

Appendix A. Data Sources and Processing

- A.1. Study Data Architecture
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- A.4. Hydrologic and water-availability data
- A.5. Illinois water-use data and comparability

Appendix to:

Southwest Indiana Regional Water Study

Letsinger, S.L., Gustin, A.R., Waddle, R.C., Petty, A.E., and Durai, R.S., 2026. Regional water study: Water Demand and Availability in Southwest Indiana. Report to Indiana Finance Authority. 145 p.

<https://www.in.gov/ifa/regional-water-studies/southwest-indiana-regional-water-study>

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A.1 Study data architecture

The study combined monthly water-use and return-flow records, demographic and socioeconomic data, facility inventories, geospatial reference layers, observed hydrology, and historical and projected climate data. Data were standardized to a common monthly time step and assigned to gage-defined subbasins. Facility and point records were assigned by location; service-area quantities were allocated to the place of use when defensible; and transfers across subbasin boundaries were treated in a spatially explicit manner.

The same National Water Availability Assessment (NWAA) HUC12 dataset version was retained throughout the analysis for flow routing in the water-availability analysis. The NWAA Data Companion (NWDC) uses the October 2020 version of the Watershed Boundary Dataset (Blodgett, 2022 [revised 2023]). This version of the HUC12 dataset can be downloaded here: https://prod-is-usgs-sb-prod-publish.s3.amazonaws.com/67082a0fd34e969edc5a1cca/102020_wbd_hu12.gdb.zip

HUC12 values were aggregated through the study routing network to local and cumulative gage catchments (see extensive presentation of flow routing, hydrologic modeling for the water-availability analysis in Appendix G).

Blodgett, D.L., 2022, Mainstem Rivers of the Conterminous United States (ver. 2.0, February 2023): U.S. Geological Survey data release, <https://doi.org/10.5066/P92U7ZUT>

Table A-1: Overview table of the different data domains, sources, and uses for this study

Domain	Primary source	Principal study use
Reported withdrawals	Indiana DNR SWWF database; Illinois State Water Survey compilations	Historical monthly demand, sector assignment, facility activity, seasonal patterns
Treated or purchased public water	IDEM Monthly Reports of Operation; utility information	Gap filling, validation, purchased-water accounting, capacity screening
Wastewater returns	EPA ECHO/ICIS-NPDES DMR records and outfall locations	Historical monthly stream returns and future return-flow anchors
Population and income	U.S. Census, IBRC/StatsIndiana, SSP county projections, IPUMS NHGIS, CPI	Public-supply baseline predictors and self-supplied residential demand
Sector-specific inventories	IDEM CFO/CAFO permits; USDA Ag Census/outlooks; EIA/utility records	Animal demand and facility-specific energy scenarios
Observed hydrology	USGS Water Data for the Nation and reservoir/dam records	Streamflow, low-flow metrics, calibration and regulated-flow interpretation
Historical/future climate	Study historical climate forcing; SWB2 outputs; LOCA2 CMIP6	Demand covariates, irrigation deficit, recharge/runoff, future forcing
Geospatial framework	NWAA HUC12/routing, gage catchments, NAD, parcels, service areas, NPDES outfalls	Spatial allocation and aggregation

A.2 Water-demand data

A.2.1 Indiana Significant Water Withdrawal Facility data

The Indiana Department of Natural Resources (IDNR) Significant Water Withdrawal Facility (SWWF) database was the primary source for reported withdrawals. Indiana law requires registration of facilities with the capacity of withdrawing more than 100,000 gallons per day in aggregate (~70 GPM). Water-use reporting began with calendar year 1985. The study used the statewide database supplied by IDNR through 2023, including attributes

not available in the simplified public download. Monthly pump or intake volumes were retained in gallons and aggregated to facility, subsector, subbasin, and month as required.

The six primary SWWF sectors are defined as the following:

1. **PS:** municipal/community utility and non-municipal public supply;
2. **IN:** manufacturing/industrial and mining/quarry/aggregate/asphalt;
3. **EP:** power generation, onsite energy use, and energy fuel/coal mining;
4. **IR:** agricultural crop irrigation and turf/landscape irrigation;
5. **RU:** registered livestock/CAFO use and aquaculture/fisheries; and
6. **MI:** miscellaneous uses, retained only where relevant to the water inventory.

Facility and source locations were reviewed because legacy SWWF coordinates are commonly generalized. Where possible, corrected locations from earlier Indiana water-inventory work were joined by the IDNR location identifier; public water utility wells and intakes were assigned the same locations as recorded by the Indiana Department of Environmental Management; newly registered facilities retained the provided IDNR locations unless a defensible correction was available. Facility sectors were also reviewed manually. Obvious classification errors, such as residential complexes classified as energy production or power plants classified as public supply, were reassigned. Water-use sectors were sub-classified where retaining the IDNR sector assignment might cloud the seasonal water-demand projections.

Reported monthly values were screened for missing periods, repeated values, unit errors, and order-of-magnitude spikes. Corrections were made only where the intended value or unit was defensible from adjacent reports, MRO records, or facility documentation. Otherwise, reported values were retained and flagged. Missing months were imputed (gap-filled) from adjacent months or comparable years only when needed for a continuous inventory and when the facility appeared operational; the imputation source was retained in the working data.

Sources

Indiana DNR, Significant Water Withdrawal Facility Data, <https://www.in.gov/dnr/water/water-availability-use-rights/significant-water-withdrawal-facility-data>

A.2.2 Public-water-system operations and utility metadata

Monthly Reports of Operation (MROs) submitted to the Indiana Department of Environmental Management (IDEM) were used to supplement and check SWWF public-supply records. The scanned forms report treated-water totals and monthly minimum, maximum, and average daily production. Selected reports were manually digitized because the Virtual File Cabinet generally stores images rather than machine-readable tables. MROs were especially useful for purchased-water systems, source transitions, missing SWWF months, and the 2012 drought benchmark. MRO data for a subset of six years (2011, 2012, 2013, 2021, 2022, and 2023) was digitized and cross-checked with SWWF data for more than 60 utilities.

Utility metadata linked PWSID, utility name, county, service area, source type, pumping location, purchased-water relationship, representative subbasin, climate zone, population served, treatment or contract capacity, and model-status flags. Withdrawal location and demand location were kept distinct. Where a source, wholesaler, or service area crossed a county or subbasin boundary, demand was allocated to the served area when the available MRO, service-area, and utility information supported that allocation.

Sources

IDEM Virtual File Cabinet MRO Reports, <https://vfc.idem.in.gov/>

A.2.3 Demographic and socioeconomic predictors

Decennial Census population counts anchored county and small-area population. Indiana county projections through 2050 were obtained from the Indiana Business Research Center (IBRC/StatsIndiana). County-scale Shared Socioeconomic Pathway (SSP) population trajectories were then evaluated as extensions through 2075. The SSP pathway whose shape best matched the IBRC trajectory was selected for each county and, where necessary, shifted multiplicatively to align the SSP series with recent Census and Indiana estimates. SSP2 was used for most counties; selected counties used SSP3 or SSP4 where those trajectories better matched observed and state-projected change.

Table A-2: Indiana and Illinois counties and the shared socioeconomic pathway model that was used for population projections. A notation of “no shift” means that the historical population trend aligned with the specified SSP projection without adjustment. A notation of “shift” signifies that the population trend was similar to the specified SSP trajectory but was shifted to align with historical (recorded) population counts. This shift was usually downward (lower population).

Indiana county	Population trajectory	Illinois county	Population trajectory
Bartholomew	SSP4 (shift)	Champaign	SSP2 (no shift)
Boone	SSP2 (no shift)	Clark	SSP2 (shift)
Brown	SSP2 (shift)	Coles	SSP2 (no shift)
Clark	SSP2 (no shift)	Crawford	SSP2 (shift)
Clay	SSP2 (shift)	Cumberland	SSP2 (shift)
Crawford	SSP2 (shift)	Douglas	SSP2 (shift)
Daviess	SSP2 (no shift)	Edgar	SSP2 (shift)
Decatur	SSP3 (shift)	Edwards	SSP2 (shift)
Dubois	SSP2 (no shift)	Effingham	SSP2 (shift)
Gibson	SSP2 (no shift)	Gallatin	SSP2 (shift)
Greene	SSP2 (shift)	Jasper	SSP2 (shift)
Hendricks	SSP2 (no shift)	Lawrence	SSP2 (no shift)
Jackson	SSP2 (shift)	Richland	SSP2 (shift)
Jefferson	SSP2 (no shift)	Wabash	SSP2 (shift)
Jennings	SSP2 (shift)	White	SSP2 (shift)
Johnson	SSP2 (shift)		
Knox	SSP2 (no shift)		
Lawrence	SSP2 (shift)		
Martin	SSP2 (shift)		
Monroe	SSP3 (shift)		
Morgan	SSP4 (shift)		
Orange	SSP2 (no shift)		
Owen	SSP2 (shift)		
Parke	SSP2 (shift)		
Pike	SSP2 (shift)		
Posey	SSP2 (shift)		
Putnam	SSP2 (shift)		
Ripley	SSP4 (shift)		
Scott	SSP4 (shift)		
Spencer	SSP2 (no shift)		
Sullivan	SSP2 (no shift)		
Vanderburgh	SSP2 (shift)		

Indiana county	Population trajectory	Illinois county	Population trajectory
Vermillion	SSP2 (shift)		
Vigo	SSP2 (no shift)		
Warrick	SSP2 (shift)		
Washington	SSP4 (shift)		

NOTE: shift = align with Census and STATS Indiana (Indiana); shift = align with Census (Illinois)

Sources

U.S. Census Bureau, <https://data.census.gov/>

StatsIndiana population projections, <https://www.stats.indiana.edu/topic/projections.asp>

IIASA SSP database, <https://tntcat.iiasa.ac.at/SspDb/dsd>

A.2.4 Population Centers and County-level Population Projections

Table A3: Full list of population center municipalities that are more than 50% inside the study area.

Municipality Name	2025 Population	Area (Sq. Miles)	Density (people/sq mi)	% in SWI
Bloomington	83,307	23.42	3,557	100
Terre Haute	58,764	34.91	1,683	100
Seymour	22,450	12.13	1,851	52
Jasper	17,279	13.43	1,287	100
Vincennes	16,378	7.56	2,166	100
Bedford	13,962	11.98	1,165	100
Washington	12,991	6.71	1,937	100
Martinsville	12,141	9.23	1,315	95
Greencastle	9,924	5.26	1,887	100
Princeton	8,524	5.47	1,559	86
Brazil	8,343	3.00	2,780	100
Scottsburg	7,478	5.51	1,356	100
Ellettsville	6,840	5.17	1,323	100
North Vernon	6,559	7.68	854	97
Huntingburg	6,522	5.31	1,227	100
Linton	5,245	3.15	1,667	100
Clinton	4,771	2.05	2,324	100
Austin	4,254	2.67	1,596	100
Sullivan	4,229	1.93	2,189	100
Mitchell	4,019	3.58	1,122	100
Paoli	3,596	3.75	959	100
Brownstown	3,154	1.62	1,943	100
Bicknell	2,982	1.32	2,256	100
Loogootee	2,633	1.58	1,667	100
Monrovia	2,485	1.76	1,413	58
Spencer	2,479	1.70	1,461	100
Bloomfield	2,306	1.32	1,744	100
Petersburg	2,289	1.47	1,556	100
Oakland City	2,274	1.12	2,022	100
Ferdinand	2,247	2.39	940	99
Cloverdale	2,174	3.55	613	100
West Terre Haute	2,160	0.70	3,101	100
Orleans	2,073	1.77	1,169	100

Municipality Name	2025 Population	Area (Sq. Miles)	Density (people/sq mi)	% in SWI
Jasonville	1,952	1.25	1,557	100
French Lick	1,772	2.06	861	100
Crothersville	1,506	1.16	1,299	100
Fairview Park	1,420	0.92	1,538	100
Worthington	1,403	0.76	1,858	100
Odon	1,378	0.94	1,471	100
Owensville	1,332	0.57	2,337	100
Nashville	1,273	1.61	793	100
Oolitic	1,142	0.67	1,701	100
Shelburn	1,103	0.73	1,519	100
Farmersburg	1,067	0.75	1,425	100
Morgantown	1,007	0.39	2,606	100
Seelyville	1,000	0.88	1,137	100
Poseyville	966	0.66	1,470	100
Jamestown	960	0.89	1,082	91
Clayton	948	0.65	1,467	100
Montezuma	929	0.59	1,583	72
Clay City	884	0.54	1,628	100
Gosport	865	0.37	2,359	100
Dugger	797	0.60	1,317	100
Montgomery	782	1.66	470	100
Winslow	742	0.58	1,276	100
West Baden Springs	721	1.12	644	100
Bainbridge	707	0.40	1,766	100
Patoka	706	1.22	581	100
New Harmony	680	0.75	903	100
Shoals	677	1.91	355	100
Knightsville	673	1.04	649	100
Harmony	668	0.84	797	100
Hymera	665	0.71	942	100
Medora	641	0.30	2,107	100
Lyons	638	0.80	794	100
Elnora	627	0.97	643	100
Carlisle	621	0.46	1,348	100
Paragon	584	0.27	2,181	100
Oaktown	576	0.27	2,106	100
Coatesville	573	0.66	863	100
Dana	554	0.35	1,604	100
Fillmore	553	1.95	284	100
Cynthiana	552	0.38	1,435	100
Francisco	539	0.61	884	100
Campbellsburg	539	1.01	535	100
Lizton	505	0.72	703	100
Monroe City	487	0.27	1,817	100
Plainville	485	0.34	1,406	100
North Salem	473	0.31	1,532	100
Staunton	467	0.33	1,436	100
Bruceville	448	0.34	1,310	100
Holton	430	1.83	234	100
Amo	428	0.62	685	100
Wheatland	391	0.40	982	100

Municipality Name	2025 Population	Area (Sq. Miles)	Density (people/sq mi)	% in SWI
Sandborn	359	0.37	958	100
Dupont	340	1.02	333	100
Universal	285	0.26	1,093	100
Bloomington	277	0.57	486	100
Edwardsport	276	0.28	992	100
Stilesville	276	0.26	1,077	100
Mecca	276	0.43	644	100
Switz City	273	0.20	1,372	100
Carbon	251	0.15	1,688	100
Riley	238	0.09	2,722	100
Vernon	236	0.21	1,149	100
Merom	210	0.37	565	100
Center Point	206	0.76	272	100
Little York	198	0.87	227	100
Stinesville	197	0.11	1,773	100
Decker	197	0.18	1,099	100
Hazleton	196	0.35	568	100
Cannelburg	174	0.21	841	100
Crane	165	0.14	1,160	100
Spurgeon	164	0.18	932	100
Newberry	160	0.48	333	100
Millhousen	145	1.18	123	100
Griffin	139	0.06	2,144	100
Livonia	103	1.21	85	92
Saltillo	101	1.14	89	100
Alfordsville	66	0.07	997	100

Population projections for counties in the Southwest Indiana regional water study area come from Gao's (2019) global spatial population projection dataset based on Shared Socioeconomic Pathway 2 (SSP 2), also known as the "Middle of the Road" pathway. SSP 2 assumes that trends of recent decades will continue and that global progress relating to development goals will be mixed. While per-capita income levels would grow steadily, many regions of the world would continue to experience high levels of income inequality. Use of fossil fuels would slowly decrease, but poorer nations would continue to experience widespread air and water pollution. Most nations would have political stability.

Table A-4: Population projections for Indiana counties in the study area

Year	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Brown	15,722	15,613	15,232	14,837	14,224	13,555	13,128	12,756	12,456	12,181	11,857
Clay	26,533	26,257	25,742	25,071	24,316	23,538	22,697	21,890	21,075	20,222	19,343
Daviess	33,890	34,392	34,739	35,077	35,376	35,647	35,802	35,846	35,744	35,478	35,020
Dubois	43,538	43,889	43,628	43,116	42,367	40,762	39,785	38,954	38,056	37,110	36,227
Gibson	32,834	32,505	32,060	31,504	30,819	30,113	29,125	28,089	26,976	25,692	24,335
Greene	31,508	30,899	30,095	29,202	28,168	27,104	25,649	24,312	23,117	21,949	20,818
Hendricks	192,472	206,661	218,811	230,568	241,935	253,068	264,736	276,128	287,378	298,383	308,920
Jackson	46,673	47,279	47,338	47,453	47,259	46,948	47,221	47,492	47,606	47,655	47,605
Jefferson	33,000	33,080	32,701	32,191	31,502	31,486	31,043	30,594	30,136	29,653	29,089

Year	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Jennings	27,704	27,227	26,599	25,943	25,088	24,161	22,766	21,444	20,248	19,045	17,793
Knox	36,171	35,407	34,514	33,573	32,558	32,405	31,750	31,114	30,368	29,536	28,754
Lawrence	45,137	44,576	43,819	43,015	42,055	41,017	39,770	38,570	37,392	36,125	34,786
Martin	10,008	9805	9553	9241	8899	8510	8086	7669	7267	6839	6423
Monroe	148,159	148,159	149,283	150,076	150,874	151,420	153,039	154,186	154,740	155,119	155,638
Morgan	74,125	75,287	75,757	75,934	75,560	75,452	75,571	75,691	75,503	75,315	74,565
Orange	19,504	19,241	18,752	18,184	17,556	16,301	15,861	15,486	15,126	14,750	14,361
Owen	21,520	21,307	20,819	20,284	19,559	18,831	17,550	16,411	15,340	14,297	13,305
Pike	12,056	11,779	11,470	11,147	10,770	10,439	10,001	9593	9214	8839	8474
Posey	24,920	24,436	23,689	22,825	22,110	21,478	20,745	20,057	19,350	18,584	17,771
Putnam	38,037	37,938	37,695	37,395	36,920	36,342	35,864	35,436	35,013	34,568	34,067
Ripley	29,426	29,500	29,387	29,054	28,621	28,127	26,979	25,923	24,892	23,798	22,701
Scott	24,870	24,953	24,915	24,844	24,651	24,455	22,796	21,212	19,725	18,273	16,865
Sullivan	20,778	20,421	19,877	19,226	18,426	17,972	17,472	16,916	16,305	15,635	14,929
Vigo	106,092	105,210	103,837	102,545	100,727	101,200	99,985	98,874	97,708	96,394	95,674
Washington	28,283	28,036	27,567	27,032	26,292	25,497	24,999	24,500	23,948	23,396	22,702

Table A-5: Population projections for Illinois counties in the study area

Year	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075
Champaign	223,848	231,416	237,587	244,321	250,094	256,432	262,960	269,167	274,712	279,954	285,823
Clark	14,914	14,318	13,696	13,078	12,466	11,868	11,337	10,826	10,311	9759	9214
Coles	53,967	53,829	52,972	52,332	51,203	49,989	48,758	47,363	45,897	44,206	42,226
Crawford	18,223	17,703	17,177	16,610	15,961	15,336	14,762	14,172	13,530	12,832	12,126
Cumberland	10,147	9770	9373	8968	8546	8128	7730	7342	6943	6550	6185
Douglas	19,415	19,144	18,877	18,594	18,286	18,020	17,784	17,530	17,241	16,925	16,572
Edgar	15,943	14,963	13,979	12,976	11,983	11,076	10,257	9466	8737	8016	7330
Edwards	5950	5628	5297	4978	4671	4385	4128	3888	3668	3451	3249
Effingham	34,347	33,814	33,116	32,224	31,089	29,960	28,977	27,996	26,873	25,585	24,220
Gallatin	4655	4364	4085	3819	3570	3340	3125	2909	2697	2499	2331
Jasper	9047	8776	8489	8209	7915	7602	7332	7079	6796	6503	6227
Lawrence	15,664	15,378	15,099	14,897	14,616	14,267	13,875	13,450	12,989	12,508	12,048
Richland	15,376	14,879	14,356	13,816	13,225	12,645	12,125	11,599	11,054	10,463	9901
Wabash	10,854	10,319	9792	9288	8801	8362	7979	7615	7258	6899	6552
White	13,513	13,081	12,654	12,267	11,865	11,524	11,247	10,964	10,601	10,182	9772

Sources

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StatsIndiana, 2026, Population Estimates for Indiana's Incorporated Places, 2020-2025, https://www.stats.indiana.edu/population/sub_cnty_estimates/2025/e2025-places.asp

A.2.5 Median Household Income and Per Capita Personal Income

Median household income (MHI) and per-capita personal income (PCI) were converted to inflation-adjusted values prior to model fitting. Inflation adjustment was performed using the national Consumer Price Index for All Urban Consumers, All Items, U.S. City Average, from the U.S. Bureau of Labor Statistics, accessed through FRED as series CPIAUCSL. CPI was used only to convert income predictors to constant-dollar terms and was not included as an independent model predictor. The inflation-adjusted income variables (MHI and PCI) were used either directly or as indices normalized to a baseline year. The Consumer Price Index was used only in preprocessing to express income variables in constant dollars; CPI was not included as an independent predictor in the water-demand models.

Reference counties used in grouped public water supply projections included: Daviess, Dubois, Gibson, Lawrence, Monroe, Morgan, Owen, Pike, Posey, and Vigo

Sources

County-level median household income was obtained from the U.S. Census Bureau Small Area Income and Poverty Estimates (SAIPE) series, accessed through Federal Reserve Economic Data (FRED) <https://fred.stlouisfed.org/release?rid=346>

County-level per capita personal income was obtained from the U.S. Bureau of Economic Analysis Personal Income by County series <https://www.bea.gov/data/income-saving/personal-income-by-county>

U.S. Bureau of Labor Statistics, Consumer Price Index for All Urban Consumers: All Items in U.S. City Average (CPIAUCSL), accessed through Federal Reserve Economic Data (FRED), Federal Reserve Bank of St. Louis. <https://fred.stlouisfed.org/series/CPIAUCSL>

A.2.6 Confined feeding operations and livestock

Active CFO/CAFO permit snapshots were obtained from IDEM for 2018, 2022, 2024, and 2026. Facility coordinates were cleaned, converted to NAD 1983 UTM Zone 16N, and spatially joined to gage-defined subbasins. Permitted animal descriptions from IDEM and USDA terminology were cross-walked into 16 animal and life-stage groups suitable for drinking-water estimation. Permit counts represent permitted capacity, not observed annual inventory.

A 2007 baseline was reconstructed from county USDA Census of Agriculture livestock counts and distributed among subbasins using the locations of older facilities that remained represented in the IDEM permit database. Piecewise linear interpolation between the 2007 reconstruction and permit snapshots created annual subbasin capacity estimates. Isolated zeros between comparable positive permit snapshots were reviewed as potential omissions; zeros before the first credible operation or after the last credible operation were retained. Annual herd/flock turnover multipliers, monthly occupancy, seasonal climate multipliers, and literature-based daily drinking rates were stored as separate model inputs.

The full description of livestock-operation (CAFO) projections is presented in Appendix D.

Sources

IDEM CFO/CAFO permit records, <https://www.in.gov/idem/cfo/resources/pending-and-issued-cfo-permits/>
USDA National Agricultural Statistics Service Quick Stats, <https://quickstats.nass.usda.gov/>
USDA 2007 National Agricultural Statistics Service Census,
https://www.nass.usda.gov/AgCensus/archive/census_year/2007-census/index.html

A.2.7 Self-supplied residential inputs

Indiana self-supplied residential population was estimated by comparing residential locations with public-water service areas. The National Address Database (NAD), statewide parcels and property-class codes, utility service areas, Indiana service-line information, aerial imagery, Census household size, and occupancy/vacancy rates were used together. Address points were assigned household counts, with manual review of duplexes, multifamily housing, mobile-home parks, general-farm residences, unknown address types, vacant subdivisions, and tax-exempt housing. Locations outside public-water service areas were treated as potentially self-supplied; household estimates inside service areas were used as a reasonableness check against reported utility population served.

Illinois could not be processed identically because approximately 95% of NAD points in the contributing area were coded as unknown and a comparable statewide parcel download was unavailable. A land-cover analogue method was tested and rejected because rural address points frequently represented field entrances, agricultural buildings, silos, infrastructure, or demolished farmsteads rather than residences. The final Illinois screening relied principally on 2020 Census blocks and EPA public-water-system service areas, adjusted to reported population served. Aerial review of address points outside service areas provided a spatial check but was not used as an unqualified residential-address count.

For both states, self-supplied population was converted to withdrawal using 76 gallons per capita per day, consistent with the 2015 USGS Indiana domestic-use estimate (Dieter et al., 2018).

Sources

U.S. Department of Transportation National Address Database,
<https://www.transportation.gov/mission/open/gis/national-address-database>
Indiana Geographic Information Office parcels, <https://dataharvest.gio.in.gov/pages/data-access>
Dieter, C.A., Maupin, M.A., Caldwell, R.R., Harris, M.A., Ivahnenko, T.I., Lovelace, J.K., Barber, N.L., and Linsey, K.S., 2018, Estimated use of water in the United States in 2015: U.S. Geological Survey Circular 1441, 65 p., <https://doi.org/10.3133/cir1441>. [Supersedes USGS Open-File Report 2017–1131.]

A.2.8 Energy, industrial, mining, irrigation, and rural-use inventories

Historical monthly withdrawals for these sectors were derived primarily from SWWF records. The sector/subsector distinction described above separated power generation from energy-fuel or coal-mining withdrawals; manufacturing from quarries and other mining; crop irrigation from turf/landscape irrigation; and registered rural uses from the separately reconstructed CAFO demand series.

The energy inventory was supplemented with facility-level information on ownership, prime mover, fuel, cooling system, water source, operating date, retirement or conversion date, and proposed additions. The working inventory includes Petersburg, Gibson, Merom, Wheatland, Lawrence County, Worthington, Sugar Creek, Eagle Valley, Wabash Hydrogen, and proposed Sycamore Riverside facilities, as well as small Illinois facilities relevant to contributing basins. Integrated resource plans, EIA generator records, permit documents, owner announcements, SWWF records, and NPDES records should be retained as source fields for every facility-level assumption.

Table A-6: Current (2023) and projected Future irrigated area for each subbasin

Subbasin	Current			Future		
	% Irrigated	Area (SqMi)	Area (Acres)	% Irrigated	Area (SqMi)	Area (Acres)
1	0%	0.0	0.0	0%	0.0	0.0
2	0%	0.3	200.8	0%	0.1	46.3
3	0%	0.2	123.6	0%	0.0	0.0
4	1%	11.0	7027.1	1%	11.9	7644.8
5	0%	0.2	123.6	0%	0.0	15.4
6	0%	0.2	108.1	0%	0.2	123.6
7	0%	0.0	0.0	0%	0.1	46.3
8	0%	0.1	77.2	0%	0.0	0.0
9	1%	11.5	7351.4	1%	11.4	7320.5
10	1%	13.8	8834.0	1%	12.7	8139.0
11	1%	1.2	787.6	1%	1.2	787.6
0	1%	5.5	3505.8	1%	4.7	3027.0
12	4%	36.7	23,459.6	4%	34.6	22,146.8
13	0%	0.0	0.0	0%	0.0	15.4
14	17%	59.7	38,224.1	16%	55.4	35,459.6
15	0%	0.0	0.0	0%	0.0	0.0
16	0%	0.0	15.4	0%	0.0	15.4
17	20%	89.9	57,560.1	18%	83.0	53,096.7
18	0%	0.0	0.0	0%	0.0	0.0
19	13%	52.0	33,266.5	12%	47.9	30,671.9
20	12%	55.9	35,799.4	11%	51.3	32,849.6

Current (2023) irrigated area per subbasin

Based on reported irrigation water withdrawal locations (IDNR SWWF), mapped unregistered irrigation locations (center pivot systems), and the LANID irrigation dataset (Xie et al., 2021; Xie and Lark, 2021)

Irrigated area includes both agricultural (row crop) and turf (golf course) irrigation

Future irrigation areas were based on a modified 2025 FORE-SCE B2 model landover dataset (see Appendix G for details of data processing to incorporate crop- and irrigation-specific details).

Sources

EIA Plant-level generation and fuel consumption data, <https://www.eia.gov/electricity/data/eia923/>

EIA Preliminary Monthly Electric Generator Inventory, <https://www.eia.gov/electricity/data/eia860M/>

EIA Planned Electric Generating Unit Additions, https://www.eia.gov/electricity/monthly/xls/table_6_05.xlsx

EIA Planned Electric Generating Unit Retirements, https://www.eia.gov/electricity/monthly/xls/table_6_06.xlsx

Indiana Department of Natural Resources (IDNR), 2023, Significant Water Withdrawal Facility (SWWF) Database <https://www.in.gov/dnr/water/water-availability-use-rights/significant-water-withdrawal-facility-data/> [Accessed, 1 August 2026].

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- Sohl, T.L., Sayler, K.L., Bouchard, M.A., Reker, R.R., Freisz, A.M., Bennett, S.L., Sleeter, B.M., Sleeter, R.R., Wilson, T., Soulard, C., Knuppe, M., and Van Hofwegen, T., 2018, Conterminous United States Land Cover Projections - 1992 to 2100: U.S. Geological Survey data release, <https://doi.org/10.5066/P95AK9HP>.
- U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS), 2023, 2023 Indiana Cropland Data Layer, https://www.nass.usda.gov/Research_and_Science/Cropland/metadata/metadata_in23.htm [Accessed, 1 August 2026].
- Xie, Y., Gibbs, H.K. and Lark, T.J., 2021. Landsat-based Irrigation Dataset (LANID): 30 m resolution maps of irrigation distribution, frequency, and change for the US, 1997–2017. *Earth System Science Data*, 13(12), pp.5689-5710.
- Xie, Y. and Lark, T.J., 2021. Mapping annual irrigation from Landsat imagery and environmental variables across the conterminous United States. *Remote Sensing of Environment*, 260, p.112445.

A.3 Wastewater-return data

A.3.1 NPDES discharge-monitoring records

Monthly reported wastewater discharges were obtained from EPA Enforcement and Compliance History Online (ECHO), which distributes ICIS-NPDES Discharge Monitoring Report (DMR) data. NPDES permit and outfall identifiers were linked to discharge-point locations, facility type, study sector, and gage-defined subbasin. The historical analysis used 2007-2023 records to match the common withdrawal period. Public-supply returns excluded records classified primarily as combined-sewer overflow or stormwater where possible; this screened series is identified in the working files as PS_minusCSO.

Flow records were standardized to monthly million gallons. When reported flow represented a 3- or 6-month reporting interval, the interval total or average was converted to monthly volumes using the number of days in the applicable months. Probable unit and order-of-magnitude errors were reviewed against adjacent records and facility behavior. Records were corrected only when the intended scale was defensible; otherwise they were retained and flagged. Multiple outfalls were summed only after confirming that doing so did not duplicate the same facility flow.

Sources

U.S. EPA ECHO data downloads, <https://echo.epa.gov/tools/data-downloads>

A.3.2 Estimated non-NPDES returns

When a withdrawal lacked an applicable reported NPDES return, return flow was estimated only where needed for the regional water balance. Irrigation and reconstructed CAFO withdrawals were assigned 20% return and 80% consumptive use. Self-supplied residential return fractions were seasonal: 100% in Winter (December-February), 98% in Spring (March-May), 81% in Summer (June-August), and 93% in Fall (September-November), based on the Indiana public-supply consumptive-use pattern reported by Shaffer (2009). Additional sector coefficients used in returns projections are listed in Appendix D because their application is part of the forecast method rather than raw-data processing.

Sources

Shaffer (2009), Variations in withdrawal, return flow, and consumptive use of water in Ohio and Indiana, with selected data from Wisconsin, 1999–2004: U.S. Geological Survey Scientific Investigations Report 2009-5096, <https://pubs.usgs.gov/sir/2009/5096/>

A.4 Hydrologic and water-availability data

A.4.1 Gage-defined subbasins and routing

Local catchments were delineated for the study streamgages and organized as a nested upstream-to-downstream network. The routing framework was used to distinguish local demand and return flow from accumulated upstream quantities. HUC12 data were associated with the same NWAA HUC12 version throughout the study and routed through the HUC12-to-HUC12 downstream linkage before aggregation to gage outlets. Cross-basin public-water transfers, wastewater returns, and reservoir operations were represented explicitly where data permitted.

Sources

U.S. Geological Survey, Watershed Boundary HUC12, <https://www.arcgis.com/home/item.html?id=cf86758469324bfbaef2b06058c11dd3#overview>

A.4.2 USGS streamflow and low-flow records

Daily streamflow was downloaded from USGS Water Data for the Nation for the study gage network. Station-specific periods were retained rather than imposing a common start date; the longest records extend to the early twentieth century, while some regulated or tributary records begin later. Daily values were screened for provisional flags, missing intervals, zero flows, and changes in regulation or gage location. The historical endpoint used in the final analysis was 2025 where data were complete.

Daily records supported annual and seasonal flow summaries, flow-duration statistics, and annual 7-day minima. Q90 was used for annual, winter, and spring low-flow thresholds; 7Q10 was used for summer and fall. Before/after analyses at regulated gages used matched pre- and post-dam periods and were interpreted separately from regional (climate-driven) post-2000 wetting. The availability model used monthly withdrawals and returns with daily discharge as an instantaneous accounting approximation; it did not model delayed stream depletion from groundwater pumping.

Sources

U.S. Geological Survey, Water Data for the Nation, <https://waterdata.usgs.gov/nwis>

A.4.3 Reservoir and managed-flow records

Reservoir operations were compiled where they materially affected downstream low flows. Patoka Lake records were evaluated with the nearby USGS gage network and U.S. Army Corps of Engineers information. Upstream inputs to the White River at Centerton included Morse, Geist, and Eagle Creek operations and the DigIndy tunnel return-flow record. Storage was represented with a signed convention (negative for storage and positive for release). Gage, owner, and planning data were reconciled at a monthly time step, with discontinuities and incomplete historical storage records documented rather than treated as observed operations.

A.4.4 Climate and hydrology modeling for water availability

A full description of climate and hydrology modeling conducted for the water-availability portion of this project can be found in Appendix D.

A.5 Illinois water-use data and comparability

Illinois inputs were retained because several Illinois catchments contribute flow to the modeled Indiana gages, but Illinois water-use records were not equivalent to Indiana SWWF data in temporal coverage, sector detail, location precision, or monthly reporting. Illinois State Water Survey compilations were cross-referenced to the Indiana water-use sector classification where feasible, assigned to contributing gage catchments, and converted to common units. Where only annual or intermittent values were available, recent annual magnitude and a defensible seasonal pattern were used; the records were not treated as if they had the same precision as Indiana monthly facility reports.

Illinois public-supply and self-supplied residential estimates relied more heavily on Census blocks, public-water-system service areas, and reported population served. Unmapped self-supplied commercial, agricultural, and small-facility uses are a likely source of underestimation. Illinois results should therefore be described as boundary-condition estimates adequate for regional routing, not a facility-complete Illinois demand inventory.

Treatment of Illinois data in projections for specific water-demand and wastewater return sectors can be found in Appendix D.