

Region Seven

Clay, Parke, Putnam, Sullivan, Vermillion, and Vigo Counties, located in west-central Indiana, form Region Seven. The region contains approximately 2,435 square miles and is bounded by Illinois to the west; Warren, Fountain, and Montgomery Counties to the north; Hendricks, Morgan, and Owen Counties to the east; and Greene and Knox Counties to the south, as shown in Figure 146.

The 1975 population was 213,950, of which fifty-one percent resided in Vigo County. The official Indiana Population Projections indicate that the region's population will increase nearly four percent to 221,900 by the year 2000.

The 1975 population and the projections for each county are tabulated below.

Table 114

The 1975 and projected populations for Region Seven.

County	1975	1980	1990	2000
Clay	24,310	25,200	26,500	28,000
Parke	15,440	16,700	18,800	21,000
Putnam	27,300	28,800	29,700	30,400
Sullivan	19,540	19,000	18,100	17,300
Vermillion	16,850	17,600	18,900	21,200
Vigo	110,510	112,400	109,200	104,000
Total	213,950	219,800	221,200	221,900

The major population centers are Terre Haute in Vigo County, Brazil in Clay County, and Clinton in Vermillion County. These urban centers accounted for forty-three percent of the region's 1975 population.

Agriculture is the dominant land use within the region with more than sixty-six percent of the area

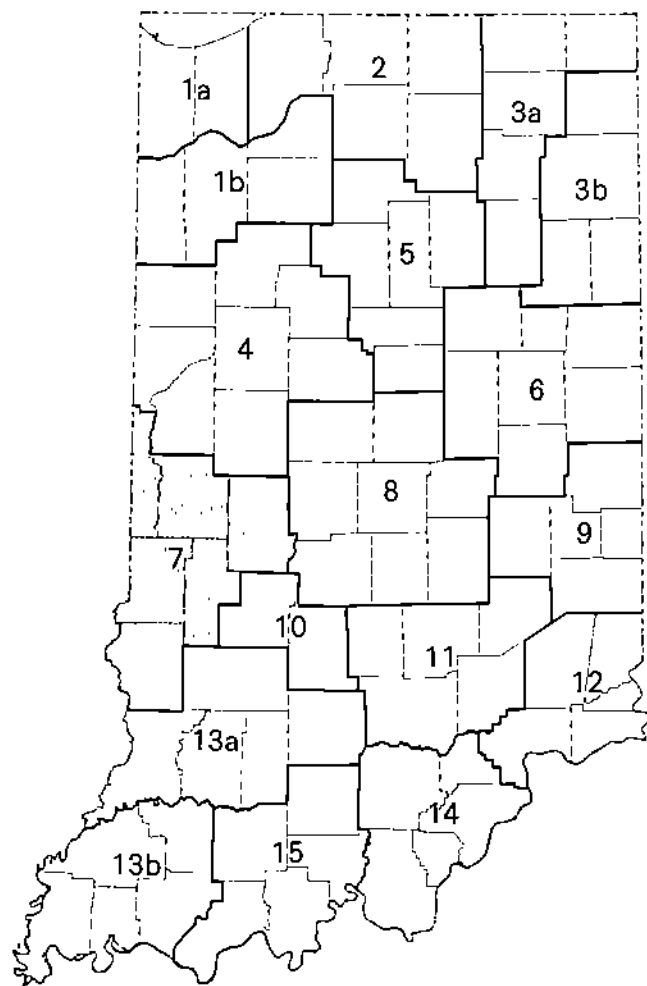


Figure 146

Map of Indiana showing the location of Region Seven.

devoted to farming. Approximately twenty-two percent of the land is forested, five percent is urban while the remaining six percent includes strip mines and other land use classifications.

Nonmanufacturing employment, including wholesale and retail trade, services, and government, represents sixty-seven percent of the work force. Manufacturing employs nearly thirty-three percent, and electrical machinery, chemicals, and paper product manufactures are the largest industrial employers.

The region receives approximately 40.5 inches of precipitation annually. This varies from a high of 4.8 inches in June to a low of 2.3 inches in February. Of the 40.5 inches of precipitation, approximately 12.5 inches appear as streamflow while 28.0 inches are consumed through evapotranspiration. The area has average temperatures ranging from 29°F. in January to 75°F. in July. The average annual temperature is 53°F. The annual prevailing wind at the Indianapolis International Airport is from the southwest at 9.7 miles-per-hour.

THE WATER RESOURCE

Ground Water

The availability of ground water is affected by both glacial deposits and the underlying bedrock. The surficial and unconsolidated deposits consist of both Illinoian and Wisconsinan age glacial material except for Clay and Sullivan Counties which contain strictly Illinoian age deposits. Incorporated within these deposits are glacial till, outwash sand and gravel, dune sand, and lake clays. The thickness of the glacial drift ranges from 100 to 200 feet. The most important water bearing formations are the outwash sand and gravel aquifers associated with the Wabash and Eel River valleys and their major tributaries. Glacial till predominates, with isolated sand and gravel lenses where Illinoian glacial drift covers the area south of the Wisconsinan glacial boundary in Clay, Sullivan, Vigo, and southwestern Putnam Counties.

Underlying the glacial deposits are bedrock formations which range in age from Mississippian to Pennsylvanian. Mississippian bedrock is located in the eastern portion of Putnam County and consists of Borden Group shales and siltstones and overlying limestone units. North of the Wisconsinan glacial boundary, well yields in the Mississippian bedrock are generally higher than in areas south of the boundary due to the influence of the more permeable and more abundant glacial materials. Further west, Pennsylvanian bedrock consists of shale, sandstone, coal, and limestone.

Ground-water availability is generally quite limited as shown in Figure 147. In areas not associated with major stream valleys, yields generally are less than fifty gallons-per-minute (gpm). Ten gpm is the highest expected yield in many areas. Most wells in these low yield areas are located in the Pennsylvanian rocks under Parke, Clay, Vermillion, Vigo, and Sullivan Counties. Sand and gravel deposits located in the Wabash River, Eel River, Raccoon Creek, and Big Walnut Creek valleys constitute the most favorable aquifers for the development of high capacity wells. Properly constructed wells in the Wabash valley sand and gravel aquifers are capable of yields exceeding 2,000 gpm.

Ground-water quality within the region is usually satisfactory for most water needs. Water hardness ranges from 200 to 400 parts-per-million (ppm) except in localities where "soda" water is encountered in wells completed in the Pennsylvanian bedrock. This naturally soft or soda water exhibits a high pH and is found in areas where hardness levels of less than 180 ppm occur. Iron contents are extremely variable, and concentrations range from 0.1 to 5.9 ppm. Lower iron contents usually occur in the outwash sand and gravel aquifers. Iron removal is practiced at several municipalities. Water softening is practiced only at Roachdale and Terre Haute. High sulfate concentrations may occur in a portion of Vermillion County where water is withdrawn from bedrock.

Surface Water

Streamflow Region Seven is drained from north to south by the Wabash River and Eel River and their tributaries. The tributaries of the Wabash River include the Vermillion River, Sugar Creek, Coal Creek, Big Raccoon Creek, and Busseron Creek. Big Walnut Creek is a major tributary of the Eel River.

The seven day, once in ten year (Q7-10); one day, once in thirty year (Q1-30); and the average annual flow for streams with gaging stations within Region Seven are tabulated in Table 115.

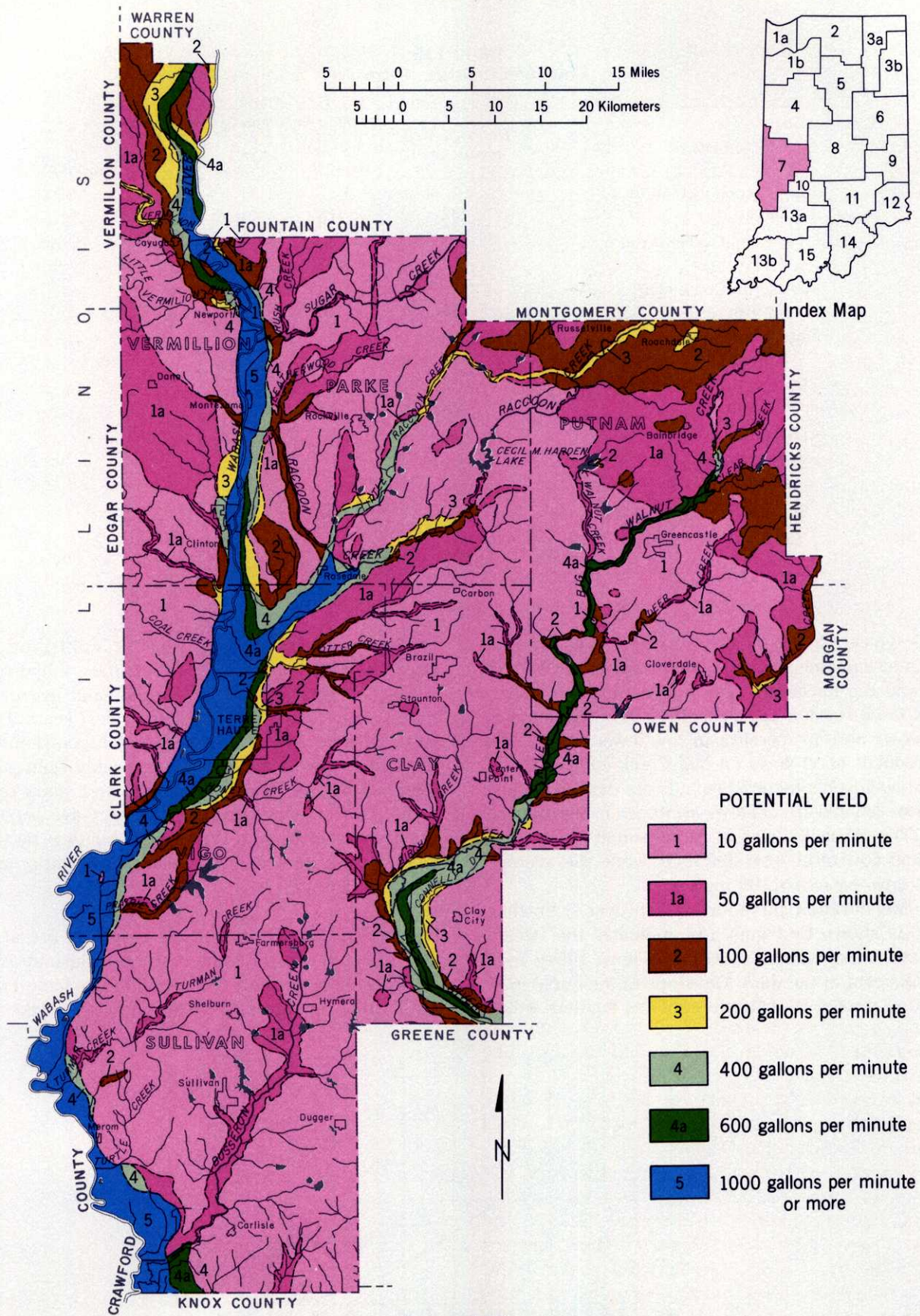


Figure 147
 Map of Region Seven showing the general location and potential yield of ground water from properly constructed large diameter wells.

Table 115
Flow characteristics of streams.

Stream	Drainage Area (square miles)	Flow in Million-Gallons-Per-Day		
		Average Annual	Q7-10	Q1-30
Big Raccoon Creek near Fincastle*	132	115	1.9	1.5
Big Walnut Creek near Reelsville	326	318	4.3	1.7
Busseron Creek near Carlisle	228	140	0.3	0
Busseron Creek at Hymera	17	12	0	0
Busseron Creek at Sullivan	138	89	1.2	0.6
Sugar Creek near Byron	670	406	14.0	10.0
Wabash River at Montezuma	11,100	6,100	550.0	390.0
Wabash River at Riverton	13,100	7,300	750.0	590.0
Wabash River at Terre Haute	12,200	6,700	630.0	470.0

*Flows recorded prior to construction of Cecil Harden Lake.

As is typical of Indiana streams, there is wide variability in streamflow in the region. Flows in the Wabash River and Big Raccoon Creek are modified by operation of Cecil Harden Lake, resulting in a reduction in flood flows and an increase in low flows. Cagles Mill Lake reduces flood flows on Mill Creek and Eel River.

The low-flow characteristics indicate that the largest and most reliable streamflows are those in the Wabash River. The Wabash River at Montezuma will have a sustained flow of at least 390 mgd, while the average annual flow exceeds 6,100 mgd.

The flow duration curve for the Eel River at Bowling Green, as shown by Figure 148, indicates the stream will have a dependable flow of at least thirty mgd ninety percent of the time. The slope of the curve indicates that the Eel River basin contains aquifers which

provide significant ground-water contribution to streamflow. To verify this, the technique of hydrograph separation was applied to three annual hydrographs representing "dry," "average," and "wet" years. The results indicate that the ground-water contribution to the streamflow amounts to forty, twenty-eight, and fifteen percent for dry, average, and wet years respectively. Conversely, from sixty to eighty-five percent of the flow, depending on the year, is due directly to surface runoff from runoff-producing precipitation events or from snowmelt.

Lakes The lakes within the region that are at least 50.0 acres in size or have a storage capacity of 32.5 million gallons or more are presented in Table 116 and are located on Figure 149. These forty-four lakes have

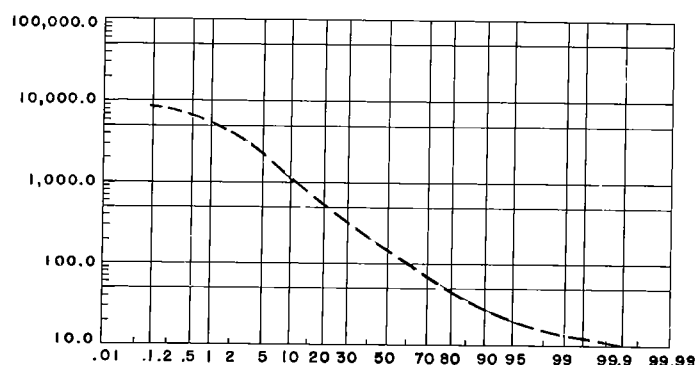


Figure 148
The flow duration curve for the Eel River at Bowling Green.

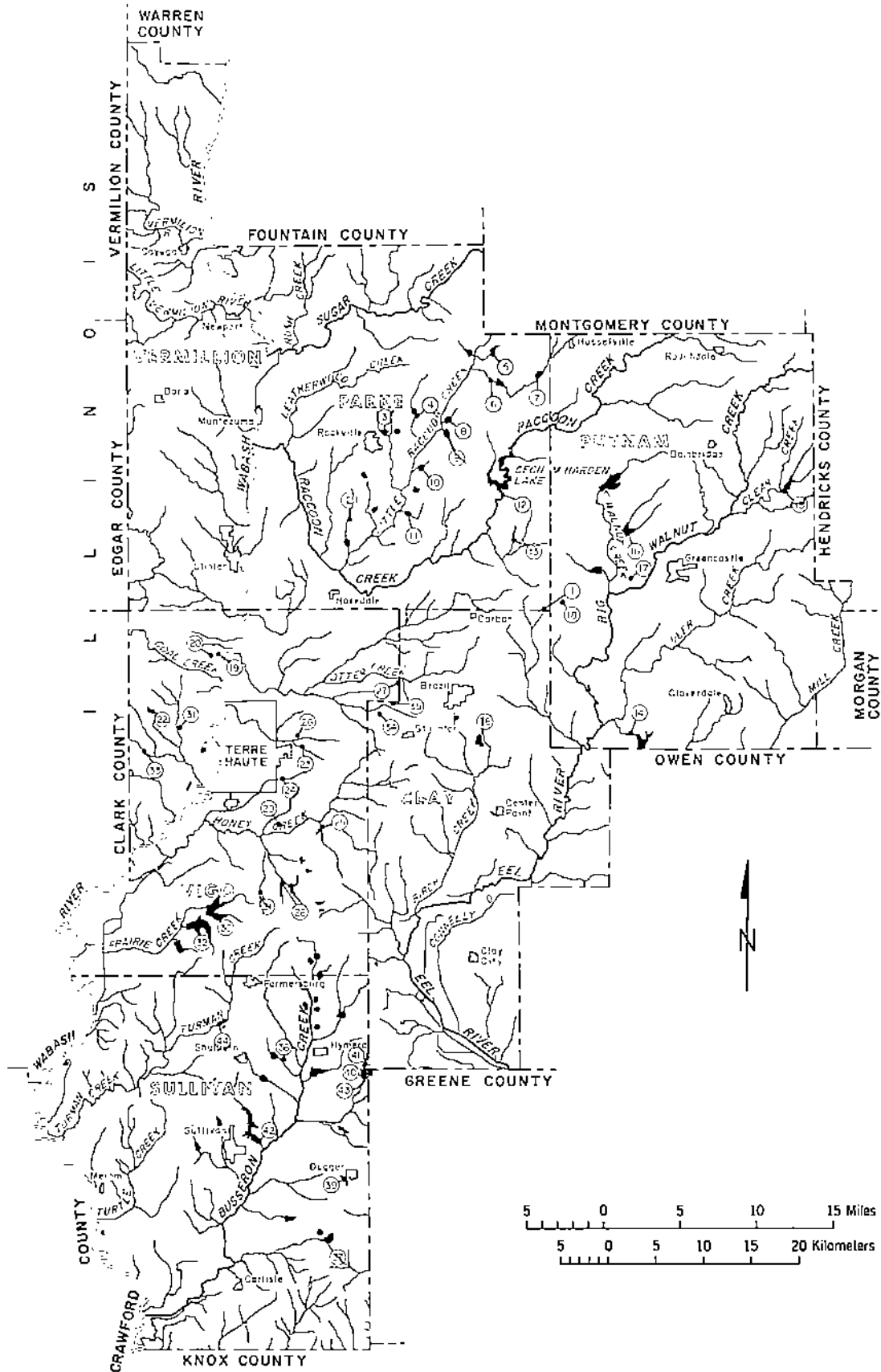


Figure 149
 Map of Region Seven showing the location of lakes that are at least 50.0 acres in size or that have a storage capacity of 32.5 million gallons or more.

a combined surface area of approximately 5,717 acres and a gross storage capacity of approximately 36,780 million gallons.

Cecil Harden Lake in Parke and Putnam Counties and Cagles Mill Lake in Owen and Putnam Counties are the two largest reservoirs in the region. Cecil Harden Lake, located on Raccoon Creek, has a storage of approximately 16,100 million gallons and a surface area of approximately 2,060 acres. Cagles Mill Lake, located on Mill Creek, has a storage of approximately 8,830 million gallons and a surface area of approx-

imately 1,400 acres. Both of these reservoirs were developed primarily for flood control but are also used for recreation and fish and wildlife purposes. While both reservoirs regulate to some extent the low flow conditions in the streams below the respective dams, Cagles Mill has no design minimum release. However, the U.S. Army Corps of Engineers maintains an actual minimum release from Cagles Mill of from 0.6 to 1.3 mgd to protect the downstream fishery. Cecil Harden Lake has a minimum release of 13 mgd.

Table 116

Lakes at least 50.0 acres in size or that have a storage capacity of 32.5 million gallons or more.

<i>Lake Number</i>	<i>Lake Name</i>	<i>Drainage Area (square miles)</i>	<i>Surface Area (acres)</i>	<i>Gross Storage (million gallons)</i>
1	Alma Lake	na	20.3	74
2	Little Raccoon Structure No. 1	4.49	32.0	58
3	Little Raccoon Structure No. 2-C	4.69	99.5	365
4	Little Raccoon Structure No. 3	4.77	35.0	65
5	Little Raccoon Structure No. 11	5.14	26.5	46
6	Little Raccoon Structure No. 12	14.10	101.0	162
7	Little Raccoon Structure No. 12-B	14.10	61.0	115
8	Little Raccoon Structure No. 14	2.22	25.0	44
9	Little Raccoon Structure No. 15	4.67	18.0	42
10	Little Raccoon Structure No. 16	4.16	18.6	42
11	Little Raccoon Structure No. 18	2.78	23.0	53
12	Cecil Harden Lake	216.00	2,060.0	16,052
13	Rocky Fork Lake	1.22	63.5	322
14	Cagles Mill Lake	293.00	1,400.0	8,834
15	Heritage Lake	10.30	375.0	1,955
16	Little Walnut Creek Structure No. 5	12.90	74.0	187
17	Oakalla Lake	na	22.2	105
18	Thomas Lake	na	18.4	78
19	Farmer Lake	na	na	37
20	Farmer Lake West	na	na	32
21	Fowler Park Lake	na	na	52
22	Green Valley Mine Pond	na	39.0	925
23	Hulman Lodge Lake	na	38.2	247
24	Hulman Street Lake	na	8.8	45
25	Lakewood Subdivision Lake	na	28.1	127
26	Maple Avenue Lake	na	18.1	52
27	Morey Lake	na	21.9	110
28	Paint Mill Lake	na	82.3	430
29	Patton or Hartman Lake	na	14.0	208
30	Prairie Creek Structure No. 1	9.76	93.2	102
31	Tri-Land Estates Lake	na	15.1	158
32	Vigo Conservancy Dam	na	na	65

Table 116 (continued)

Lake Number	Lake Name	Drainage Area (square miles)	Surface Area (acres)	Gross Storage (million gallons)
33	Windemere Lake	na	5.7	39
34	Izaak Walton Lake	na	11.4	48
35	Twin Beach Lake	na	9.4	48
36	Lake of the Woods	na	28.9	104
37	Busseron Creek Structure No. A-3	4.56	43.3	49
38	Busseron Creek Structure No. I-2	2.41	20.0	46
39	Dugger Lake	na	52.6	208
40	Lake Kickapoo	na	na	2,456
41	Lake Shakamak	1.54	60.4	606
42	Lake Sullivan	na	507.8	1,609
43	Shakamak Lake, Dam No. 7	na	56.0	198
44	Thunderbird Lake	24.60	90.0	175

na: not available.

UTILIZATION OF THE WATER RESOURCE

Instream Uses

The supply and demand analysis for recreational uses of water by the residents of Region Seven is presented in Table 117. The existing supply for recreational activity is expressed as a percentage of the demand. Therefore, when this percentage exceeds one hundred the supply exceeds the demand. Conversely, when the supply is less than one hundred the supply is less than the projected demand.

Boating and Waterskiing Cecil Harden and Cagles Mill Lakes in conjunction with the Wabash and Eel Rivers constitute the major supply of the region's boating and waterskiing resources. A few of the strip mine lakes also offer boating and waterskiing opportunities.

The supply of boating opportunities is sufficient to meet the current boating demand as well as the projected demand through the year 2000. The available

supply of waterskiing areas is expected to meet only eighty-five percent of the anticipated demand by Region Six residents. A shortage of waterskiing opportunities is expected to continue through the year 2000.

Canoeing There are 210 miles of free-flowing streams with sufficient base flow to provide opportunity for canoeing. The Wabash River, Big Walnut Creek, and Sugar Creek are good canoeing streams. The available supply of canoeable streams is more than enough to meet current and projected demands.

Swimming and Ice-skating Swimming areas, both beach and pool acreage, do not meet current or projected demands by residents of Region Seven. It is estimated that the 1980 supply will meet only sixty-one percent of the projected swimming demand. The ice-skating demand also exceeds the current and projected supply.

Fishing The quality of the fisheries habitat is indicated on Figure 150. Many of the smaller streams

Table 117
The outdoor recreation demand and supply analysis.

Activity	Percent of Population Participating	Density Guideline	Approximate Supply	Existing Supply as a Percentage of Projected Demand		
				1980	1990	2000
Boating	19	19.6 boats/acre/year	10,300 acres	100+	100+	100+
Waterskiing	7	34.4 skiers/acre/year	2,000 acres	85	90	90
Canoeing	9	585 canoes/mile/year	210 miles	100+	100+	100+
Swimming	33	76,600 swimmers/acre/year	14 acres	61	64	61
Ice-Skating	4	6,678 skaters/acre/year	5 acres	56	63	63
Fishing	44	66 persons/acre/year	17,900 acres	77	81	81

This table is based upon the 1979 Indiana State Outdoor Recreation Plan. Only the supply and recreational demands of residents of the region are displayed. The available recreational opportunities outside the region are not considered, nor are the recreational demands of nonresidents considered.

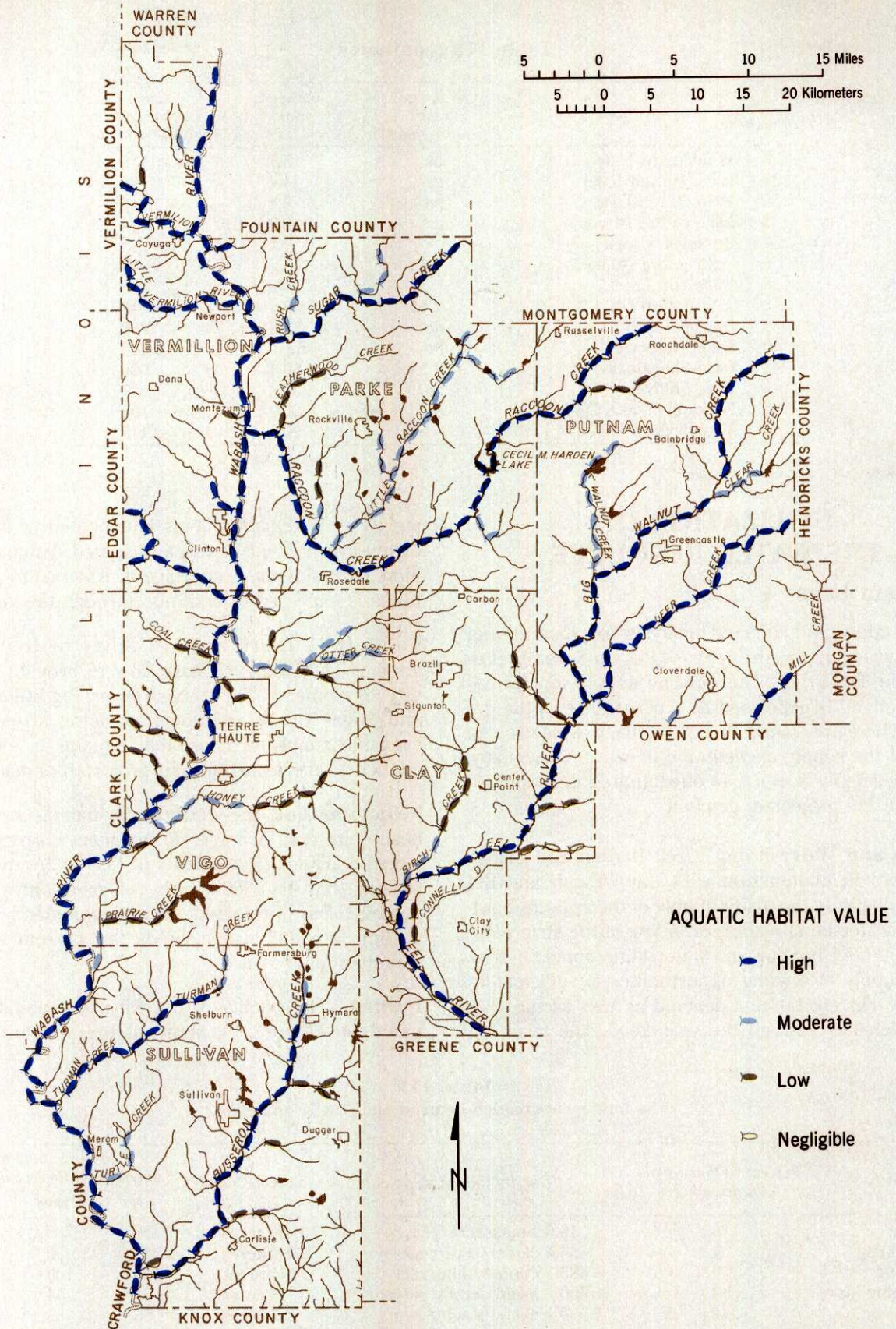


Figure 150
Map of Region Seven showing the quality of the fisheries habitat.

within the region maintain seasonal fisheries. During the spring high water they have spawning runs of fish, but at drier times of the year they carry only enough water for some forage fish and small sunfish. The Wabash River, Raccoon Creek, Big Walnut Creek, Eel River, and Sugar Creek are large enough to have year-round fisheries. The Wabash River not only is important for sport fishing but also commercial fishing, offering freshwater drum, buffalo, and bait minnows. All the larger streams have excellent aquatic habitat for sunfish and catfish, and in some streams, northern pike.

Most man-made and strip mine lakes have good aquatic habitat for warmwater fisheries. Cecil Harden Lake, the largest reservoir, and Cagles Mill Lake provide excellent habitat for walleye, catfish, bass, and other sunfish. A variety of sunfish and catfish also live in many of the smaller lakes.

State-owned public access sites are available at Raccoon Creek in Putnam County and the Wabash River in Sullivan and Vermillion Counties. Four lakes in Sullivan County are accessible from state fishing sites. Fishing is available in the Green Valley State Fishing Area, Cecil Harden and Cagles Mill Lakes, and in Turkey Run State Park.

It is estimated that seventy-seven percent of the demand for fishing will be met by 1980, increasing to eighty-one percent by 2000.

Riparian Habitat The quality of the riparian habitat associated with streams and lakes is indicated in Figure 151. The best wildlife habitat along streams occurs on larger waterways, such as the Wabash and Eel Rivers, Raccoon Creek, Big Walnut Creek, and some tributaries. Streamside vegetation is predominantly hardwoods with some interspersions of grass or cropland. Upland game and furbearers utilize streamside habitat for feeding. Various birds, including wood ducks, nest along the streams. Riparian habitat around the lakes is similar to the stream bank habitat and attracts many of the same wildlife species. Resident and especially migratory waterfowl may be more attracted to the lakes.

Withdrawal Uses

Public Water Supplies Clay, Parke, Putnam, Sullivan, Vermillion, and Vigo Counties are served by 53 public water utilities. Information on public water supplies in Region Seven is presented in Table 118. The water service areas are shown in Figure 152.

In 1975, these 53 public water utilities withdrew an average of 16.0 mgd. Approximately thirteen percent of this total was consumed. All public water utilities, with the exception of Terre Haute, withdraw their supplies

Table 118
The public water supply systems as of 1975.

Counties	Number of Systems	Service Population	Average Daily Withdrawals in Million-Gallons-Per-Day
Clay	10	11,100	1.3
Parke	8	6,900	0.8
Putnam	10	15,000	2.0
Sullivan	10	10,600	1.4
Vermillion	10	12,600	1.3
Vigo	7	71,100	9.0
Total	55*	127,300	15.8

*Because of multi-county systems, the county totals do not add up to the regional total.

from ground-water sources. Terre Haute withdraws approximately 6.8 mgd from ground-water sources and 2.0 mgd from the Wabash River.

Several public utilities not only supply water to their service areas, but also sell water to one or more other utilities in the region. Several utilities in Putnam County purchase their water from Greencastle. Likewise, Brazil supplies water to many of the other Clay County systems. Other suppliers in the region include Clinton, Fayette Township, Terre Haute, and Sullivan. Most of the region's systems withdraw water originally obtained within the county of use. However some systems may buy water from out-of-county and out-of-region systems (such as Linton and Jasonville). The relationships between public water suppliers and buyers are presented in the following table.

Table 119
Public water utility suppliers and purchasers.

Suppliers	Purchasers
Brazil City Water Works	Carbon Water Corporation Center Point Water Company Knightsville Water Works
Clinton Water Utility	Clinton Township Water Company St. Bernice Water Corporation
Fayette Township Water Association	L & S Water Supply
Greencastle Water Department	Big Walnut Water Corporation North 43 Water Corporation Reelsville Water Company South 43 Water Association 240 Water Corporation

Table 119 (continued)

<i>Suppliers</i>	<i>Purchasers</i>
Jasonville Water Department*	Hymera Water Works Wilfred Water Corporation
Linton Municipal Water Utility*	Dugger Water Utility Pleasantville Water Company
Sullivan District	Shelburn Water Works Utility Farmersburg Water Works
Terre Haute Water Works Corporation	Seelyville Water Works

*Supplier located outside of Region Seven.

Projections of public water supply withdrawals indicate that withdrawals by the region's public water utilities may increase to approximately 18.5 mgd by the year 2000, as shown below.

Table 120

The 1977 and projected withdrawal and consumption rates of public water supplies, in million-gallons-per-day.

<i>Public Water Supply</i>	<i>1977</i>	<i>1980</i>	<i>1990</i>	<i>2000</i>
Withdrawal	16.0	16.5	17.6	18.5
Consumption	2.1	2.1	2.3	2.4

Industrial Water Use Industrial establishments had an estimated water intake averaging 38.5 mgd in 1977. Of the total industrial intake, 34.8 mgd was withdrawn by the industries themselves while 3.7 mgd was purchased from the region's public water utilities. Approximately 6.9 mgd of industrial water is consumed. The majority of the self-supplied water is withdrawn from ground-water sources.

Total industrial water use will increase to 50.9 by the year 2000. The self-supplied component is expected to increase by approximately thirty-six percent to 47.2 mgd, as indicated below. Public utility supplied industrial water may decline to 3.6 mgd.

Table 121

The 1977 and projected self-supplied withdrawal and consumption rates for industries, in million-gallons-per-day.

<i>Industrial Self-Supply</i>	<i>1977</i>	<i>1980</i>	<i>1990</i>	<i>2000</i>
Withdrawal	34.8	36.0	41.4	47.2
Consumption	7.0	7.8	11.4	15.8

Rural Self-Supplied Water Domestic rural water use in 1975 was approximately 5.1 mgd. Residential rural water use may increase to 7.4 mgd by the year 2000. The bulk of domestic water is withdrawn from ground-water sources, however some water may be

trucked in and stored in cisterns. Rural self-supplied water use for livestock amounted to 2.0 mgd in 1975, and is projected to increase to 2.6 mgd by 2000. Water for livestock often is supplied from ponds, streams, and springs. The total withdrawal of rural self-supplied water may increase from the current 7.2 mgd to approximately 9.4 mgd by the year 2000, as indicated in the following table.

Table 122

The 1977 and projected water withdrawal and consumption rates for rural self-supplied water, in million-gallons-per-day.

<i>Rural Self-Supply</i>	<i>1977</i>	<i>1980</i>	<i>1990</i>	<i>2000</i>
Withdrawal	7.2	7.5	8.5	9.4
Consumption	7.2	7.5	8.5	9.4

Irrigation Water Soil associations with irrigation potential are generally located adjacent to the Wabash River. Figure 153 shows these potential irrigation areas.

Based upon the survey of irrigated lands, approximately 2,200 acres of croplands were irrigated in 1977: 2,000 acres in Sullivan County and 100 acres in Parke County. Assuming 1977 as a normal growing year, approximately 5.6 mgd would have been applied during the peak irrigation period of July and August. Irrigation water is currently withdrawn from ground-water sources.

It is estimated that approximately 46,200 acres of croplands in the region could be profitably irrigated. Irrigation of croplands is expected to increase to 10,000 acres by the year 2000. Sullivan County has an estimated 15,000 acres with irrigation potential. Vermillion and Vigo Counties have 10,000, and Parke County has 6,000 acres of potential irrigation. The projected increase in irrigation acreage by the year 2000 is expected to increase the peak July–August irrigation demand for agricultural purposes in an "average" season to approximately 26.4 mgd. The average year increase in ground-water use is expected to increase to 19.0 mgd by the year 2000.

In addition to the irrigation for agricultural use, fairways and greens on the region's golf courses are irrigated. Approximately 1.2 mgd was applied to these areas during the peak July–August 1977 irrigation period.

The total withdrawal for irrigation of croplands and golf courses during the average irrigation season of 1977 was approximately 6.8 mgd. These withdrawals may increase to 27.6 mgd by the year 2000, as indicated in Table 123.

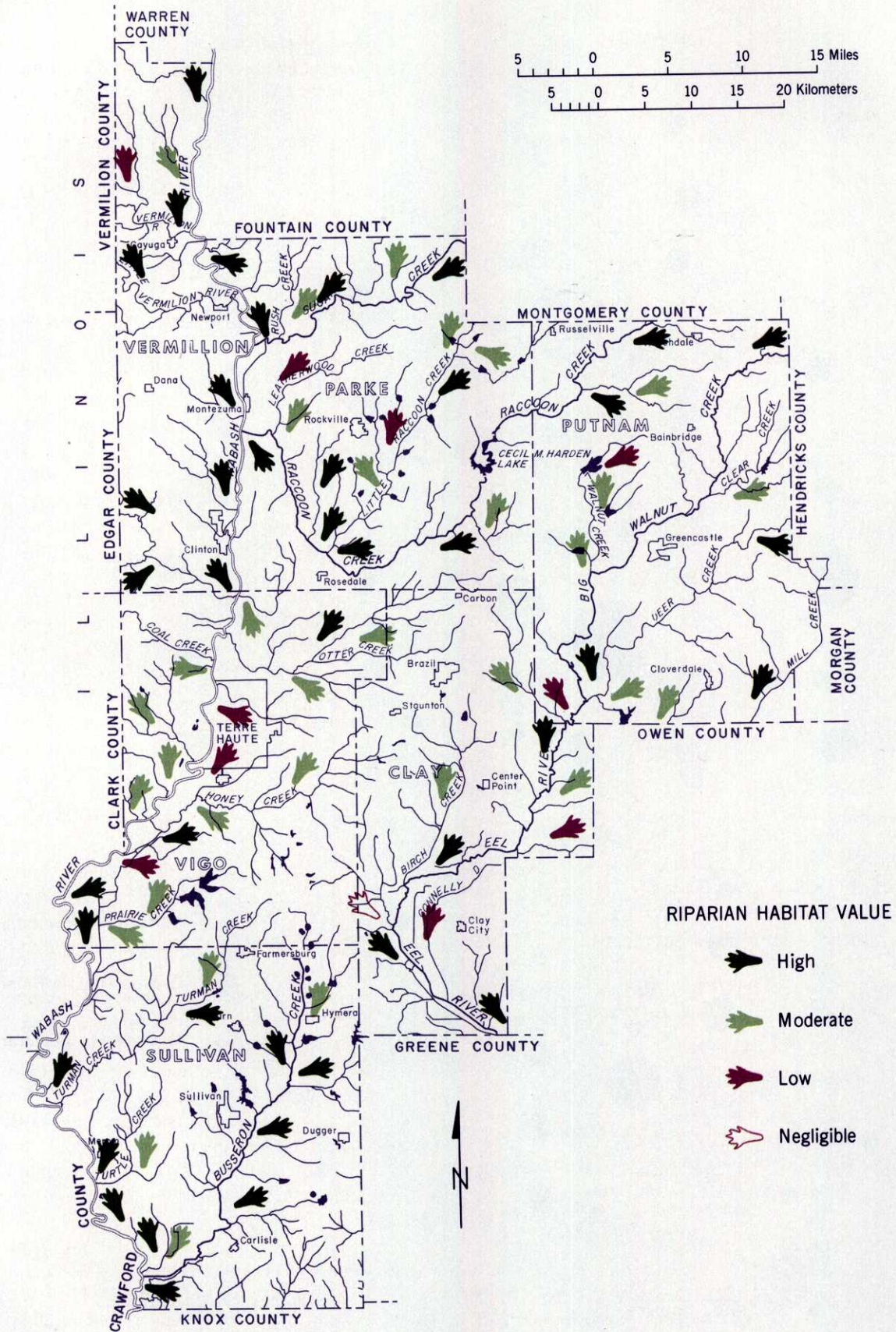


Figure 151
Map of Region Seven showing the quality of the riparian habitat.

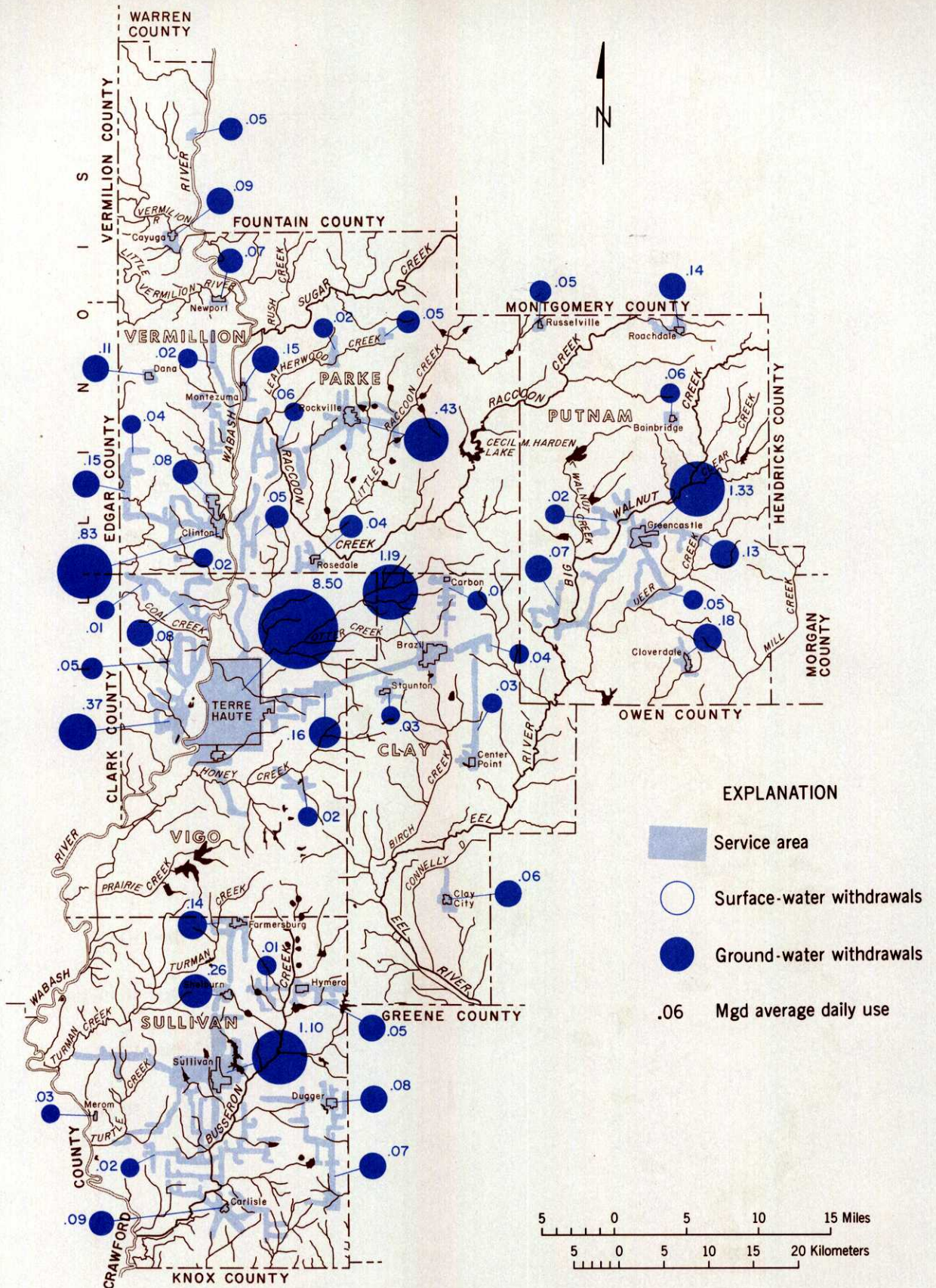


Figure 152
Map of Region Seven showing the service areas of the public water utilities and average daily use in million-gallons-per-day.