety and welfare of the citizens of Monroe for the reason that the protection of the entire Great Miami/Little Miami aquifer is essential to the future growth and continued protection of both the population and economy of the Municipality; therefore, this Resolution shall take effect and be in force from and after its passage.

PASSED: May 5, 1987

395

ATTEST:

Linda Egelston
Clerk of Council

APPROVED:

Elbert R. Turnentine Jr.
Mayor

This legislation was enacted in open meeting pursuant to the terms and provisions of the Sunshine Law, Section 121.22 of the Ohio Revised Code.

"I, the undersigned Clerk of Council of the Municipality of Monroe, Ohio, hereby certify that the foregoing (ordinance or resolution) was published as required by Section 7.16 of the Charter of said Municipality by posting a copy thereof at (1) Monroe Post Office, (2) Monroe Municipal Building, (3) Monroe Council Chambers, (4) Monroe Village and (5) Mt Pleasant on the 6th day of May 1987."

Linda Egelston
Clerk of Council
Municipality of Monroe, Ohio

C E R T I F I C A T E

The undersigned, Clerk of Council of Council of the Municipality of Monroe, Ohio, hereby certifies that the foregoing is a true and correct copy of Emergency Resolution No. 10-85, adopted by Council on the 5th day of May, 1987.

Linda Egelston
Clerk of Council

MUNICIPAL OFFICE BUILDING

CITY OF TRENTON

May 8, 1987

Mr. Dory Montazemi
Assistant Director
Ohio-Kentucky-Indiana Regional
Council of Governments
426 East Fourth Street
Cincinnati, Ohio 45202

Dear Mr. Montazemi:

Enclosed please find a certified copy of City of Trenton Resolution No. 6-87, supporting sole source aquifer designation for portions of the buried valley aquifer system of the Great Miami/Little Miami Basins, which was passed by Trenton City Council on May 7, 1987.

If you have any questions, please contact Melvin P. Ruder, City Manager.

Very truly yours,

Marcia M. Szala

Marcia M. Szala
Clerk of Council

cc: File
M-Reading File

A-10

21 EAST STATE STREET • TRENTON, OHIO 45067 • (513) 988-6304

RESOLUTION NO. 6-87

A RESOLUTION SUPPORTING SOLE SOURCE AQUIFER DESIGNATION FOR PORTIONS OF THE BURIED VALLEY AQUIFER SYSTEM OF THE GREAT MIAMI/LITTLE MIAMI BASINS.

WHEREAS, Butler, Clermont, Hamilton, and Warren Counties in Ohio are underlain by various waterbearing geologic formations which are a major source of the area's domestic, agricultural, and industrial water supplies; and

WHEREAS, these resources include portions of the Class 1 and Class 2 buried valley aquifer system associated with the Great and Little Miami Rivers and the Mill Creek and their tributaries; and

WHEREAS, a petition has been prepared for the Great Miami/Little Miami aquifer system as a basis for requesting designation as a sole source under the provisions of Section 1424(e) of the Safe Drinking Water Act of 1974 (P.L. 93-523); and

WHEREAS, the aquifer's protection is essential to the future viability of this area's population and economy; and

WHEREAS, the opportunity to protect and manage the Great Miami/ Little Miami aquifer system would be facilitated by its designation as a sole source aquifer; and

WHEREAS, a petition for the aquifer's designation has been prepared by the Miami Valley Regional Planning Commission (MVRPC); and

WHEREAS, the MVRPC is the Designated Planning Agency (DPA) for water quality management planning (pursuant to Section 208 of the Federal Water Pollution Control Act Amendments of 1972 and 1977) for only five of the counties in the area to which the petition applies; and

WHEREAS, the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) is the DPA for the counties of Butler, Clermont, Hamilton, and Warren; and

WHEREAS, responsibility for the preparation, maintenance, and administration of areawide management planning and programs for surface and groundwater in Butler, Clermont, Hamilton, and Warren Counties is delegated to OKI as a DPA for water quality management planning;

NOW, THEREFORE BE IT RESOLVED BY THE COUNCIL OF THE CITY OF TRENTON, BUTLER COUNTY, OHIO:

Section 1. That the Council of the City of Trenton, Ohio, endorses the petition before the United States Environmental Protection Agency to designate the Class 1 and Class 2 buried valley aquifer system of the Great Miami/Little Miami Basins as a sole source aquifer under Section 1424(e) of the Safe Drinking Water Act of 1974.

Section 2. That the Council of the City of Trenton, Ohio requests that that part of Butler, Clermont, Hamilton, and Warren Counties within the sole source aquifer boundary as defined in the petition be included in the area designated as a Sole Source Aquifer.

Section 3. That the Clerk of Council be and hereby is authorized and directed to forward a certified copy of this Resolution to the Ohio-Kentucky-Indiana Regional Council of Governments for transmittal to the United States Environmental Protection Agency.

Section 4. That this Resolution shall take effect and be in full force from and after the earliest period allowed by law.

PASSED May 7, 1987

AYES 6 NAYS 0

First Reading 5/7/87

Second Reading -

Third Reading -

Jack L. Allen/s/ Jack L. Allen
MAYOR

Rules Suspended May 7, 1987

AYES 6 NAYS 0

ATTEST:

Marcia M. Szala/s/ Marcia M. Szala
CLERK OF COUNCIL

CERTIFICATION

I hereby certify that the above resolution is a true and correct copy of Resolution No. 6-87 according to the Record of Resolutions of the City of Trenton, Butler County, Ohio.

Marcia M. Szala
Clerk of Council

THE WATER ASSOCIATION 395

3640 OLD-OXFORD HIGHWAY
HAMILTON, OHIO 45013
PHONE: 863-0828

April 30, 1987

Mr. Dory Montazemi
OKI Regional Council of Governments
426 East Fourth St.
Cincinnati, Ohio 45202

Dear Mr. Montazemi:

In response to Jim Hinchberger's request, I am enclosing a resolution adopted by The Water Association's Board of Trustees reflecting our support of Sole Source Aquifer Designation for the Great Miami/Little Miami River Basins.

The resolution was based upon your model sent to Jim on April 23rd.

If I can be of further assistance or if you have any questions concerning the resolution please don't hesitate to reply.

Sincerely,

Robert C. Hubbard
General Manager

cc:file

enclosure

WHEREAS, Butler, Clermont, Hamilton, and Warren Counties in Ohio are underlain by various waterbearing geologic formations which are a major source of the area's domestic, agricultural, and industrial water supplies; and

WHEREAS, these resources include portions of the Class 1 and Class 2 buried valley aquifer system associated with the Great and Little Miami Rivers and the Mill Creek and their tributaries; and

WHEREAS, a petition has been prepared for the Great Miami/Little Miami aquifer system as a basis for requesting designation as a sole source under the provisions of Section 1424(e) of the Safe Drinking Water Act of 1974 (P.L. 93-523); and

WHEREAS, the aquifer's protection is essential to the future viability of this area's population and economy; and

WHEREAS, the opportunity to protect and manage the Great Miami/Little Miami aquifer system would be facilitated by its designation as a sole source aquifer; and

WHEREAS, a petition for the aquifer's designation has been prepared by the Miami Valley Regional Planning Commission ((MVRPC); and

WHERAS, the MVRPC is the Designated Planning Agency (DPA) for water quality management planning (pursuant to Section 208 of the Federal Water Pollution Act Amendments of 1972 and 1977) for only five of the counties in the area to which the petition applies; and

WHEREAS, the Ohio-Kentucky-Indiana Regional Council of Governments (OKI) is DPA for the counties of Butler, Clermont, Hamilton, and Warren; and

WHEREAS, responsibility for the preparation, maintenance, and administration of areawide management planning and programs for surface and groundwater in Butler, Clermont, Hamilton, and Warren Counties is delegated to OKI as a DPA for water quality management planning;

NOW, THEREFORE BE IT RESOLVED, that THE WATER ASSOCIATION, a rural water cooperative whose sole source of supply is located on the Great Miami River Aquifer in the County of Butler, in the State of Ohio, endorses the petition before the United States Environmental Protection Agency to designate the Class 1 and Class 2 buried valley aquifer system of the Great Miami/Little Miami Basins as a sole source aquifer under Section 1424(e) of the Safe Drinking Water Act of 1974; and

BE IT FURTHER RESOLVED, that THE WATER ASSOCIATION requests that that part of Butler, Clermont, Hamilton, and Warren Counties within the Sole Source Aquifer Boundry as defined in the petition be included in the area designated as a Sole Source Aquifer.

ADOPTED 4/28/87

W. Guy Metcalf
PRESIDENT, BOARD OF TRUSTEES

POSTED 4/28/87

4/28/87
APPROVED DATE

ATTEST

Donald A. Schwartz
SECRETARY, BOARD OF TRUSTEES

APPENDIX B

Construction of ODNR County Ground-Water Resources Maps - Letter from Michael Hallfrisch

ODNR
OHIO DEPARTMENT OF
NATURAL RESOURCES
Division of Water
Fountain Square
Columbus, Ohio 43224

August 25, 1987

Ms. Kathy Watkins
MVRPC
117 S. Main St., Suite 200
Dayton, OH 45402

Dear Ms. Watkins:

In response to your request for an explanation of how hydrogeologists at the Division of Water, Ground-Water Resources Section (GWRS) make ground-water resources maps, I have prepared this letter. To simplify matters, I am dividing my response into two parts: data collection and methodology.

Data collection

In the process of making ground-water resources maps, a hydrogeologist in the GWRS uses many varied sources of information. These sources fall into the following four broad categories.

1) Water well logs, test borings and test wells.

2) Reports and information published by the Ohio Department of Natural Resources, the U.S.G.S and other public agencies.

3) Consultants' reports on file with the Division of Water.

4) Unpublished information on file at the Ohio Department of Natural Resources and at other public agencies.

Water well logs, test borings and test wells

The Ohio Revised Code 1521.05 requires that drilling contractors file a well log with the Division of Water for each water well they drill. The Division of Water currently has on file approximately 500,000 water well logs from locations across the state.

Information typically found on the water well log includes: well depth, thickness and type of formations encountered, water producing horizon, well yield and depth to bedrock. All of this information is vital to the hydrogeologist when making a ground-water resources map.

In addition to well logs the GWRS has on file records of several test wells and formation borings drilled for the Division of Water. The test wells have detailed information on transmissivity, stratigraphy and water chemistry. Borings have detailed information of stratigraphy and sieve analyses of permeable formations.

Richard F. Celeste, Governor

Published information

The Ohio Department of Natural Resources, Divisions of Water and Geological Survey and the U.S.G.S. periodically publish bulletins, reports, information circulars, and maps on the geology and hydrogeology of Ohio. Information typically contained in these documents, which the GWRS hydrogeologist may find useful includes: depth to bedrock, formation type, stratigraphy, aquifer thickness and the areal extent of a formation.

Consultants' reports

The GWRS has on file numerous private consultants' reports. These reports contain the results of ground-water studies performed for municipalities, public agencies and private industries. Information contained within most consultants' reports includes: thickness and areal extent of the aquifer, transmissivity and storativity of the aquifer, anticipated long-term well yields, and recharge rates.

Unpublished information

Data on file but not published at the Ohio Department of Natural Resources and at other public agencies are often useful to the GWRS hydrogeologist. Types of information often available includes: aerial photos, soil surveys, surface and bore hole geophysics, chemical quality data, and theses from universities across the state.

Methodology

Every hydrogeologist in the GWRS uses a slightly different approach to construct a ground-water resources map. However, certain basic methods are common to all.

First, the well logs for the county to be mapped are field located. During the field location process a member of the GWRS staff travels to the county of interest with the well logs in hand. The staff member then travels the streets, highways and backroads of the county verifying the addresses on the logs and plotting their locations on U.S.G.S. 7.5 minute quadrangle maps. Only well logs that have had their locations verified and plotted in this manner are used to construct ground-water resources maps.

Next, the GWRS hydrogeologist gathers together all available information for the county to be mapped. This data includes all the data types listed above.

Finally, the GWRS hydrogeologist obtains a 1:62,500 scale base map of the county and begins work on the original draft of the ground-water resources map. During construction of the map the hydrogeologist must carefully review and assimilate all the available information; searching for areas underlain by a common aquifer. The hydrogeologist then delineates this region on the draft map and prepares a concise written description to be printed in the map legend. When making ground-water resources maps GWRS hydrogeologists endeavor to be as objective as possible, however, a certain amount of interpretation, tempered by basic geologic and hydrogeologic principles, are always required.

Ms. Kathy Watkins August 25, 1987

GWRS hydrogeologists often apply fundamental geologic techniques when constructing a map. These techniques include, but are not limited to, three point problems for determining strike and dip, constructing geologic cross sections and making bedrock topography maps. During the map making process the hydrogeologist may confer with other hydrogeologists in the GWRS as well as with drillers and consultants who are familiar with the county being mapped. All ground-water resources maps are reviewed for completeness before being sent to the cartographer.

I hope this letter has answered any questions you may have had on how ground-water resources maps are made. If you have any further questions please call me at 614/265-6745.

Sincerely,

Michael Hallfrisch
Hydrogeologist
Ground-Water Resources Section

MH/ww

KEY TO WATER WITHDRAWAL SITES SHOWN ON PLATES 1-4

Plate 1

CI-B	Cincinnati-Bolton
FAI	Fairfield
GTA	Green Tree Apartment
HA-N	Hamilton-North
HA-S	Hamilton-South
MID	Middletown
MHP	Mobile Home Park
NM	New Miami
OXF	Oxford
7MI	Seven Mile
TRE	Trenton
WA	The Water Association
WHN	Woodland Manor Nursing Home

Plate 2

CMC	Carlisle Manor Clinic
DUB	Dubois Apartment
FRA	Franklin
H-EF	Harlan-East Fork Water System
LCI	Lebanon Correctional Institute
LE-1	Lebanon-Plant 1
LE-2	Lebanon-Plant 2
MAS	Mason
MHP	Mobile Home Park
MON	Monroe
MOR	Morrow
OTT	Otterbein Home
SL	South Lebanon
SPR	Springboro
WC-DH	Warren County/Deerfield-Hamilton
WC-FL	Warren County/Franklin-Lebanon
WAY	Waynesville

Plate 3

ADD	Addyston
CI-C	Cincinnati-California
CLE	Cleves
GLE	Glendale
HAR	Harrison
IH	Indian Hill
LOC	Lockland
LOV	Loveland
MHP	Mobile Home Park
REA	Reading
TWC	Twightwee Welfare Corp
WYO	Wyoming

Plate 4

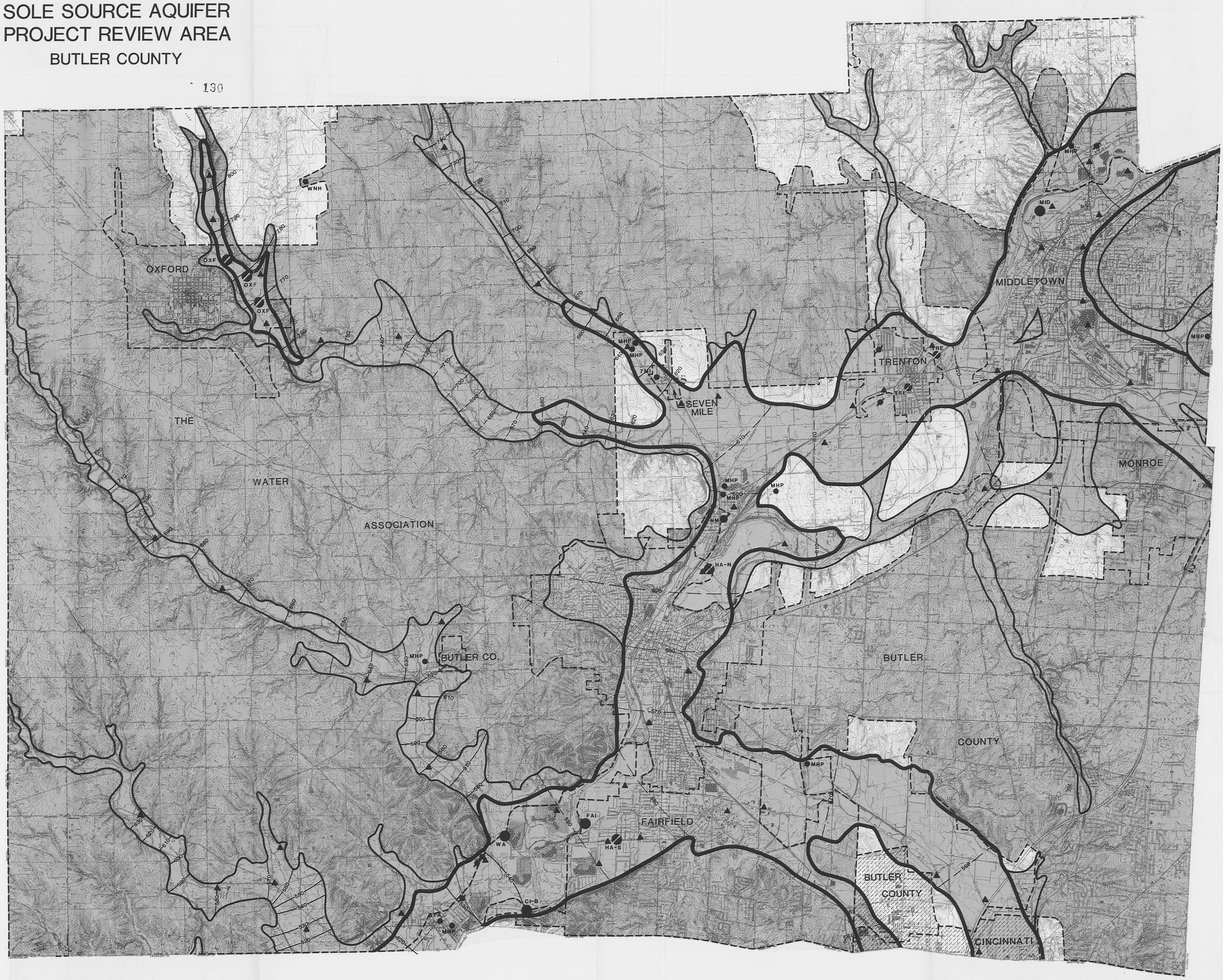
BAT	Batavia
BET	Bethel
CL-M	Clermont County-MGS
CL-P	Clermont County-PUB
FEL	Felicity
MHP	Mobile Home Park
MIL	Milford
NR	New Richmond
T-M	Tate-Monroe Water Association
WIL	Williamsburg

PLATE 1 395

SOLE SOURCE AQUIFER PROJECT REVIEW AREA

BUTLER COUNTY

130



Proposed Designated and Project Review Area

Class 1 Boundary *

Class 2 Boundary *

620 Potentiometric Line ** (dashed where inferred)

Data Point For Potentiometric Line

Public Water Service Area

supplied by surface water

WATER WITHDRAWAL SITES

Well/Well Field		Surface Water Intake
	≥ 1.0 mgd	
	0.1 – < 1.0 mgd	
	< 0.1 mgd	

Wells Located at 2 or More Sites

Non-Community Water System

NORTH

* PRIMARY SOURCE: Ground-Water Resources Maps, Ohio Department of Natural Resources, Division of Water. Aquifer boundaries are approximate. Class 1 area yields exceed 100 gpm; Class 2 area yields are less than 100gpm.

** Contour lines represent a generalized potentiometric surface considered indicative of average conditions. Solid contours depict water table elevations based on water well and/or drilling log data. Dashed contours depict inferred water table elevations based on surface hydrology and/or topography.

SCALE IN MILES

0 1 2

FEB. 1988

106732-1

395

PLATE 2

SOLE SOURCE AQUIFER PROJECT REVIEW AREA

WARREN COUNTY

131

Proposed Designated and Project Review Area

Class 1 Boundary *

Class 2 Boundary *

—620— Potentiometric Line** (dashed where inferred)

▲ Data Point For Potentiometric Line

Public Water Service Area

supplied by surface water

WATER WITHDRAWAL SITES

Well/Well Field		Surface Water Intake
●	≥ 1.0 mgd	●
●	0.1 – < 1.0 mgd	●
●	< 0.1 mgd	●

Wells Located at 2 or More Sites

Non-Community Water System

SCALE IN MILES 0 1 2

NORTH

FEB. 1988

* PRIMARY SOURCE: Ground-Water Resources Maps, Ohio Department of Natural Resources, Division of Water. Aquifer boundaries are approximate. Class 1 area yields exceed 100 gpm. Class 2 area yields are less than 100gpm.

** Contour lines represent a generalized potentiometric surface considered indicative of average conditions. Solid contours depict water table elevations based on water well and/or drilling log data. Dashed contours depict inferred water table elevations based on surface hydrology and/or topography.

106732-2

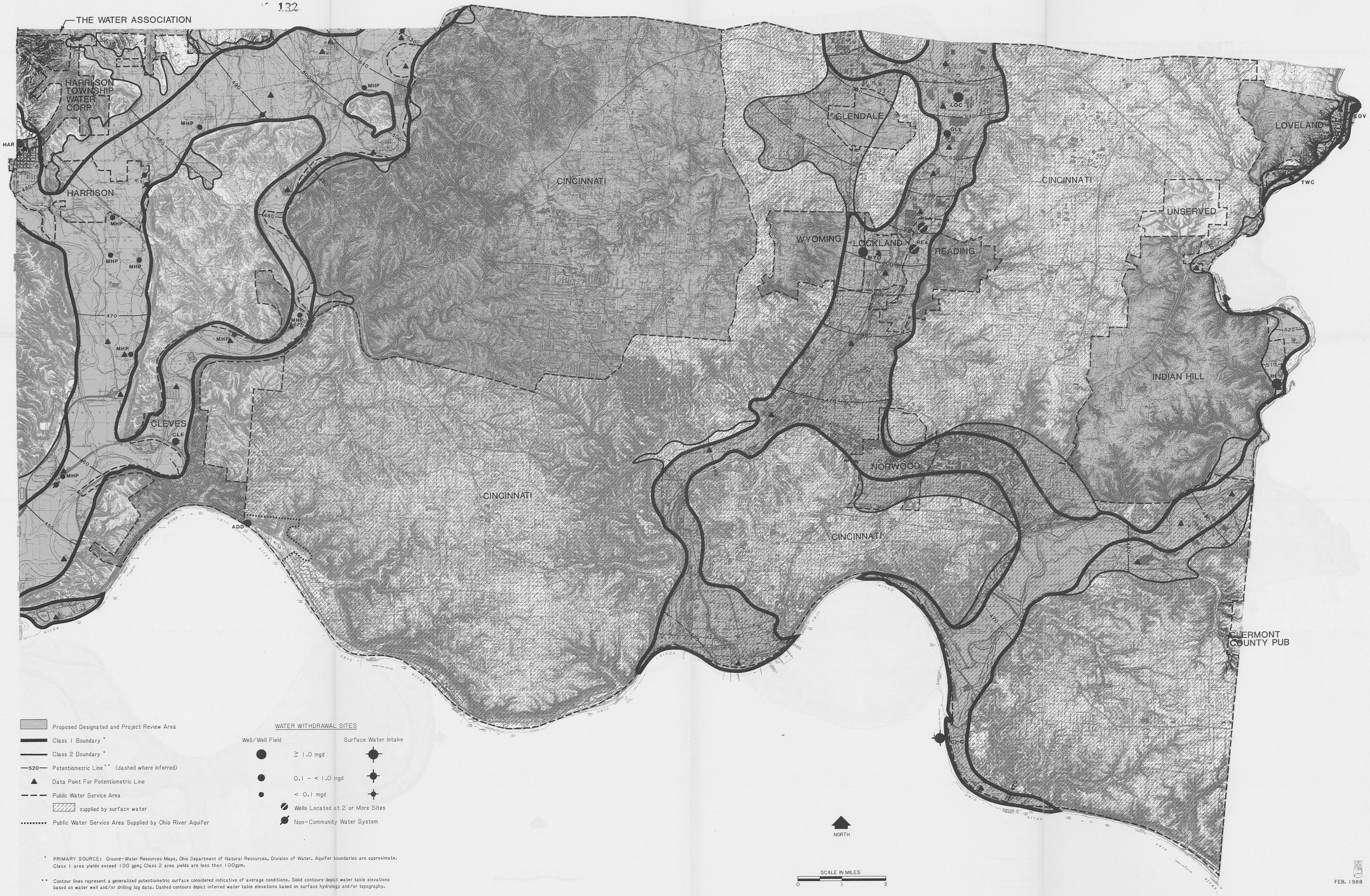
PLATE 3

395

SOLE SOURCE AQUIFER PROJECT REVIEW AREA

HAMILTON COUNTY

132



* PRIMARY SOURCE: Ground-Water Resources Maps, Ohio Department of Natural Resources, Division of Water. Aquifer boundaries are approximate. Class 1 area yields exceed 100 gpm; Class 2 area yields are less than 100gpm.

** Contour lines represent a generalized potentiometric surface considered indicative of average conditions. Solid contours depict water table elevations based on water well and/or drilling log data. Dashed contours depict inferred water table elevations based on surface hydrology and/or topography.

FEB. 1988

PLATE 4

SOLE SOURCE AQUIFER PROJECT REVIEW AREA

CLERMONT COUNTY

Proposed Designated and Project Review Area

Class 1 Boundary *

Class 2 Boundary *

—620— Potentiometric Line ** (dashed where inferred)

▲ Data Point For Potentiometric Line

Public Water Service Area

supplied by surface water

Public Water Service Area Supplied by Ohio River Aquifer

WATER WITHDRAWAL SITES

Well/Well Field		Surface Water Intake
●	≥ 1.0 mgd	
●	0.1 - < 1.0 mgd	
•	< 0.1 mgd	

Wells Located at 2 or More Sites

Non-Community Water System

* PRIMARY SOURCE: Ground-Water Resources Maps, Ohio Department of Natural Resources, Division of Water. Aquifer boundaries are approximate. Class 1 area yields exceed 100 gpm; Class 2 area yields are less than 100gpm.

** Contour lines represent a generalized potentiometric surface considered indicative of average conditions. Solid contours depict water table elevations based on water well and/or drilling log data. Dashed contours depict inferred water table elevations based on surface hydrology and/or topography.