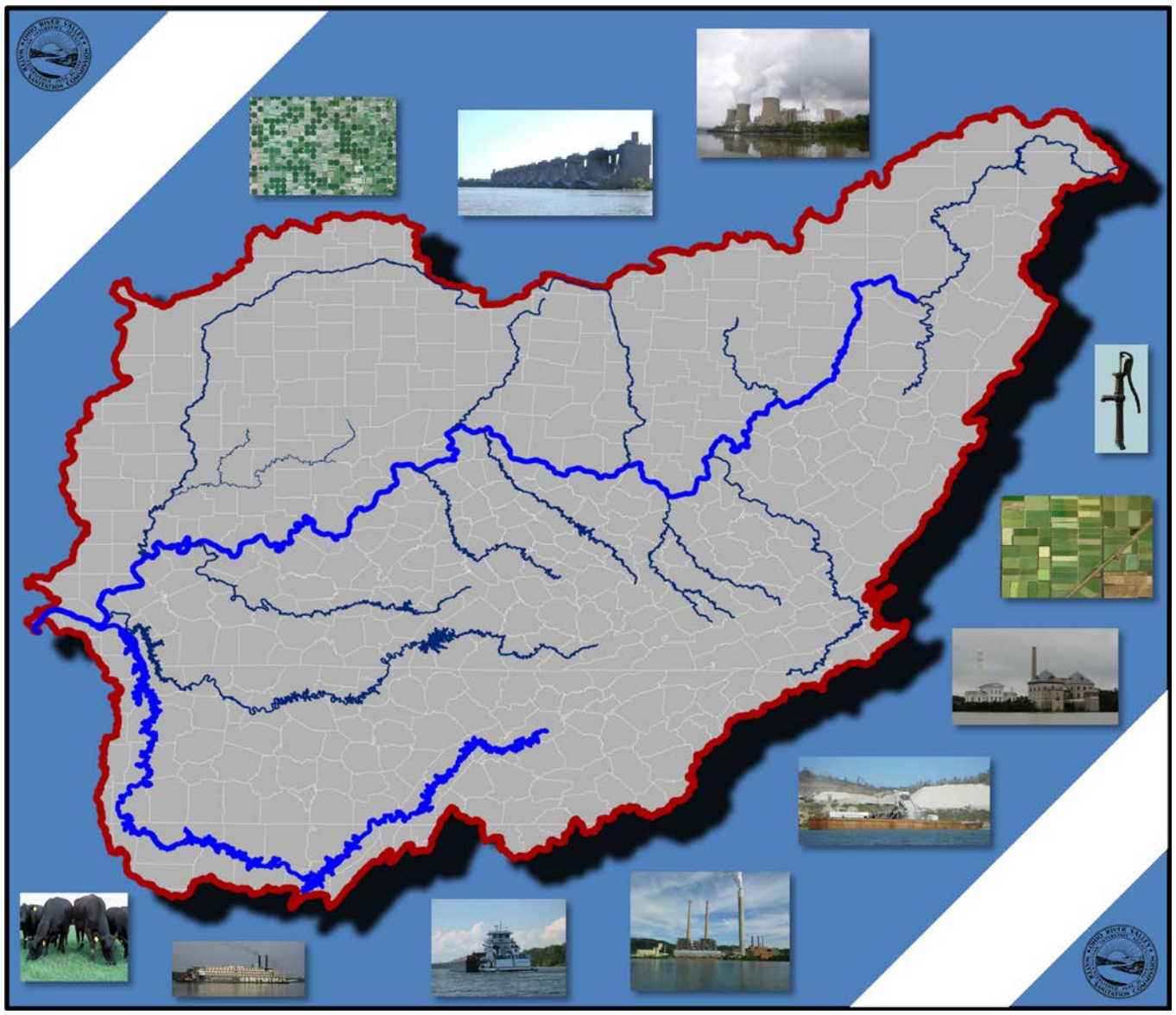

Characterizing the water-use in the Ohio River Basin

Water Resources Initiative

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Conversions/ Abbreviations/Acronyms

CFS = Cubic feet per second (ft^3/sec)
Mgal/day = Million gallons per day
Bgal/day = Billion gallons per day = 1,000 Mgal/day
kWh = Kilowatt-hour
MWh = Megawatt-hour = 1,000 kWh
GWh = Gigawatt-hour = 1,000 MWh
mg/L = milligrams per liter = 1.001142303 ppm
ppt = parts per thousand = 1,000 ppm
ppm = parts per million
acre-foot – volume of water required to fill one acre of surface area to one-foot depth

HUC = Hydrologic Unit Code
USGS = United States Geological Survey
ORB = Ohio River Basin
TVA = Tennessee Valley Authority

1.0 ft^3 = cubic feet = 7.480519 US gallons
1.0 m^3 = cubic meter = 264.1721 US gallons
1.0 acre-foot = 325,851.429 US gallons
1.0 CFS = 0.6463168 Mgal/day

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Estimation of Freshwater-Use within the Ohio River Basin

It has been recognized that the demand for water has increased nationally and globally and, in accordance with the supply and demand principle, the level of competition is dependent upon its availability. Water-users within an area can experience conflicting demands for water. Identifying and assessing the water demands of stakeholders may help communicate and possibly attenuate present and/or future conflicting water-use circumstances. Therefore, it is deemed beneficial to evaluate the water-use quantities within targeted regions and impart the relative interests of those stakeholders.

Purpose

Presently, the volume of anthropogenic water-use within the entirety of the Ohio River Basin (ORB) is unknown. Water-use estimates for the Ohio and Tennessee River basins were determined in 1995 (Solley, Pierce, and Perlman 1998) but have not been explored since nor comprehensively. Land-use practices, population, energy policies, and environmental regulations have changed since the 1995 investigation as have the associated water demands. Every 5 years, water withdrawal data is organized by a multitude of agencies, both federal and state, and systematically compiled by the United States Geological Survey (USGS). The purpose of this chapter is to characterize the water-use within the ORB by source and categorical-use using the most contemporary and publicly-available dataset (2005).

Geographical Scale

Collectively, the ORB incorporates two major river systems: the Ohio and Tennessee Rivers with each river system assigned a unique, 2-Digit Hydrologic Unit Code (HUC) of 05 and 06, respectively. Henceforth, unless otherwise noted, references to the ORB will comprehensibly include both river basins. Water-use estimates were determined based on county-level data that was constrained to conform to the aggregated land-area of the ORB.

Data Analyses

The USGS currently estimates the amount of water-use in the United States on a 5-year rotation by publishing a report of compiled data incorporating the amount of water withdrawn by categorical use (e.g. thermoelectric, industrial, mining, public supply ,etc.), source (e.g. ground-, surface-, fresh-, saline water), and state. These water use estimates originated in 1950 and have since continued with various modifications. The water-use data incorporated in the generation of the 2005 USGS report (Kenny et al. 2009) is available for public-use and was downloaded for the analytical purposes of this report (http://water.usgs.gov/watuse/). County-level (including parish or municipality) water-use data is provided in the form of its water withdrawal source (e.g. fresh, saline, ground, surface waters) and divided into 8 categorical uses (Table 1). Due to the limited use of saline waters, this report primarily focuses only on freshwater sources, though saline withdraws are briefly addressed for reasons explained. Maps and geographic analyses were created and analyzed using various tools in GIS (ArcGIS 10).

As previously stated, the anthropogenic water withdrawal data is compiled by USGS personnel from an assortment of data sources which can vary by categorical water-use. These sources include national datasets, state agencies, questionnaires and local contacts. Appropriate personnel at each of the USGS Water Science Centers in each state are responsible for following the guidance document titled: "Guidelines for preparation of State water-use estimates for 2005" which can be accessed at http://pubs.usgs.gov/tm/2007/tm4e1/. Of course, limitations exist in regard the reliability and precision of the data included. For more information, please see (Kenny et al. 2009).

The units for most of these quantities are based on the volume of water per day (i.e. million gallons per day). Applicable to any category, there are seasonal dynamics to water-use quantities, such as irrigation where the greatest volume is likely used during the growing season in spring/summer; therefore the quantities reported are based on the yearly average (gallons per day per year). This report does not discuss the seasonality components of categorical water-uses. For more information regarding seasonality, see (Shaffer 2009).

Table 1. County-level data pertaining to eight categorical freshwater uses of groundwater (GW) and surface water (SW) were provided via USGS data (per Kenny et. al 2009) and estimated for the ORB.

Freshwater Category	GW	SW	Total
Public Supply	√	√	√
Domestic Supply	√	√	√
Industrial	√	√	√
Irrigation	√	√	√
Livestock	√	√	√
Aquaculture	√	√	√
Mining	√	√	√
Thermoelectric	√	√	√

County-Level Conveyance to the Ohio River Basin

Water-use data was compiled and supplied at the county-level by the USGS; therefore counties were identified as 'fully' or 'partially' within the ORB (Figure 1). In total, there are 546 counties that are either fully (412 counties) or partially (134) within the ORB. Peripheral-county-water-use estimations required calculations and modifications of the water-use data to enable a more-accurate approximation of a county's water-use and consequently that of the entire basin. For these peripheral counties, the amount of water withdrawn was assumed to be proportional to the county's land-area within the ORB. For example, Pulaski County, Indiana has 96.0% of its land area within the ORB and the amount of domestic water supply used for the entirety of the county was 0.71 Mgal/day; therefore the calculated domestic supply use for Pulaski County, Indiana was 0.68 Mgal/day. This approach was used for each water-use category with the exception of the thermoelectric sector. The location and water source of each thermoelectric facility within peripheral counties was determined and designated as within or outside the ORB (U.S. Department of Energy, Energy Information Administration (EIA) 2012). Only those facilities located within the basin and withdrawing water from ORB sources were used in analyses.

The county-level conveyances of water-use data for each category are presented using color-coded maps. Disproportional quantities were observed between categories therefore a uniform,

quantitative range could not be applied; hence the colors used to represent the water-use quantities were independently determined. The number of colors used per categorical water use also varied based on the distribution of quantities. Attempts were made to present these data with visual acuity. For example, thermoelectric water-use by county exhibited a minimum-maximum range of 2,075 Mgal/day and was divided into 4 different intervals and represented by 4 colors. By contrast, the industrial water-use had a range of values equal to 509 Mgal/day and was divided into 3 different intervals and represented by 3 colors. (See Figures 6 and 9, respectively.)

Water-use vs. Consumption

Data provided by the USGS represent the amount of water withdrawn from a water source for a particular use and does not indicate the amount that is consumptively used. *Water-use is defined as water that is withdrawn from a source.* The amount of water returned or consumed is not reflected in those water-use quantities. Consumptive use can be defined in different ways, however for the purposes of this report, *consumptive-use is defined as water that is withdrawn and subsequently rendered no longer immediately available for other withdrawals.* Examples of consumptive losses include (but are not limited to) water that is evaporated, transpired, consumed by humans or livestock, or assimilated into crops or products. Unless specified as a consumptive use, all values pertain to the amount of water withdrawn per category.

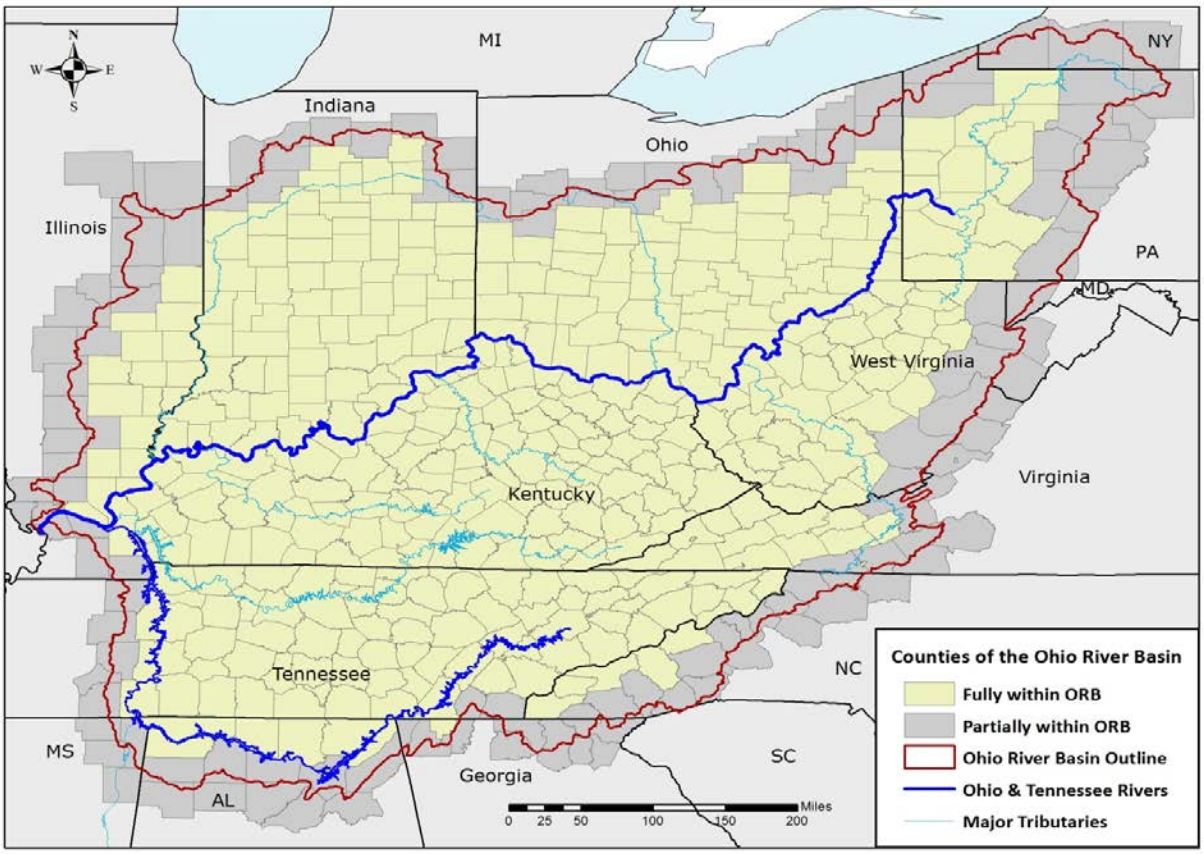

Figure 1. There are 546 counties fully or partially within the ORB from 14 different states. Four-hundred and twelve counties (yellow) are fully within the ORB and 134 counties (gray) are on the periphery of the basin and have partial land areas in the basin.

2005 Estimation of Water-Use within the Ohio River basin

Total Freshwater – *43,817 Mgal/day*

The total freshwater-use within the ORB is estimated at 43,817 Mgal/day, which equates to approximately 12.5% of the nation's total freshwater-use (349,418 Mgal/day). According to the 2010 U.S. Census estimation, 9.5% of the total population resides in the ORB. Furthermore, the ORB comprises greater than 5% of the total U.S. land area.

From within the ORB, 2,137 Mgal/day (4.9%) of the total water was withdrawn from groundwater sources and 41,680 Mgal/day (95.1%) from surface water sources. By comparison, the ORB withdraws a greater proportion of its water from surface water sources than the national estimate of 77.2%. Conversely, the proportion of groundwater withdrawals from within the ORB was less than the national estimation (22.8%).

There are thirty-one counties that exhibited withdrawal quantities ≥500 Mgal/day and twelve that exhibited quantities >1,000 Mgal/day. The majority of these counties are adjacent to a large surface-water source (such as the Ohio and Tennessee rivers) and all but one of the 31 counties possesses a thermoelectric facility within the county. The expressed geographic patterns can generally be attributed to the presence of thermoelectric facilities within a county primarily because these facilities require large volumes of water for their cooling systems (Figure 2).

Note: Of the 50 largest water-using counties nationwide, 11 are within the ORB.

The thermoelectric category exhibited the greatest percentage of water withdrawals at 34,452 Mgal/day and comprised 78.6% of the water-use within the ORB. Industrial (3,639 Mgal/day) and public water supply (3,584 Mgal/day) were the next largest categories of water-use and the remaining 5 categories combined for 5% of the total freshwater use (Figure 3).

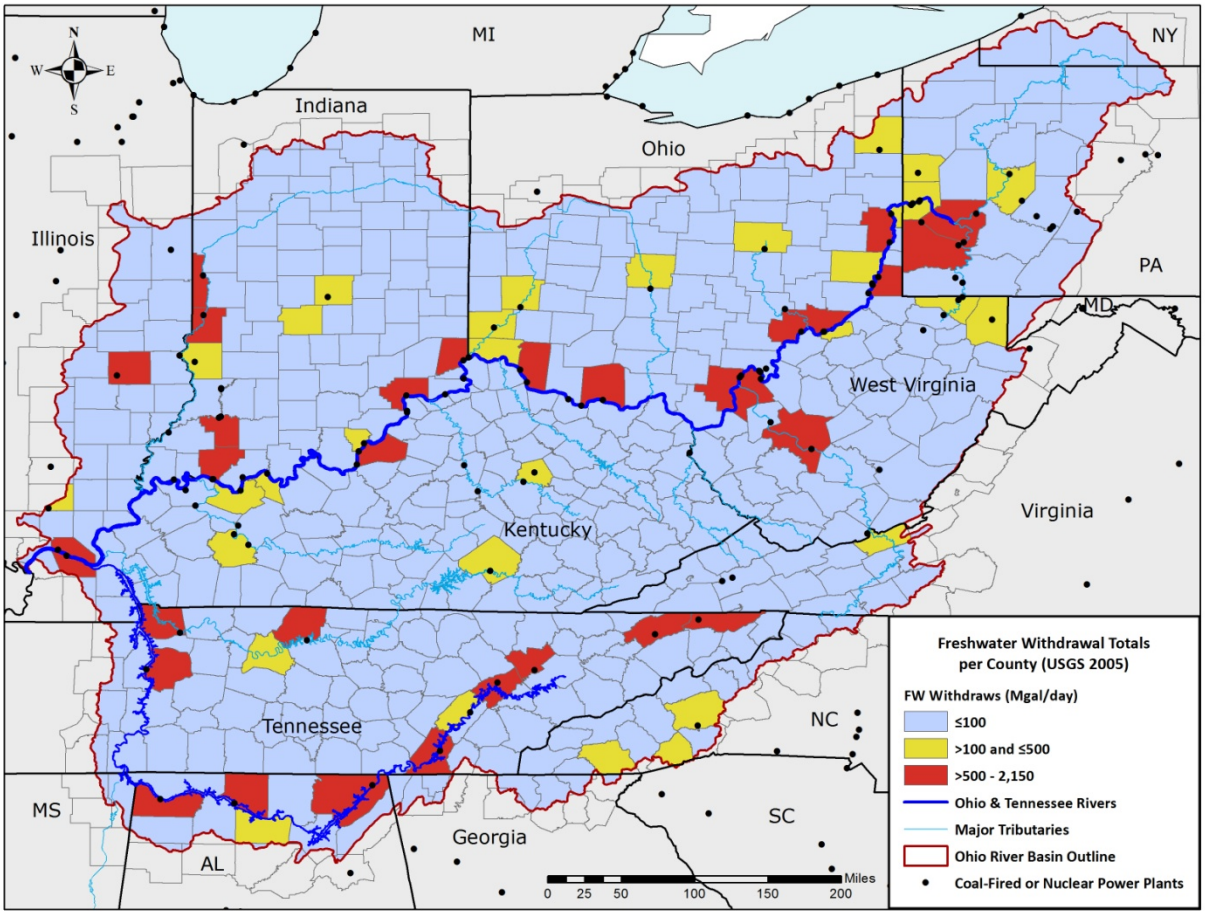

Figure 2. An estimated total of 43,817 Mgal/day of freshwater is withdrawn from the ORB. Thirty-one counties exhibited withdrawal quantities ≥500Mgal/day and twelve exhibited quantities >1,000 Mgal/day.

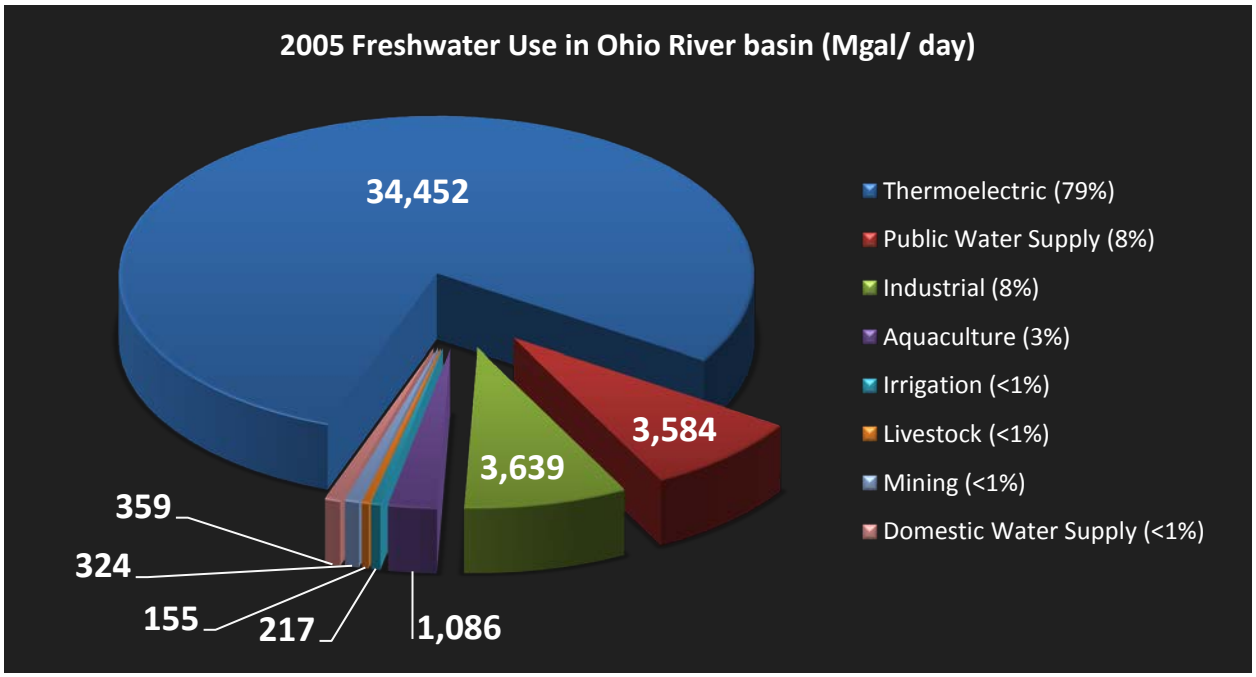

Figure 3. The 2005 total freshwater use within the ORB was estimated at 43,817 Mgal/day and quantities of freshwater withdrawn were partitioned into 8 different water-use categories. For each category, the relative percent of total freshwater use from within the ORB is provided.

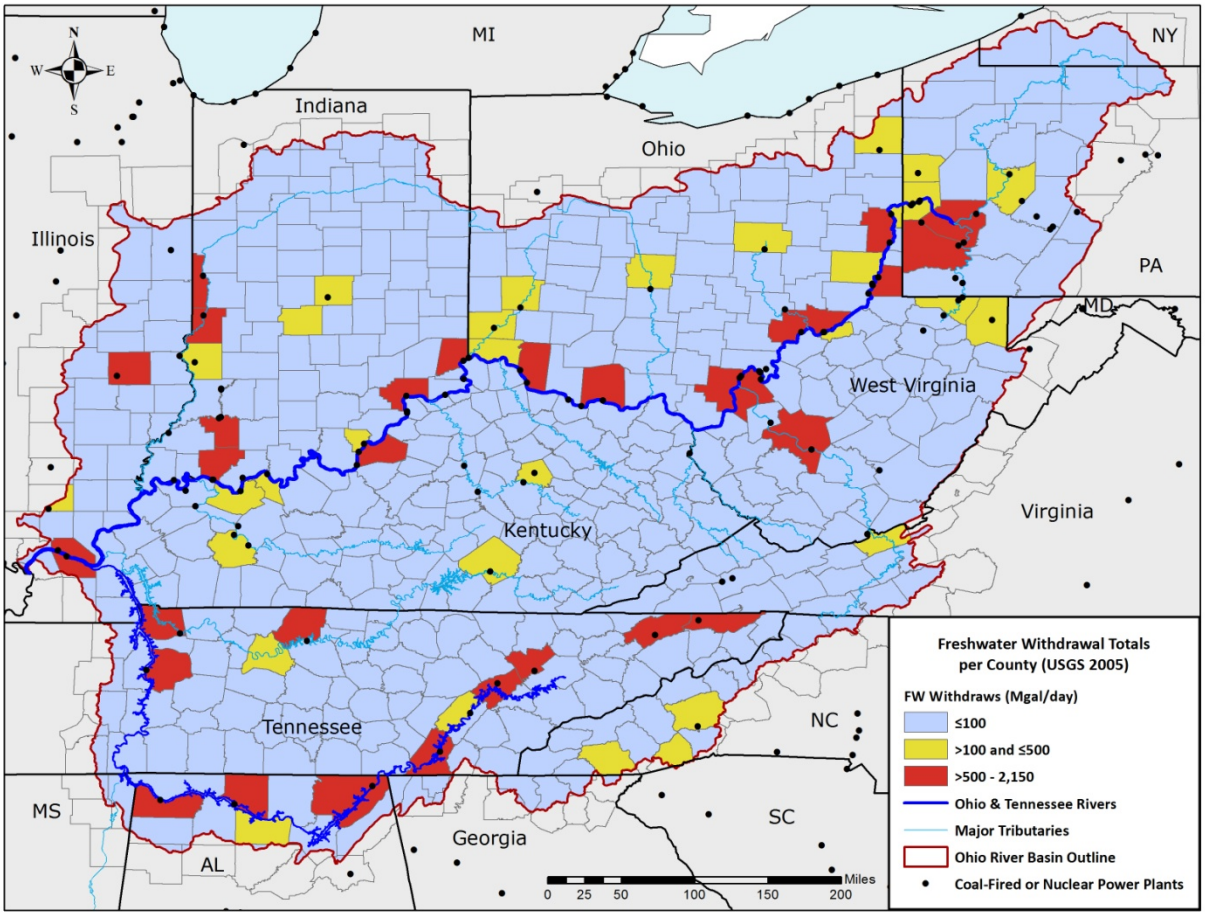

Figure 4. The total freshwater-use from the entire ORB is depicted at the county-level. Total withdrawals from within the ORB are estimated at 43,817 Mgal/day.

Margin of Error ±3.44%

The amount of water withdrawn in the ORB is estimated and therefore subject to error. Peripheral counties were subject to the assumption that the amount of water withdrawn from a county is proportional to the county's land area within the ORB. This assumption was applied to peripheral county water-use data for 7 of the 8 categories. Since the locations of thermoelectric facilities locations were known (U.S. Department of Energy, Energy Information Administration (EIA) 2012), the actual quantities of thermoelectric water withdrawals in those peripheral counties were retained 'as-is' in the error calculations. To determine the potential error introduced by estimating the peripheral county water-use based on proportional land area in the ORB, the minimum and maximum water withdrawals were calculated (using data from the 7 categories) and based on the following assumptions:

1) Zero withdrawals were made from the peripheral county's land-area within the ORB therefore zero quantities were included in the Minimum estimation. (Figure 5a).
2) All of the water withdrawn from the peripheral county's land-area was made from within the ORB therefore 100% of the county's withdrawal quantity was included in the Maximum estimation (Figure 5b).

Following these assumptions, the minimum estimation was calculated as 42,049 Mgal/day and the maximum estimation was 45,066 Mgal/day. Therefore, the estimated total freshwater-use in the ORB is 43,817 Mgal/day with a ±3.44% error.

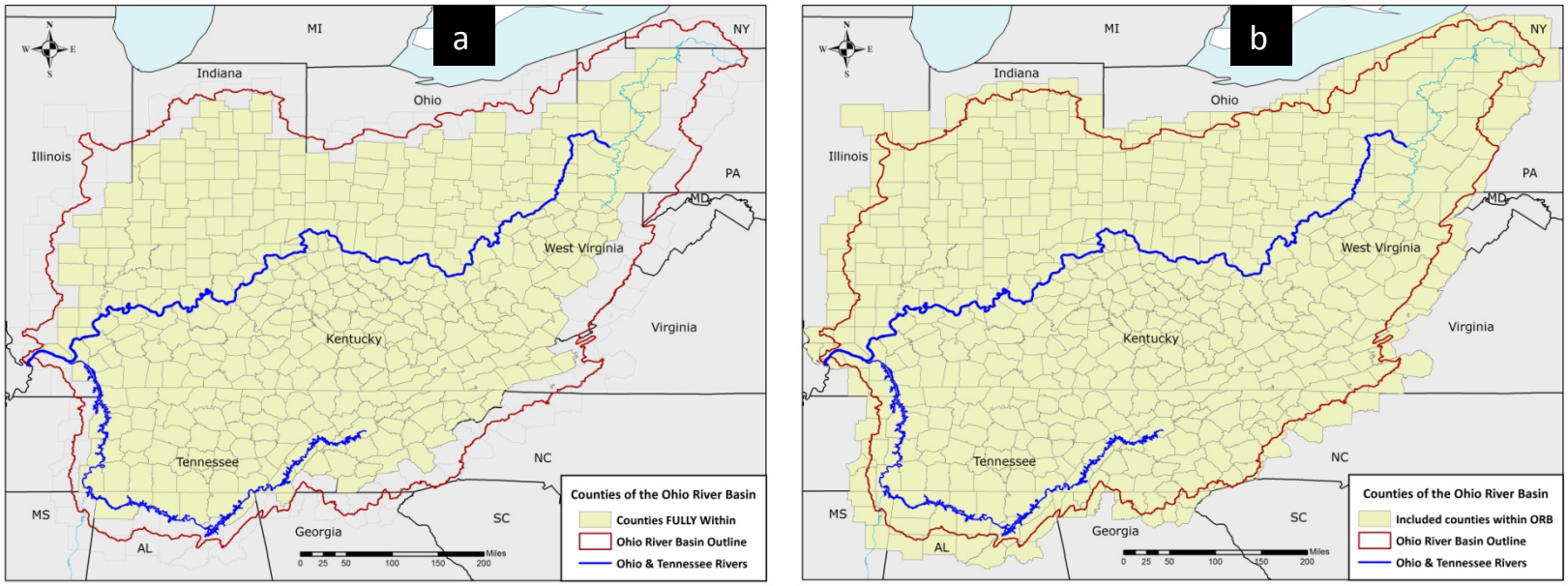

Figure 5. Percent error estimations were calculated for water withdrawals in the ORB by determining the minimum (a) and maximum (b) quantities. The minimum estimation was calculated by excluding the water withdrawal data in the peripheral counties whereas the maximum estimation incorporated data from the entirety of the peripheral counties. Data included for the minimum and maximum estimations are highlighted in yellow.

Saline Water – 22.2 Mgal/day

This report focuses on freshwater sources largely because of the 'land-locked 'geographical scope of this project. Additionally, there are relatively few saline water withdrawals within the ORB (in 2005), which totals an estimated 22.2 Mgal/day or <0.1% of the total water withdrawn from the ORB. This water was reported as solely extracted from groundwater sources for the purposes of mining activities. Illinois and West Virginia were the only states that reported values >0 for saline waters from within 23 and 27 counties, respectively (Figure 6). Individual counties reported values ranging from 0.1 to 7.2 Mgal/day with 6 counties reporting withdrawals >1.0 Mgal/day.

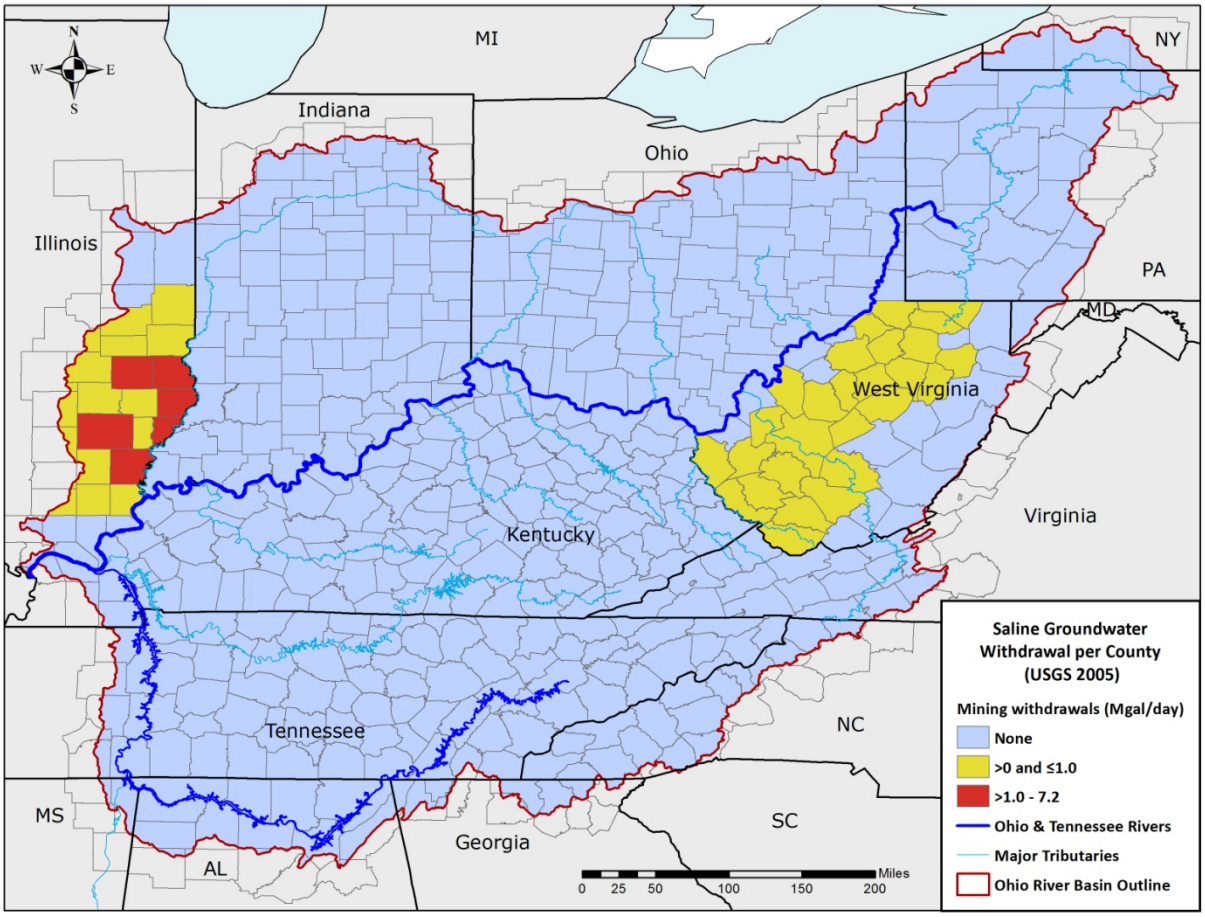

Figure 6. The ORB is entirely 'land-locked' therefore access to saline waters (>1,000 mg/L or 1.0 ppt) is only available from groundwater sources. Counties within 2 states (WV and IL) reported withdrawals of saline waters for mining purposes.

Thermoelectric – *34,452 Mgal/day*

Description: Thermoelectric water-use is defined as water withdrawn for the use of cooling systems (for both once-through and closed-loop systems) for power generating systems. A once-through cooling system draws water into the facility, circulates it through heat exchangers, and then returns the water. Closed-loop cooling systems withdraw water from a source, circulate it through heat exchangers, cool it and then recycle it. Fuel sources for these facilities include coal-fired, oil, natural gas, nuclear, and exclude hydroelectric-power generation.

2005 Estimated Use:
In 2005, the estimated total freshwater-use for thermoelectric generating facilities within the ORB is 34,452 Mgal/day which equates to 78.6% of the water used within the basin. Of this total, only 43 Mgal/day (0.12%) is withdrawn from groundwater sources and 34,410 Mgal/day (99.88%) from surface water sources. Thermoelectric facilities rely on relatively large water sources primarily for the cooling systems of the generating stations therefore many of the counties that have the largest water withdraws are near a major waterway (Figure 7). Of the 546 counties within the ORB, 102 reported values for thermoelectric withdrawals. It is estimated that 631,148 GWh of net-electricity is produced from thermoelectric facilities within the ORB and this equates to approximately 19.8% of the nation's self-supplied thermoelectric energy production.

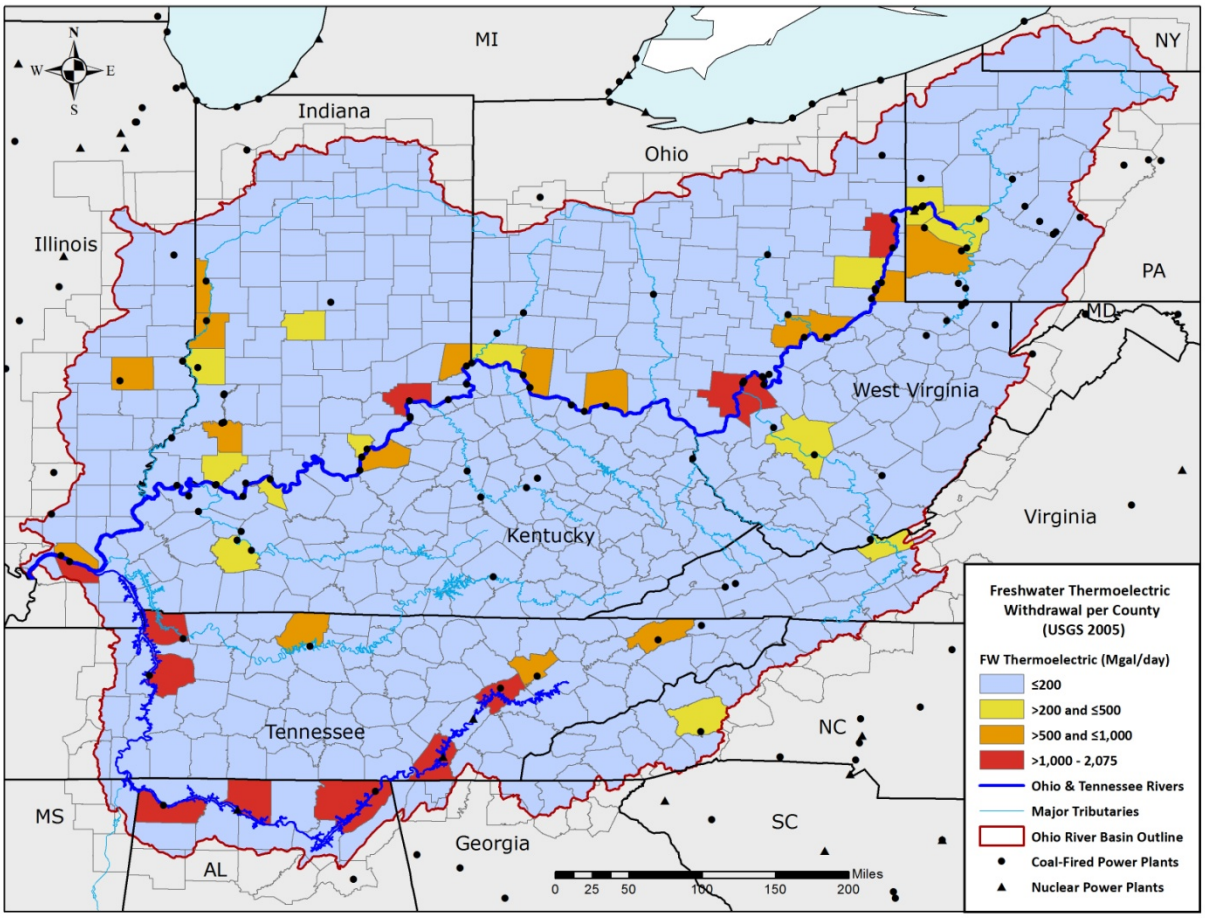

Figure 7. Thermoelectric withdrawals from the ORB are estimated at 34,452 Mgal/day and are responsible for approximately 79% of the total freshwater withdrawals. Thirteen counties within the basin reported withdrawal quantities >1,000 Mgal/day.

Public Water Supply – *3,584 Mgal/day*

Description: Public Supply water-use is defined as water withdrawn by public and private water suppliers to a minimum of 25 people or has a minimum of 15 connections within its system. Water is delivered for purposes such as domestic, commercial, industrial, public services, and system losses.

2005 Estimated Use: In 2005, the estimated total freshwater-use for public water supply within the ORB is 3,584 Mgal/day which consists of 8.2% of the water used within the basin. Of this total, 1,054 Mgal/day (29.4%) is withdrawn from groundwater sources and 2,530 Mgal/day (70.6%) from surface water sources. Urban areas are the explicable predictor of public water supply as indicated by the six most populous counties in the basin exhibiting withdrawals >100 Mgal/day (Figure 8). These counties include the metropolitan areas of Pittsburgh (PA), Columbus (OH), Cincinnati (OH), Louisville (KY), Indianapolis (IN), and Nashville (TN). The average per-capita water use for the population served in the ORB is estimated at 154 gallons per day.

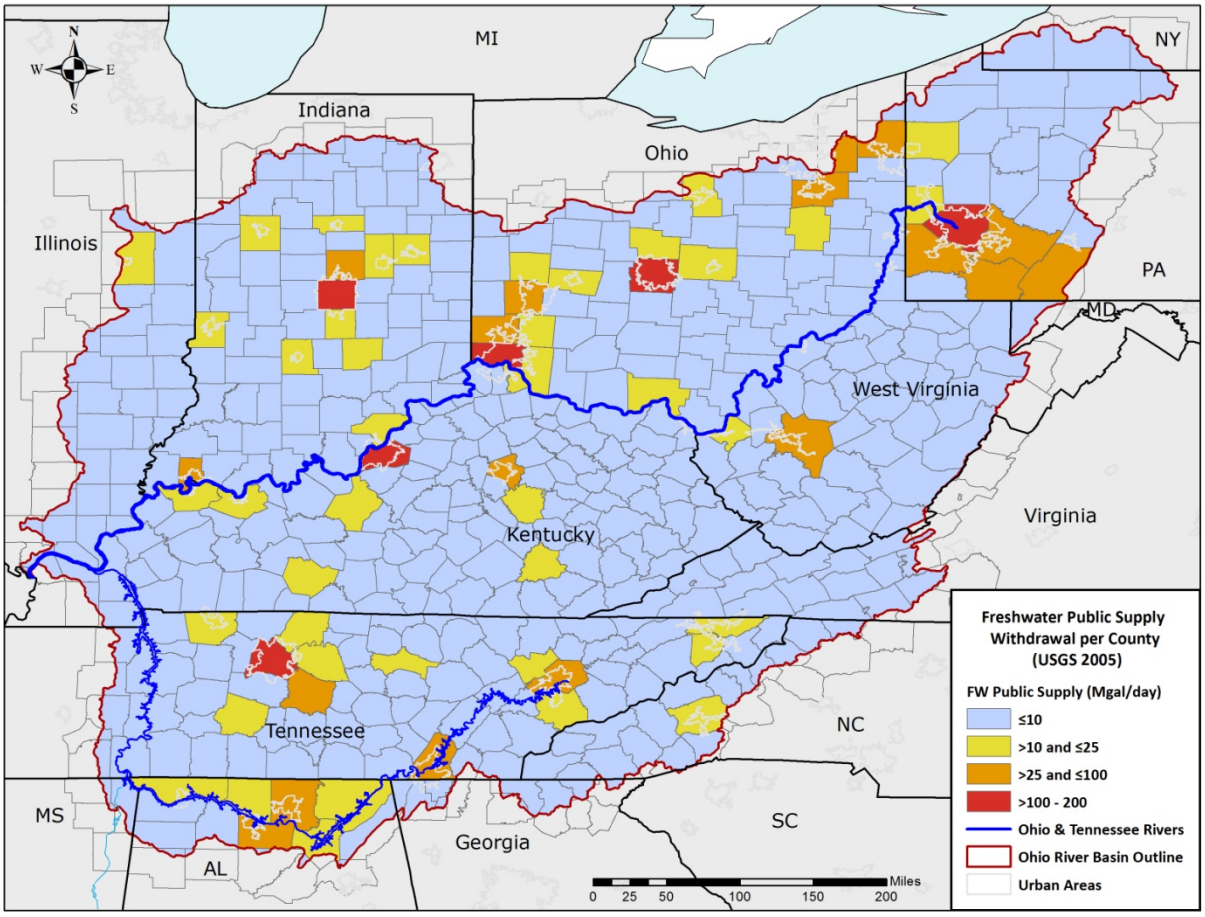

Figure 8. Public water supply withdrawals from the ORB are estimated at 3,584 Mgal/day and are responsible for approximately 8% of the total freshwater withdrawals. Counties with the largest withdrawals are those with urban areas. Each of the 6 counties with withdrawal quantities >100 Mgal/day have a major metropolitan area within.

Domestic Water Supply – *359 Mgal/day*

Description: Domestic water-use is defined as self-supplied water (excluding deliveries) used for residential purposes (both indoor and outdoor) from various sources:

Purposes

- Drinking
- Food preparation
- Washing (clothes, dishes, etc)
- Flushing Toilets
- Bathing
- Watering Lawns
- Watering Gardens
- Washing cars

Source

- Well
- Cistern – via rainwater

2005 Estimated Use:

In 2005, the estimated total freshwater-use for self-supplied domestic water supply within the ORB is 359 Mgal/day which consists of 0.82% of the water used within the basin. Of this total, 344 Mgal/day (95.8%) is withdrawn from groundwater sources and 15 Mgal/day (4.2%) from surface water sources. Only counties within 3 states (KY, OH, and WV) reported water withdrawals >0 from surface water sources. Domestic water-use represents a small fraction of total water-use within the ORB and the majority of counties reporting quantities >1.5 Mgal/day are located north of the Ohio River (Figure 9) and could possibly be associated with the glacially-tilled geology. The average per-capita water use for the self-supplied population in the ORB is estimated at 71 gallons per day.

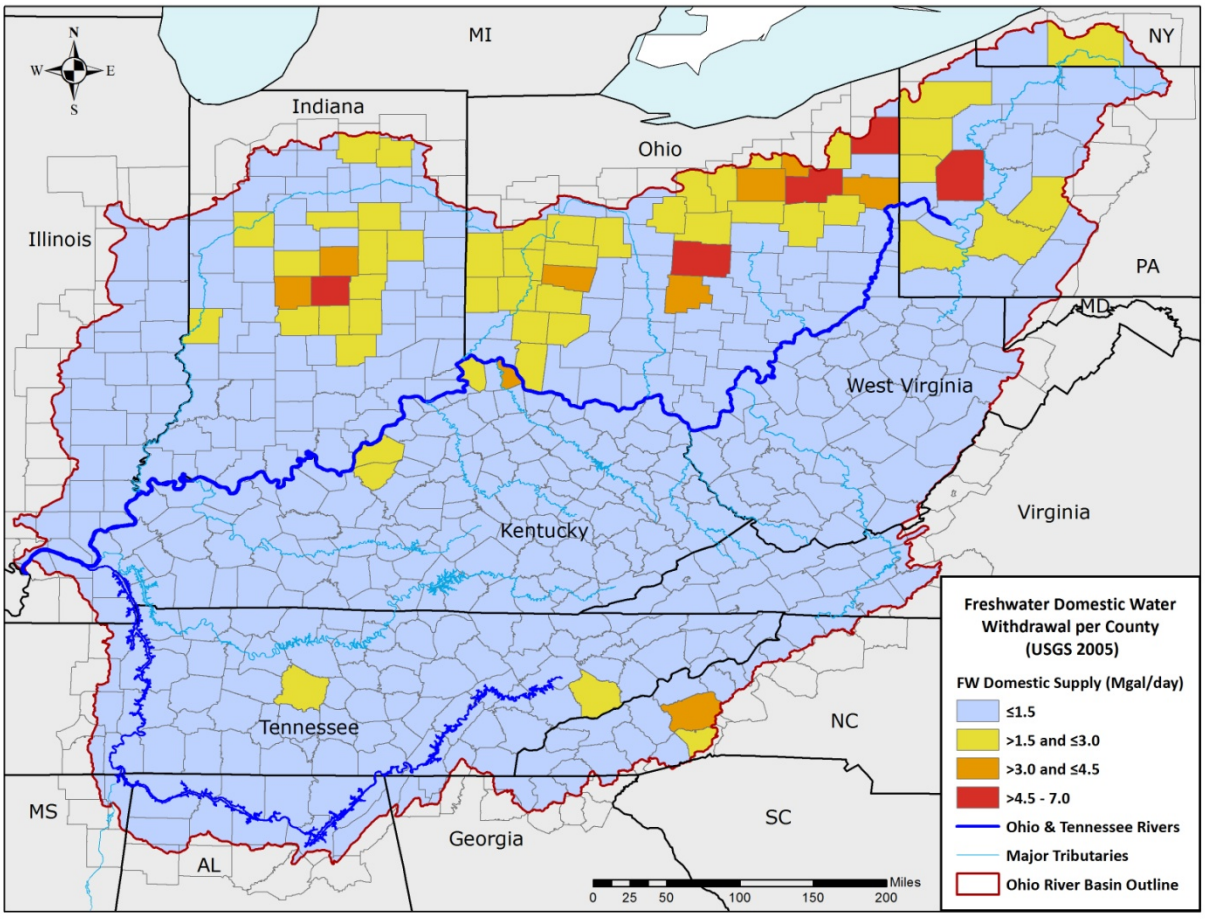

Figure 9. Domestic water supply withdrawals from the ORB are estimated at 359 Mgal/day and are responsible for approximately <1% of the total freshwater withdrawals. The majority of the self-supplied domestic water withdrawals occurred in counties north of the Ohio River.

Industry – *3,639 Mgal/day*

Description: Industrial water-use is defined as self-supplied water used for the following purposes and commodities:

Purposes

- Fabricating
- Processing
- Washing
- Cooling
- Transport of product
- Sanitation of facility

Commodities/Products

- Chemicals
- Refined Petroleum
- Metals
- Food
- Paper

- Diluting

2005 Estimated-Use:
In 2005, the estimated total freshwater-use for industrial purposes within the ORB is 3,369 Mgal/day which consists of 8.3% of the water used within the basin. Of this total, 343 Mgal/day (9.4%) is withdrawn from groundwater sources and 3,297 Mgal/day (90.6%) from surface water sources. Eight counties exhibited withdrawals ≥100 Mgal/day. The greatest concentration of counties reporting withdrawals >10 Mgal/day are located in the counties in West Virginia bordering the Ohio River and extending upstream to the Pittsburgh area in southwestern Pennsylvania (Figure 10).

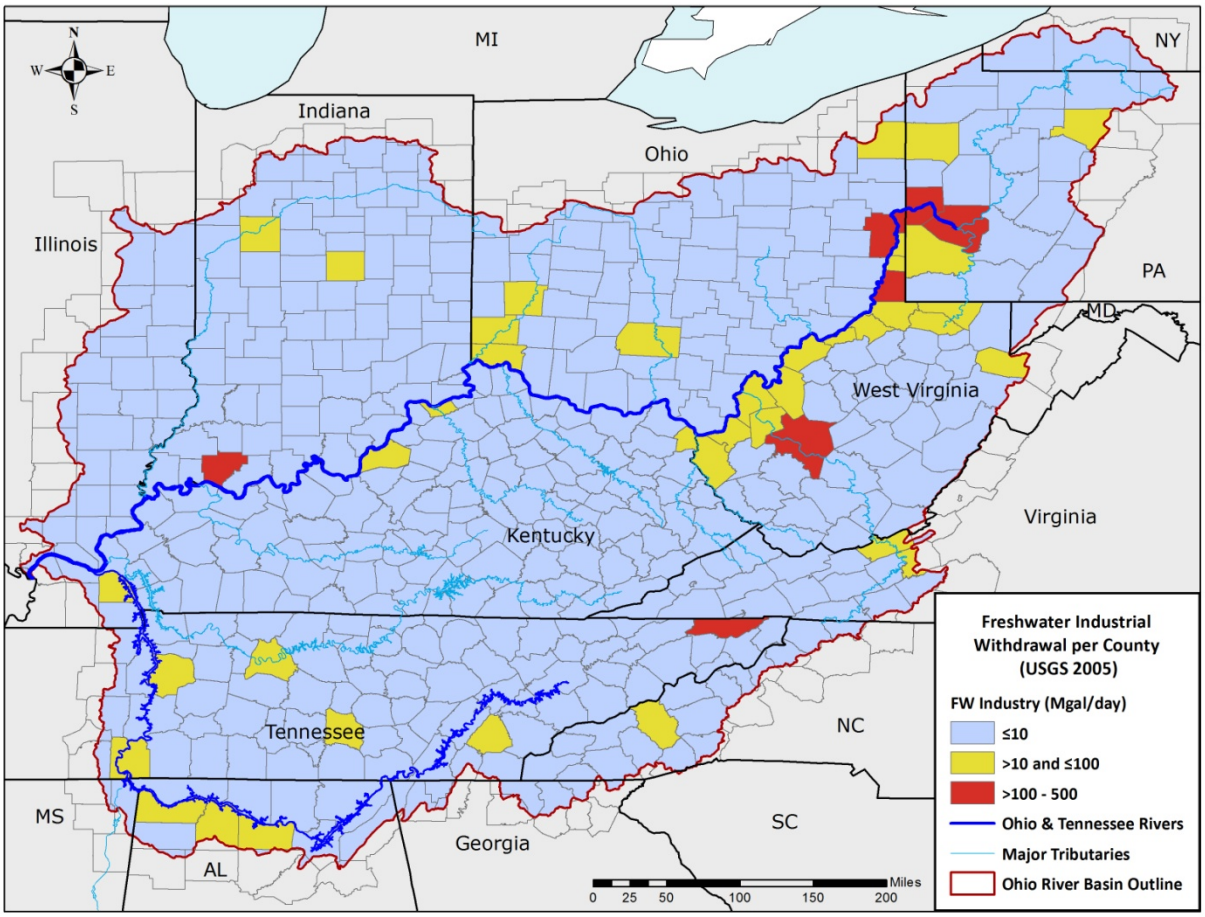

Figure 10. Industrial withdrawals from the ORB are estimated at 3,639 Mgal/day and are responsible for approximately 8% of the total freshwater withdrawals. The majority of counties reporting the largest industrial withdrawals are located near a large waterbody source. Note the concentration of counties in West Virginia and southwestern Pennsylvania bordering the Ohio River.

Irrigation – *217 Mgal/day*

Description: The use of water for irrigation purposes is defined as water applied for a multitude of agricultural and horticultural practices including (but not limited to):

- Pre-irrigation
- Frost protection
- Chemical applications
- Weed Control
- Harvesting
- Dust suppression
- Leaching salts
- Self-supplied
- Golf courses
- Parks
- Nurseries
- Turf Farms

- Field Preparation
- Crop Cooling

withdrawals/deliveries

- Cemeteries
- Misc. Landscaping uses

2005 Estimated-Use:

In 2005, the estimated total freshwater-use for irrigation purposes within the ORB is 217 Mgal/day and consists of 0.5% of the water used within the basin. Of this total, 137 Mgal/day (62.9%) is withdrawn from groundwater sources and 81 Mgal/day (37.1%) from surface water sources. Ten counties exhibited irrigation withdrawals ≥5 Mgal/day and all are located in the western portion of the ORB (Figure 11).

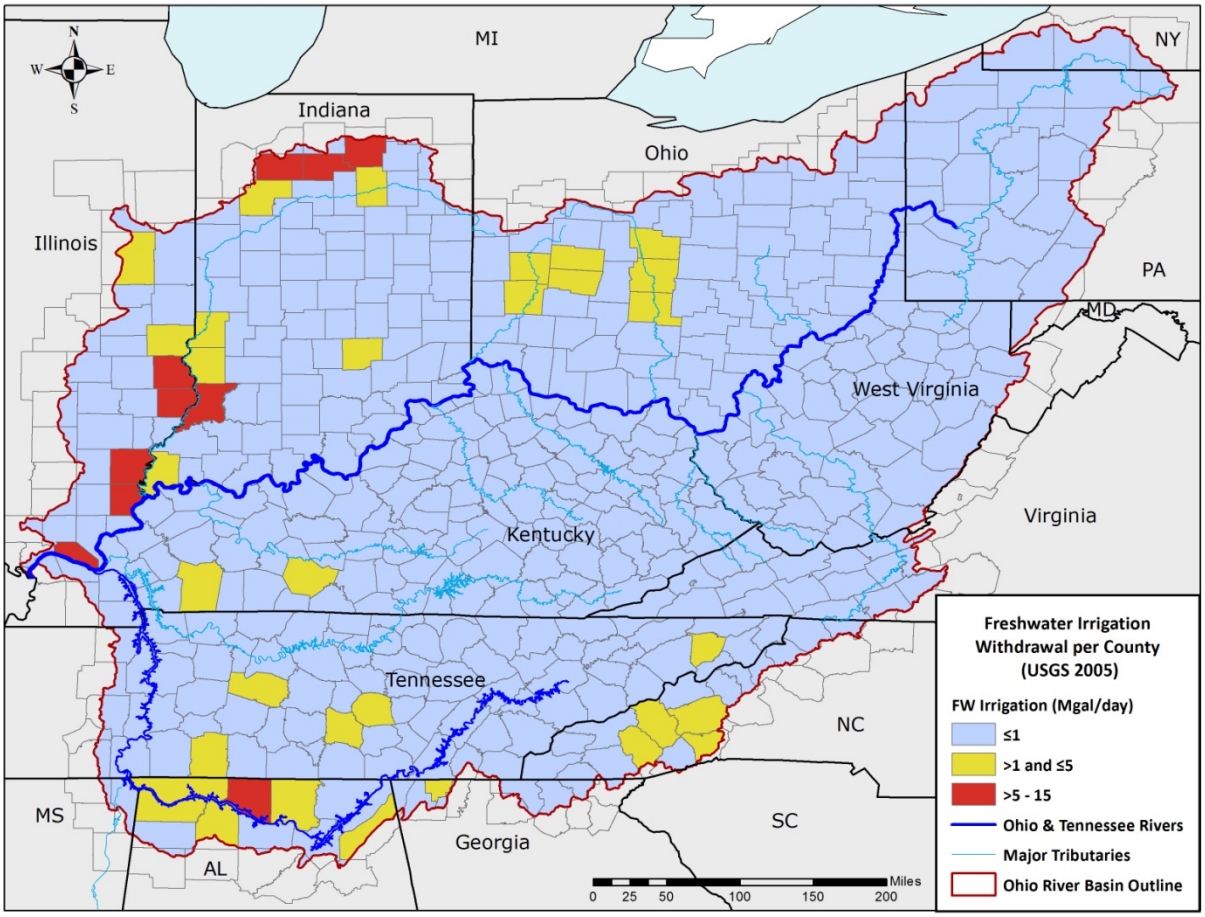

Figure 11. Irrigation withdrawals from the ORB are estimated at 217 Mgal/day and are responsible for <1% of the total freshwater withdrawals. The majority of counties reporting the largest irrigation withdrawals are located in the western portion of the ORB.

Livestock – *155 Mgal/day*

Description: Livestock water-use is defined as water used for the following animals and applications:

Animals

- Dairy/ Beef Cattle
- Sheep/ Lambs
- Hogs/ Pigs
- Horses
- Goats
- Poultry

Applications

- Cooling of:
  - Facilities
  - Animals
  - Animal products
- Dairy Sanitation
- Facility Cleaning
- Animal waste disposal
- Incidental water losses

2005 Estimated-Use:

In 2005, the estimated total freshwater-use for livestock within the ORB is 155 Mgal/day which consists of 0.35% of the water used within the basin. Of this total, 62 Mgal/day (40.3%) is withdrawn from groundwater sources and 93 Mgal/day (59.7%) from surface water sources. The quantities reported by each county are relatively small by comparison to other categories. There were 28 counties that reported livestock water withdrawals ≥1.0 Mgal/day (Figure 12).

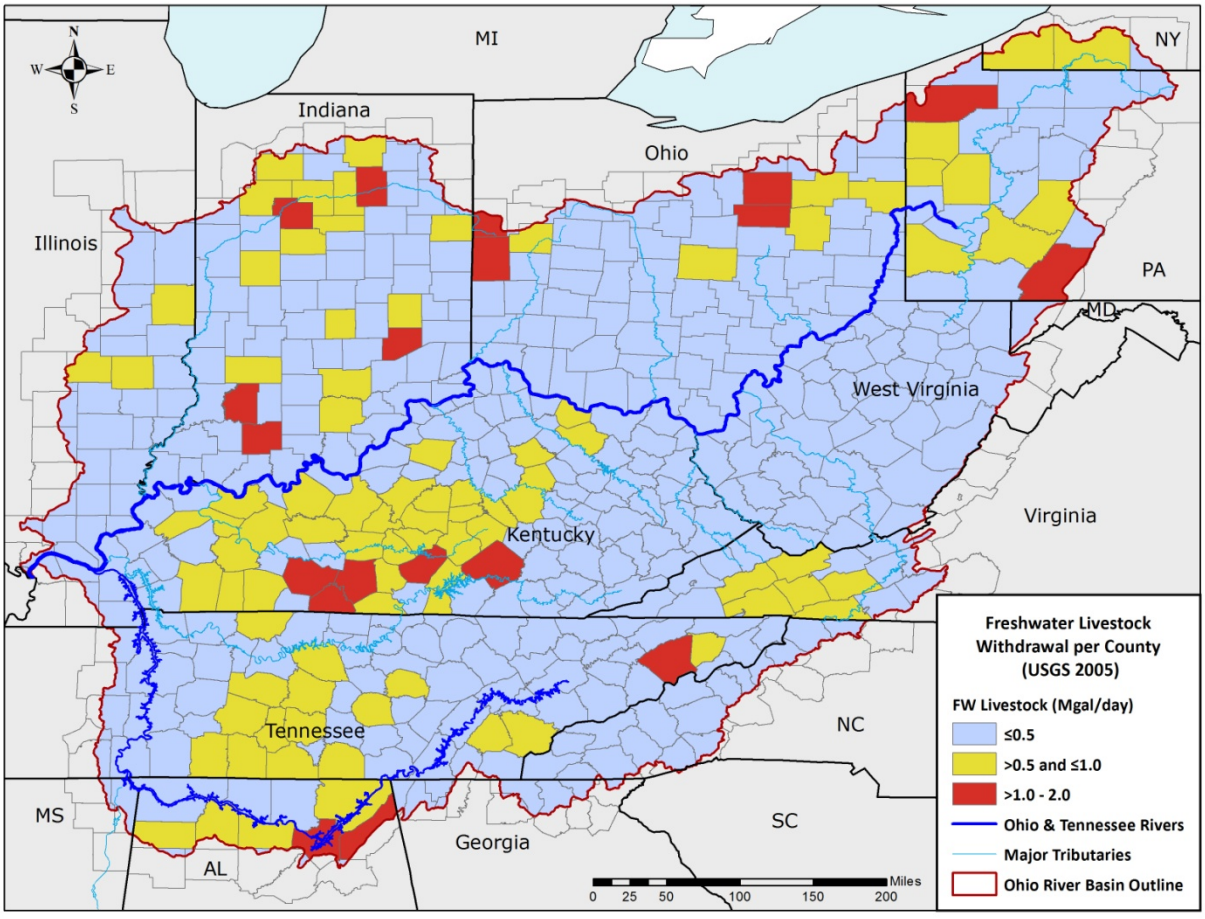

Figure 12. Livestock withdrawals from the ORB are estimated at 155 Mgal/day and are responsible for <1% of the total freshwater withdrawals.

Aquaculture – *1,086 Mgal/day*

Description: Aquaculture water-use is defined as the self-supplied water required for the farming/cultivation of aquatic organisms and its associated practices. Examples of its organisms and purposes include (but are not limited to):

Organisms	Purposes
▪ Fish	▪ Food
▪ Molluscs	▪ Sport
▪ Crustaceans	▪ Restoration
	▪ Conservation

2005 Estimated-Use:

In 2005, the estimated total freshwater-use for aquaculture within the ORB is 1,086 Mgal/day which consists of 2.5% of the water used within the basin. Of this total, 37 Mgal/day (3.4%) is withdrawn from groundwater sources and 1,049 Mgal/day (96.6%) from surface water sources. The estimated quantities of aquacultural withdrawals display a disproportional range of quantities. Most of the counties exhibited <5 Mgal/day however two counties in North Carolina exhibited quantities of 300 and 427 Mgal/day (Figure 13).

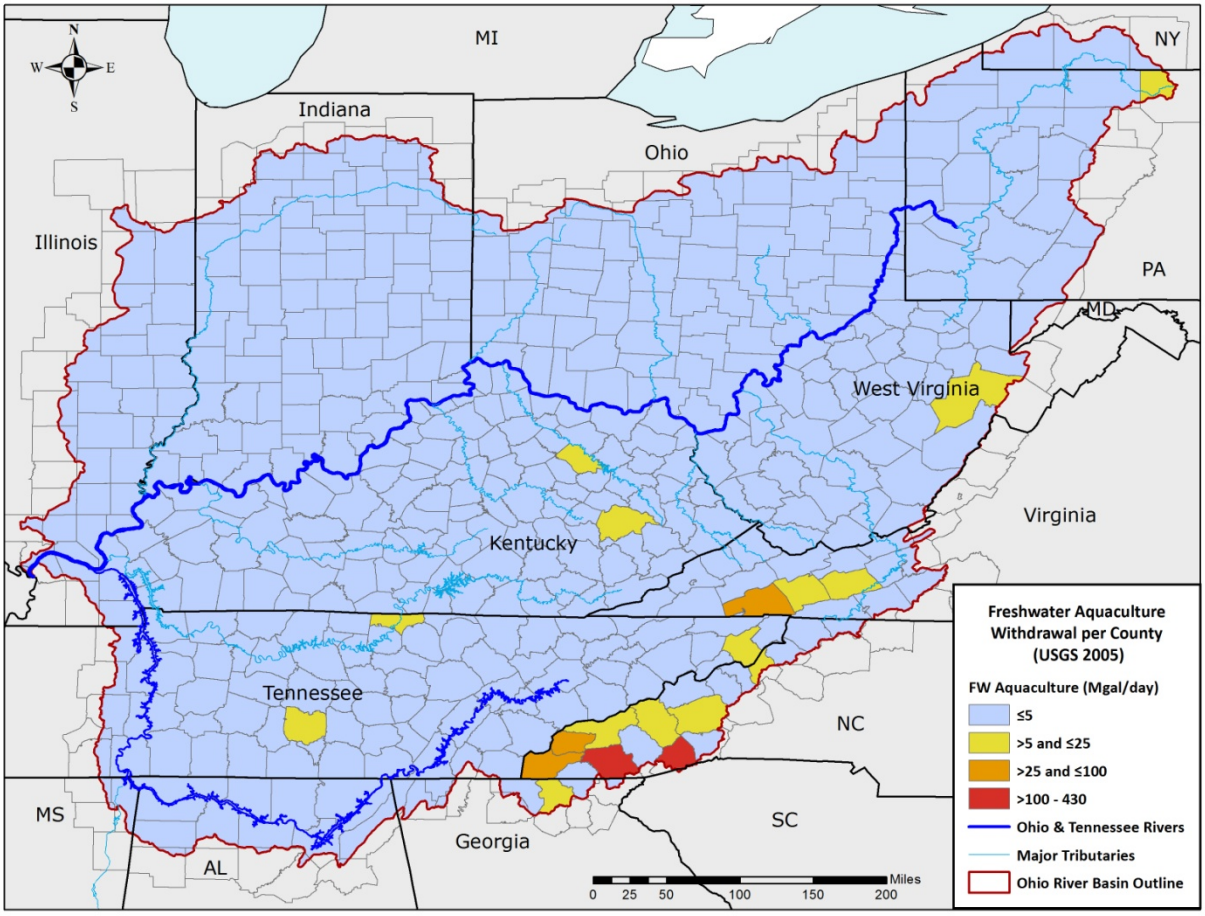

Figure 13. Aquaculture withdrawals from the ORB are estimated at 1,086 Mgal/day and are responsible for approximately 2.5% of the total freshwater withdrawals. The counties reporting the largest aquacultural withdrawals are located in the southeastern portion of the ORB.

Mining – *324 Mgal/day*

Description: Mining water-use is defined as the self-supplied water for (but not limited to) the following resources and processes:

Resources		Process	
▪ Coal	▪ Iron	▪ Quarrying	▪ Milling
▪ Crude Petroleum	▪ Sand	▪ Re-injecting extracted water For secondary oil recovery	▪ Crushing
▪ Natural Gas	▪ Gravel	▪ Dust Suppression	▪ Screening
			▪ Washing

2005 Estimated Water-Use:

In 2005, the estimated total freshwater-use for mining purposes within the ORB is 324 Mgal/day which consists of 0.7% of the water used within the basin. Of this total, 118 Mgal/day (36.4%) is withdrawn from groundwater sources and 206 Mgal/day (63.6%) from surface water sources. Four counties exhibited withdrawal quantities ≥10 Mgal/day and these are located north of the Ohio River in the states of Ohio and Indiana (Figure 14).

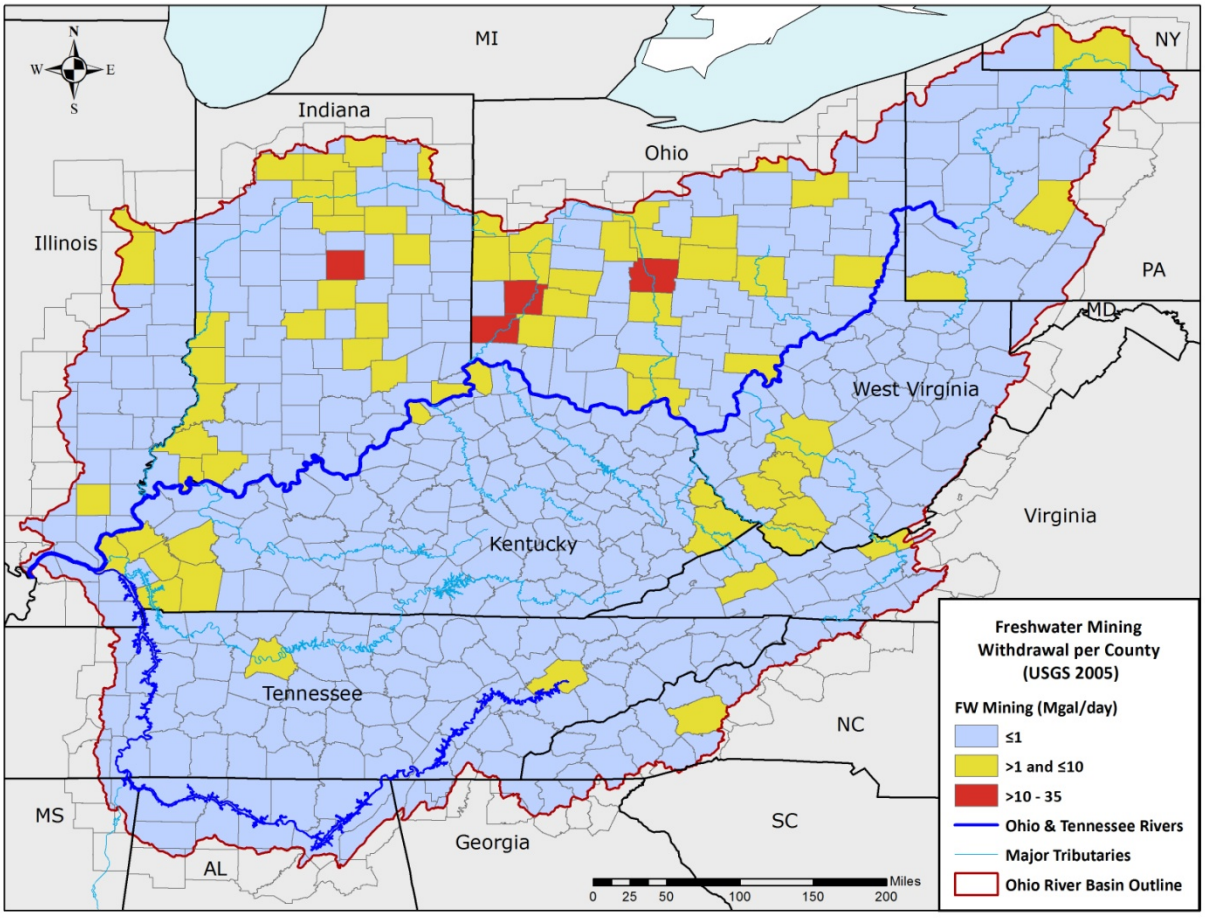

Figure 14. Mining withdrawals from the ORB are estimated at 324 Mgal/day and are responsible for <1% of the total freshwater withdrawals. The counties reporting the largest mining withdrawals in the ORB are located in the states of Ohio and Indiana.

What proportion of the nation's withdrawals come from the Ohio River basin?

The ORB is a basin rich in natural and economic resources and this is reflected in the proportion of water used for the 8 different categories by comparison to the rest of the United States. It is estimated that 12.5% of the nation's freshwater is withdrawn from the ORB (Table 2). The ORB comprises approximately 6.5% of the conterminous U.S. land-area and 9.6% of the conterminous population. The ORB is a major water supply source for thermoelectric and industrial uses as indicated by the total freshwater withdraws for these categories being responsible for 24.1% and 21.5% of the nation's total water-use per category, respectively (Figure 15). These figures reflect the affluent economic and manufacturing history of the region that has capitalized on the rich water and natural resources by which raw materials could be processed and transported. Mining and aquacultural sectors also exhibit above-average water-use. Irrigation within the ORB accounts for only 0.2% of the total water withdrawals. Irrigation withdrawals represent a rather insignificant proportion of water-use for this category considering 27.6% of the land area in the ORB is allocated for cultivated crops.

Table 2. The amount of water (Mgal/day) used within the ORB was determined (using the USGS 2005 dataset) based on 8 different categorical uses. These categorical uses were subdivided into groundwater (GW) and surface water (SW) withdrawals. Each category and subdivision determined for the ORB was compared to their respective national uses (denoted by numerical values in parentheses).

	2005 Freshwater-use (Mgal/day)					
	Ohio River Basin			National		
Category	GW	SW	Total	GW	SW	Total
Public Supply	1,054 (7.2%)	2,530 (8.5%)	3,584 (8.1%)	14,580	29,623	44,203
Domestic Supply	344 (9.2%)	15 (17.2%)	359 (9.4%)	3,741	88	3,829
Industrial	343 (11.2%)	3,297 (23.7%)	3,639 (21.5%)	3,070	13,895	16,965
Irrigation	137 (0.3%)	81 (0.1%)	217 (0.2%)	53,510	74,925	128,434
Livestock	62 (4.8%)	93 (11%)	155 (7.3%)	1,290	846	2,136
Aquaculture	37 (1.9%)	1,049 (15.3%)	1,086 (12.4%)	1,906	6,875	8,781
Mining	118 (11.6%)	206 (15.9%)	324 (14.0%)	1,019	1,296	2,315
Thermoelectric	43 (8.4%)	34,410 (24.2%)	34,452 (24.1%)	510	142,246	142,756
Total	2,137 (2.7%)	41,680 (15.4%)	43,817 (12.5%)	79,625	269,793	349,418

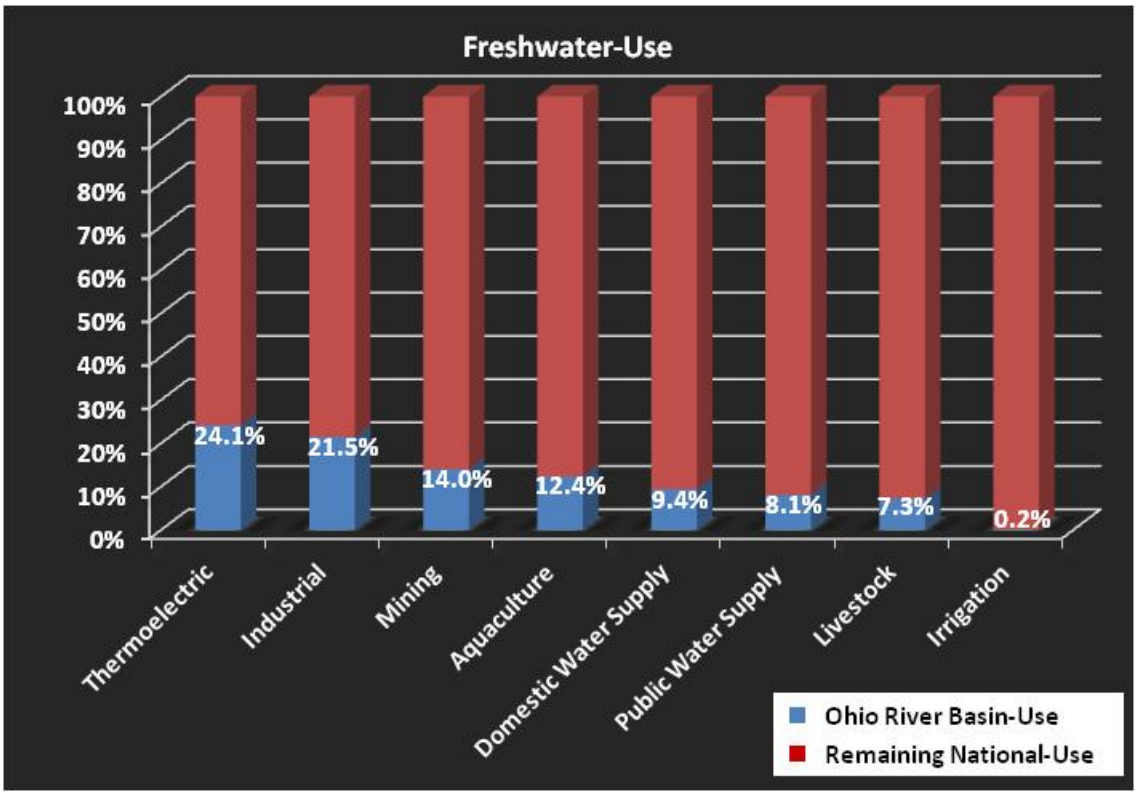

Figure 15. The amount of water withdrawn from within the ORB in 2005 was compared to the national water-use per category. For example, thermoelectric water-use from within the ORB accounted for 24.1% of the nation's total thermoelectric water use.

Comparisons to National Estimations

The estimations of total freshwater-use for each category were calculated to determine if the amount of water used within the ORB is proportional to the national freshwater-use. All categorical comparisons are subjective and present a relative perspective. Visual representations are provided by Figure 16.

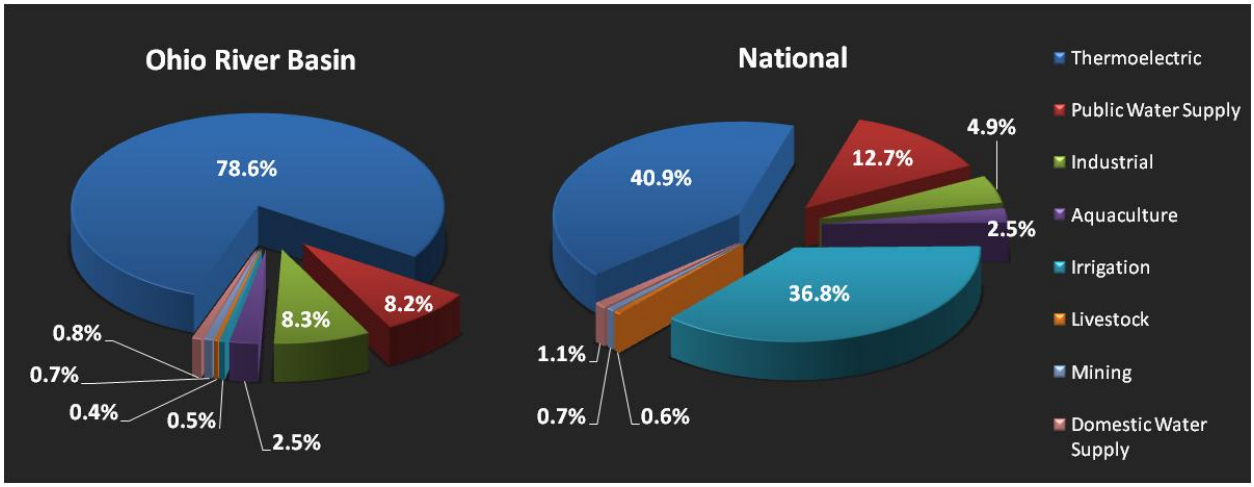

Figure 16. Categorical freshwater-use percentage estimations were calculated from within ORB and compared to the national estimations. For example, 78.6% of the water withdrawn from the ORB were used by the thermoelectric sector whereas only 40.9% were withdrawn nationally. All data are based on 2005 USGS water-use estimates (Kenny et al. 2009).

Thermoelectric

Within the ORB, thermoelectric consists of 78.6% of the total freshwater-use whereas nationally this category consists of 40.9%. The proportion of water withdrawn for thermoelectric facilities within the ORB is considerably larger than the national estimate.

Public Water Supply

Within the ORB, public water supply consists of 8.2% of the total freshwater-use whereas nationally this category consists of 12.7%. The proportion of water withdrawn for public water supply within the ORB is considerably less than the national public water supply use. Surface water as a public supply source consisted of 67.0% nationally. Within the ORB, 70.6% was derived from surface waters.

Domestic Water Supply

Within the ORB, domestic water supply consists of 0.8% of the total freshwater-use and nationally this category consists of 1.1%. The proportion of water withdrawn within the ORB for domestic water supply is comparable to the national domestic water supply use. The majority of domestic water supply is derived from ground water sources both in the ORB (95.8%) and nationally (97.7%).

Industry

Within the ORB, industrial water withdrawals consist of 8.3% of the total freshwater-use whereas nationally this category consists of 4.9%. Within the ORB the proportion of water withdrawn for industrial use is considerably greater than the national industrial water-use. The Ohio River corridor has historically been considered an 'industrial' river, particularly in the upper section (in WV and PA). The availability of multi-faceted infrastructural components (e.g. navigational waterways, highways, railways, pipelines, river terminals, airports, etc.) within the ORB enable the

cost-effective transport of raw materials, products, and commodities both intra- and internationally. Surface waters were the primary source of industrial withdrawals at both scales (90.6% in ORB vs. 81.9% nationally). Despite the elevated concentration of industrial withdrawals in the West Virginia-Ohio River border counties, two counties outside of this area in the ORB were ranked within the top-5 counties for industrial withdrawals. These counties were in Indiana and Tennessee and reflect the water-use primarily by a specific industrial facility per each county.

Irrigation

Within the ORB, irrigation consists of 0.5% of the total freshwater-use whereas nationally this category consists of 36.8%. The amount of water extracted for irrigation pales in comparison to the national average despite 27.6% of the ORB's land-use is devoted to cultivated crop production. The majority of the irrigation uses occurs west of the ORB. The 5 states exhibiting the greatest volume of irrigation-use are outside of the ORB (California, Nebraska, Texas, Arkansas, and Idaho). The state of California solely withdraws (24,400 Mgal/day) 100 times more water for irrigation than the entirety of the ORB.

Livestock

Within the ORB, livestock water supply consists of 0.4% of the total freshwater-use whereas nationally this category consists of 0.6%. The proportion of water withdrawn for livestock water supply within the ORB is comparable to the national livestock water supply use.

Aquaculture

Within the ORB, aquaculture water supply consists of 2.5% of the total freshwater-use and is proportional to the national use of 2.5%. Despite the restrictive quantity of water used for aquaculture throughout the ORB, two counties in North Carolina were ranked 5th and 6th nationally for aquacultural withdrawal amounts.

Mining

Within the ORB, mining water supply consists of 0.7% of the total freshwater-use and is proportional to the national use of 0.7%.

County-Ranks: The Ohio River basin vs. The Rest of the Nation

The water-use estimations of counties within the ORB were compared to all counties/parishes (N=3,222) in the United States to gain a relative perspective of the geographical distributions and locations of those counties with the greatest withdrawals. Every county within the U.S. was ranked according to the volume of water withdrawn per categorical-use and the number of counties within the ORB was identified. Based on the geographical distributions of the Top 50 counties withdrawing freshwaters, patterns indicated these counties are concentrated in California/Arizona, Idaho, metropolitan areas on the Great Lakes, and counties within the southern portion of the ORB (Figure 17). The Tennessee River Valley portion of the ORB contains the majority of these counties.

Eleven counties were ranked in the top-50 for total freshwater-use and all of these were ranked between 13th and 50th. Summaries of these rank-relative volumes are presented in Table 3. There were zero counties in the ORB that withdrew the single-largest quantity of water for any categorical use. Two counties were ranked in the top-5 for industrial-use and 2 counties in the top-10 for aquaculture. Industrial and thermoelectric water-uses reported the most counties within the top-50 with 15 and 14 counties, respectively.

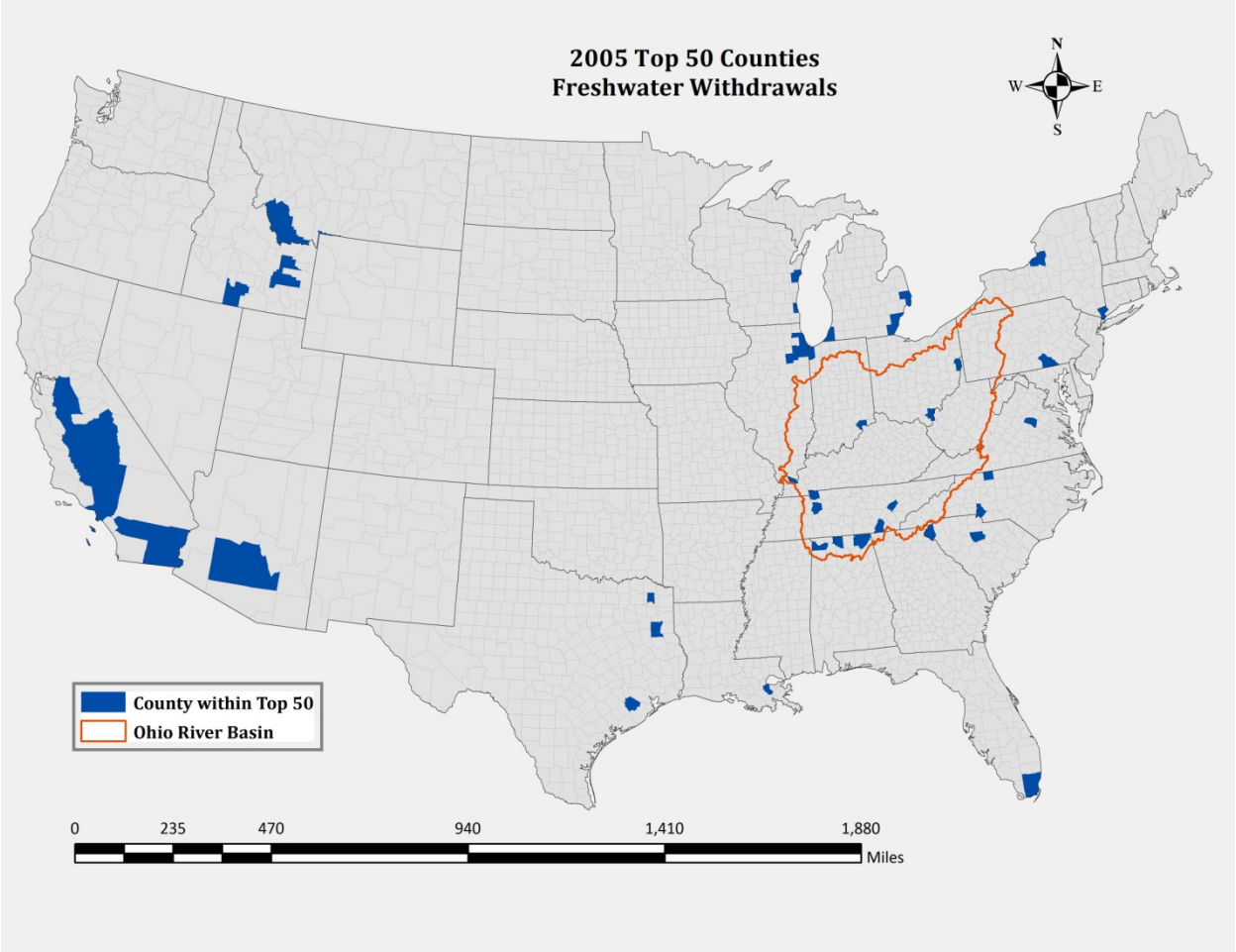

Figure 17. The Top-50 counties withdrawing freshwaters (by volume) within the conterminous U.S. and the 11 counties that occur on that list within the ORB are displayed.

Table 3. Within the ORB, the amount of freshwater withdrawals at the county level were determined and ranked in comparison to all counties/parishes of the US (e.g. Top 5, Top 10, and Top 50 nationally). The amount of counties within the basin reporting values greater than zero was also included to provide a reference for the commonality of withdrawals from the basin.

	# ORB Counties:			
Category	Top 5	Top 10	Top 50	reporting values >0 Mgal/day
Thermoelectric	0	0	14	102
Industrial	2	3	15	263
Mining	0	1	5	332
Aquaculture	1	2	5	138
Domestic Water Supply	0	0	0	538
Public Water Supply	0	0	2	531
Livestock	0	0	0	532
Irrigation	0	0	0	429
Total Freshwater[a]	0	0	11	546

[a] Total freshwater county rankings were based on the total water-use in counties within the ORB to all counties nationally.

2005 Consumptive-Use Estimates

Consumptive-use is defined as water that is withdrawn and subsequently rendered no longer immediately available for other withdraws.

Multiple analytical approaches were available to determine the estimated consumption rates within the ORB and their determinations were dependent on the resolution from which data were available. With the resources available for this report, information was either acquired via plant-level information (when possible) or substituted with literary sources that listed categorical consumption coefficients that were prioritized based on geographical proximity to the ORB. Plant-level information was available for thermoelectric(U.S. Department of Energy, Energy Information Administration (EIA) 2012) and nuclear facilities (See Table 5). For the other water-use categories, the consumptive coefficients established for the Great Lakes basin per Shaffer & Runkle (2007) were applied to the 2005 USGS dataset. It is understood that there are inherent errors in using a meta-analysis investigation to assign the consumption coefficient values. Estimated consumptive–uses were calculated based on resolution of data on-hand and were derived from geographically and climatically similar basins. Confirmation of the similar consumption coefficient approximations was evident in previous ORB quintennial water-use estimations. These details will be subsequently discussed in the section titled: *Consumption Coefficients Validation* (page 43).

Plant-Level Data Consumption Estimates

Closed Loop vs Once-through Cooling Systems

The configuration and design of each power generating facility's cooling system is dependent on the amount of water required for cooling. There are two types of cooling systems: closed-loop and once-through. A once-through cooling system draws water into the facility, circulates it through heat exchangers, and then returns the water. Closed-loop cooling systems withdraw water from a source, circulate it through heat exchangers, cool it and then recycle it. Therefore, once-through systems require the withdrawal of a greater volume of water but result in less consumption. Conversely, closed-loop systems result in larger consumptive uses because of evaporation, blowdown, leaks, and drift. The estimated amount of water withdrawn for once-through systems was 30.09 Bgal/day (87.3%) and 4.362 Bgal/day for close-loop systems (12.7%) however, these closed-loop systems were responsible for 92% of the total consumption.

US EIA 2005 Dataset = 678 Mgal/day consumed

Using 2005 data compiled by the U.S. Energy Information Administration(U.S. Department of Energy, Energy Information Administration (EIA) 2012), all power generating facilities were identified within the ORB. Each facility reports the amount of water withdrawn, discharged, and consumed in conjunction with ancillary data that was selectively used for this report. These data were available for all power generating stations that operate with both the electrical utilities and independently-operating stations. (The quintennial USGS reports exclude water-uses by independently-operating facilities and therefore may underestimate the actual water-use by the thermoelectric sector). Using these data, it was estimated that 34,018 Mgal/day of freshwater were withdrawn from within the ORB and 678 Mgal/day or 2.0% were consumed. This estimated coefficient is similar to the 2% consumption coefficient calculated for thermoelectric facilities in the Great Lakes Basin (Shaffer and Runkle 2007).

Table 4. Consumptive-uses for each category were calculated using consumption-coefficients or plant-level information (where available). It was estimated that 4.4% of the total water consumed within the ORB was consumed in 2005 and totals a consumptive rate of 1,919 Mgal/day.

Water-use category	Mgal/day in ORB[a]	Median Consumptive-use Coefficients[b] (%)	Estimated Consumptive- use (Mgal/day)
Industrial	3,639	10	364
Mining	324	10	32
Aquaculture	1,086	0	0
Domestic Water Supply	359	12	43
Public Water Supply	3,584	12	430
Livestock	155	83	129
Irrigation	217	90	196
Thermoelectric[c]	34,452		678
Nuclear			46.7
Total	43,817		1,919
% Total Consumptive-use			4.4%

[a] Water withdrawal data per USGS 2005 dataset(Kenny et al. 2009).

[b] Coefficients derived from Shaffer and Runkle (2007)

[c] Thermoelectric and nuclear consumption values were derived from 2005 EIA data and various sources (See Table 5).

Nuclear Power Generating Facilites = 46.7 Mgal/day consumed

The EIA 2005 dataset does not include water-use information from nuclear power generating facilities therefore consumption estimates were independently calculated for the 4 nuclear facilities within the basin. (The USGS quintennial reports do include the nuclear plants' withdrawal data). Various souces were utilized in the determination of water consumption rates by nuclear plants. In total, it was estimated that the amount of water consumed in the ORB was 46.7 Mgal/day (Table 5).

Table 5. The amount of water consumed by each of the 4 nuclear power generating facilities in the ORB were estimated using various sources of information. (*Estimations are yearly averages in Mgal/day and are based on the number of operational units in 2005.)

Nuclear Plant	State	Mgal/day consumed*	Source
Beaver Valley	PA	26	US Nuclear Regulatory Commission 2009
Brown's Ferry	AL	1.9	US Nuclear Regulatory Commission 2005
Sequoyah	TN	0.1	TVA 2011
Watts Bar	TN	18.7	US Nuclear Regulatory Commission 2011
Total		**46.7**	

Hydroelectricity and Surface Water Evaporation Rates

The USGS 2005 report (Kenny et al. 2009) excludes water-use via hydroelectric facilities because hydroelectric power generation is considered an instream use since all of the water passes through the structure. However, the installation of the hydropower structure and its resulting impoundment could deviate from the evaporative losses in its free-flowing potential. According to(Torcellini, Long, and Judkoff 2003), this evaporative discrepancy is considered negligible therefore the consumptive losses resulting from hydroelectric generation were not estimated. These data would be valuable in future studies should resources be allocated for such investigations.

Consumption Summary

In total, it was estimated that **1,919 Mgal/day** of freshwater is consumed within the ORB which equates to approximately 4.4% of the total withdrawals. The largest consumer of water was the thermoelectric sector at 724.7 Mgal/day and comprised 38% of the water consumed in the ORB. However, despite the large volumes of water withdrawn, only 2% of the water-used was actually consumed. Public water supply and industrial consumption were estimated at 430 and 364 Mgal/day, respectively. Consumption-use for irrigation purposes is estimated at 196 Mgal/day which is attributable to only 10% of the total consumption. The remaining 4 categories contributed to the remaining 10.6% of the total consumption.

The total freshwater consumption for individual counties ranged from 0 to 157 Mgal/day. The majority of the counties consumed ≤10 Mgal/day whereas 16 of the total 546 counties (3%) in the ORB consumed >25 Mgal/day but were responsible for 42% of the total consumption (Figure 18).

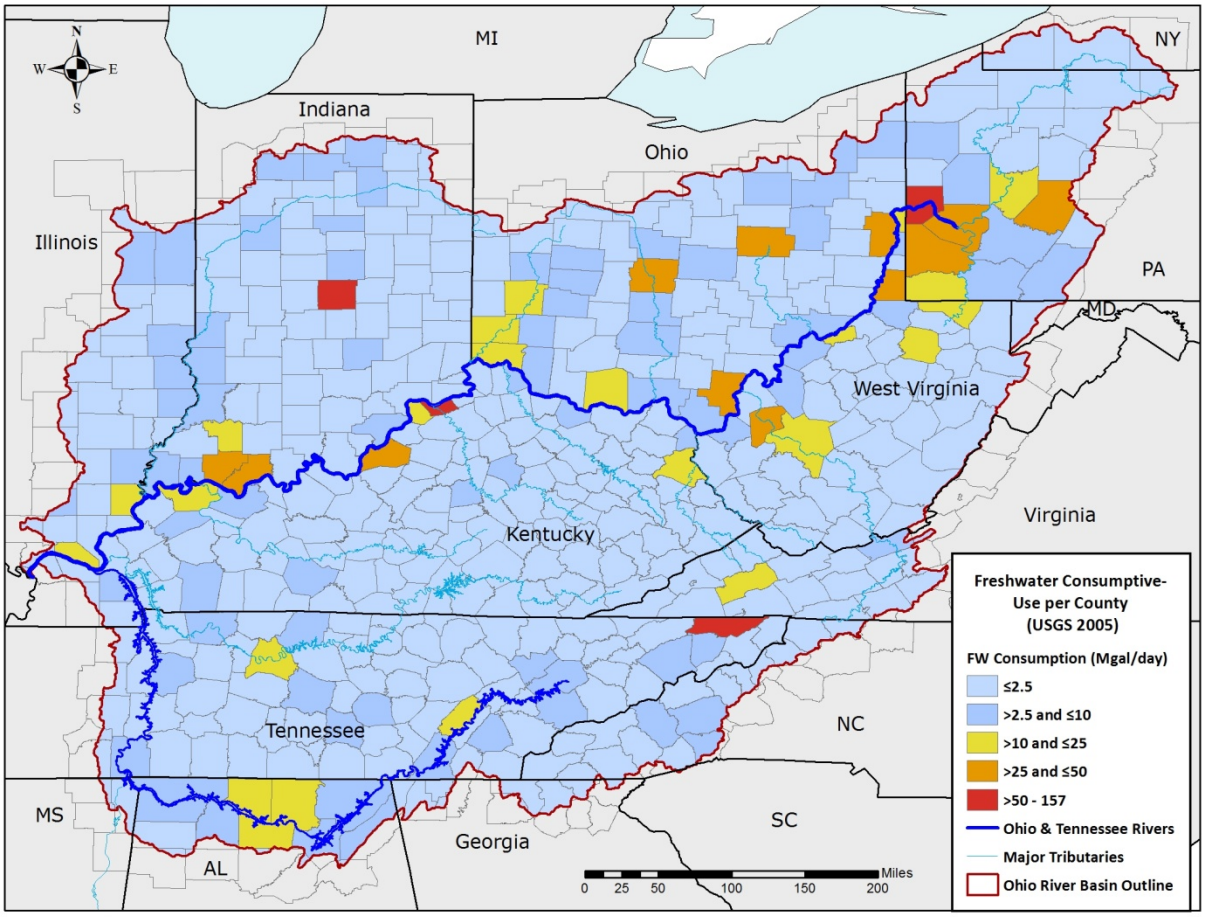

Figure 18. The total freshwater consumptive-use estimates were calculated for each county within the ORB and ranged from 0 to 157 Mgal/day. Sixteen counties consumed >25 Mgal/day in which 4 counties were estimated at >50 Mgal/day.

Perspective – The ORB's Consumptive-Use

Great Lakes Basin

The Great Lakes land-drainage area (including Canada) approximates 201,460 mi^2 (521,779 km^2) and contains a population estimate of 34 million people (Great Lakes Commission 2012); hence both statistics are relatively similar to the ORB. In 2005, the consumptive-use estimation for the Great Lakes basin was 2,529 Mgal/day which is relatively similar to the consumption estimate within the ORB. Of the entire water withdrawn from within the Great Lakes basin, 5.9% was consumed (vs. 4.4% in ORB). The 3 largest categories were public water supply, thermoelectric, and industry (Table 6).

Table 6. The consumptive water-use was estimated for 7 categorical water-uses from within the Great Lakes basin (including Canada) using 2005 water-withdrawal data (Obtained data from (Great Lakes Commission 2011).

	(Mgal/day)	
Water-use Category[a]	**Withdrawal**	**Consumptive**
Public Supply	5,871	1,075
Domestic Supply	490	121
Thermoelectric	30,895	534
Industrial	4,390	516
Irrigation	443	118
Livestock	138	129
Other	501	36
Total	**42,728**	**2,529**

[a] Categorical assignments are similar to the USGS 2005 data; caution is warranted in directly relating the categorical estimates between basins.

Tennessee River Valley

In 2005, the total consumptive-use in the Tennessee River Valley was estimated at 432 Mgal/day (Bohac and McCall 2008). This consumptive use is incorporated into the ORB's total 1,919 Mgal/day and equates to 23% of the total water consumed in the ORB. Of the total water withdrawn in the Tennessee River Valley, approximately 3.5% was consumed (Table 7). The overall consumption coefficient is relatively similar to the ORB and the primary reason for the decreased coefficient observed in the Tennessee River Valley is due to the 0.3% consumption coefficient in the thermoelectric category. This is considerably less than the 2.0% consumption coefficient that was calculated for the entirety of the ORB (and reasons for the discrepant percentages are unknown).

Table 7. The consumptive use was estimated for 4 categorical water-uses from within the Tennessee River Valley in 2005 ((Bohac and McCall 2008). The consumptive coefficient is calculated based on the ratio of water consumed and the total withdrawn per category.

	(Mgal/day)		Calculated Consumptive Coefficient (%)
Water-use Category[a]	**Withdrawal**	**Consumptive**	
Thermoelectric	10,531	33	0.3
Industrial	1,179	82	7.0
Public Supply	684	273	39.9
Irrigation	43	43	100
Total	**12,437**	**432**	**3.5**

[a] Categorical assignments are similar to the USGS 2005 data; caution is warranted in directly relating the categorical estimates between basins.

Water-Use Changes in the Ohio River Basin

1955 to 2005 – Fifty Years of Water Use

From 1955 to 1995, water-withdrawal estimations were determined for each of the major river regions of the United States. Quantifications were estimated in the Ohio and Tennessee Rivers and were incorporated into each quintennial water-use report. Evaluations of the water-use per drainage region were excluded henceforth from the 2000 report. (The amount of water withdrawn from within the ORB in the years 2000 and 2005 were calculated via county-level information provided by the USGS. Despite variability that may be present due to the improvement and/or accuracy of reporting, trends in water-use were observed throughout the 50 years (Figure 19). From 1955 to 1980, the total amount of water withdrawn increased steadily and exhibited a reduction in 1985. The thermoelectric category has remained the largest user of water for the entire 50 year period of record.

Since 1955, the amount of water withdrawn from the ORB has increased by 61% but at its peak in 1980, a maximum increase of 90% was observed. The peak water-use in 1980 was estimated at 51.7 Bgal/day of which the thermoelectric sector was the largest user. Total freshwater-use then decreased by 17% between 1980 and 1985 primarily due to a 21% decrease in thermoelectric use.

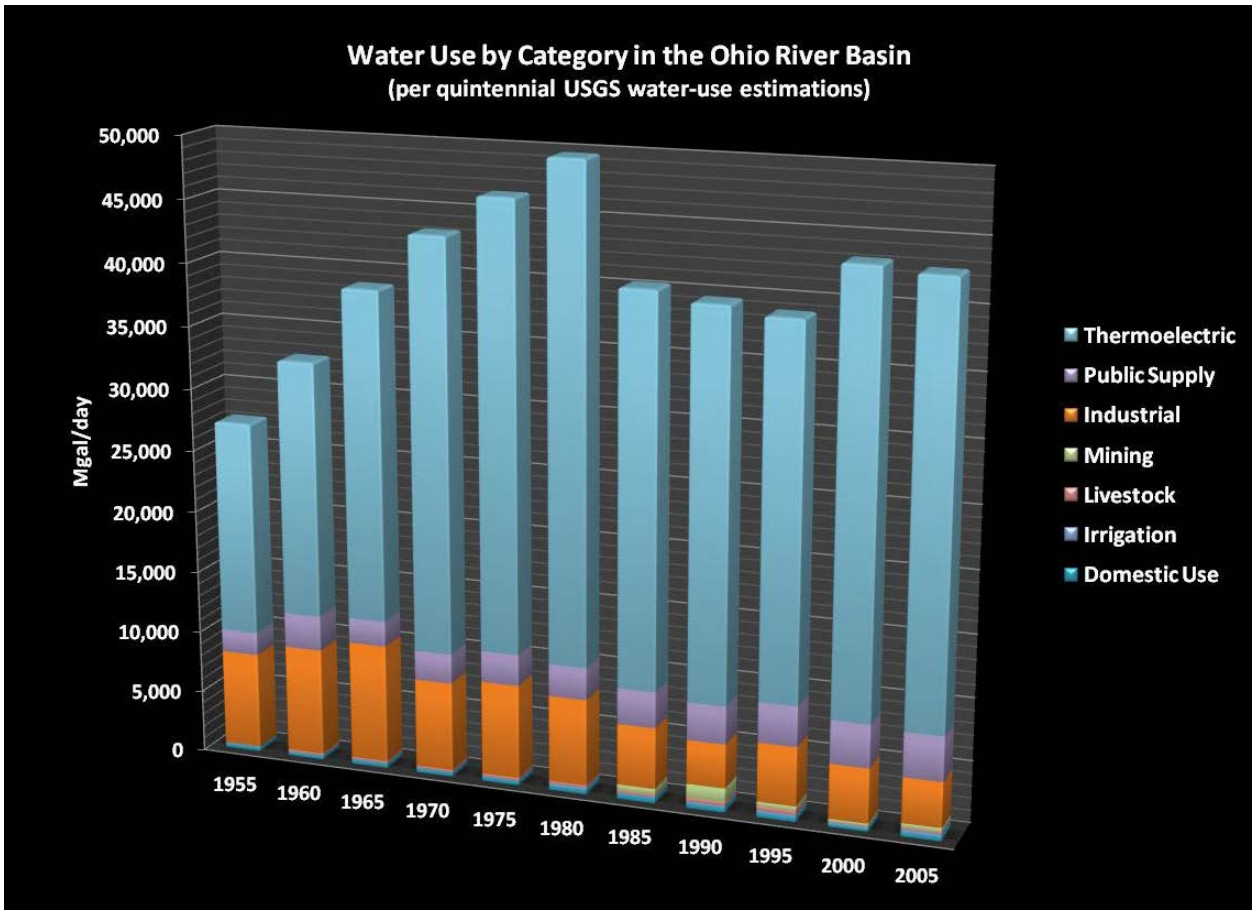

Figure 19.The amount of water withdrawn from 1955 to 2005 by category (1,000 Mgal/day = 1 Bgal/day)

Excluding Thermoelectric

For illustrative purposes, the thermoelectric category was eliminated due to its large composition of withdrawals that inhibited the ability to view temporal trends in other categories (Figure 20).

Contradictory to the thermoelectric water-use in the basin, which expressed an overall increase, the total use by the 6 remaining categories slightly decreased over the past 50 years. Industrial water-used peaked in 1965 and has exhibited the largest relative reduction in water withdrawals. Public supply has slightly increased over the 50 years in conjunction with the total population in the ORB. Although irrigation is a minor contributor to total water withdrawals, it has expressed an increase particularly since 1995. Mining water-use displayed a peak in 1990 and has decreased since, however, there is a possibility that various adjustments in the reporting requirements/accuracy of mining water-uses have been made throughout the time-frame.

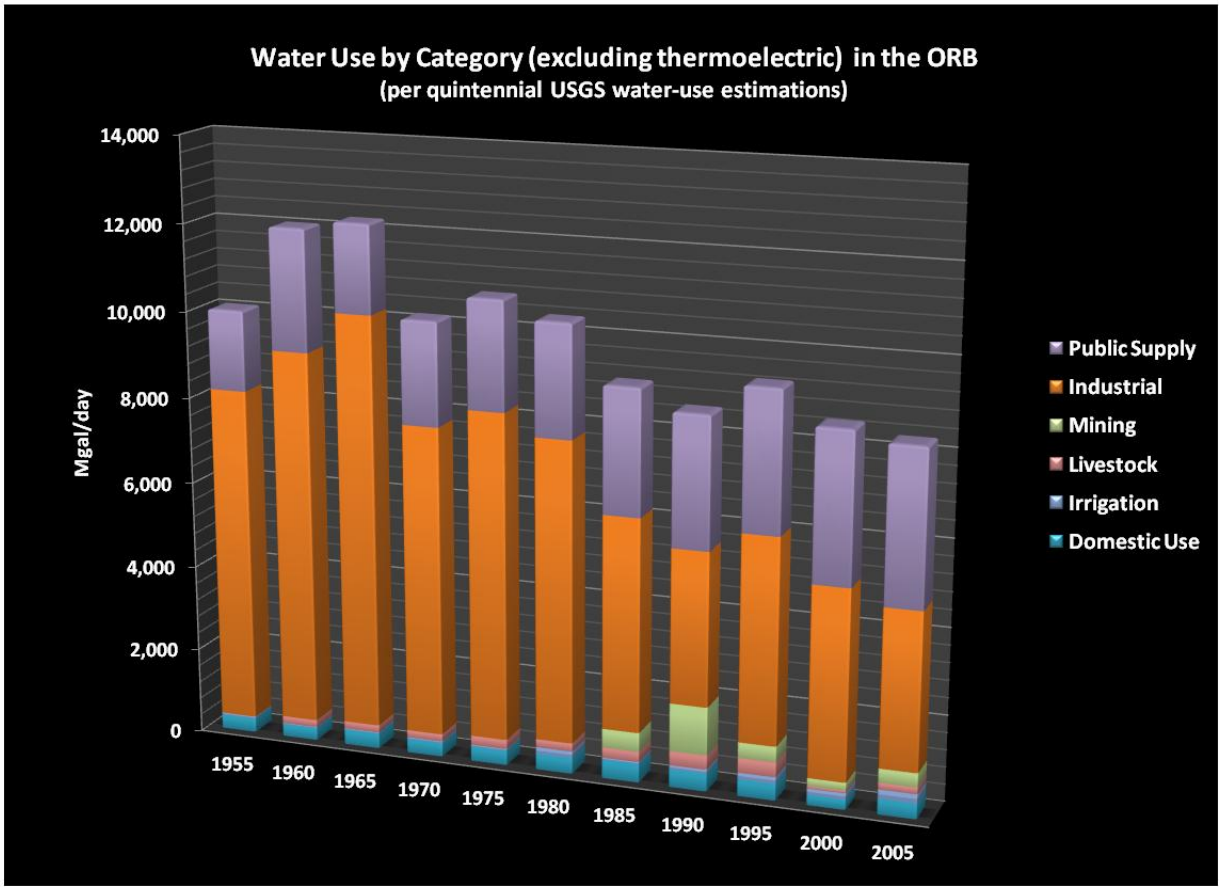

Figure 20. The total amount of freshwater withdrawn in the ORB from 1955 to 2005 by category (excluding thermoelectric).

Consumptive-Use Trends

The consumptive estimates from 1960 to 1995 were reported in the USGS quintennial water-use estimates whereas the 2000 and 2005 estimates were calculated according to the aforementioned methods (See 2005 Consumptive-Use Estimates, page 24). The temporal trends in consumptive uses may reflect on issues such as modifications in energy policies, aging infrastructures, agricultural and horticultural practices, and residential and commercial water conservation practices.

Freshwater consumption has exhibited an increasing trend since its inaugural reporting in 1960 and displayed a peak in 1985 and 1990 (Figure 21). The consumptive minimum occurred in 1970 and then steeply increased toward it peaks. Due to the some of the aforementioned issues that have occurred in the ORB since 2005, it is anticipated that the quantity of water consumed in the 2010 will express a continued increase.

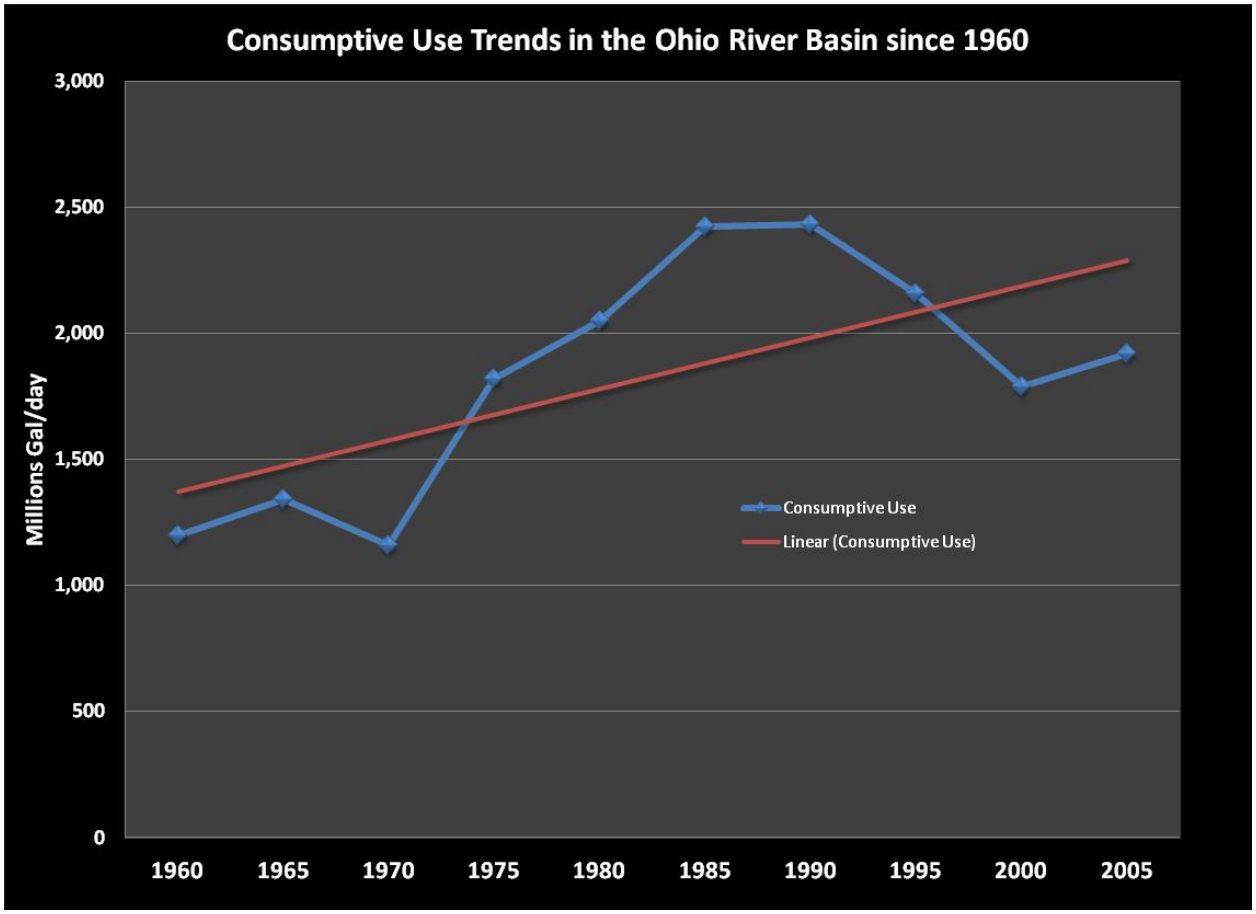

Figure 21. USGS Quintennial estimations of freshwater consumption within the ORB were 1st reported in 1960 and continued in their reports until 1995. In 2000 and 2005, estimations of consumptive use were calculated via consumption coefficients. Overall, consumption quantities have increased since 1960 though deviations from this trend can be observed between the 5-year estimations.

1985 to 2005 Water-Use: Twenty Years of Change

County-level water-use data was acquired from publicly available datasets via the USGS (http://water.usgs.gov/watuse/) and is based on data reported in 1985 by (Solley, Merk, and Pierce 1988) and in 2005 by (Kenny et al. 2009). Seven water withdrawal categories were assigned in the 1985 dataset. That number increased to eight in the 2005 dataset. Aquaculture was not included in the 1985 dataset therefore all comparisons between the datasets exclude the aquaculture category. In (Solley, Merk, and Pierce 1988), the amount of water withdrawals were reported according to major river regions such as the Ohio River and Tennessee River basins therefore the amount reported within these basins per category were aggregated to estimate the categorical totals.

20-year Changes in Total Freshwater-Use

In 1985, the total freshwater-use in the ORB was estimated at 40,508 Mgal/day and increased to 42,731 (excluding aquaculture) in 2005; representing a 5.5% increase over the past 20 years (Table 8). The total freshwater withdraw estimates in 1985 for the entire nation was 338 Bgal/day and slightly increased (by 0.7%) to 341 Bgal/day in 2005 (excluding aquaculture) therefore the water-use in the ORB has increased more than the national average.

Table 8. Water-withdrawal estimates were calculated from within the ORB (ORB) and were compiled for years 1985 and 2005 to determine 20-year categorical water-use changes. (* Aquacultural water withdrawals were not reported in 1985 dataset and will be excluded from subsequent analyses).

	Water Withdrawal in ORB (Mgal/day)		
Water-use Category	**1985**	**2005**	**% Change**
Thermoelectric	31,534	34,452	9.3%
Public Water Supply	2,917	3,584	22.9%
Domestic Water Supply	428	359	-16.1%
Industrial	4,903	3,639	-25.8%
Mining	431	324	-24.9%
Irrigation	51	217	328.3%
Livestock	244	155	-36.3%
Aquaculture*	na	1,086	na
Total	40,508	43,817	8.2%
Total (excl. Aquaculture)	**40,508**	**42,731**	**5.5%**

Categorical Water-Use Changes

Within this section, the quintennial median centers of each categorical use (based on the county-level data) were applied to the ORB to identify geographical patterns in water withdrawals. For each category, the median center was calculated based on the independent, weighted-average of categorical values using county-level data compiled by the USGS as part of their quintennial water-use estimations. The geographical center of the basin was determined to provide a reference of geographical deviation from center. Quintennial median centers exhibit the shifts in the uses of water throughout the various parts of the ORB.

Thermoelectric +9.3%

Thermoelectric use in 1985 was estimated at 31.534 Bgal/day and exhibited a+9.3% increase to 34.452 Bgal/day in 2005 (Table 8).

The quintennial median centers of thermoelectric water-use has exhibited a southwesterly arching trend since 1985 where the median center was northeast of the geographical center and is now (as of 2005) to its southwest (Figure 22). These patterns indicate that there has likely been an increase in thermoelectric water-use in the Tennessee River Valley region.

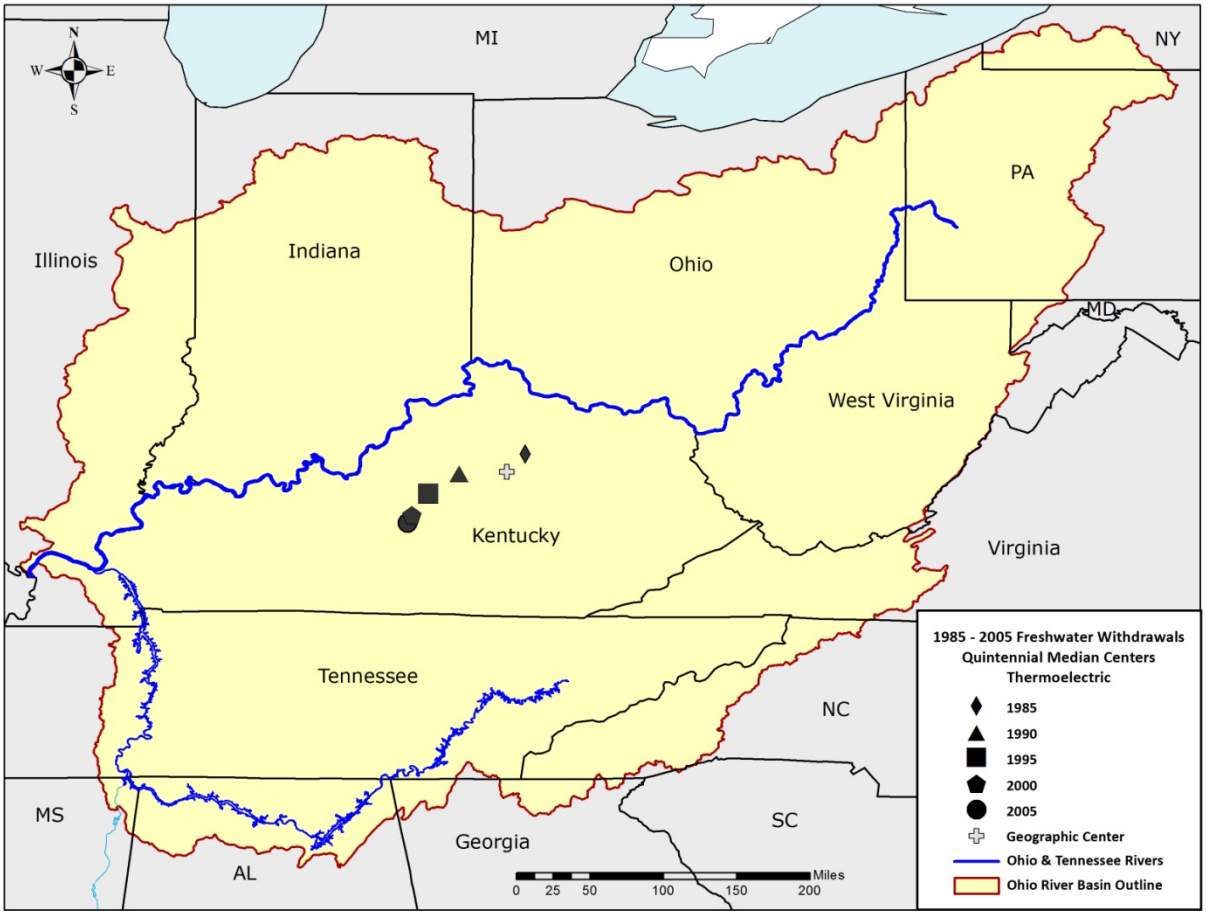

Figure 22. The quintennial median centers of thermoelectric water-use exhibited a southwesterly arching trend since 1985 where the median center was northeast of the geographical center and is now (as of 2005) to its southwest.

Public Water Supply +22.9%

Public water supply was estimated at 2.917 Bgal/day in 1985 and exhibited a +22.9% increase to 3.584 Bgal/day in 2005 (Table 8). In this same time frame, the population served has exhibited a similar increase estimated at 23.1%. In 1985 the per capita use was an estimated 157 gal/day whereas the 2005 per capita estimates was 154 gal/day (Table 9).

The quintennial median center of public water supply has remained relatively stable over the 20 year period. The median centers have remained to the north-northeast of the geographic center and exhibited a southern linear movement.

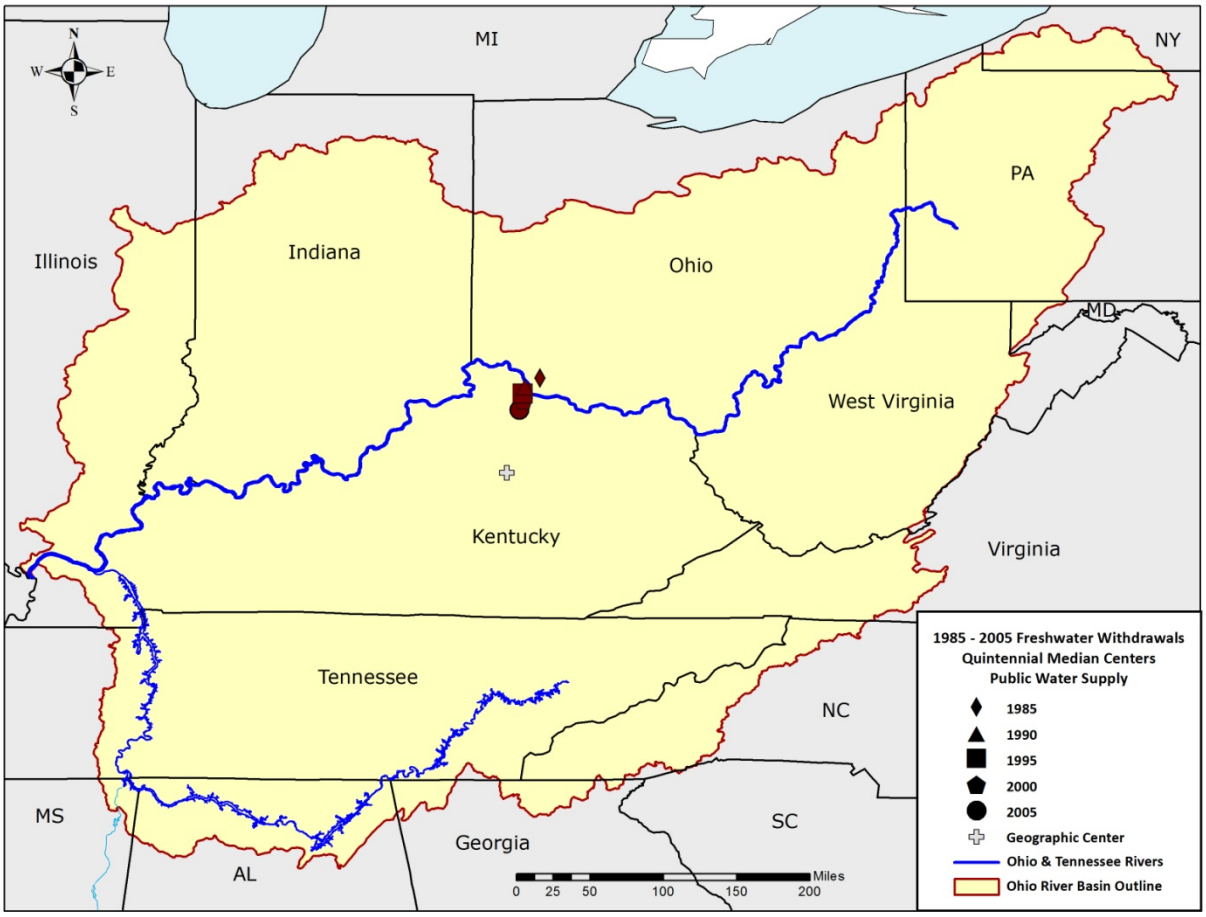

Figure 23. The quintennial median center of public water supply has remained relatively stable over the 20-year period. The median centers have remained to the north-northeast of the geographic center and exhibited a southern linear movement.

Table 9. The daily per capita water use for publicly supplied and domestically self-supplied water has ranged from 154 to 163 gallons and 65 to 71 gallons per day. Some components for the 2000 water-use dataset were incomplete therefore not used in calculations.

	Per-Capita Water-Use (Gal/day)	
Year	Public Supply	Self-Supplied Domestic
1985	157	65
1990	161	65
1995	163	69
2000	--	--
2005	154	71

Domestic Water Supply -16.1%

The domestic self-supplied water use was estimated at 428 Mgal/day in 1985 and exhibited a 16.1% reduction to 359 Mgal/day in 2005 (Table 8). In the same 20-year span, the domestic population served has displayed an even greater reduction at -26.0%. In 1985 the per capita use was an estimated 65 gal/day whereas the 2005 per capita estimates increased to71 gal/day (Table 9).

The quintennial median center of domestic water supply has been consistently located in southwestern Ohio and has not exhibited a linear pattern in the movement of the median centers (Figure 24). The 2000 median center was determined based on an incomplete county-level dataset therefore should be disregarded when comparing to other estimations.

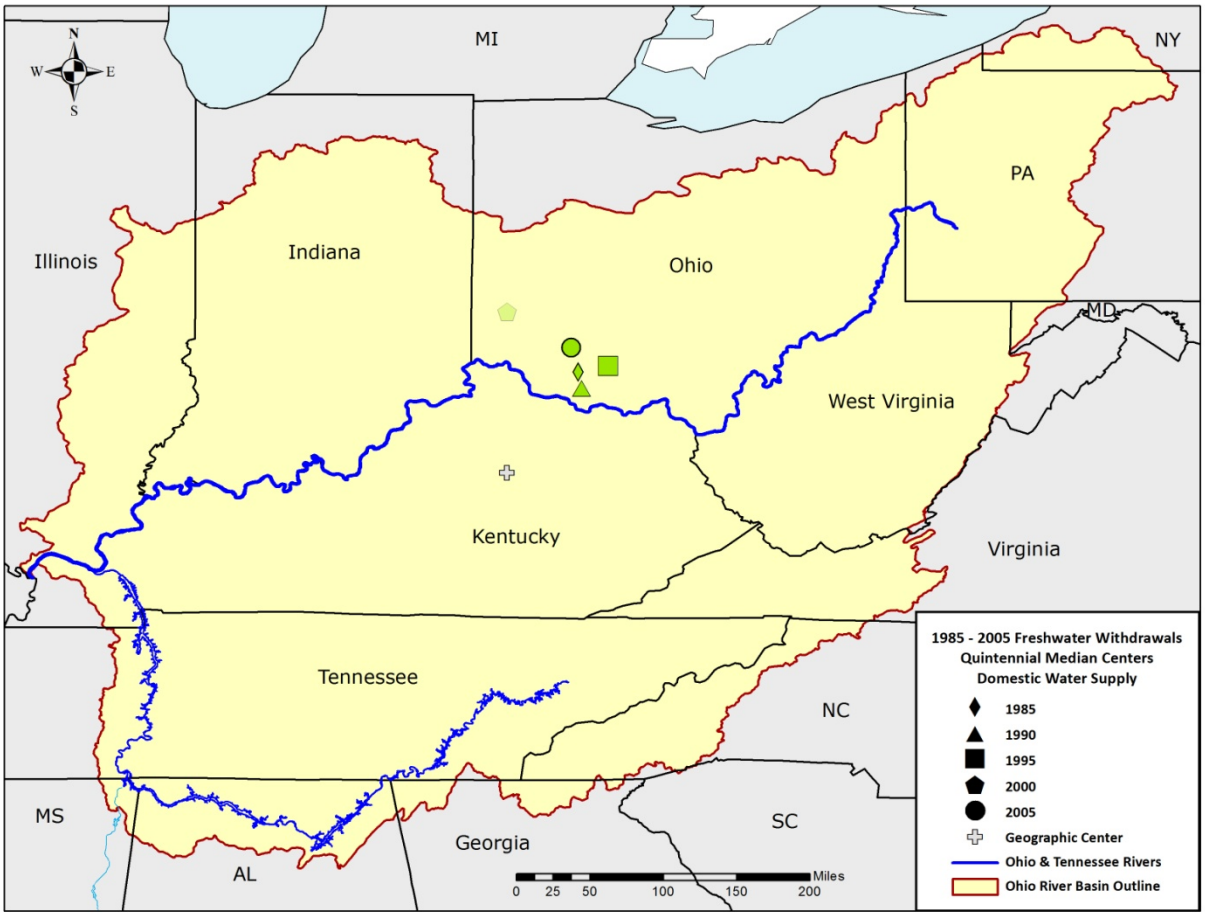

Figure 24. The quintennial median center of domestic water supply has been consistently located in southwestern Ohio and has not exhibited a linear pattern in the movement of the median center. The 2000 median center was determined based on an incomplete county-level dataset therefore should be disregarded when comparing to other estimations.

Industry -25.8%

The industrial self-supplied water use was estimated at 4,903 Mgal/day in 1985 and exhibited a 25.8% reduction to 3,639 Mgal/day in 2005 (Table 8).

The quintennial median centers of industrial water-use have consistently remained east of the geographical center. It has shifted around the areas of eastern Kentucky and West Virginia (Figure 25). Since 1995, the median center has moved in a southwesterly-arched direction. These observations are congruent with the original map of the 2005 county-level industrial withdrawal densities (See Figure 10).

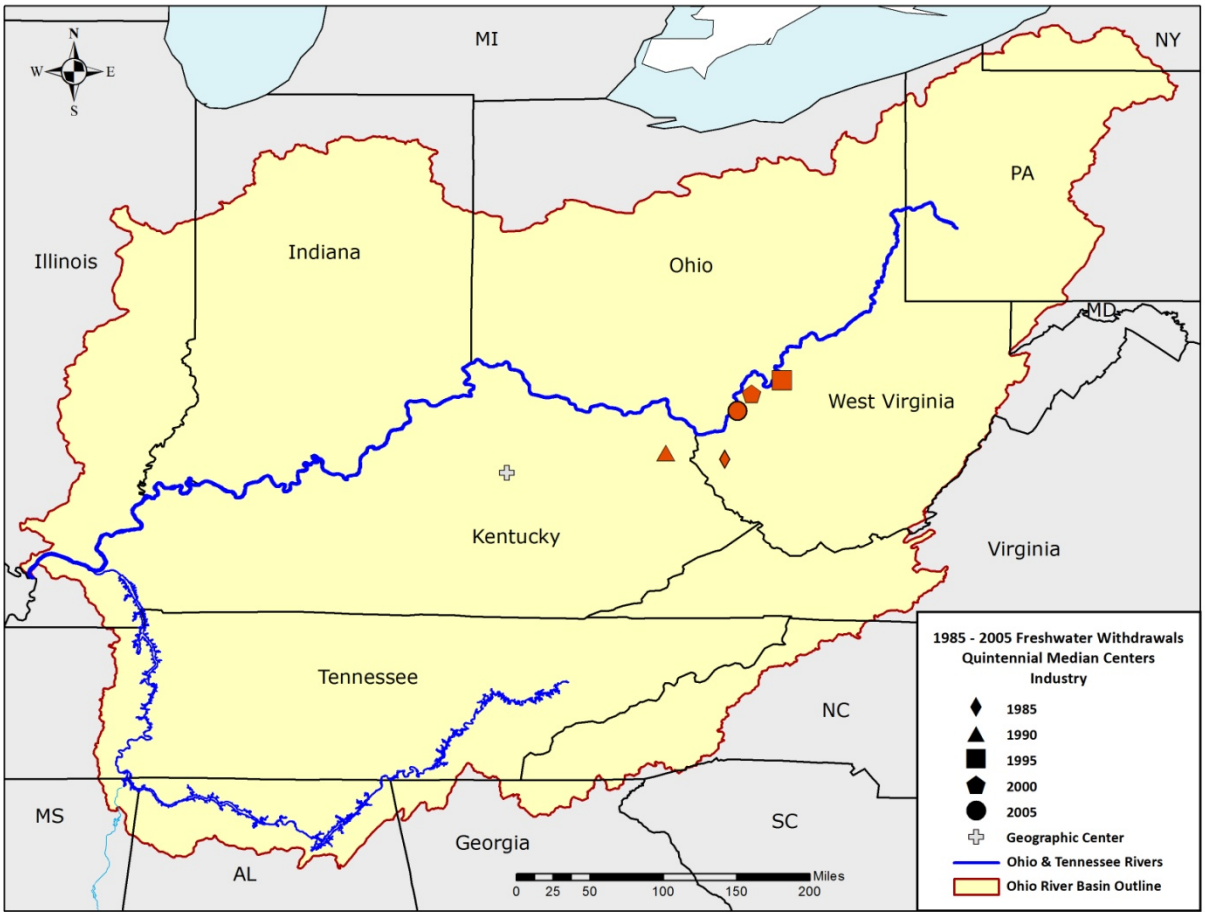

Figure 25. The quintennial median center of industrial water-use has consistently remained east of the geographical center. It has shifted around the areas of eastern Kentucky and West Virginia. Since 1995, the median center has moved in a southwesterly-arched direction.

Mining -24.9%

The mining water use was estimated at 431 Mgal/day in 1985 and exhibited a 24.9% reduction to 324 Mgal/day in 2005 (Table 8).

The quintennial median center of mining water use has exhibited an extensive shift within the ORB since 1985 (Figure 26). The 1985 median center was located in southern Ohio then shifted southeast into West Virginia in 1990. Then a large shift in water-use (or perhaps in the reporting process) because the 1995 median center moved to southwestern Ohio. The 2000 median center was determined based on an incomplete county-level dataset therefore should be disregarded when comparing to other estimations.

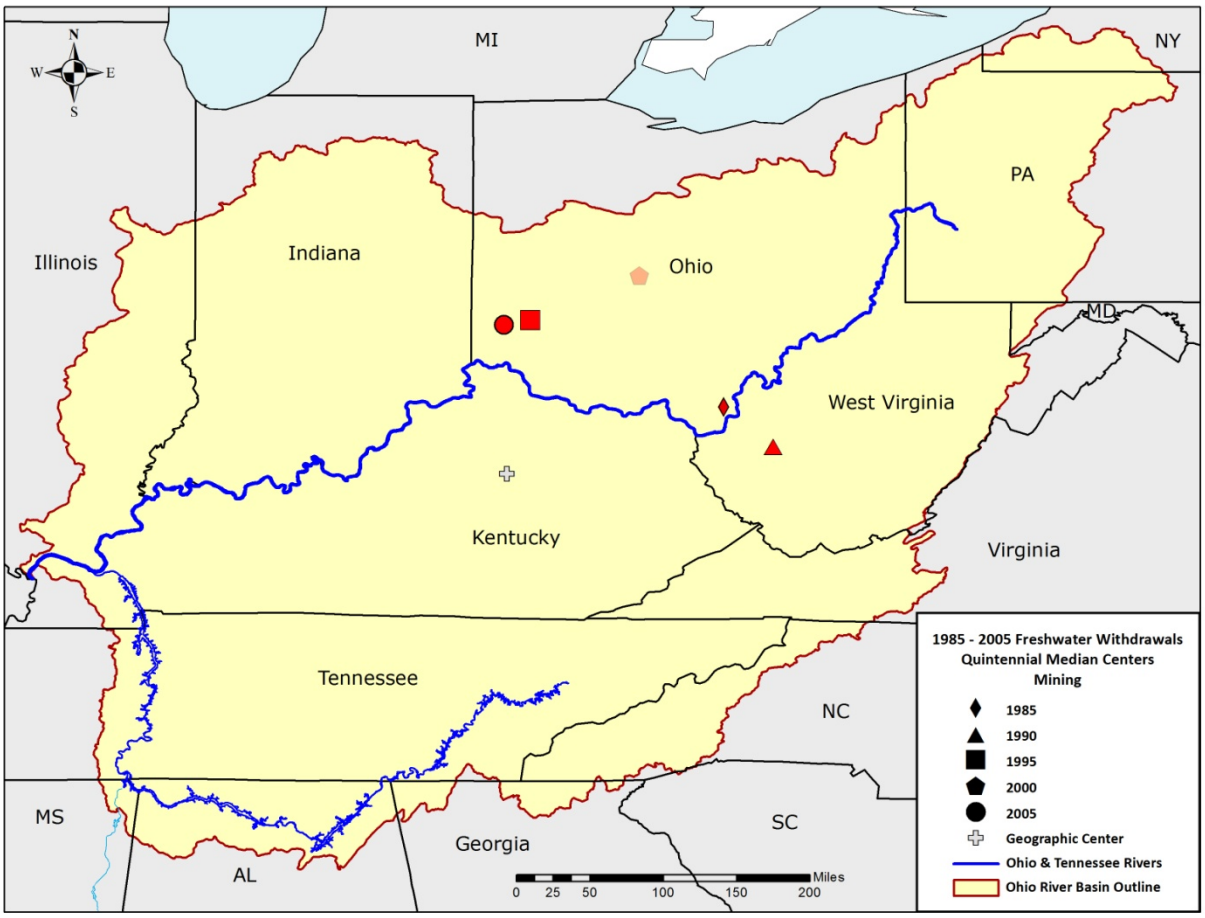

Figure 26. The quintennial median center of mining water use has exhibited an extensive shift within the ORB since 1985. The 1985 median center was located in southern Ohio then shifted southeast into West Virginia in 1990. A shift in water-use (or perhaps in the reporting process) occurred between 1990 and 1995 because the 1995 median center moved to southwestern Ohio. The 2000 median center was determined based on an incomplete county-level dataset therefore should be disregarded when comparing to other estimations.

Irrigation +328.3%

The irrigation water use was estimated at 51 Mgal/day in 1985 and exhibited a 328% increase to 217 Mgal/day in 2005 (Table 8). This is a rather significant increase in irrigation within the ORB and this observed increase is in stark contrast to the national irrigation water-use exhibiting a 6.6% reduction.

The quintennial median centers of irrigation water-use have consistently remained to the west of the geographical center but have not exhibited any consistent movement (Figure 27). Coincidentally, the greatest proportion of land-area for row-crop production is located in the western portion of the ORB.

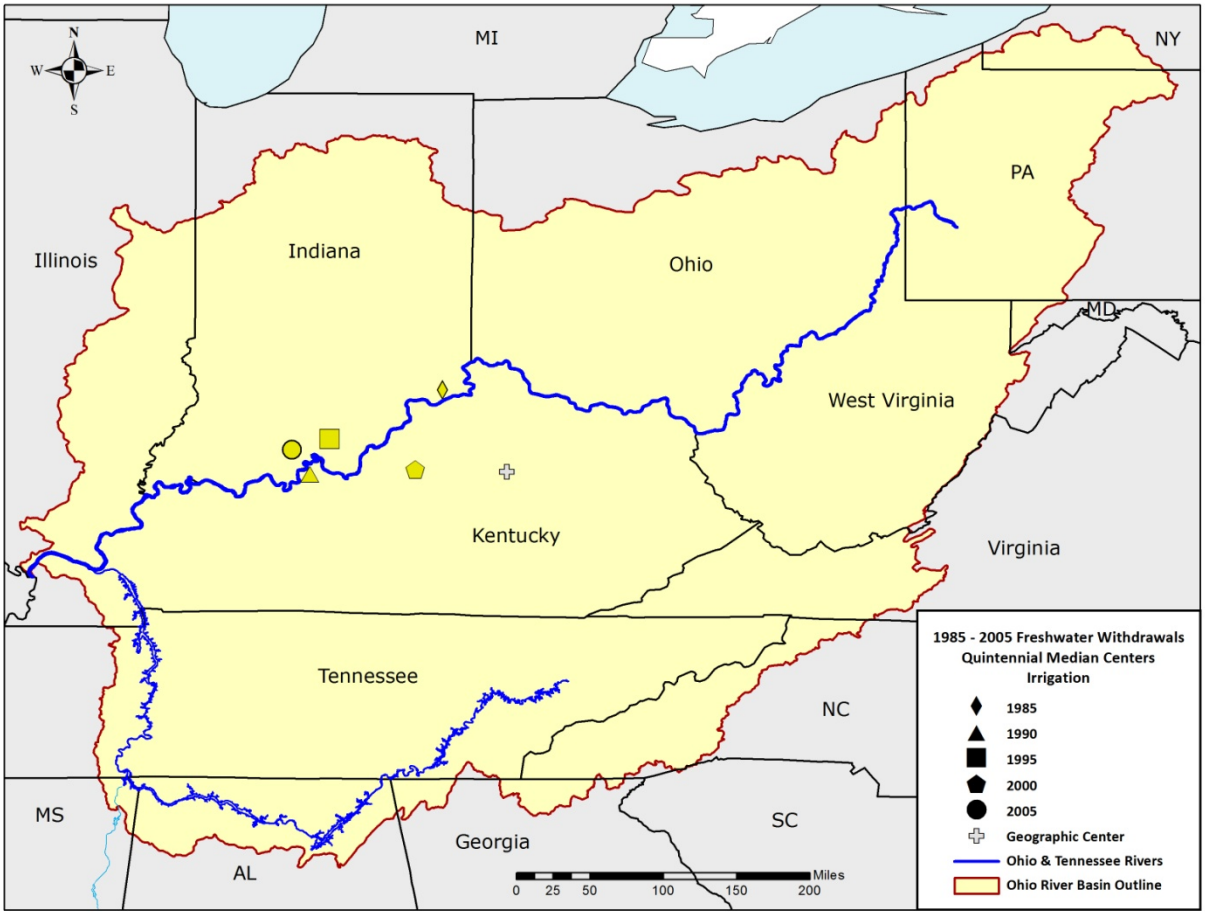

Figure 27. The quintennial median centers of irrigation water-use have consistently remained to the west of the geographical center but have not exhibited any consistent movement.

Livestock -36.3%

The livestock water use was estimated at 244 Mgal/day in 1985 and exhibited a 36.3% decrease to 155 Mgal/day in 2005 (Table 8).

The quintennial median center of livestock water use has remained to the west and relatively close to the geographic center of the ORB (Figure 28). The 2000 median center was determined based on an incomplete county-level dataset therefore should be disregarded when comparing to other estimations.

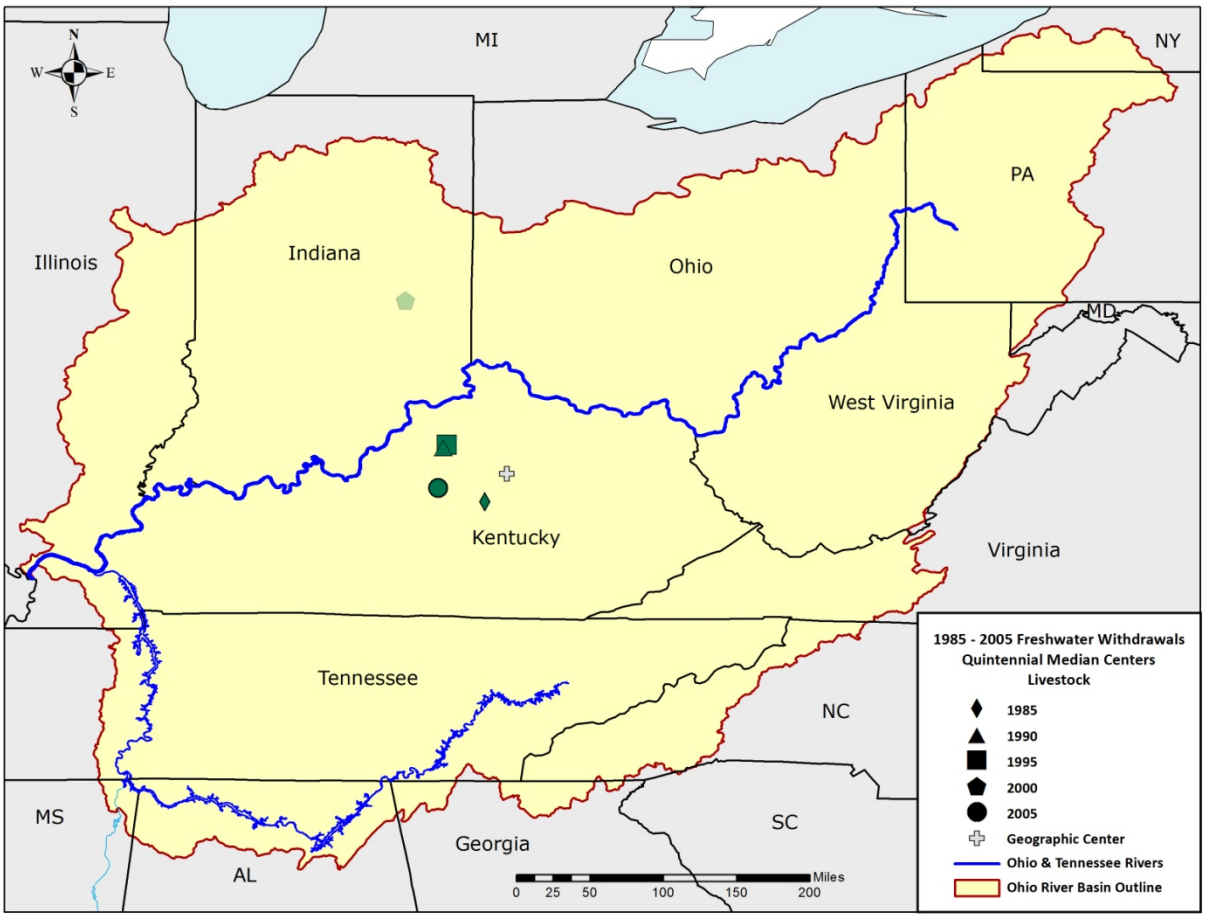

Figure 28. The quintennial median center of livestock water use has remained to the west and relatively close to the geographic center of the ORB. The 2000 median center was determined based on an incomplete county-level dataset therefore should be disregarded when comparing to other estimations.

Aquaculture	na

As previously mentioned, the aquacultural water-use was not reported in 1985 therefore prohibiting a 20 year-comparison (Table 8).

The quintennial median center of aquacultural water-use is focused in the extreme southeast of the ORB in North Carolina (Figure 29). The 2000 median center was determined based on an incomplete county-level dataset therefore should be disregarded when comparing to other estimations.

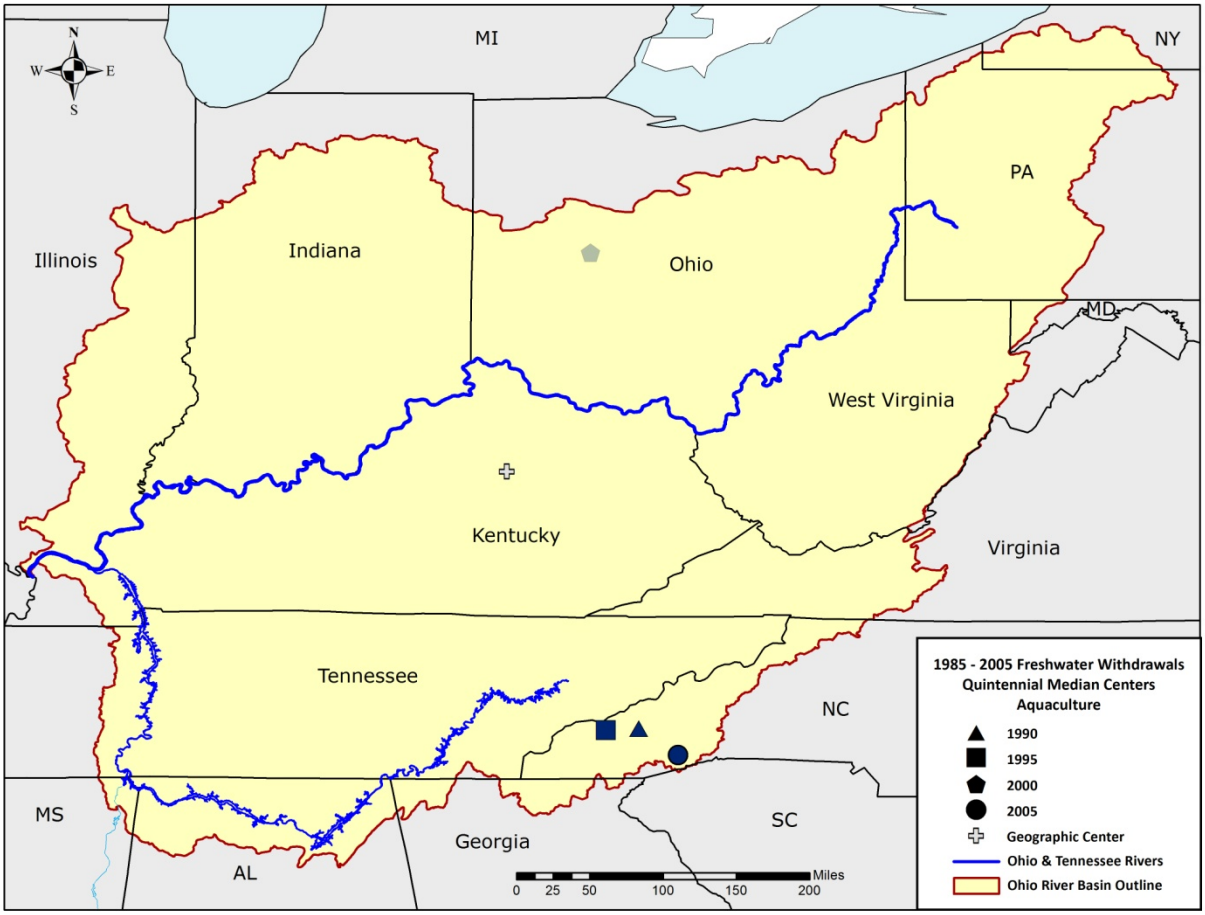

Figure 29. The quintennial median center of aquacultural water-use is focused in the extreme southeast of the ORB in North Carolina. Aquacultural water-use was not reported in 1985 and the 2000 median center was determined based on an incomplete county-level dataset therefore should be disregarded when comparing to other estimations.

Consumption Changes

Water-use and consumption estimates were determined for major river regions of the nation which included the Ohio and Tennessee River basins until 1995. The 2000 and 2005 consumption estimates were generated according to consumption coefficients derived from (Shaffer and Runkle 2007)-See 2005 Consumptive-Use Estimates. It should be noted that the categorical water-uses within some states were not completely reported in 2000. As such the consumptive estimates for this dataset is based on an incomplete dataset and is reflected in the relatively low consumption estimate (Figure 30). Since 1985, the estimated consumption quantity has expressed a decrease. Unfortunately, the consumption values are not available at the county-level thereby prohibiting the determination of quintennial median centers.

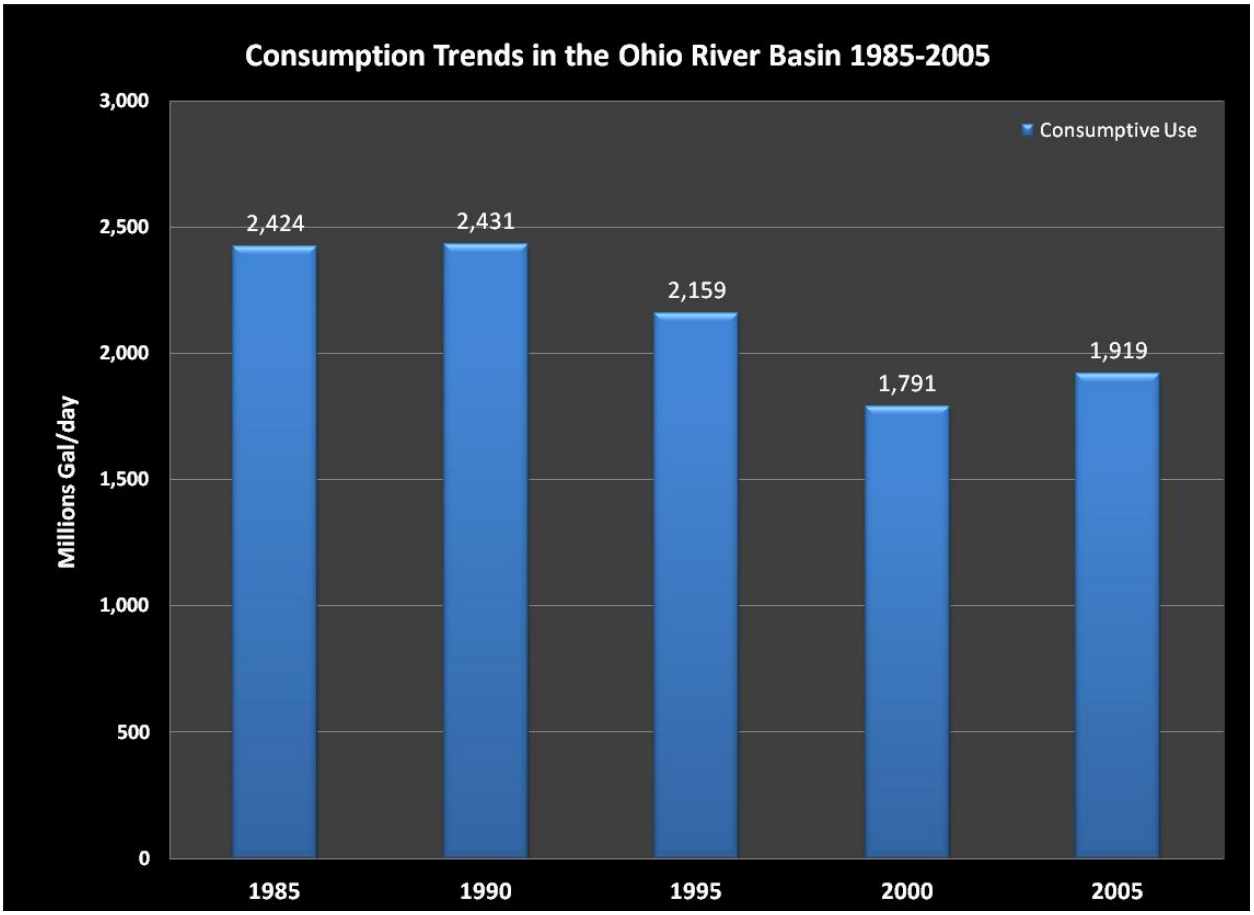

Figure 30. The quintennial consumption estimates in the ORB exhibited a decreasing trend since 1985. Estimates from 1985 to 1995 were based on USGS data reported for major river regions whereas 2000 and 2005 were calculated based on consumptive coefficients derived from (Shaffer and Runkle 2007).

Consumption Coefficients Validation

Consumption coefficients were calculated using the categorical consumption ratios exhibited in the two river basins within each respective quintennial report. This provides a reference for validating/refuting the appropriateness of applying the 2005 median consumption coefficients (determined based on Shaffer and Runkle's (2007) meta-analysis) as well as determining the likelihood of under/over-estimating the 2005 consumption value.

Based on the values from previous quintennial estimates (and assuming negligible changes in the consumptive behaviors within each sector), the 2005 consumption estimate is most likely an underestimate of the total amount of water consumed in the ORB. Six of the 7 consumption coefficient values for 2005 expressed decreased coefficients than the average of the 3 quintennial surveys (Table 10). It is also worthy to note that the one category (irrigation) expressing a greater value in 2005 varied only by 0.1%.

The changes of the consumption coefficient for any category can have unequal effects on the consumption value. A one-percent change for the thermoelectric category has greater consequences than the same percentage for another category based on the disproportionate withdrawal volumes. For example, if the thermoelectric coefficient were increased from 2.0% to 3.0% then the 2005 estimate would increase from 725 to 1,034 Mgal/day whereas the same 1.0% change applied to the livestock category would increase the estimate from 129 to 130.2 Mgal/day. Subtle changes in these coefficients can have unequal effects on the consumptive values and is determinant on the magnitude of the original withdrawal quantity. In summary, the 2005 consumptive estimate is extremely likely to be an underestimate of the actual representative value.

Table 10. Consumption coefficients were determined for the ORB from previous quintennial water-use reports generated by the USGS for comparative investigations to the estimated consumption coefficients applied to the 2005 water-use dataset.

	ORB Consumption Coefficients (%)				
Water-use Category	**1985**	**1990**	**1995**	**Avg 1985-1995**	**2005***
Public Water Supply	16.2	16.6	17.1	16.6	12
Domestic Water Supply	15.0	13.9	13.2	14.1	12
Industrial	13.9	12.9	12.5	13.1	10
Thermoelectric	3.3	2.9	2.9	3.0	2.0[+]
Mining	13.0	47.5	16.4	25.6	10
Livestock	75.3	91.1	91.5	86.0	83
Irrigation	91.4	83.0	95.4	89.9	90

1985, 1990, 1995 consumption coefficients were determined based on their respective quintennial USGS report which included water withdrawals and consumption estimates for major river regions; including both the Ohio and Tennessee River basins.

*2005 median consumption coefficients derived from Shaffer & Runkle 2007

[+]Thermoelectric consumption coefficient was calculated using US EIA 2005 dataset.

References

Bohac, C. E. and M. J. McCall. 2008. “Water Use for the Tennessee River Valley for 2005 and Projected Use in 2030.”. Retrieved October 19, 2012 (www.tva.gov/river/watersupply/watersupply_report_to_2030.pdf).

Great Lakes Commission. 2011. “Great Lakes Regional Water Use Database.” Retrieved October 26, 2012 (http://glc.org/wateruse/database/query.html).

Great Lakes Commission. 2012. “Great Lakes Information Network.” Retrieved October 24, 2012 (http://www.great-lakes.net/).

Kenny, J. F., N. L. Barber, S. S. Hutson, K. S. Linsey, J. K. Lovelace, and M. A. Maupin. 2009. “Estimated use of water in the United States in 2005.” *U.S. Geological Survey Circular 1344* 52.

Shaffer, K. H. 2009. “Variations in withdrawal, return flow, and consumptive use of water in Ohio and Indiana, with selected data from Wisconsin, 1999–2004.”.

Shaffer, K. H. and D. L. Runkle. 2007. “Consumptive Water-Use Coefficients for the Great Lakes Basin and Climatically Similar Areas.”.

Solley, W. B., C. F. Merk, and R. R. Pierce. 1988. “Estimted Use of Water in the United States in 1985.” U.S. Geological Survey Circular 1004, Denver, CO.

Solley, W. B., R. R. Pierce, and H. A. Perlman. 1998. “Estimated Use of Water in the United States in 1995.” U.S. Geological Survey Circular 1200, Denver, CO.

Tennessee Valley Authority (TVA). 2011. “Final Supplemental Environmental Impact Statement, Sequoyah Nuclear Plant Units 1 and 2 License Renewal.” EIS-Administrative Record.

Torcellini, P, N Long, and R Judkoff. 2003. “Consumptive Water Use for U.S. Power Production.”.

U. S. Nuclear Regulatory Commission. 2011. “Draft Final Environmental Statement: Related to the Operation of Watts Bar Nuclear Plant, Unit 2: NUREG-0498; Supplement 2: Docket Number 50-391.”.

U.S. Department of Energy, Energy Information Administration (EIA). 2012. “Annual Steam-Electric Plant operation and Design Data (EIA-767 2005 Data file).” (http://www.eia.gov/cneaf/electricity/page/eia767/).

U.S. Nuclear Regulatory Commission. 2005. “Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Regarding Browns Ferry Nuclear Plant, Units 1,2,3; Final Report; Supplment 21, NUREG 1437.” Washington, DC.

US Nuclear Regulatory Commission. 2011. “Draft Final Environmental Statement: Related to the Operation of Watts Bar Nuclear Plant, Unit 2 (Supplement 2, Docket Number 50-391, Tennessee Valley Authority) (NUREG-0498).” Washington DC. Retrieved October 19, 2012.

Appendix A. Categorical, county-level data was acquired from the USGS compilation of 2005 water-use data and applied to the Ohio River basin to calculate a water-use estimate. Values are presented as county land-area adjusted data (Mgal/day) and the 'County Full_Partial' column indicates if the listed county's land area is fully (F) or partially (P) within. Categorical totals are also presented for each state.

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
01009	AL	Blount	P	0.810	0.039	0.000	0.038	0.048	0.000	0.014	0.000
01033	AL	Colbert	F	9.560	0.310	56.440	2.340	0.300	0.020	0.050	1294.140
01043	AL	Cullman	P	1.053	0.008	0.070	0.049	0.087	0.000	0.006	0.000
01049	AL	DeKalb	P	5.818	0.856	0.381	1.343	1.196	0.006	0.035	0.000
01055	AL	Etowah	P	0.740	0.012	0.378	0.040	0.017	0.001	0.006	5.463
01059	AL	Franklin	P	4.449	0.298	0.000	0.451	0.695	0.000	0.514	0.000
01071	AL	Jackson	F	10.720	0.910	8.780	0.710	0.720	0.000	0.100	1476.300
01077	AL	Lauderdale	F	14.190	1.300	0.000	1.170	0.480	0.030	0.000	0.000
01079	AL	Lawrence	P	5.629	0.399	46.581	1.458	0.611	0.065	0.187	0.000
01083	AL	Limestone	F	13.390	1.050	0.000	8.260	0.440	0.000	0.500	1990.240
01089	AL	Madison	F	62.560	1.120	0.890	4.910	0.330	0.000	0.700	0.000
01093	AL	Marion	P	0.528	0.077	0.000	0.007	0.034	0.000	0.011	0.000
01095	AL	Marshall	P	20.212	0.318	0.301	0.569	1.004	0.008	0.234	0.000
01103	AL	Morgan	P	30.220	0.298	90.053	0.854	0.725	0.099	0.536	1.192
01133	AL	Winston	P	0.025	0.012	0.000	0.002	0.013	0.000	0.002	0.000
	AL	**Total**		**179.903**	**7.008**	**203.874**	**22.201**	**6.701**	**0.230**	**2.896**	**4767.335**
13047	GA	Catoosa	F	4.680	0.710	0.000	1.050	0.200	0.000	0.050	0.000
13083	GA	Dade	P	2.235	0.000	0.000	0.437	0.086	0.000	0.000	0.000
13111	GA	Fannin	P	1.533	0.654	0.000	0.043	0.077	0.077	0.000	0.000
13123	GA	Gilmer	P	0.277	0.097	0.475	0.015	0.055	0.000	0.021	0.000
13137	GA	Habersham	P	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13187	GA	Lumpkin	P	0.030	0.037	0.000	0.005	0.006	0.000	0.004	0.000
13241	GA	Rabun	P	0.298	0.050	0.242	0.088	0.011	0.000	0.023	0.000
13281	GA	Towns	P	1.954	0.046	0.000	0.306	0.028	3.713	0.046	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
13291	GA	Union	P	1.879	0.512	0.000	0.148	0.089	5.224	0.098	0.000
13295	GA	Walker	P	4.234	0.011	0.629	0.395	0.195	0.000	0.056	0.000
13311	GA	White	P	0.007	0.004	0.000	0.001	0.001	0.000	0.000	0.000
13313	GA	Whitfield	P	5.871	0.012	0.000	0.085	0.045	0.073	0.037	0.000
	GA	**Total**		**22.999**	**2.134**	**1.346**	**2.571**	**0.792**	**9.088**	**0.335**	**0.000**
17003	IL	Alexander	P	0.109	0.005	0.000	0.172	0.002	0.000	0.001	0.000
17019	IL	Champaign	P	16.248	0.844	1.761	3.020	0.098	0.000	1.626	0.000
17023	IL	Clark	F	2.830	0.680	0.000	4.140	0.220	0.000	0.700	0.000
17025	IL	Clay	F	0.740	0.540	0.000	0.020	0.260	0.000	0.000	0.000
17029	IL	Coles	P	3.654	0.142	0.000	0.229	0.103	0.000	0.119	0.000
17033	IL	Crawford	F	2.300	0.600	5.310	5.650	0.140	0.110	0.140	84.180
17035	IL	Cumberland	F	0.540	0.550	0.000	0.040	0.420	0.000	0.180	0.000
17041	IL	Douglas	P	0.591	0.401	1.422	0.182	0.117	0.000	0.175	0.000
17045	IL	Edgar	F	1.720	0.620	0.000	0.180	0.570	0.020	0.000	0.000
17047	IL	Edwards	F	0.020	0.250	0.000	0.000	0.170	0.000	0.000	0.000
17049	IL	Effingham	P	2.213	1.165	0.000	0.170	0.762	0.000	0.000	0.000
17051	IL	Fayette	P	0.085	0.035	0.000	0.008	0.016	0.003	0.004	0.000
17053	IL	Ford	P	0.629	0.102	0.000	0.267	0.072	0.000	1.164	0.000
17055	IL	Franklin	P	0.426	0.005	0.000	0.006	0.007	0.000	0.000	0.000
17059	IL	Gallatin	F	3.800	0.080	0.000	14.090	0.070	0.160	0.440	0.000
17065	IL	Hamilton	P	0.000	0.093	0.000	0.176	0.148	0.009	0.000	0.000
17069	IL	Hardin	F	0.270	0.110	0.000	0.040	0.120	0.420	0.850	0.000
17075	IL	Iroquois	P	0.029	0.012	0.000	0.029	0.006	0.000	0.001	0.000
17079	IL	Jasper	F	1.510	0.260	0.000	0.070	0.530	0.000	0.000	605.410
17081	IL	Jefferson	P	0.000	0.236	0.000	0.157	0.062	0.000	0.000	0.000
17087	IL	Johnson	P	1.051	0.713	0.000	0.084	0.244	0.009	0.366	0.000
17101	IL	Lawrence	F	1.560	0.390	0.000	6.010	0.200	0.000	0.190	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
17105	IL	Livingston	P	0.042	0.007	0.000	0.004	0.004	0.000	0.006	0.000
17121	IL	Marion	P	1.958	0.060	0.000	0.135	0.083	0.000	0.000	0.000
17127	IL	Massac	F	2.930	0.290	3.690	5.330	0.190	0.060	0.350	618.040
17139	IL	Moultrie	P	0.012	0.003	0.000	0.001	0.002	0.000	0.000	0.000
17151	IL	Pope	F	0.000	0.010	0.000	0.320	0.090	0.010	0.000	0.000
17153	IL	Pulaski	P	0.104	0.088	0.000	0.478	0.032	0.000	0.233	0.000
17159	IL	Richland	F	1.460	0.210	0.000	0.050	0.430	0.000	0.000	0.000
17165	IL	Saline	F	0.000	0.320	0.000	0.720	0.170	0.000	1.710	0.000
17173	IL	Shelby	P	0.312	0.090	0.000	0.016	0.090	0.000	0.013	0.010
17181	IL	Union	P	0.266	0.132	0.000	0.207	0.042	0.008	0.056	0.000
17183	IL	Vermilion	P	9.088	0.883	2.535	0.225	0.178	0.000	0.629	2.544
17185	IL	Wabash	F	1.850	0.210	0.000	0.320	0.070	0.000	0.290	0.000
17191	IL	Wayne	F	1.320	0.470	0.000	0.900	0.460	0.000	0.000	0.000
17193	IL	White	F	1.200	0.190	0.000	9.920	0.140	0.000	0.950	0.000
17199	IL	Williamson	P	1.105	0.625	0.000	0.053	0.053	1.016	0.003	34.272
	IL	**Total**		**61.971**	**11.420**	**14.718**	**53.422**	**6.370**	**1.826**	**10.196**	**1344.456**
18001	IN	Adams	P	0.584	0.237	0.546	0.000	0.252	0.000	0.060	0.000
18003	IN	Allen	P	9.811	0.940	0.464	0.028	0.118	0.000	1.613	0.064
18005	IN	Bartholomew	F	12.450	1.720	0.740	3.300	0.230	0.000	2.780	0.000
18007	IN	Benton	P	0.288	0.144	0.000	0.030	0.048	0.000	0.000	0.000
18009	IN	Blackford	F	1.040	0.330	0.620	0.000	0.210	0.000	0.000	0.000
18011	IN	Boone	F	2.080	1.610	0.010	0.510	0.300	0.000	0.260	0.000
18013	IN	Brown	F	0.000	0.280	0.000	0.000	0.040	0.000	0.000	0.000
18015	IN	Carroll	F	0.940	1.100	4.400	0.010	1.260	0.000	0.000	0.000
18017	IN	Cass	F	7.280	1.330	0.490	0.270	0.510	0.000	1.720	22.030
18019	IN	Clark	F	17.060	0.290	6.080	0.000	0.220	0.000	0.410	0.000
18021	IN	Clay	F	0.750	0.670	0.000	0.000	0.160	0.000	0.030	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
18023	IN	Clinton	F	4.460	0.940	0.000	0.000	1.000	0.000	0.000	0.000
18025	IN	Crawford	F	1.680	0.290	2.760	0.000	0.130	0.000	0.000	0.000
18027	IN	Daviess	F	2.940	0.640	1.710	0.700	1.100	0.000	0.050	0.000
18029	IN	Dearborn	F	4.360	0.550	6.530	0.000	0.140	0.000	0.430	737.140
18031	IN	Decatur	F	3.110	0.840	0.000	0.000	1.040	0.000	0.120	0.000
18035	IN	Delaware	F	11.330	2.490	2.650	0.050	0.190	0.000	1.030	0.000
18037	IN	Dubois	F	5.740	0.310	0.000	0.000	1.200	0.000	0.000	0.000
18041	IN	Fayette	F	2.680	0.490	0.000	0.000	0.160	0.000	0.000	0.000
18043	IN	Floyd	F	1.320	0.200	0.000	0.000	0.050	0.000	0.410	266.480
18045	IN	Fountain	F	1.120	0.580	0.260	0.060	0.170	0.000	0.000	0.000
18047	IN	Franklin	F	2.620	0.860	0.270	0.020	0.390	0.000	0.000	0.000
18049	IN	Fulton	F	1.280	0.880	0.010	6.330	0.380	0.000	6.190	0.000
18051	IN	Gibson	F	2.000	0.410	0.290	0.400	0.250	0.000	3.120	45.590
18053	IN	Grant	F	5.300	1.560	1.370	0.000	0.220	0.000	4.340	0.000
18055	IN	Greene	F	3.020	0.490	0.620	0.080	0.600	0.000	0.000	0.020
18057	IN	Hamilton	F	31.960	4.270	15.700	0.590	0.140	0.000	24.960	0.870
18059	IN	Hancock	F	3.690	2.820	0.260	0.030	0.250	0.000	0.000	0.000
18061	IN	Harrison	F	2.600	0.500	0.000	0.000	0.460	0.000	0.050	0.000
18063	IN	Hendricks	F	4.600	4.040	0.050	0.000	0.220	0.000	0.770	0.000
18065	IN	Henry	F	3.950	1.420	1.020	0.020	0.280	0.000	0.000	0.000
18067	IN	Howard	F	12.430	1.780	0.260	0.000	0.510	0.000	6.050	0.000
18069	IN	Huntington	F	3.310	1.050	0.760	0.000	0.290	0.000	0.000	0.000
18071	IN	Jackson	F	5.090	1.010	0.000	0.790	0.700	0.000	0.710	0.000
18073	IN	Jasper	P	0.052	0.079	0.008	0.878	0.053	0.000	0.088	1.432
18075	IN	Jay	F	1.280	0.720	1.090	0.030	0.990	0.000	0.000	0.000
18077	IN	Jefferson	F	8.270	0.190	0.000	0.000	0.220	0.000	0.000	1278.950
18079	IN	Jennings	F	1.310	0.550	0.000	0.000	0.380	0.000	1.320	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
18081	IN	Johnson	F	12.460	1.710	0.590	0.240	0.520	0.000	0.000	0.000
18083	IN	Knox	F	4.940	0.500	0.500	5.660	0.340	0.000	1.260	41.330
18085	IN	Kosciusko	P	2.695	2.965	2.227	8.953	0.854	0.000	1.563	0.000
18093	IN	Lawrence	F	4.450	0.380	0.980	0.000	0.360	0.000	0.000	0.020
18095	IN	Madison	F	11.110	2.840	1.160	0.230	0.220	0.000	0.000	0.000
18097	IN	Marion	F	141.020	5.640	9.420	0.150	0.030	0.000	6.380	148.510
18099	IN	Marshall	P	0.677	0.556	0.103	0.697	0.135	0.000	0.029	0.000
18101	IN	Martin	F	0.700	0.220	0.350	0.000	0.320	0.000	0.000	0.000
18103	IN	Miami	F	2.700	1.170	7.260	0.290	0.720	0.300	1.230	21.460
18105	IN	Monroe	F	14.810	0.470	1.340	0.000	0.150	0.000	0.190	0.000
18107	IN	Montgomery	F	1.960	1.190	1.020	0.370	0.770	0.000	0.210	0.190
18109	IN	Morgan	F	5.670	2.260	1.910	0.000	0.150	0.820	1.830	211.550
18113	IN	Noble	P	0.300	0.203	0.145	0.270	0.056	0.000	0.064	0.000
18115	IN	Ohio	F	0.680	0.050	0.000	0.080	0.030	0.000	0.000	0.000
18117	IN	Orange	F	0.500	0.640	0.010	0.000	0.250	0.000	0.000	0.000
18119	IN	Owen	F	1.170	1.090	0.000	0.000	0.150	0.000	0.000	0.000
18121	IN	Parke	F	0.900	0.670	0.190	0.430	0.180	0.000	0.000	0.000
18123	IN	Perry	F	0.570	0.250	1.190	0.000	0.240	0.000	0.000	0.000
18125	IN	Pike	F	1.240	0.150	0.000	0.000	0.080	0.000	0.600	527.430
18129	IN	Posey	F	3.450	0.990	9.470	2.490	0.180	0.010	0.000	6.740
18131	IN	Pulaski	P	0.403	0.682	0.250	5.040	0.576	0.000	2.217	0.000
18133	IN	Putnam	F	3.320	1.140	1.640	0.110	0.380	0.000	0.250	0.000
18135	IN	Randolph	F	1.460	0.940	1.480	0.000	0.480	0.000	0.000	0.000
18137	IN	Ripley	F	2.060	0.660	0.000	0.000	0.410	0.000	0.300	0.000
18139	IN	Rush	F	0.900	0.720	0.770	0.050	0.630	0.000	0.000	0.000
18143	IN	Scott	F	2.720	0.130	0.000	0.000	0.070	0.000	0.530	0.000
18145	IN	Shelby	F	4.060	1.770	0.280	0.810	0.230	0.000	1.650	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
18147	IN	Spencer	F	1.840	0.480	0.000	0.550	0.410	0.000	0.000	32.240
18149	IN	Starke	P	0.113	0.223	0.000	0.805	0.008	0.000	0.000	0.000
18153	IN	Sullivan	F	1.630	0.310	0.220	3.590	0.140	0.000	2.750	454.800
18155	IN	Switzerland	F	1.250	0.150	0.000	0.000	0.100	0.000	1.270	0.000
18157	IN	Tippecanoe	F	13.200	2.410	16.830	0.950	0.500	0.000	0.260	0.000
18159	IN	Tipton	F	1.130	0.630	0.010	0.000	0.270	0.000	0.000	0.000
18161	IN	Union	F	0.320	0.260	0.000	0.000	0.210	0.000	0.000	0.000
18163	IN	Vanderburgh	F	30.670	0.910	0.000	0.070	0.060	0.000	1.390	0.000
18165	IN	Vermillion	F	1.030	0.250	8.100	0.080	0.190	0.000	0.400	636.090
18167	IN	Vigo	F	10.550	2.050	2.990	1.160	0.110	0.000	4.500	546.080
18169	IN	Wabash	F	4.470	1.000	0.530	1.040	1.120	0.000	0.000	0.000
18171	IN	Warren	F	0.610	0.440	0.660	0.110	0.310	0.000	0.000	0.000
18173	IN	Warrick	F	3.290	0.350	442.360	0.000	0.140	0.000	1.350	311.700
18175	IN	Washington	F	2.320	0.680	0.000	0.000	0.600	0.000	0.650	0.000
18177	IN	Wayne	F	6.710	1.340	2.260	0.030	0.370	0.000	0.000	0.850
18179	IN	Wells	P	1.712	1.010	1.188	0.000	0.327	0.000	0.000	0.009
18181	IN	White	P	0.975	1.061	0.010	1.312	0.926	0.000	0.704	0.000
18183	IN	Whitley	F	1.550	1.540	0.520	0.180	0.380	0.000	0.000	0.000
	IN	**Total**		**494.080**	**83.691**	**566.930**	**49.873**	**29.546**	**1.130**	**88.089**	**5291.575**
21001	KY	Adair	F	1.710	0.040	0.000	0.010	1.130	0.000	0.000	0.000
21003	KY	Allen	F	0.770	0.050	0.000	0.070	1.010	0.000	0.000	0.000
21005	KY	Anderson	F	2.170	0.050	1.250	0.070	0.260	0.000	0.000	0.000
21007	KY	Ballard	P	0.350	0.090	3.562	0.037	0.180	0.011	0.000	0.000
21009	KY	Barren	F	7.120	0.220	0.000	0.050	1.720	0.000	0.000	0.000
21011	KY	Bath	F	0.240	0.030	0.000	0.050	0.380	5.120	0.000	0.000
21013	KY	Bell	F	3.580	0.110	0.000	0.020	0.010	0.000	0.930	0.000
21015	KY	Boone	F	0.060	1.760	0.000	0.480	0.170	0.010	1.340	14.990

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21017	KY	Bourbon	F	1.600	0.300	0.000	0.320	0.820	0.000	0.000	0.000
21019	KY	Boyd	F	9.710	0.120	42.690	0.020	0.050	0.000	0.000	0.000
21021	KY	Boyle	F	5.450	0.070	0.000	0.230	0.520	0.000	0.400	0.000
21023	KY	Bracken	F	0.990	0.070	0.230	0.200	0.250	0.000	0.000	0.000
21025	KY	Breathitt	F	0.810	0.470	0.000	0.010	0.020	8.730	0.000	0.000
21027	KY	Breckinridge	F	1.110	0.320	0.000	0.020	0.640	0.000	0.000	0.000
21029	KY	Bullitt	F	0.000	2.720	0.210	0.010	0.150	0.000	0.080	0.000
21031	KY	Butler	F	1.200	0.010	0.000	0.010	0.370	0.020	0.000	0.000
21033	KY	Caldwell	F	1.280	0.030	0.000	0.720	0.280	0.000	1.250	0.000
21035	KY	Calloway	P	3.265	0.485	1.028	0.295	0.390	0.171	0.000	0.000
21037	KY	Campbell	F	24.970	4.350	0.000	0.100	0.120	0.000	0.000	0.000
21041	KY	Carroll	F	1.460	0.030	18.270	0.130	0.110	0.000	0.000	61.650
21043	KY	Carter	F	3.910	0.150	0.000	0.010	0.170	0.000	0.010	0.000
21045	KY	Casey	F	1.020	0.150	0.000	0.040	0.710	0.000	0.000	0.000
21047	KY	Christian	F	9.580	0.170	0.800	1.040	0.800	0.000	2.080	0.000
21049	KY	Clark	F	5.470	0.170	0.000	0.110	0.610	0.010	0.000	181.240
21051	KY	Clay	F	3.920	0.520	0.000	0.010	0.050	0.010	0.000	0.000
21053	KY	Clinton	F	3.250	0.020	0.000	0.010	0.530	0.000	0.000	0.000
21055	KY	Crittenden	F	0.220	0.320	0.000	0.090	0.300	0.000	1.260	0.000
21057	KY	Cumberland	F	0.720	0.010	0.000	0.010	0.190	0.010	0.000	0.000
21059	KY	Daviess	F	14.100	0.330	8.890	0.750	0.520	0.000	0.000	198.590
21061	KY	Edmonson	F	0.900	0.030	0.000	0.000	0.310	0.080	0.000	0.000
21063	KY	Elliott	F	0.180	0.190	0.000	0.000	0.080	0.000	0.000	0.000
21065	KY	Estill	F	1.180	0.090	0.000	0.010	0.110	0.000	0.000	0.000
21067	KY	Fayette	F	48.140	0.670	0.000	0.750	0.340	0.000	0.000	0.000
21069	KY	Fleming	F	0.190	0.020	0.000	0.030	0.970	0.000	0.020	0.000
21071	KY	Floyd	F	4.300	0.110	0.000	0.010	0.010	0.000	0.000	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
21073	KY	Franklin	F	9.270	0.120	0.110	0.390	0.190	1.390	0.200	0.000
21077	KY	Gallatin	F	0.840	0.070	1.540	0.050	0.070	0.000	0.220	0.000
21079	KY	Garrard	F	1.560	0.070	0.000	0.010	0.550	0.000	0.000	0.000
21081	KY	Grant	F	2.170	0.010	0.000	0.110	0.230	0.000	0.000	0.000
21083	KY	Graves	P	0.564	0.171	0.851	0.148	0.220	0.127	0.000	0.000
21085	KY	Grayson	F	2.830	0.060	0.000	0.020	0.800	0.010	0.000	0.000
21087	KY	Green	F	0.900	0.030	0.000	0.030	0.670	1.450	0.000	0.000
21089	KY	Greenup	F	3.730	0.010	6.910	0.010	0.130	0.000	0.000	0.000
21091	KY	Hancock	F	0.560	0.160	1.110	0.030	0.160	0.000	0.000	264.830
21093	KY	Hardin	F	12.730	0.240	0.000	0.270	0.740	0.000	0.000	0.000
21095	KY	Harlan	F	2.660	0.510	0.000	0.010	0.000	0.130	0.980	0.000
21097	KY	Harrison	F	2.380	0.010	0.000	0.510	0.460	0.000	0.000	0.000
21099	KY	Hart	F	3.690	0.050	0.000	0.020	0.880	0.000	0.000	0.000
21101	KY	Henderson	F	10.130	0.370	0.000	0.880	0.200	0.000	0.120	24.480
21103	KY	Henry	F	0.000	0.040	0.000	0.290	0.490	0.000	0.080	0.000
21107	KY	Hopkins	F	8.590	0.120	0.000	0.010	0.450	0.020	4.300	0.000
21109	KY	Jackson	F	1.040	0.030	0.000	0.010	0.190	0.000	0.000	0.000
21111	KY	Jefferson	F	140.510	2.000	65.760	0.790	0.080	0.000	0.000	585.030
21113	KY	Jessamine	F	5.050	0.540	0.000	0.230	0.290	0.000	0.000	0.000
21115	KY	Johnson	F	2.320	0.420	0.000	0.010	0.020	0.000	0.000	0.000
21117	KY	Kenton	F	5.880	0.380	0.000	0.010	0.110	0.010	0.000	0.000
21119	KY	Knott	F	0.360	0.760	0.000	0.000	0.000	0.000	0.780	0.000
21121	KY	Knox	F	0.490	0.560	0.000	0.010	0.060	0.000	0.000	0.000
21123	KY	Larue	F	0.590	0.080	0.000	0.040	0.520	0.000	0.000	0.000
21125	KY	Laurel	F	11.640	0.140	0.000	0.010	0.350	0.000	0.000	0.000
21127	KY	Lawrence	F	1.050	0.510	0.000	0.010	0.050	0.000	0.070	12.270
21129	KY	Lee	F	0.700	0.040	0.000	0.010	0.030	0.000	0.000	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
21131	KY	Leslie	F	0.850	0.310	0.000	0.000	0.000	0.000	0.120	0.000
21133	KY	Letcher	F	1.490	0.780	0.000	0.270	0.000	0.000	0.890	0.000
21135	KY	Lewis	F	1.320	0.230	0.000	0.010	0.220	0.000	0.010	0.000
21137	KY	Lincoln	F	1.720	0.320	0.000	0.080	0.980	0.020	0.000	0.000
21139	KY	Livingston	F	1.310	0.020	0.000	0.070	0.210	0.000	6.140	0.000
21141	KY	Logan	F	0.000	0.070	0.260	0.070	0.740	0.000	0.000	0.000
21143	KY	Lyon	F	2.910	0.020	0.000	0.020	0.100	0.000	0.000	0.000
21145	KY	McCracken	P	7.160	0.513	0.019	0.112	0.075	0.009	0.000	1206.092
21147	KY	McCreary	F	1.850	0.110	0.000	0.010	0.030	0.000	0.000	0.000
21149	KY	McLean	F	0.750	0.100	0.000	0.030	0.680	0.000	0.000	0.000
21151	KY	Madison	F	11.860	0.230	0.000	0.140	0.820	0.000	0.050	0.000
21153	KY	Magoffin	F	0.780	0.110	0.000	0.020	0.030	0.000	0.000	0.000
21155	KY	Marion	F	4.410	0.040	0.070	0.060	0.910	0.000	0.010	0.000
21157	KY	Marshall	F	3.390	0.070	19.210	0.040	0.300	0.000	0.000	0.000
21159	KY	Martin	F	3.410	0.200	0.000	0.000	0.010	0.000	1.290	0.000
21161	KY	Mason	F	4.580	0.040	5.370	0.050	0.540	0.000	0.000	5.140
21163	KY	Meade	F	1.280	0.800	0.000	0.110	0.360	2.160	0.030	0.000
21165	KY	Menifee	F	0.540	0.030	0.000	0.010	0.050	0.000	0.000	0.000
21167	KY	Mercer	F	2.580	0.050	0.000	0.120	0.630	0.000	0.000	22.490
21169	KY	Metcalfe	F	0.000	0.200	0.000	0.010	0.830	0.000	0.000	0.000
21171	KY	Monroe	F	1.380	0.030	0.000	0.020	0.960	0.030	0.000	0.000
21173	KY	Montgomery	F	2.840	0.060	0.000	0.020	0.370	0.010	0.000	0.000
21175	KY	Morgan	F	0.000	0.360	0.000	0.020	0.140	0.000	0.000	0.000
21177	KY	Muhlenberg	F	4.200	0.080	0.000	0.020	0.610	0.000	0.110	491.710
21179	KY	Nelson	F	5.080	0.100	1.530	0.090	0.930	0.090	0.000	0.000
21181	KY	Nicholas	F	2.310	0.020	0.000	0.060	0.300	0.000	0.000	0.000
21183	KY	Ohio	F	4.110	0.070	0.000	0.020	0.640	0.000	0.560	13.680

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21185	KY	Oldham	F	4.170	1.430	0.000	0.120	0.180	0.010	0.000	0.000
21187	KY	Owen	F	1.420	0.250	0.000	0.350	0.350	0.000	0.000	0.000
21189	KY	Owsley	F	0.290	0.010	0.000	0.000	0.020	0.000	0.000	0.000
21191	KY	Pendleton	F	0.930	0.110	0.000	0.270	0.230	0.000	0.010	0.000
21193	KY	Perry	F	4.150	0.450	0.000	0.000	0.010	0.000	0.160	0.000
21195	KY	Pike	F	5.770	1.470	0.000	0.010	0.010	0.000	7.100	0.000
21197	KY	Powell	F	1.160	0.030	0.000	0.000	0.040	0.000	0.000	0.000
21199	KY	Pulaski	F	7.530	0.150	0.160	0.030	1.050	0.000	0.000	123.830
21201	KY	Robertson	F	0.000	0.080	0.000	0.020	0.070	0.000	0.000	0.000
21203	KY	Rockcastle	F	2.150	0.050	0.000	0.010	0.280	0.000	0.000	0.000
21205	KY	Rowan	F	6.540	0.060	0.000	0.130	0.100	0.000	0.000	0.000
21207	KY	Russell	F	3.400	0.050	0.000	0.020	0.630	0.000	0.000	0.000
21209	KY	Scott	F	2.210	0.710	0.000	0.660	0.420	0.010	0.140	0.000
21211	KY	Shelby	F	3.130	0.090	0.000	0.750	0.740	0.020	0.000	0.000
21213	KY	Simpson	F	1.860	0.040	0.000	0.010	0.290	0.000	0.000	0.000
21215	KY	Spencer	F	0.000	0.290	0.000	0.370	0.240	0.000	0.000	0.000
21217	KY	Taylor	F	5.000	0.060	0.000	0.010	0.600	0.000	0.000	0.000
21219	KY	Todd	F	0.000	0.030	0.000	0.110	0.820	0.010	0.000	0.000
21221	KY	Trigg	F	1.810	0.040	0.000	0.200	0.230	0.000	3.780	0.000
21223	KY	Trimble	F	2.690	0.100	0.000	0.060	0.140	0.000	1.290	11.420
21225	KY	Union	F	3.090	0.040	0.000	0.490	0.210	0.000	0.000	0.000
21227	KY	Warren	F	15.790	0.790	0.000	1.750	1.280	0.010	0.000	0.000
21229	KY	Washington	F	1.630	0.050	0.000	0.160	0.630	0.000	0.000	0.000
21231	KY	Wayne	F	2.180	0.010	0.000	0.010	0.470	0.000	0.000	0.000
21233	KY	Webster	F	1.820	0.110	0.000	0.030	0.760	0.000	0.100	74.950
21235	KY	Whitley	F	1.600	0.270	0.000	0.010	0.150	0.010	0.700	0.000
21237	KY	Wolfe	F	0.480	0.120	0.000	0.010	0.050	0.000	0.000	0.000

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21239	KY	Woodford	F	3.080	0.080	0.000	0.410	0.370	0.000	0.000	50.190
	KY	**Total**		**553.149**	**33.710**	**179.830**	**17.122**	**44.055**	**19.698**	**36.610**	**3342.582**
24023	MD	Garrett	P	1.948	1.074	0.056	0.256	0.256	1.236	0.424	0.000
	MD	**Total**		**1.948**	**1.074**	**0.056**	**0.256**	**0.256**	**1.236**	**0.424**	**0.000**
28003	MS	Alcorn	P	0.748	0.060	0.000	0.012	0.017	0.052	0.000	0.000
28057	MS	Itawamba	P	0.032	0.002	0.000	0.000	0.001	0.000	0.001	0.000
28117	MS	Prentiss	P	0.076	0.004	0.000	0.000	0.003	0.000	0.000	0.000
28141	MS	Tishomingo	P	1.819	0.325	0.000	0.000	0.046	0.000	0.008	0.000
	MS	**Total**		**2.675**	**0.391**	**0.000**	**0.012**	**0.067**	**0.052**	**0.009**	**0.000**
36003	NY	Allegany	P	0.467	0.304	0.142	0.059	0.099	0.010	0.056	0.000
36009	NY	Cattaraugus	P	6.394	1.925	1.571	0.295	0.538	2.640	1.032	0.000
36013	NY	Chautauqua	P	6.844	0.613	2.678	0.520	0.541	3.625	0.072	222.502
	NY	**Total**		**13.705**	**2.842**	**4.391**	**0.874**	**1.178**	**6.275**	**1.161**	**222.502**
37005	NC	Alleghany	P	0.375	0.500	0.000	0.742	0.313	1.752	0.000	0.000
37009	NC	Ashe	P	0.757	1.415	0.000	0.757	0.216	0.000	0.138	0.000
37011	NC	Avery	P	0.684	0.364	0.702	0.928	0.006	5.061	0.006	0.000
37021	NC	Buncombe	P	19.342	3.682	0.000	1.652	0.231	12.753	1.024	241.682
37027	NC	Caldwell	P	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37039	NC	Cherokee	F	0.790	1.130	0.000	0.360	0.060	29.100	0.070	0.000
37043	NC	Clay	P	0.155	0.570	0.000	0.271	0.068	0.000	0.077	0.000
37075	NC	Graham	F	0.490	0.310	0.000	0.340	0.020	40.830	0.050	0.000
37087	NC	Haywood	F	6.020	1.200	24.730	2.680	0.270	10.380	0.170	0.000
37089	NC	Henderson	P	5.808	2.037	0.000	1.705	0.108	0.000	0.181	0.000
37099	NC	Jackson	P	1.315	0.962	0.000	1.482	0.018	0.000	0.176	0.000
37111	NC	McDowell	P	0.005	0.005	0.005	0.004	0.001	0.001	0.000	0.000
37113	NC	Macon	P	1.769	1.299	0.000	0.941	0.056	300.176	0.085	0.000
37115	NC	Madison	F	0.530	1.010	0.000	0.490	0.130	1.030	0.070	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
37121	NC	Mitchell	P	1.316	0.663	0.000	0.312	0.019	1.452	0.585	0.000
37171	NC	Surry	P	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
37173	NC	Swain	F	0.740	0.710	0.000	0.150	0.010	15.550	0.040	0.000
37175	NC	Transylvania	P	1.167	0.872	0.000	0.748	0.041	427.082	0.271	0.000
37189	NC	Watauga	P	2.725	0.677	1.435	0.822	0.137	0.008	0.161	0.000
37193	NC	Wilkes	P	0.025	0.007	0.000	0.004	0.030	0.000	0.000	0.000
37199	NC	Yancey	P	0.581	1.084	0.000	0.345	0.079	0.000	0.079	0.000
	NC	**Total**		**44.595**	**18.497**	**26.873**	**14.732**	**1.813**	**845.176**	**3.184**	**241.682**
39001	OH	Adams	F	2.100	0.270	0.000	0.020	0.270	0.000	0.360	596.890
39003	OH	Allen	P	0.194	0.007	0.009	0.004	0.001	0.000	0.035	0.000
39005	OH	Ashland	P	2.720	1.733	0.117	0.042	0.418	0.000	0.176	0.000
39007	OH	Ashtabula	P	0.771	0.193	0.804	0.010	0.035	0.000	0.004	18.743
39009	OH	Athens	F	7.520	0.730	0.000	0.040	0.130	0.090	0.000	0.000
39011	OH	Auglaize	P	1.146	0.296	0.025	0.002	0.111	0.139	0.307	1.283
39013	OH	Belmont	F	8.480	0.260	0.000	0.030	0.240	0.000	1.280	252.200
39015	OH	Brown	F	3.870	0.540	0.000	0.030	0.180	0.000	0.800	0.000
39017	OH	Butler	F	64.360	0.520	47.220	0.630	0.210	0.000	19.550	57.880
39019	OH	Carroll	F	1.180	1.650	0.080	0.050	0.230	0.000	0.030	0.000
39021	OH	Champaign	F	2.690	1.590	0.840	2.050	0.210	0.750	0.790	0.000
39023	OH	Clark	F	17.470	3.260	0.050	2.510	0.200	0.000	4.360	0.000
39025	OH	Clermont	F	18.930	2.010	0.000	0.090	0.090	0.000	0.000	697.660
39027	OH	Clinton	F	0.890	1.590	0.000	0.090	0.120	0.000	0.780	0.000
39029	OH	Columbiana	F	6.680	3.430	0.180	0.390	0.520	0.000	0.040	0.000
39031	OH	Coshocton	F	5.950	1.230	6.900	0.390	0.420	0.000	0.380	193.320
39033	OH	Crawford	P	0.439	0.291	0.003	0.053	0.066	0.000	0.103	0.000
39037	OH	Darke	F	2.770	2.130	0.000	0.310	1.330	0.000	1.390	0.010
39041	OH	Delaware	F	21.470	0.610	0.030	1.510	0.130	0.000	1.340	0.000

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39045	OH	Fairfield	F	9.380	4.270	0.000	0.430	0.210	0.000	0.000	0.000
39047	OH	Fayette	F	1.820	0.860	0.000	0.200	0.100	0.000	0.180	0.000
39049	OH	Franklin	F	166.000	0.550	0.690	2.690	0.060	0.000	34.700	0.360
39053	OH	Gallia	F	3.760	0.000	0.000	0.000	0.190	0.000	0.000	1184.850
39055	OH	Geauga	P	0.019	0.075	0.000	0.004	0.003	0.000	0.000	0.000
39057	OH	Greene	F	9.670	2.820	0.420	0.650	0.120	0.000	3.970	0.000
39059	OH	Guernsey	F	4.740	0.480	0.000	0.070	0.230	1.160	0.000	0.000
39061	OH	Hamilton	F	129.400	0.700	35.390	0.430	0.040	0.000	0.010	211.320
39065	OH	Hardin	P	1.347	0.549	0.000	0.096	0.243	0.000	0.221	0.000
39067	OH	Harrison	F	0.520	0.450	0.000	0.000	0.200	0.000	0.470	0.000
39071	OH	Highland	F	2.570	0.210	0.000	0.000	0.200	0.000	0.390	0.000
39073	OH	Hocking	F	1.400	1.330	0.040	0.150	0.040	0.000	0.000	0.000
39075	OH	Holmes	F	1.610	2.430	0.440	0.000	1.300	0.000	0.380	0.000
39079	OH	Jackson	F	1.770	0.460	0.000	0.000	0.090	0.000	0.000	0.000
39081	OH	Jefferson	F	9.790	0.610	148.420	0.130	0.120	0.000	0.040	1987.760
39083	OH	Knox	F	5.110	2.040	0.000	0.370	0.360	0.000	1.500	0.000
39087	OH	Lawrence	F	5.730	0.150	1.170	0.000	0.080	0.000	0.000	0.850
39089	OH	Licking	F	13.960	4.620	0.320	0.620	0.610	0.940	1.080	0.000
39091	OH	Logan	F	2.570	1.820	0.270	0.000	0.260	0.560	0.800	0.000
39097	OH	Madison	F	2.210	0.990	0.000	0.010	0.170	0.960	0.000	0.000
39099	OH	Mahoning	F	4.550	0.590	1.460	0.340	0.250	0.000	0.000	0.000
39101	OH	Marion	P	5.648	1.091	0.016	0.160	0.112	0.000	1.171	0.000
39103	OH	Medina	P	1.111	2.354	0.000	0.325	0.095	0.000	1.594	0.000
39105	OH	Meigs	F	1.930	0.100	0.000	0.000	0.130	0.000	3.040	0.000
39107	OH	Mercer	P	1.444	0.791	0.112	0.138	1.020	0.000	2.103	0.000
39109	OH	Miami	F	11.180	3.000	0.000	1.190	0.170	0.000	5.340	0.010
39111	OH	Monroe	F	1.570	0.160	5.740	0.270	0.160	0.000	0.000	0.000

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39113	OH	Montgomery	F	94.070	1.520	11.110	2.680	0.100	0.000	14.870	137.280
39115	OH	Morgan	F	0.980	0.790	0.010	0.000	0.170	0.000	0.000	0.000
39117	OH	Morrow	F	0.820	2.100	0.000	0.030	0.220	0.000	0.000	0.000
39119	OH	Muskingum	F	9.270	0.950	2.800	0.030	0.280	0.000	5.540	0.000
39121	OH	Noble	F	0.920	0.270	0.000	0.000	0.120	0.000	0.050	0.000
39127	OH	Perry	F	1.130	0.710	0.000	0.000	0.130	0.000	0.700	0.000
39129	OH	Pickaway	F	3.540	1.300	5.460	1.560	0.190	0.000	2.200	32.440
39131	OH	Pike	F	2.450	0.340	0.000	0.080	0.110	0.970	3.690	0.000
39133	OH	Portage	P	26.889	2.806	0.253	0.337	0.084	0.000	0.404	0.000
39135	OH	Preble	F	2.840	1.590	0.000	0.000	0.280	0.000	0.000	0.000
39139	OH	Richland	P	11.593	2.516	0.072	0.063	0.380	0.000	0.145	0.000
39141	OH	Ross	F	7.940	1.240	28.440	0.500	0.180	0.000	0.330	0.000
39145	OH	Scioto	F	12.380	0.100	2.390	0.450	0.140	0.000	2.890	0.000
39149	OH	Shelby	P	3.916	1.669	0.351	0.038	0.521	0.000	6.533	0.000
39151	OH	Stark	P	33.554	6.802	6.881	0.932	0.526	0.000	1.081	0.000
39153	OH	Summit	P	4.666	3.449	3.615	0.331	0.012	0.000	0.000	0.000
39155	OH	Trumbull	P	33.399	4.871	35.616	0.546	0.195	0.000	0.000	85.836
39157	OH	Tuscarawas	F	19.980	2.070	7.380	0.340	0.600	0.000	0.920	0.000
39159	OH	Union	F	2.460	1.860	1.380	0.190	0.380	0.000	4.520	0.000
39163	OH	Vinton	F	0.200	0.600	0.000	0.000	0.030	0.000	0.000	0.000
39165	OH	Warren	F	17.000	2.860	0.180	0.580	0.120	0.000	1.050	0.000
39167	OH	Washington	F	7.530	0.100	0.450	0.040	0.260	0.000	0.420	951.660
39169	OH	Wayne	F	8.020	4.400	1.960	0.160	1.820	0.000	0.000	0.120
39175	OH	Wyandot	P	0.006	0.003	0.000	0.000	0.001	0.000	0.012	0.000
	OH	**Total**		**875.992**	**100.756**	**359.093**	**25.413**	**18.325**	**5.569**	**134.068**	**6410.471**
42003	PA	Allegheny	F	191.990	0.000	258.040	0.660	0.070	0.000	0.000	289.990
42005	PA	Armstrong	F	3.020	1.400	0.060	0.330	0.390	0.000	0.020	175.770

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42007	PA	Beaver	F	21.860	0.210	218.200	0.250	0.250	0.000	0.050	242.520
42019	PA	Butler	F	9.610	4.730	2.190	0.520	0.530	0.000	0.000	0.000
42021	PA	Cambria	P	9.118	0.317	0.006	0.061	0.172	0.000	0.000	0.645
42023	PA	Cameron	P	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000
42031	PA	Clarion	F	2.370	1.110	0.020	0.090	0.430	0.000	0.010	0.330
42033	PA	Clearfield	P	0.523	0.044	0.000	0.017	0.018	0.100	0.000	30.704
42039	PA	Crawford	P	7.471	2.927	0.370	0.145	1.138	3.839	0.018	0.000
42047	PA	Elk	P	4.307	0.099	10.165	0.026	0.046	0.000	0.000	0.000
42049	PA	Erie	P	9.497	0.640	1.471	0.253	0.177	1.955	0.256	0.000
42051	PA	Fayette	F	35.730	1.320	0.000	0.100	0.500	4.320	0.420	0.390
42053	PA	Forest	F	0.130	0.090	0.000	0.000	0.010	0.000	0.000	0.000
42059	PA	Greene	F	5.320	0.610	0.000	0.020	0.300	0.000	2.190	12.660
42063	PA	Indiana	P	3.897	2.031	0.000	0.579	0.570	0.000	3.814	35.535
42065	PA	Jefferson	P	2.316	1.228	0.010	0.030	0.289	2.226	0.000	0.000
42073	PA	Lawrence	F	8.820	2.220	0.000	0.100	0.580	0.000	0.000	149.590
42083	PA	McKean	P	2.485	0.689	3.155	0.078	0.107	0.000	0.748	0.000
42085	PA	Mercer	F	15.740	1.660	13.680	0.180	0.940	0.000	0.000	0.000
42105	PA	Potter	P	0.304	0.159	0.000	0.000	0.122	5.115	0.000	0.000
42111	PA	Somerset	P	25.011	1.234	0.008	0.201	1.351	0.000	0.520	0.000
42121	PA	Venango	F	5.690	0.960	0.280	0.130	0.210	0.000	0.000	1.190
42123	PA	Warren	F	3.760	1.160	9.090	0.100	0.400	0.000	0.020	0.000
42125	PA	Washington	F	46.260	1.910	17.280	0.750	0.800	0.000	0.000	739.640
42129	PA	Westmoreland	F	30.610	2.420	2.340	0.660	0.690	2.970	0.110	0.000
	PA	**Total**		**445.841**	**29.168**	**536.365**	**5.281**	**10.091**	**20.526**	**8.176**	**1678.964**
47001	TN	Anderson	F	15.170	0.320	1.560	0.640	0.120	0.060	0.670	551.700
47003	TN	Bedford	F	6.560	0.060	0.000	0.030	0.970	18.380	0.300	0.000
47005	TN	Benton	F	1.460	0.390	0.000	0.090	0.120	0.010	0.440	0.000

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47007	TN	Bledsoe	F	0.550	0.610	0.000	0.320	0.350	0.020	0.020	0.000
47009	TN	Blount	F	12.260	0.970	0.000	0.690	0.390	0.000	0.330	0.000
47011	TN	Bradley	P	9.389	0.436	2.901	0.081	0.443	0.007	0.140	0.000
47013	TN	Campbell	F	3.820	0.310	0.000	0.050	0.140	0.000	0.320	0.000
47015	TN	Cannon	F	1.060	0.410	0.000	0.030	0.300	0.000	0.040	0.000
47017	TN	Carroll	P	0.739	0.209	0.476	0.054	0.060	0.000	0.090	0.000
47019	TN	Carter	F	8.850	0.970	0.080	0.120	0.140	11.410	0.170	0.000
47021	TN	Cheatham	F	2.830	0.140	0.000	0.290	0.120	0.000	0.000	0.000
47023	TN	Chester	P	0.167	0.101	0.015	0.035	0.017	0.000	0.000	0.000
47025	TN	Claiborne	F	3.000	0.550	0.000	0.040	0.370	0.000	0.400	0.000
47027	TN	Clay	F	1.260	0.040	0.000	0.020	0.300	12.020	0.020	0.000
47029	TN	Cocke	F	3.960	0.840	0.080	0.170	0.260	0.000	0.060	0.000
47031	TN	Coffee	F	5.090	0.390	24.740	1.330	0.500	0.000	0.080	0.000
47035	TN	Cumberland	F	5.440	0.100	0.000	0.120	0.350	0.000	0.470	0.000
47037	TN	Davidson	F	129.840	0.120	28.710	0.730	0.110	0.000	1.150	0.000
47039	TN	Decatur	F	1.500	0.040	0.000	0.040	0.130	0.010	0.490	0.000
47041	TN	DeKalb	F	1.180	0.040	0.000	0.630	0.300	0.000	0.090	0.000
47043	TN	Dickson	F	4.930	0.270	0.000	0.030	0.300	0.000	0.200	0.000
47049	TN	Fentress	F	1.520	0.110	0.000	0.010	0.390	0.000	0.140	0.000
47051	TN	Franklin	F	5.330	0.030	0.000	0.900	0.620	0.000	0.400	0.000
47055	TN	Giles	F	3.100	0.140	0.000	0.640	0.760	0.000	0.060	0.000
47057	TN	Grainger	F	0.130	1.080	0.000	0.390	0.290	2.660	0.000	0.000
47059	TN	Greene	F	8.460	0.120	1.760	0.590	1.100	0.010	0.440	0.000
47061	TN	Grundy	F	1.770	0.000	0.000	0.260	0.200	0.000	0.020	0.000
47063	TN	Hamblen	F	9.030	0.050	0.000	0.420	0.230	0.030	0.130	0.000
47065	TN	Hamilton	F	61.650	0.190	8.420	0.650	0.230	0.000	0.850	1576.600
47067	TN	Hancock	F	0.230	0.340	0.000	0.040	0.140	0.000	0.000	0.000

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47071	TN	Hardin	F	3.040	0.060	23.700	0.360	0.140	0.000	0.360	0.000
47073	TN	Hawkins	F	4.380	1.270	0.340	0.230	0.430	0.010	0.320	693.700
47077	TN	Henderson	P	2.318	0.007	0.000	0.063	0.251	0.000	0.000	0.000
47079	TN	Henry	P	1.660	0.459	0.000	0.586	0.333	0.000	0.264	0.000
47081	TN	Hickman	F	2.390	0.400	0.000	0.020	0.290	0.010	0.130	0.000
47083	TN	Houston	F	1.120	0.070	0.000	0.020	0.120	0.000	0.000	0.000
47085	TN	Humphreys	F	2.520	0.450	62.720	0.040	0.240	0.000	0.050	1226.650
47087	TN	Jackson	F	0.500	0.310	0.020	0.020	0.130	0.020	0.000	0.000
47089	TN	Jefferson	F	4.450	0.860	0.790	0.230	0.490	0.010	0.020	0.000
47091	TN	Johnson	F	1.930	0.440	0.050	0.050	0.140	0.010	0.140	0.000
47093	TN	Knox	F	66.320	0.240	0.090	0.240	0.290	0.000	1.420	0.000
47099	TN	Lawrence	F	4.060	0.490	1.000	1.060	0.710	0.010	0.190	0.000
47101	TN	Lewis	F	1.540	0.170	0.040	0.000	0.060	0.000	0.000	0.000
47103	TN	Lincoln	F	3.780	0.180	0.000	0.850	0.860	2.200	0.060	0.000
47105	TN	Loudon	F	9.520	0.360	6.430	0.040	0.460	0.000	0.130	0.000
47107	TN	McMinn	F	5.750	0.930	62.810	0.210	0.650	1.020	0.150	0.000
47109	TN	McNairy	P	1.197	0.064	0.000	0.127	0.042	0.007	0.081	0.000
47111	TN	Macon	F	2.130	0.210	0.470	0.080	0.330	0.000	0.000	0.000
47115	TN	Marion	F	3.750	0.260	0.650	0.030	0.160	0.000	0.410	0.000
47117	TN	Marshall	F	2.670	0.410	0.000	0.110	0.600	0.000	0.220	0.000
47119	TN	Maury	F	12.430	0.220	0.480	0.200	0.680	0.000	0.280	0.000
47121	TN	Meigs	F	0.700	0.490	0.000	0.090	0.150	0.000	0.030	0.000
47123	TN	Monroe	F	4.890	0.690	0.000	0.020	0.540	3.240	0.190	0.000
47125	TN	Montgomery	F	21.880	0.180	1.180	0.330	0.330	0.000	0.360	0.000
47127	TN	Moore	F	0.560	0.160	0.700	0.000	0.230	0.000	0.040	0.000
47129	TN	Morgan	F	1.350	0.710	0.000	0.000	0.140	0.000	0.000	0.000
47133	TN	Overton	F	2.620	0.010	0.000	0.020	0.430	0.020	0.150	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
47135	TN	Perry	F	0.930	0.050	0.000	0.010	0.080	0.000	0.400	0.000
47137	TN	Pickett	F	0.640	0.040	0.000	0.030	0.180	0.000	0.000	0.000
47139	TN	Polk	P	1.311	0.583	3.287	0.018	0.200	0.000	0.046	0.000
47141	TN	Putnam	F	13.640	0.100	0.000	0.050	0.320	0.010	0.550	0.000
47143	TN	Rhea	F	3.920	0.020	0.000	0.350	0.150	0.000	0.200	188.200
47145	TN	Roane	F	8.200	0.170	0.000	0.130	0.170	2.880	0.050	1280.040
47147	TN	Robertson	F	5.550	1.360	0.000	0.320	0.560	0.010	0.230	0.000
47149	TN	Rutherford	F	31.600	2.070	0.000	0.250	0.530	0.000	0.700	0.000
47151	TN	Scott	F	2.710	0.040	0.000	0.010	0.080	0.000	0.030	0.000
47153	TN	Sequatchie	F	0.750	0.360	0.000	0.010	0.100	0.000	0.060	0.000
47155	TN	Sevier	F	8.970	1.990	0.520	0.140	0.230	0.000	0.400	0.000
47159	TN	Smith	F	1.810	0.140	0.000	0.090	0.340	0.000	0.090	0.000
47161	TN	Stewart	F	6.950	0.330	0.000	0.110	0.090	0.000	0.000	2075.400
47163	TN	Sullivan	F	24.110	0.080	508.930	0.330	0.370	0.000	0.610	0.000
47165	TN	Sumner	F	24.890	0.080	0.100	0.280	0.490	0.010	0.160	940.460
47169	TN	Trousdale	F	0.940	0.070	0.000	0.070	0.110	0.000	0.000	0.000
47171	TN	Unicoi	F	1.950	0.120	0.000	0.030	0.030	4.010	0.090	0.000
47173	TN	Union	F	1.020	0.520	0.000	0.010	0.120	0.000	0.300	0.000
47175	TN	Van Buren	F	0.840	0.010	0.000	0.100	0.100	0.000	0.000	0.000
47177	TN	Warren	F	5.140	0.040	0.000	1.950	0.550	0.000	0.130	0.000
47179	TN	Washington	F	19.760	0.520	0.000	1.070	0.740	0.000	0.320	0.000
47181	TN	Wayne	F	1.190	0.610	0.050	0.080	0.310	0.000	0.000	0.000
47185	TN	White	F	3.250	0.110	0.000	0.020	0.580	0.000	0.110	0.000
47187	TN	Williamson	F	2.740	0.140	0.000	1.780	0.510	0.000	0.380	0.000
47189	TN	Wilson	F	13.970	0.320	0.000	0.240	0.620	0.000	0.320	0.000
	TN	**Total**		**666.511**	**29.349**	**743.099**	**21.944**	**26.537**	**58.094**	**17.691**	**8532.750**
51005	VA	Alleghany	P	0.006	0.001	0.064	0.000	0.000	0.000	0.000	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
51017	VA	Bath	P	0.000	0.000	0.001	0.000	0.000	0.158	0.000	0.000
51021	VA	Bland	F	0.200	0.320	0.120	0.090	0.250	0.000	0.000	0.000
51027	VA	Buchanan	F	0.000	0.560	0.420	0.020	0.010	0.000	0.400	6.560
51035	VA	Carroll	P	0.780	1.094	0.000	0.280	0.458	0.000	0.000	0.000
51045	VA	Craig	P	0.012	0.039	0.000	0.005	0.014	0.000	0.000	0.000
51051	VA	Dickenson	F	4.020	0.680	0.000	0.000	0.020	0.000	0.810	0.000
51063	VA	Floyd	P	0.160	0.817	0.000	0.258	0.408	0.000	0.000	0.000
51067	VA	Franklin	P	0.001	0.002	0.000	0.000	0.001	0.000	0.000	0.000
51071	VA	Giles	P	1.183	0.525	64.088	0.124	0.143	0.000	1.651	250.685
51077	VA	Grayson	P	0.249	0.977	0.070	0.379	0.509	0.000	0.000	0.000
51091	VA	Highland	P	0.001	0.001	0.051	0.000	0.001	0.068	0.000	0.000
51105	VA	Lee	F	1.750	0.960	0.000	0.470	0.370	0.000	0.230	0.000
51121	VA	Montgomery	P	2.995	0.593	11.229	0.180	0.168	0.000	0.000	0.000
51141	VA	Patrick	P	0.001	0.004	0.001	0.001	0.001	0.001	0.000	0.000
51155	VA	Pulaski	F	4.150	0.590	1.460	0.200	0.350	0.000	0.000	0.000
51167	VA	Russell	F	1.520	1.220	0.010	0.080	0.580	0.000	3.470	15.160
51169	VA	Scott	F	1.110	0.900	0.000	0.110	0.350	0.000	0.000	0.000
51173	VA	Smyth	F	6.230	0.670	0.000	0.250	0.540	18.120	0.000	0.000
51185	VA	Tazewell	F	4.580	0.880	0.000	0.190	0.530	2.180	0.050	0.000
51191	VA	Washington	F	8.890	0.530	0.070	0.490	0.970	62.990	0.000	8.560
51195	VA	Wise	F	5.770	0.550	0.000	0.100	0.040	0.000	0.970	0.000
51197	VA	Wythe	F	3.230	0.960	0.000	0.370	0.810	7.140	0.000	0.000
51520	VA	Bristol	F	0.000	0.000	0.000	0.050	0.000	0.000	0.000	0.000
51640	VA	Galax	F	1.670	0.000	0.000	0.070	0.000	0.000	0.000	0.000
51720	VA	Norton	F	0.890	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51750	VA	Radford	F	2.210	0.000	0.000	0.060	0.000	0.000	0.000	0.000
	VA	**Total**		**51.609**	**12.874**	**77.584**	**3.778**	**6.522**	**90.657**	**7.581**	**280.965**

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
54001	WV	Barbour	F	1.110	0.340	0.280	0.000	0.080	0.000	0.030	0.000
54005	WV	Boone	F	0.180	0.870	0.110	0.000	0.000	2.300	1.650	0.000
54007	WV	Braxton	F	0.940	0.550	7.040	0.000	0.050	0.000	0.020	0.000
54009	WV	Brooke	F	5.100	0.150	75.980	0.000	0.020	0.000	0.000	0.000
54011	WV	Cabell	F	14.180	0.580	43.990	0.000	0.030	0.000	0.000	0.000
54013	WV	Calhoun	F	0.310	0.340	0.050	0.000	0.030	0.000	0.030	0.000
54015	WV	Clay	F	0.420	0.500	0.170	0.000	0.010	0.000	0.410	0.000
54017	WV	Doddridge	F	0.160	0.400	0.090	0.000	0.040	0.000	0.060	0.000
54019	WV	Fayette	F	5.320	0.650	0.750	0.000	0.030	0.000	0.090	33.430
54021	WV	Gilmer	F	0.510	0.340	0.550	0.000	0.050	0.000	0.030	0.000
54023	WV	Grant	P	0.005	0.001	0.007	0.000	0.001	0.039	0.000	5.193
54025	WV	Greenbrier	P	3.903	1.023	2.334	0.000	0.348	1.510	0.149	0.000
54029	WV	Hancock	F	1.250	0.190	183.790	0.000	0.010	0.000	0.000	0.060
54033	WV	Harrison	F	8.720	0.520	7.400	0.000	0.110	0.000	0.140	39.520
54035	WV	Jackson	F	1.590	0.880	29.160	0.000	0.120	0.000	0.020	0.000
54039	WV	Kanawha	F	33.910	1.120	121.720	0.000	0.020	0.010	1.510	343.860
54041	WV	Lewis	F	1.350	0.450	2.150	0.000	0.070	0.000	0.060	0.000
54043	WV	Lincoln	F	0.750	0.920	0.040	0.000	0.020	0.000	0.060	0.000
54045	WV	Logan	F	3.670	0.740	0.840	0.000	0.000	0.050	1.230	0.000
54047	WV	McDowell	F	3.110	0.660	0.290	0.000	0.000	0.000	1.470	0.000
54049	WV	Marion	F	6.530	0.240	11.220	0.000	0.040	0.000	0.030	28.270
54051	WV	Marshall	F	2.960	0.360	160.700	0.000	0.070	0.000	0.370	558.740
54053	WV	Mason	F	2.280	0.450	19.360	0.000	0.160	0.000	0.000	1071.780
54055	WV	Mercer	F	4.080	1.100	5.040	0.000	0.050	2.000	0.120	0.000
54059	WV	Mingo	F	4.000	1.140	0.930	0.000	0.000	0.000	0.870	0.000
54061	WV	Monongalia	F	9.980	0.400	59.490	0.000	0.070	4.800	0.700	93.300
54063	WV	Monroe	P	0.813	0.503	0.059	0.000	0.184	2.656	0.000	0.000

FIPS Code	State	County	County Full_Partial	Public Supply	Domestic Supply	Industry	Irrigation	Livestock	Aquaculture	Mining	Thermoelectric
54067	WV	Nicholas	F	2.300	0.660	1.330	0.000	0.050	0.000	0.750	0.000
54069	WV	Ohio	F	6.540	0.130	11.380	0.000	0.040	0.000	0.330	0.000
54071	WV	Pendleton	P	0.002	0.001	0.001	0.000	0.002	0.036	0.000	0.000
54073	WV	Pleasants	F	0.680	0.180	17.120	0.000	0.020	0.000	0.000	82.650
54075	WV	Pocahontas	P	0.804	0.437	0.506	0.000	0.119	4.137	0.040	0.000
54077	WV	Preston	P	1.717	1.068	1.777	0.000	0.200	1.118	0.160	104.905
54079	WV	Putnam	F	2.180	0.870	12.910	0.000	0.050	0.000	0.010	40.920
54081	WV	Raleigh	F	9.340	0.520	5.250	0.000	0.030	0.000	0.290	0.000
54083	WV	Randolph	P	2.999	0.737	7.005	0.000	0.100	7.314	0.139	0.000
54085	WV	Ritchie	F	0.440	0.430	1.550	0.000	0.060	0.000	0.080	0.000
54087	WV	Roane	F	0.680	0.640	0.860	0.000	0.080	0.000	0.020	0.000
54089	WV	Summers	F	3.140	0.550	0.030	0.000	0.070	0.000	0.000	0.000
54091	WV	Taylor	F	1.940	0.210	8.860	0.000	0.060	0.000	0.010	0.000
54093	WV	Tucker	P	0.585	0.198	16.537	0.000	0.020	0.000	0.089	0.000
54095	WV	Tyler	F	0.440	0.320	19.230	0.000	0.050	0.000	0.010	0.000
54097	WV	Upshur	F	2.100	0.580	3.740	0.000	0.060	0.000	0.040	0.000
54099	WV	Wayne	F	3.230	0.840	15.170	0.000	0.030	0.000	0.710	0.000
54101	WV	Webster	F	0.430	0.370	0.460	0.000	0.010	0.000	0.370	0.000
54103	WV	Wetzel	F	1.780	0.430	23.370	0.000	0.020	0.000	0.010	0.000
54105	WV	Wirt	F	0.110	0.250	0.370	0.000	0.040	0.000	0.000	0.000
54107	WV	Wood	F	8.800	0.610	42.140	0.000	0.080	0.000	0.000	0.000
54109	WV	Wyoming	F	1.870	0.800	2.060	0.000	0.000	0.000	1.140	0.000
	WV	**Total**		**169.236**	**26.248**	**925.195**	**0.000**	**2.803**	**25.969**	**13.248**	**2402.627**
		Ohio River Basin TOTAL		**3,584.213**	**359.161**	**3,639.355**	**217.480**	**155.056**	**1,085.525**	**323.668**	**34,515.909**