Indiana Regional Water Studies

North Central Indiana Regional Water Study Update

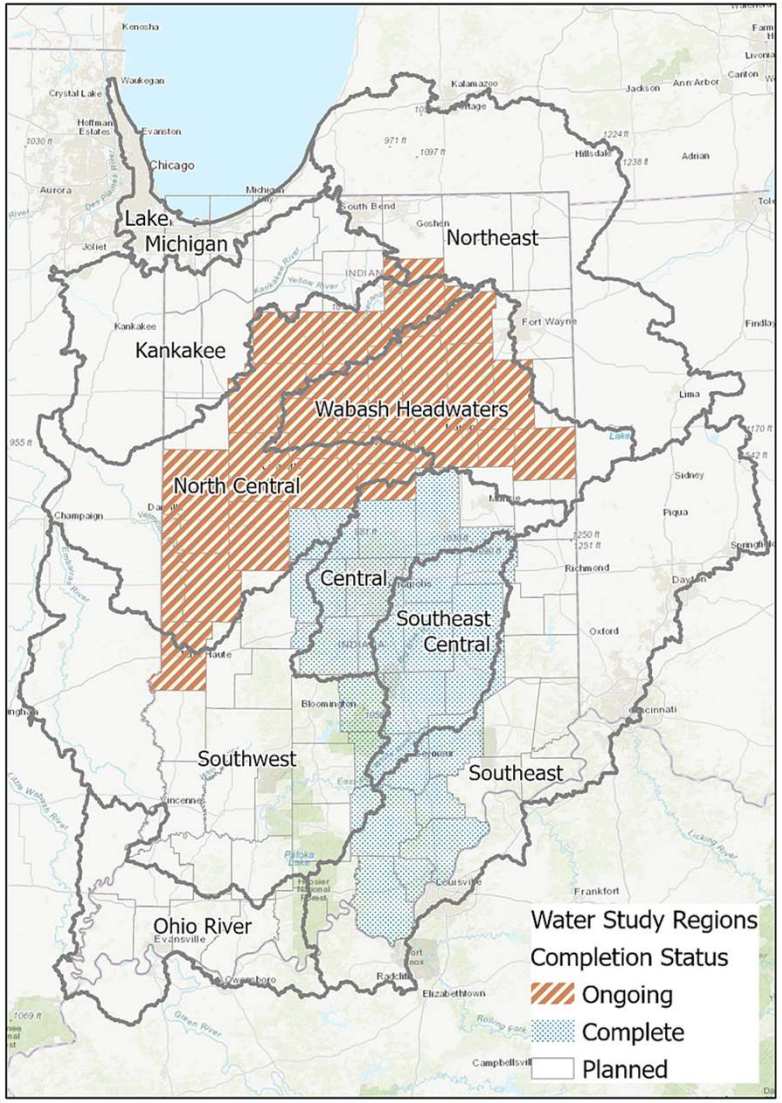
December 12 & 16, 2024

IFA Regional Water Studies – History

IC 5-1.2-11.5

https://iga.in.gov/laws/2024/ic/titles/5#5-1.2-11.5

- Southeastern Indiana Regional Water Supply Report, 2018
- Central Indiana Water Study, 2021
- Southeast Central (I-74) Water Study, 2024
- *North Central Indiana Water Study, 2025*
- *Wabash Headwaters Water Study, 2025*



IFA Regional Water Studies – General Goals

- Statewide understanding of water resources and needs
- Water studies provide data to support water planning
- Organized outreach with utilities, public officials, the public, economic development interests, other stakeholders
- Standardized process/comparable across regions
- Link to all studies: https://www.in.gov/ifa/regional-water-studies/

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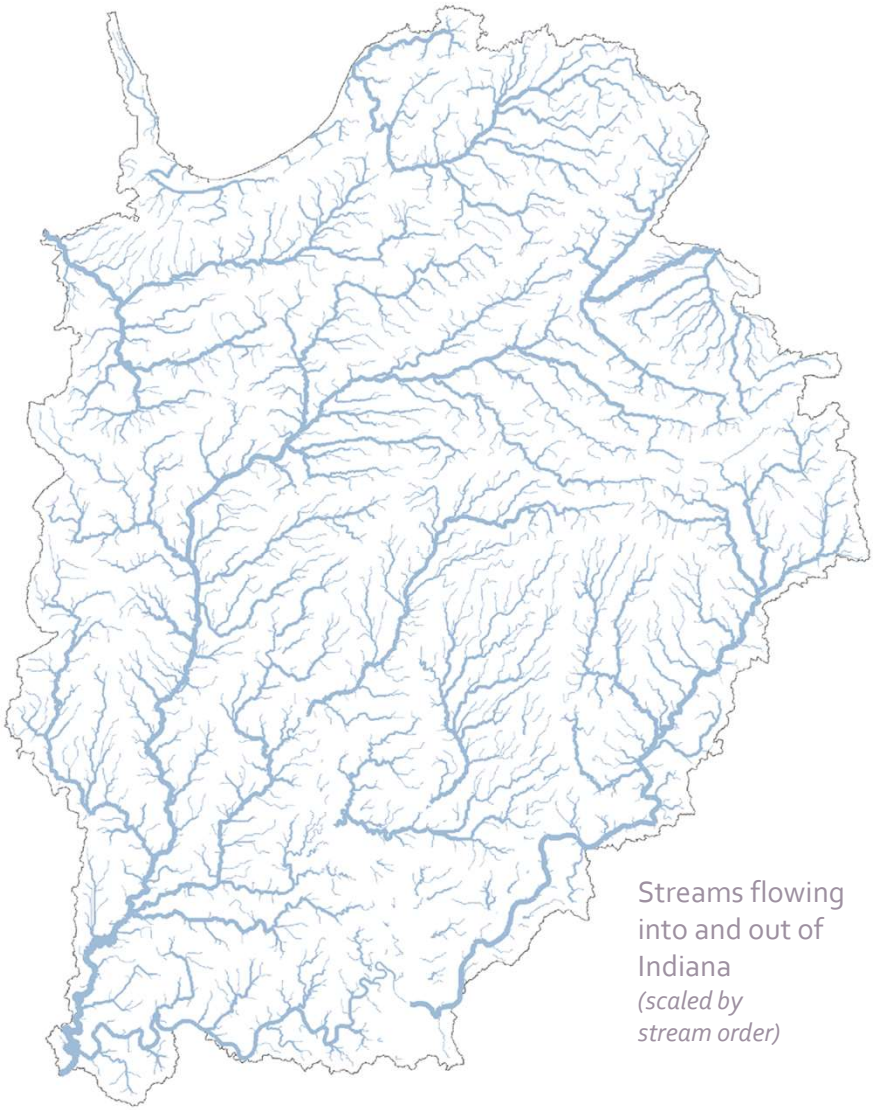
Approach:
Data-driven and Science-based

- Studies are supported by an **Advisory Board** with representatives from state and federal agencies, stakeholders from water-use sectors, and universities
- **Regional approach** allows us to focus on characteristics important to each region, incorporating region-specific economic factors, land use, water use, and geological factors
- Recognize administrative (i.e., county) boundaries, but **primarily focused on hydrology** (both surface and groundwater) at subbasin scale



Streams flowing into and out of Indiana
(scaled by stream order)

Wabash Headwaters and North Central Indiana Water Studies Advisory Board Composition

- Indiana Finance Authority – Lead
- Indiana Department of Natural Resources
- Indiana Department of Environmental Management
- U.S. Geological Survey
- Indiana Farm Bureau
- White River Alliance
- Purdue University
- Indiana University

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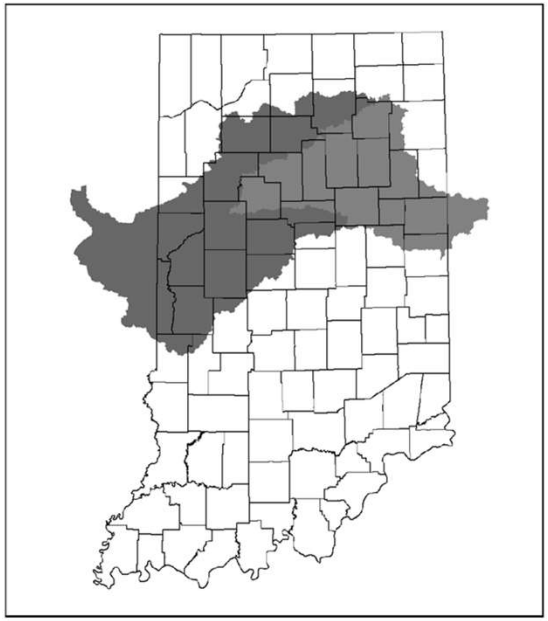
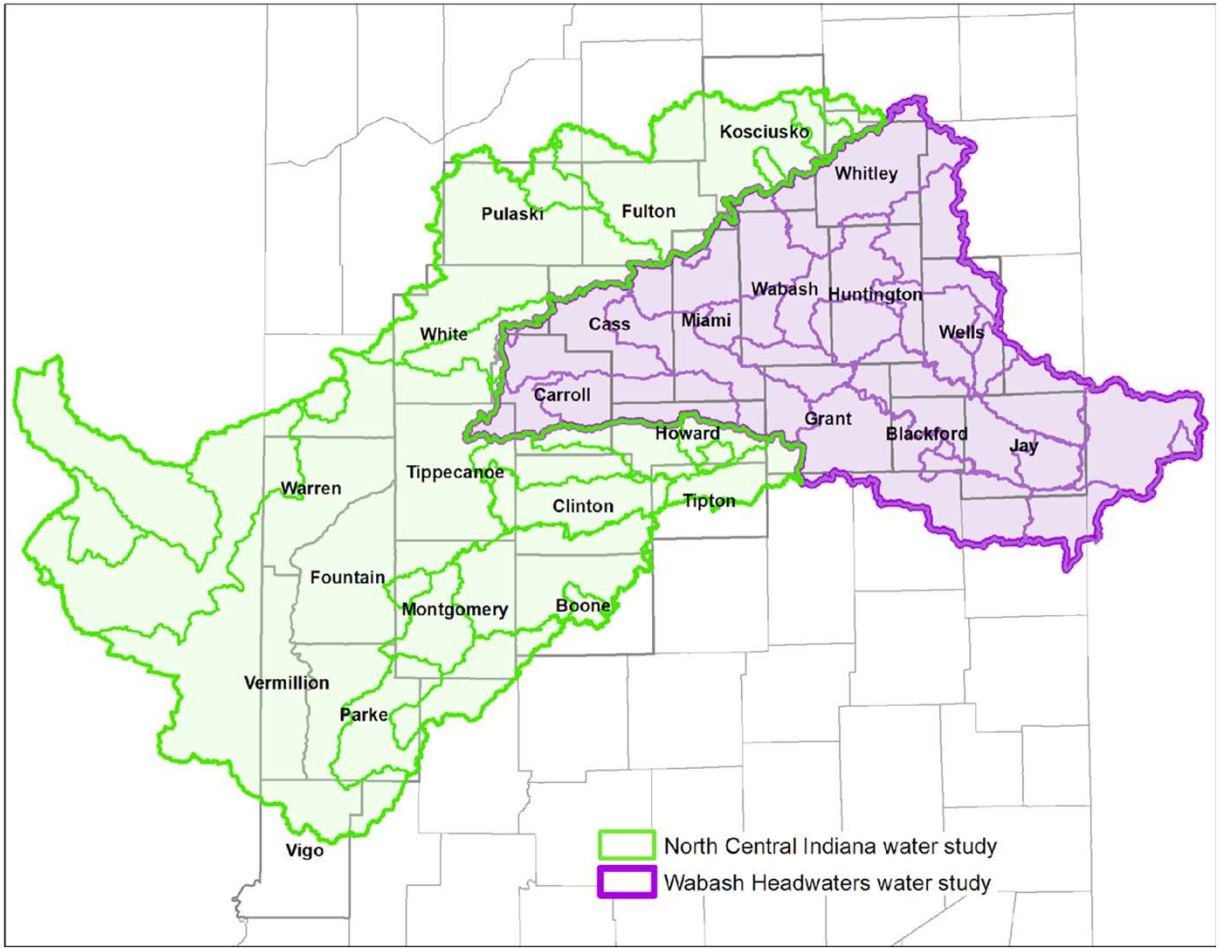


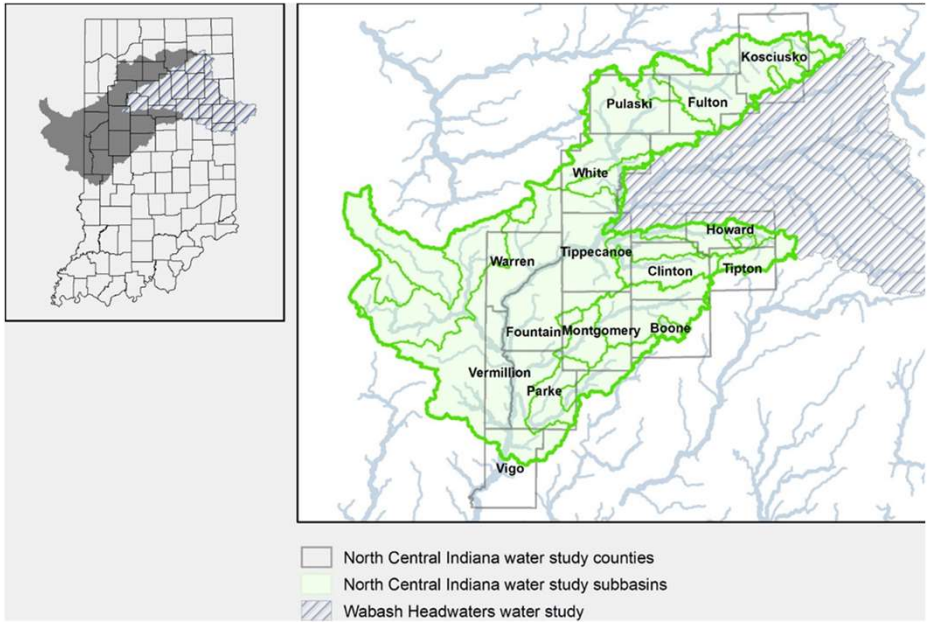
Current Studies:
Wabash River Basin



Current Studies: Wabash River Basin

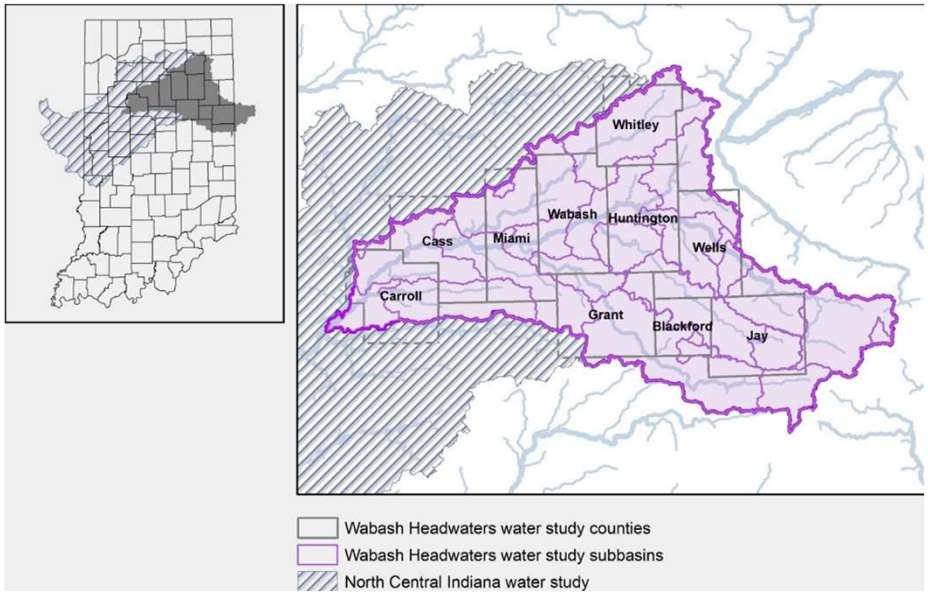
Stantec

Team: North Central Indiana (downstream)



Jacobs

Team: Wabash Headwaters (upstream)



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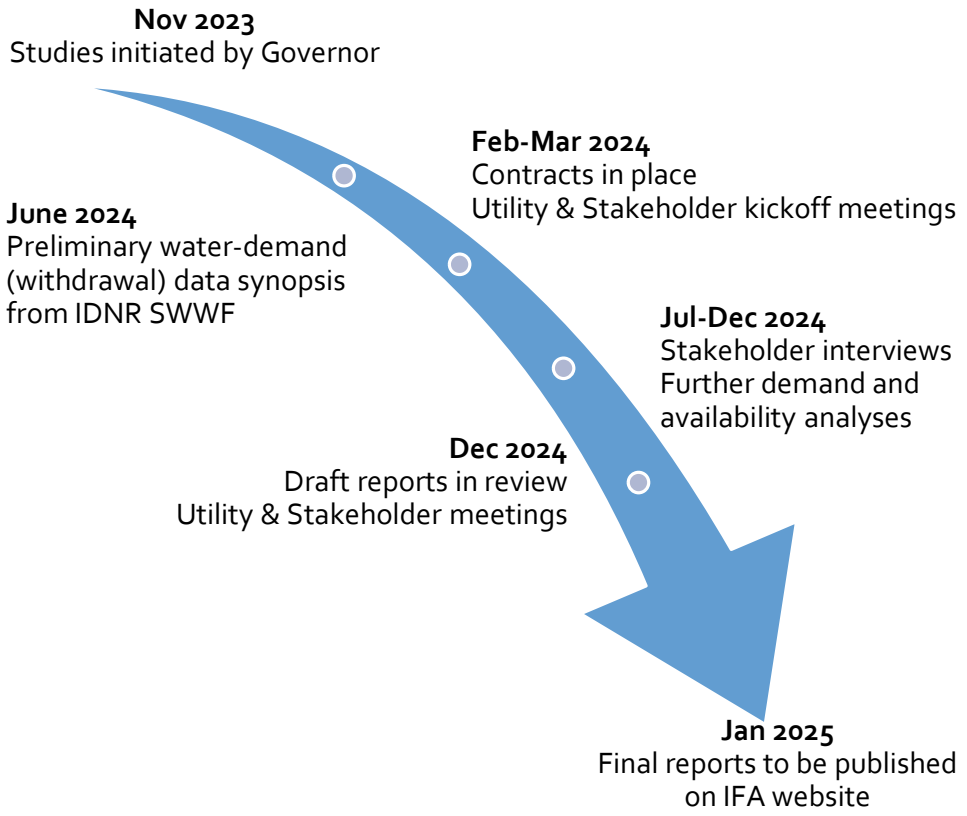
Wabash Headwaters & North Central Indiana Regional Water Studies Timeline



Water Studies: Objectives

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- Establish historical and future projections of water demand and availability
- Intended to support a 50-year regional water planning horizon

Overarching Approach in Regional Water Studies

Water balance

Natural water balance + human alterations + climate change

Water Demand
(atmospheric and ecosystem needs + human and altered land cover needs)

Water Availability
(climate/precip/runoff; storage | bank and floodplain storage, aquifers)

Modified by:

- Human withdrawals and inputs
- Climate change

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APPROACH: Water Demand - Historical

Approach:

- Based on historical data collected by the IDNR (1985-2022)
- Water-use sectors
  - Public supply (PS)
  - Industrial (IN)
  - Energy (EN)
  - Irrigation (agricultural and turf) (IR)
  - Rural (livestock, fisheries) (RU)

  Residential wells (estimated)
  Smaller livestock operations (estimated)

Assumptions:

- Water withdrawals are a proxy for water demand (treated as equivalent)
- Reported water use for significant water withdrawal facilities (SWWF) is representative of all water use
- Self-supplied residents all use water the same way

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APPROACH: Water Demand – Future Forecasts

COMPARE

- Compare historical water use by sector and location to potential influential factors, such as:
  - Economic variables (population trends, income, inflation)
  - Climate variables (temperature, precipitation, atmospheric thirst, crop demands, drought indices)

RELATE

- Identify mathematical relationships between water use and economic and climate variables

MODEL

- Use the relationships to estimate potential future water use by applying projections of the economic and climate variables.

Assumptions:

- Water sources (groundwater, surface water) used in the past by sectors or facilities will be the same in the future
- Future climate models provide an opportunity to calculate the likely hydrological response to changes in timing and magnitude of precipitation and temperature

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APPROACH: Water Availability – Historical and Future Projections

fx

Function of:

- proximity to and distribution of **geologic materials**
- human impacts and timing of demand/withdrawals (**seasonality**)
- **ecosystem** needs
- **climate**/future climate

Subbasin water availability

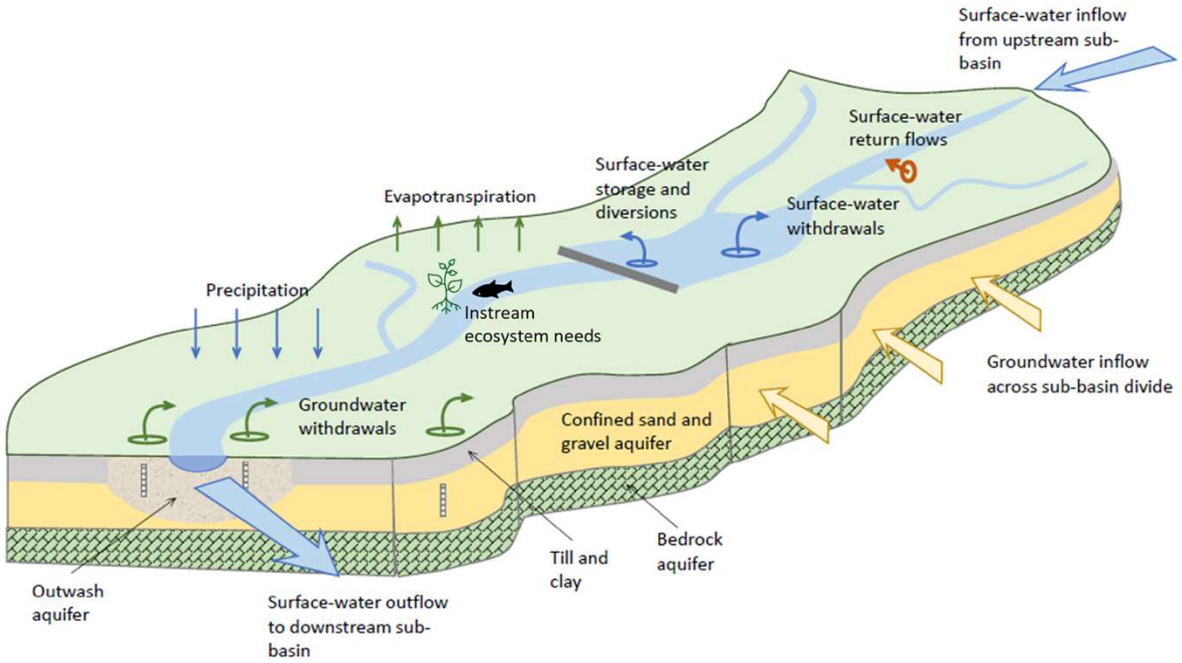

Figure modified from IFA, 2021 (Central Indiana Water Study)

Water inflows and outflows in a subbasin include processes and activities WITHIN the basin, and UPSTREAM/ DOWNSTREAM of the basin

Water availability is calculated throughout the entire stream/river network

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Wabash Headwaters Region

Regional Water Study

Jacobs

Challenging today.
Reinventing tomorrow.

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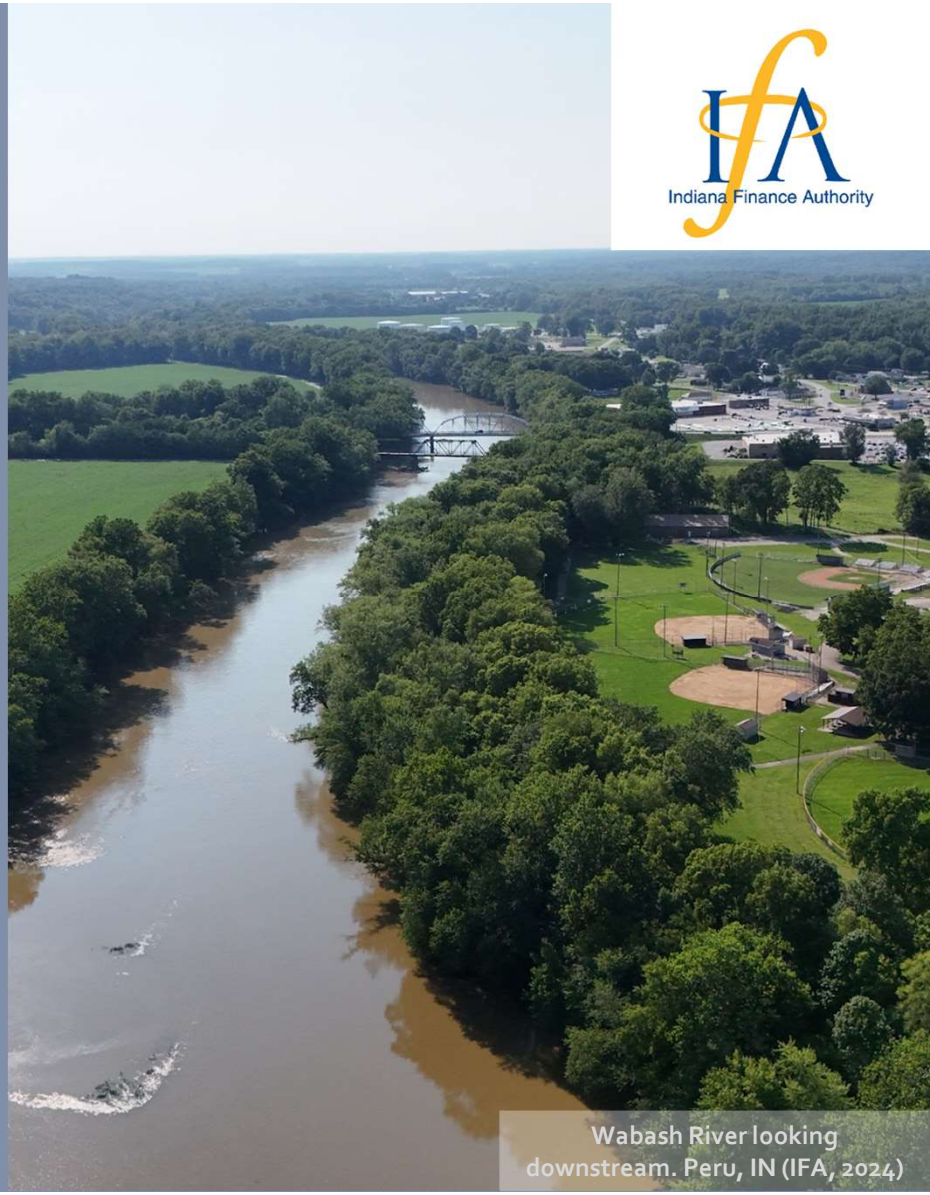
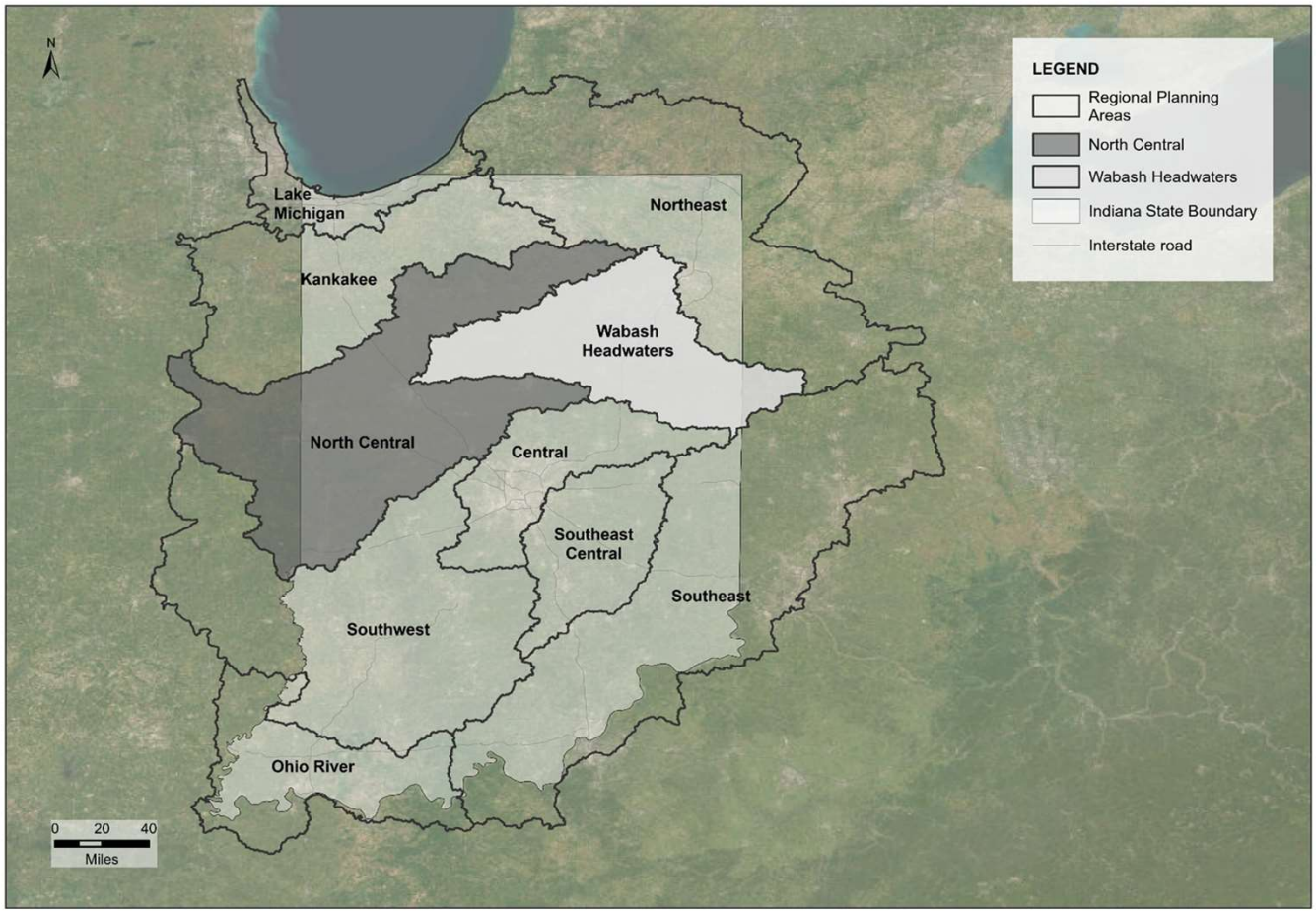


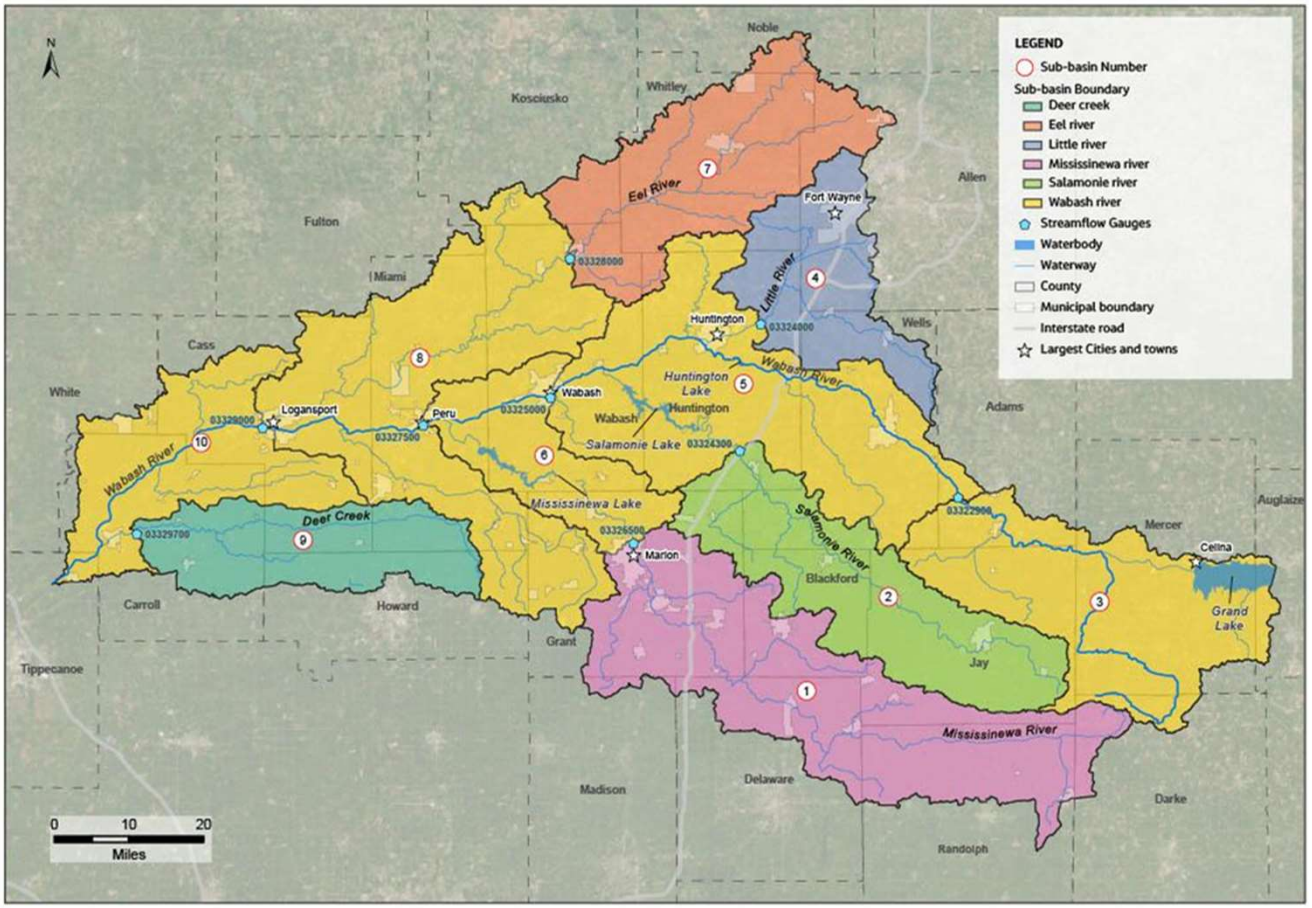
Wabash River looking downstream. Peru, IN (IFA, 2024)

Wabash River connects Headwaters Region to North Central Indiana Region

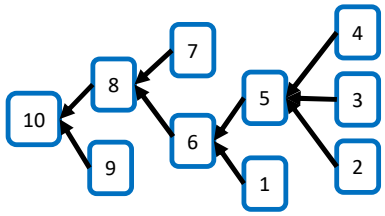


- Wabash Headwaters Region is connected to North Central Region at the Tippecanoe River confluence
- Demand and supply in this region affects water supply availability downstream

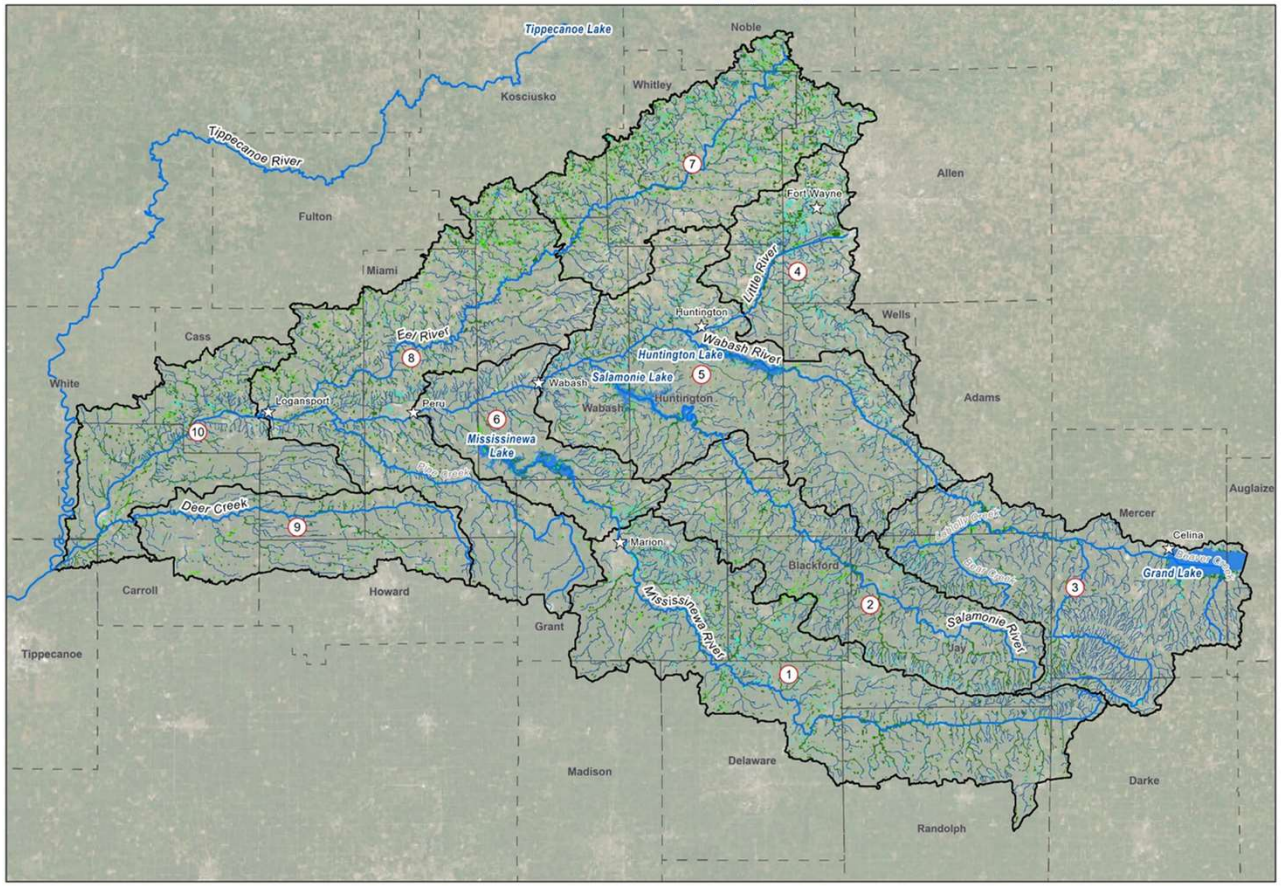
Region is defined by hydrology and includes whole and partial counties in Indiana and a small area of Ohio

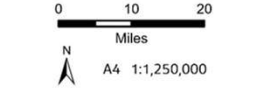


- Mainstem Wabash River and 5 tributaries
- 10 sub-basins
- 10 full counties and portions 14 counties
- 3 flood control and recreational reservoirs

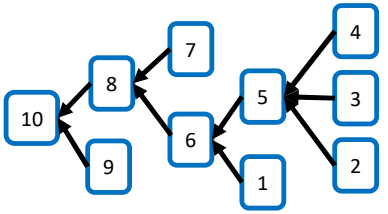


Wabash River, its main tributaries (Salamonie and Mississinewa Rivers), and reservoirs have unique characteristics affecting localized and downstream water supply availability

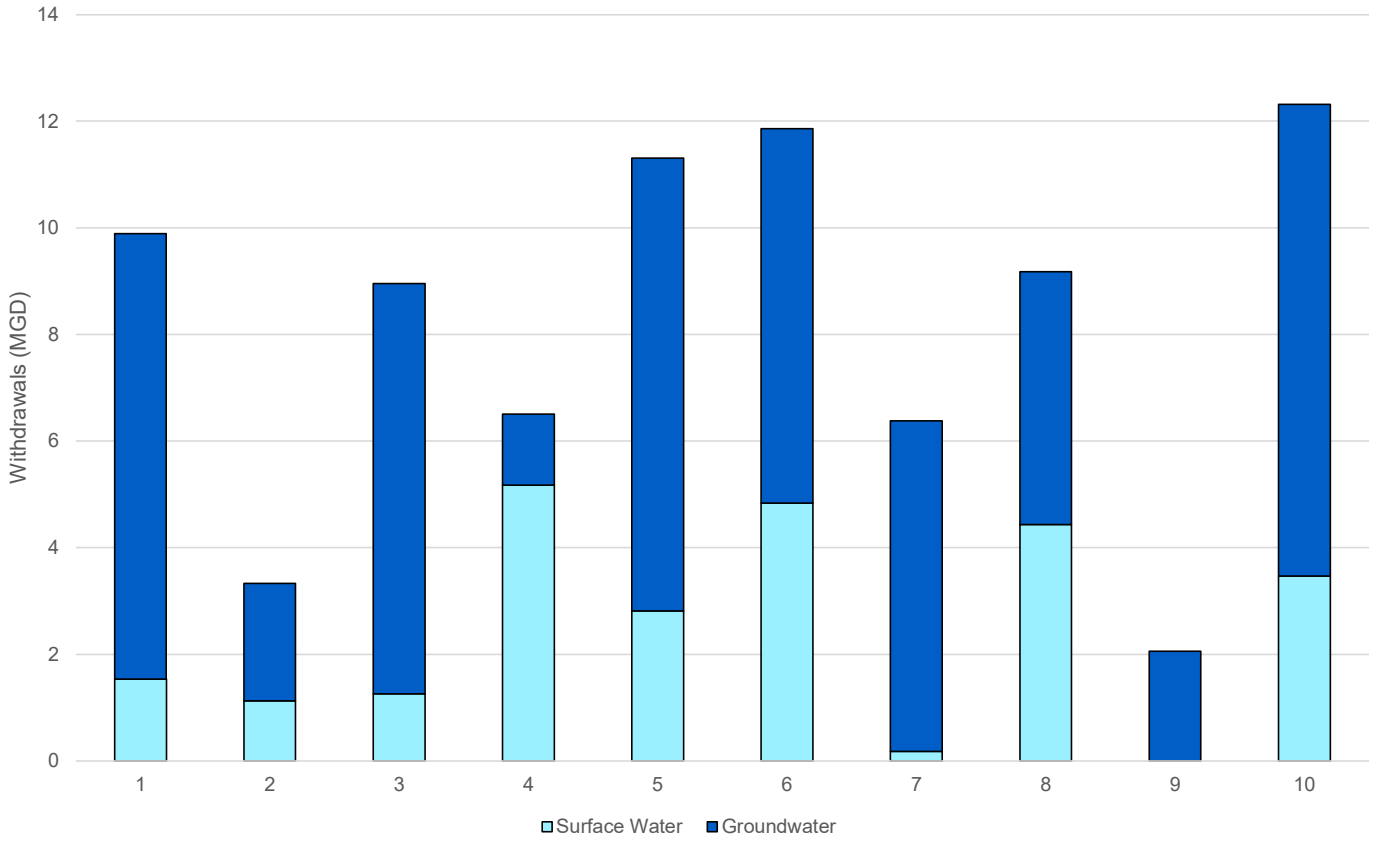




- Sub-watershed characteristics differ between mainstem or tributaries
- Reservoir operations (storage and releases) are a big driver of the water balance

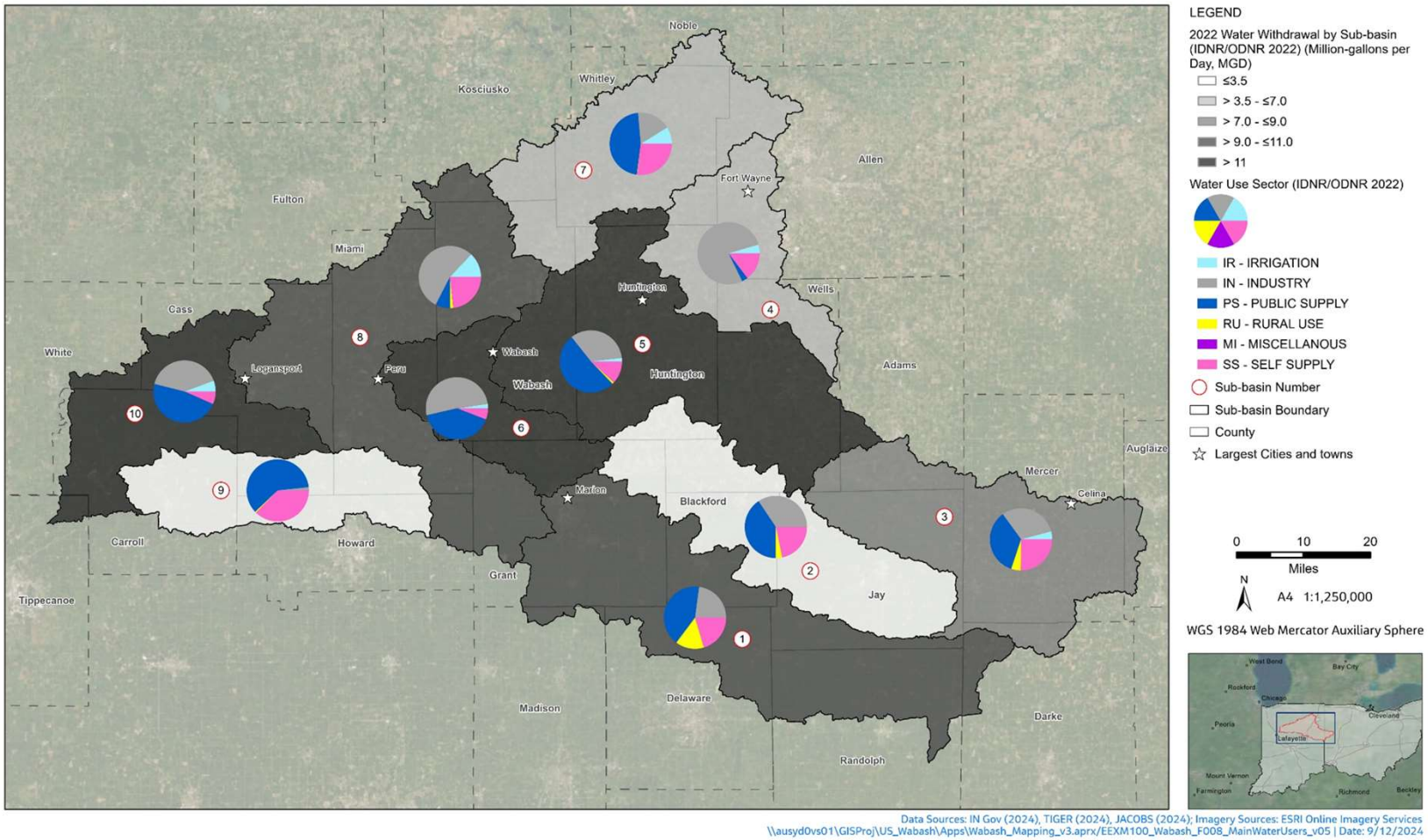


Water sources provide supply for over 400,000 people

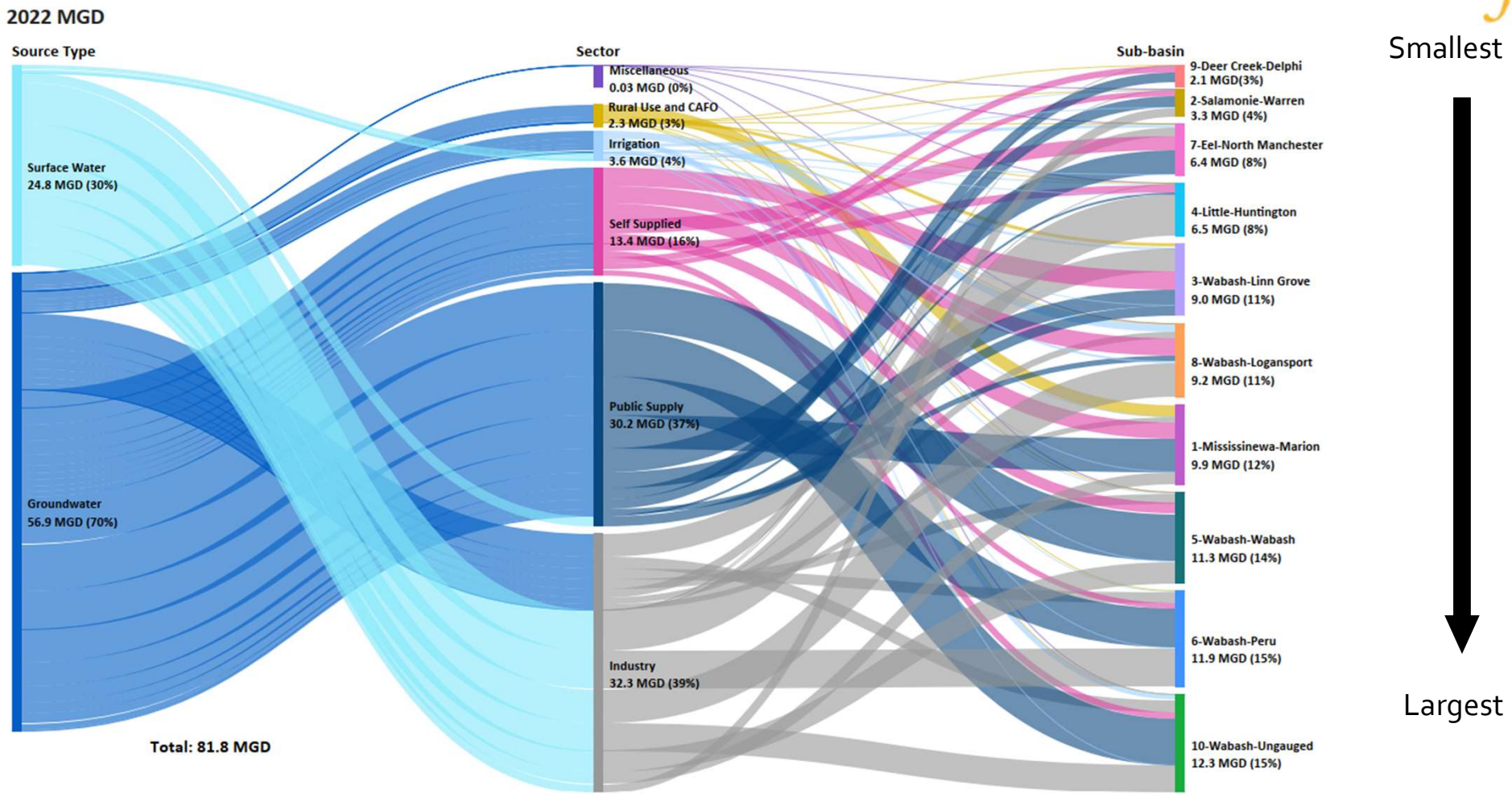


- Rural region with an average of ~90 people per square mile
- Some larger concentrations in cities
- Largely agricultural
- Over 70% of water supply is groundwater, historically and not expected to change much through 2070

Public water supply (utilities) and industry account for 76% of total water demand

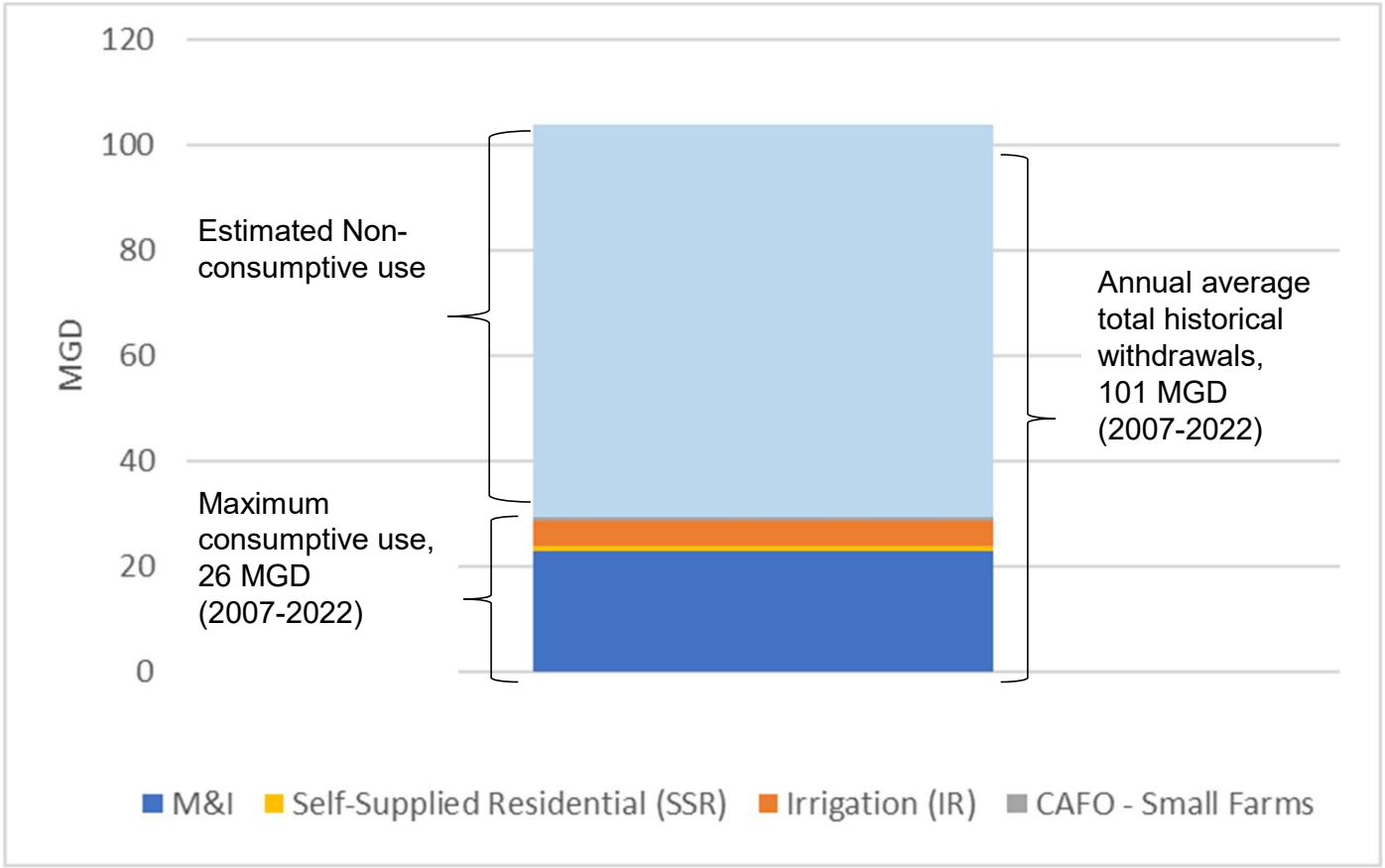


Where do water withdrawals come from and where do they go?



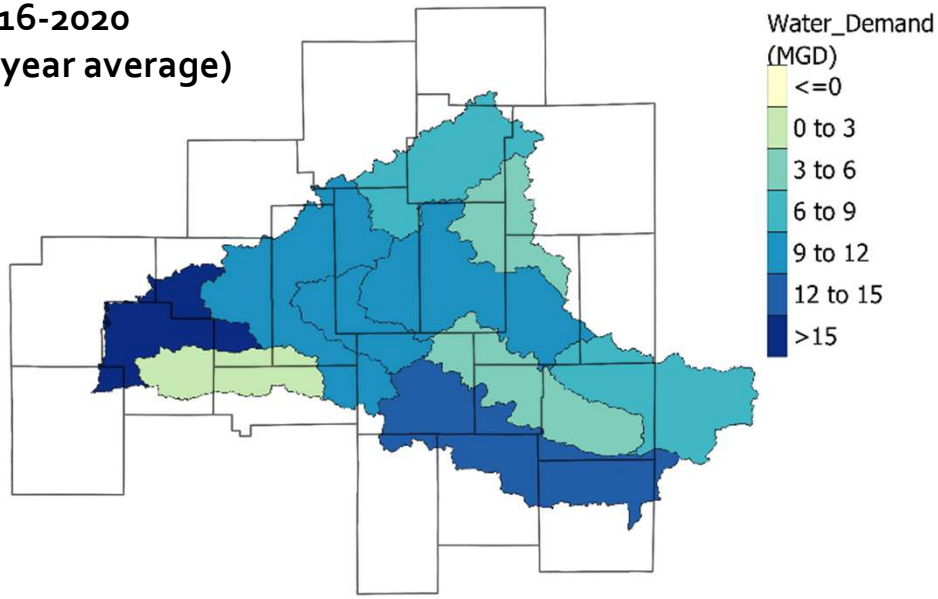
Maximum historical consumptive water use is 26 MGD (26% of total use)

- Generally, almost 75% of water withdrawals return to the system
- Discharged directly or through infiltration or seepage
- Some water withdrawals come from outside the region add to return flows

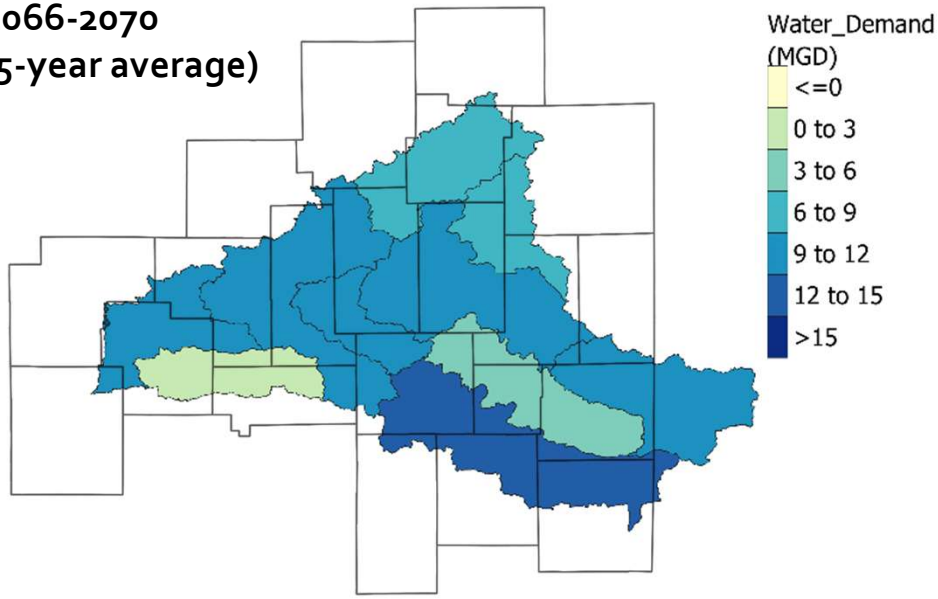


Water demand is expected to increase by ~10% by 2070

2016-2020
(5-year average)

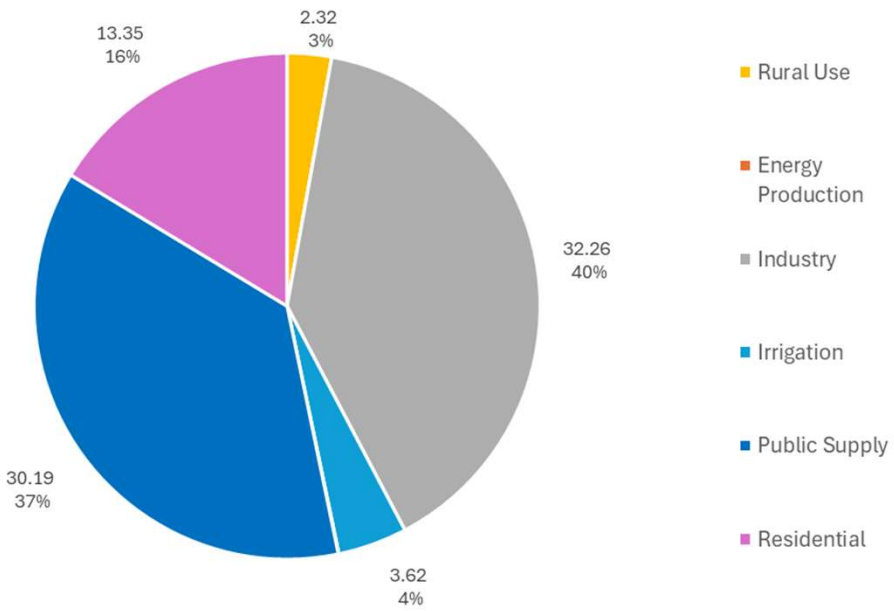


2066-2070
(5-year average)



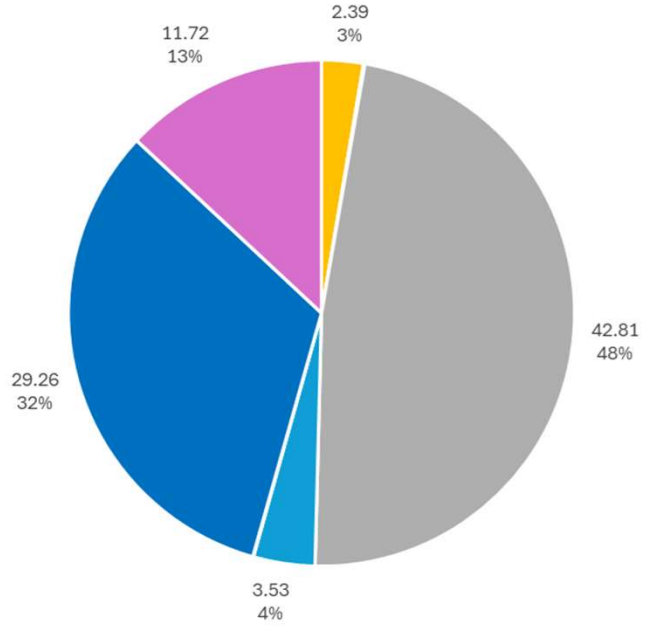
Industrial water use is driving demand growth – population expected to decrease in State projections

Historical Demand (2022)



Total 81.8 MGD

Future Demand (2070)

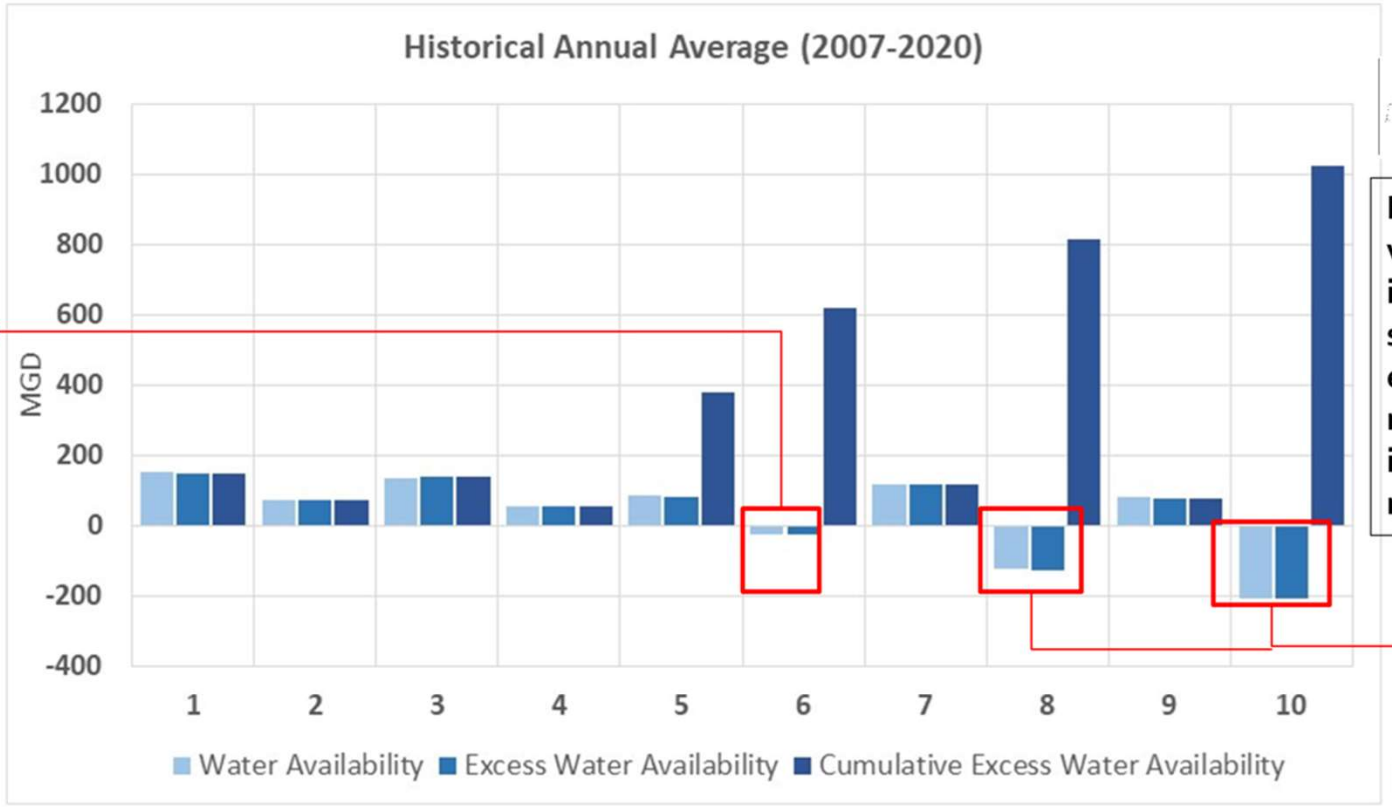


Total 89.8 MGD

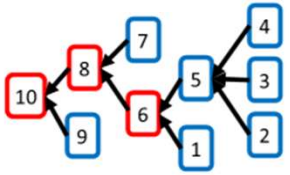
No reported withdrawals for Energy Production in 2022.
Water use less than 1% is not shown, but is included in the total.

Historical annual water availability is positive within the region, but some negative water balance values within certain watersheds

Negative values influenced by reservoir operations (when water is stored or released)



Negative values influenced by statistically estimated minimum instream flow requirements

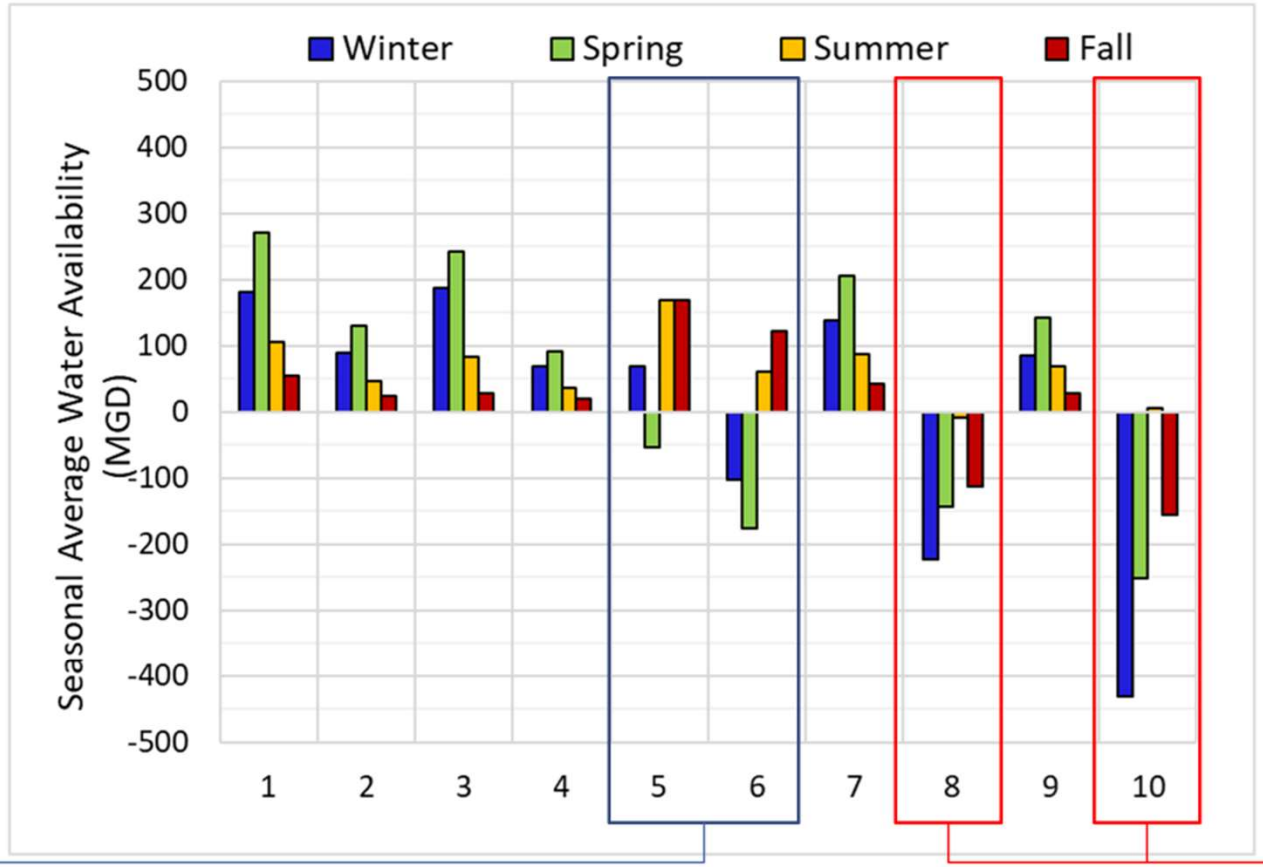


Positive supply availability in the Wabash Headwaters region as a whole

Seasonal Water Availability: Larger during Winter & Spring, Lower during Summer & Fall

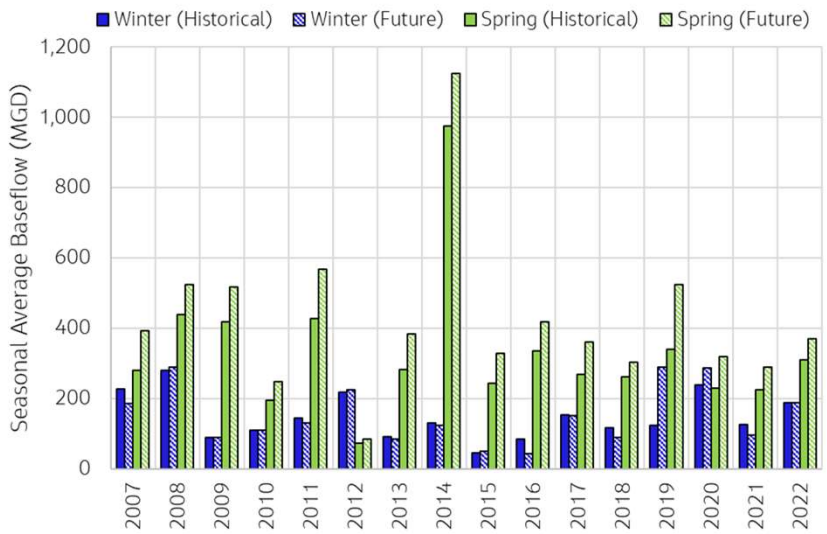
Influenced by <u>flood control reservoirs</u>:

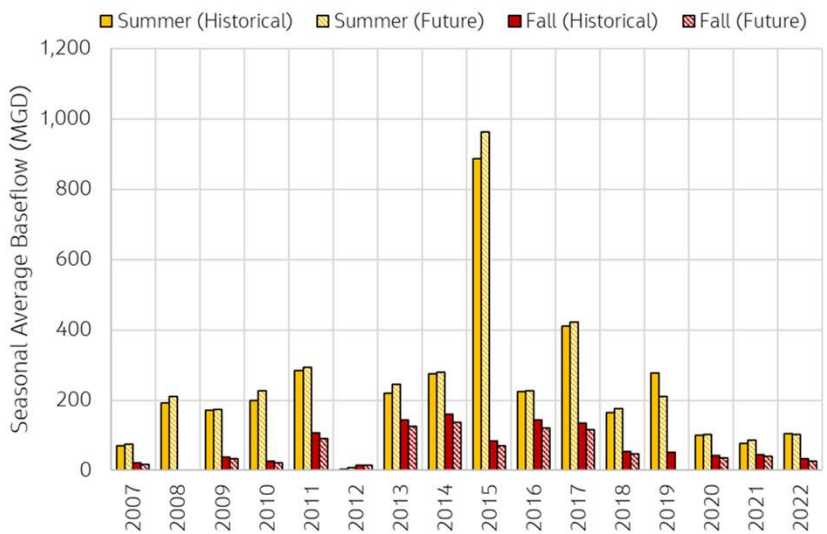
- Released flows during Summer & Fall
- Stored water during Winter & Spring



Negative values across all seasons, influenced by <u>statistically estimated minimum instream flow requirements</u>

Future water availability differs between seasons: projected baseflow mostly influences the expected changes





Future average baseflow conditions changes by season:

Winter ↓ ↑ = Variation in both directions, -43 to 164 MGD

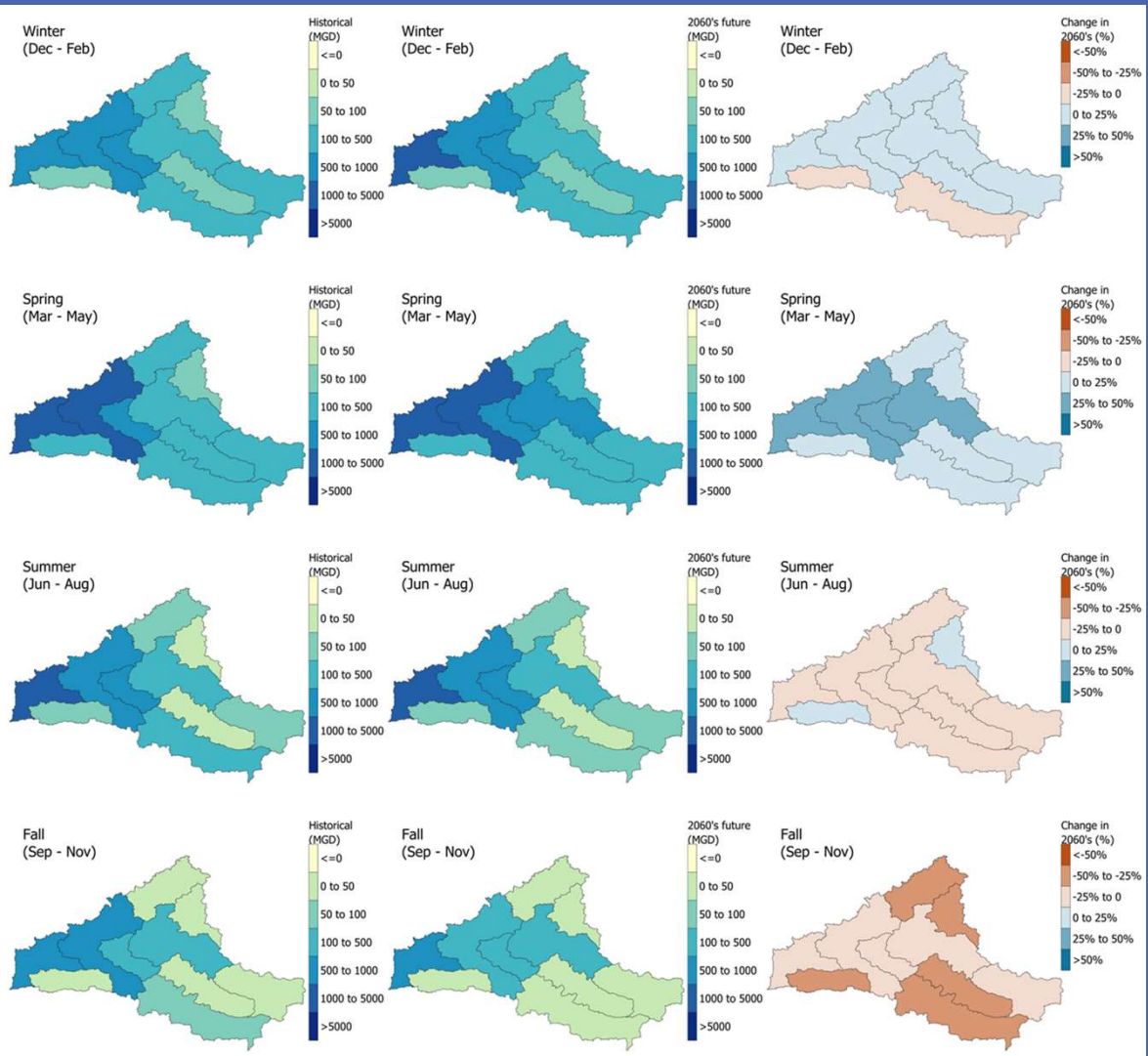
Spring ↑ Always increases, up to 185 MGD

Summer ↑ Generally, increases, up to 75 MGD

Fall ↓ Always decreases, ranging to -51 MGD

Conclusions

- Results indicate a modest increase in demand by 2070
- Biggest drivers are statistically determined instream flow (ecosystem) demand and reservoir releases
- Study provides a sound and useful estimate of historical and future projected demands within the region based on the best available data
- Future water supply studies can be enhanced moving forward



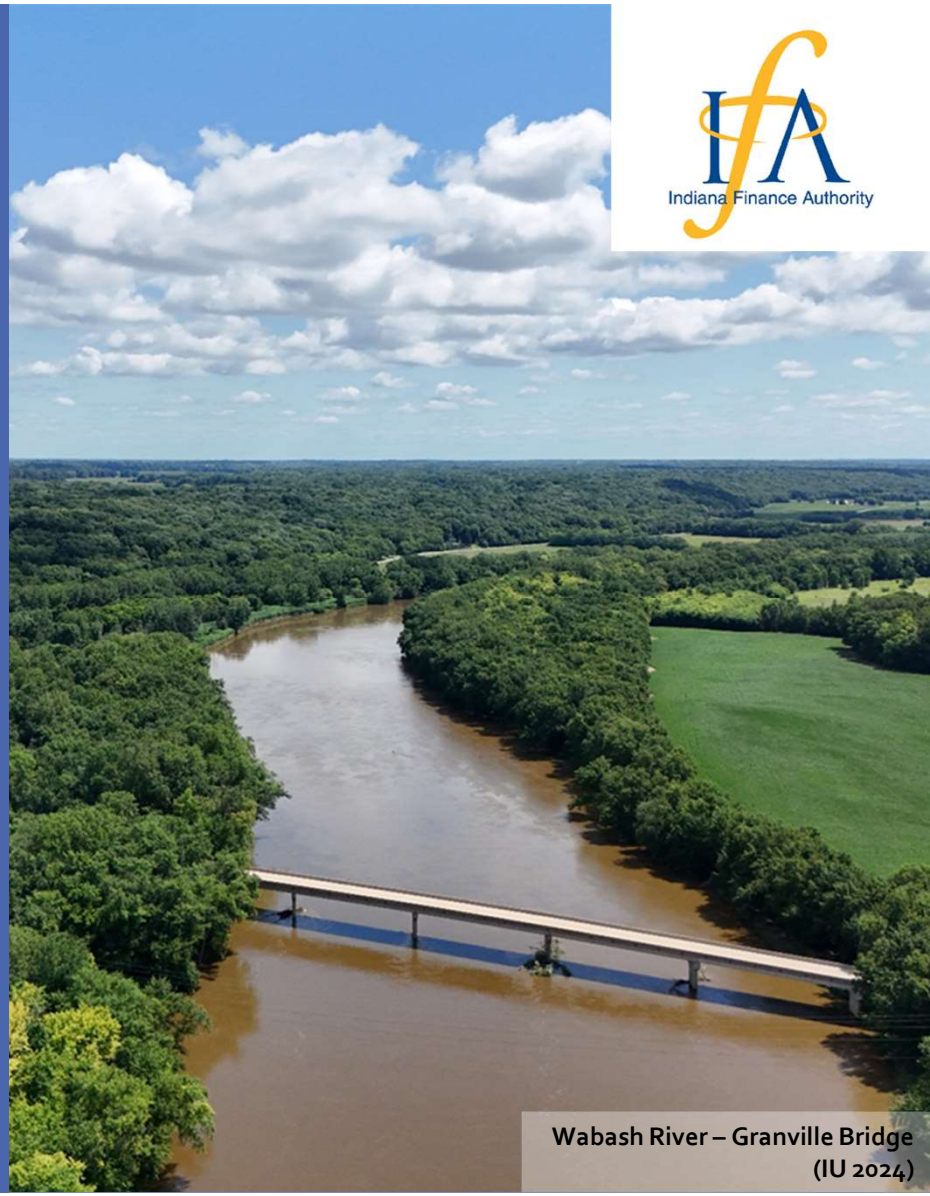
Recommendations presented in the report

Topics

- Water demand
- Groundwater yield and sustainability
- Water availability forecasting and data
- Minimum instream flow requirement

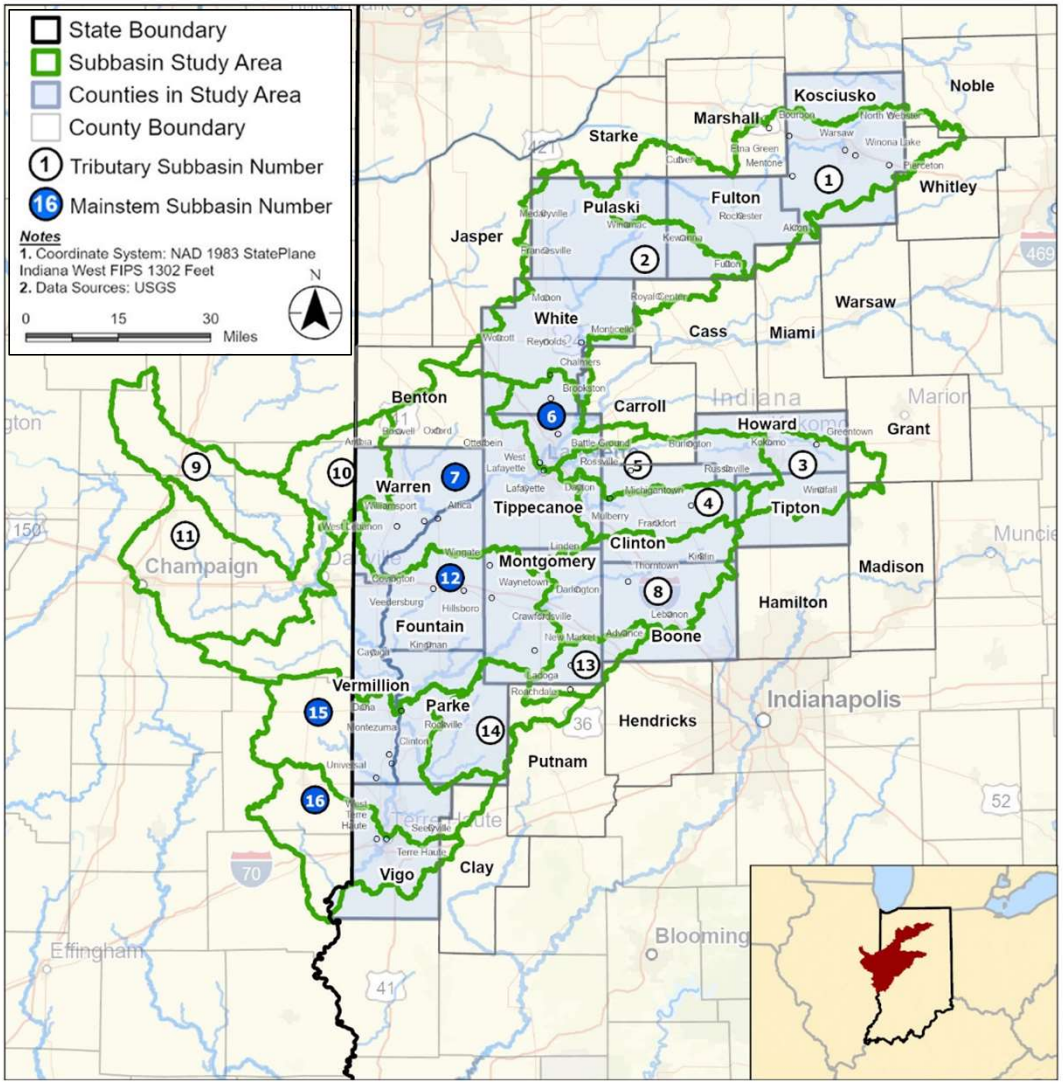
North Central Indiana Regional Water Study

Stantec

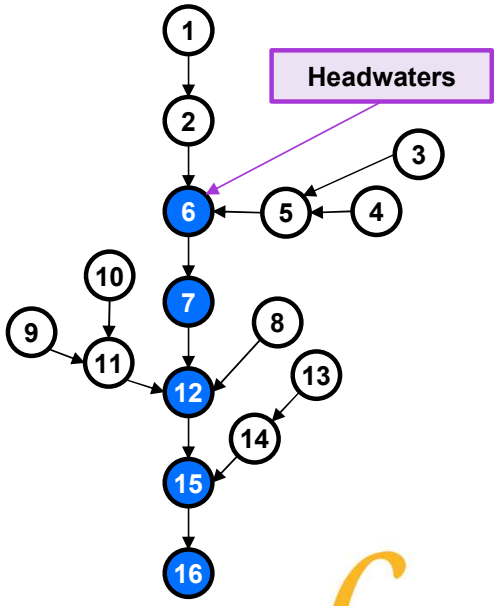


Wabash River – Granville Bridge (IU 2024)

North Central Indiana Regional Water Study Area



ID	Subbasin Name
1	Upper Tippecanoe
2	Lower Tippecanoe
3	Wildcat Kokomo
4	South Fork Wildcat
5	Wildcat Lafayette
6	Wabash Lafayette
7	Wabash Covington
8	Sugar
9	Middle Vermilion
10	North Vermilion
11	Vermilion
12	Wabash Montezuma
13	Upper Big Raccoon
14	Lower Big Raccoon
15	Wabash Terre Haute
16	Wabash Vigo



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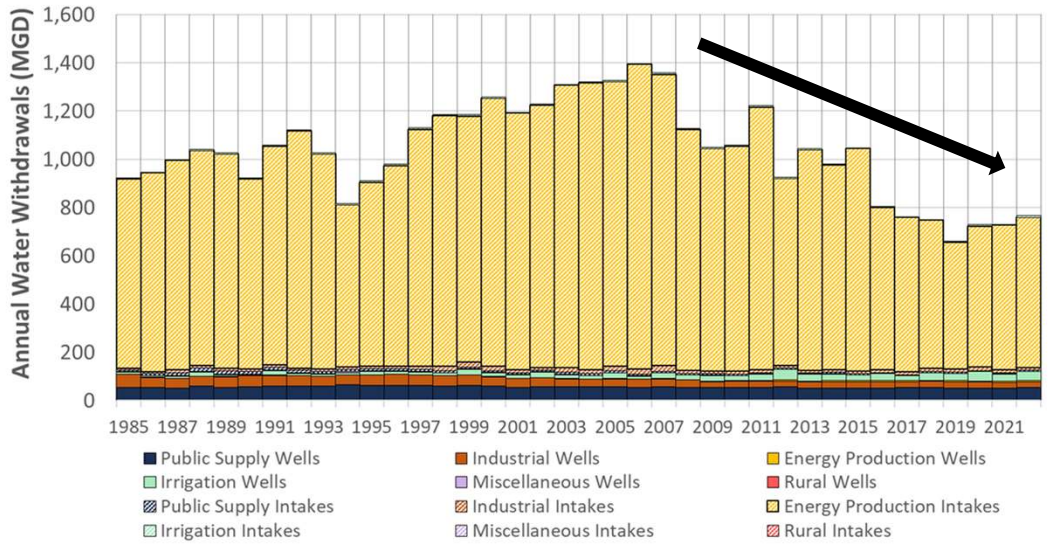
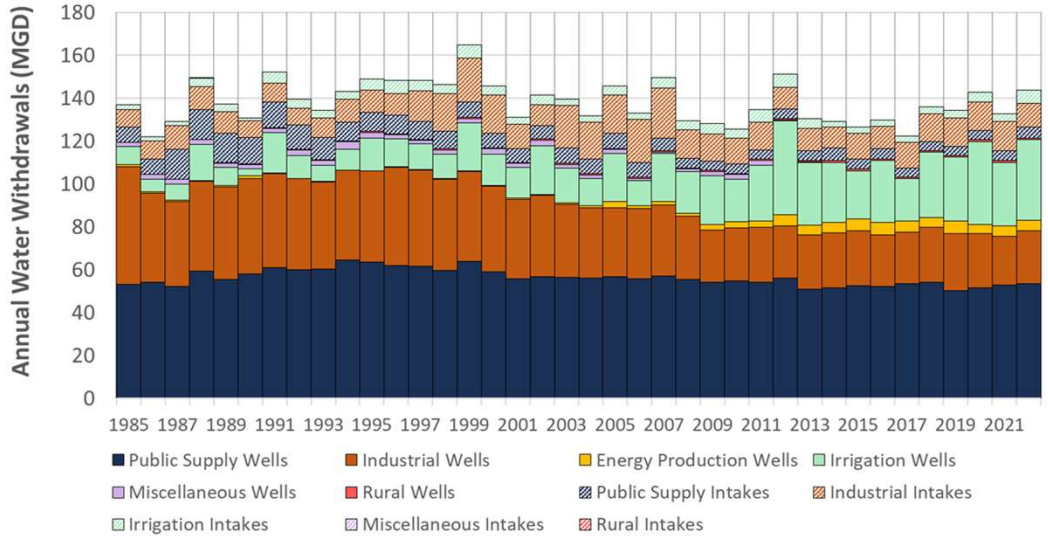
Historical Water Withdrawals



2022 total demand = 790 MGD

Significant Water Withdrawals, 1985-2022, all SWWF sectors

2022:
644 MGD surface water (84%)
120 MGD groundwater (16%)



*Significant Water Withdrawals, 1985-2022, **excluding energy production** withdrawals from surface water intakes*

2022:
22 MGD surface water (16%)
115 MGD groundwater (84%)

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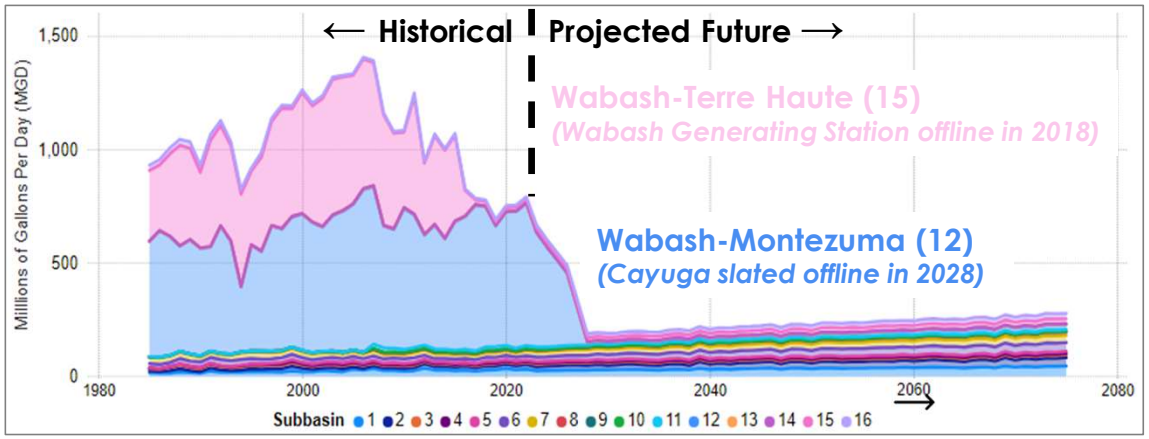
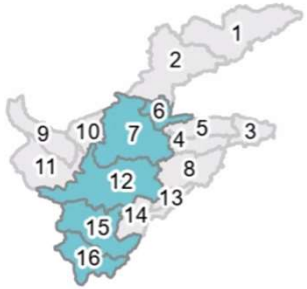
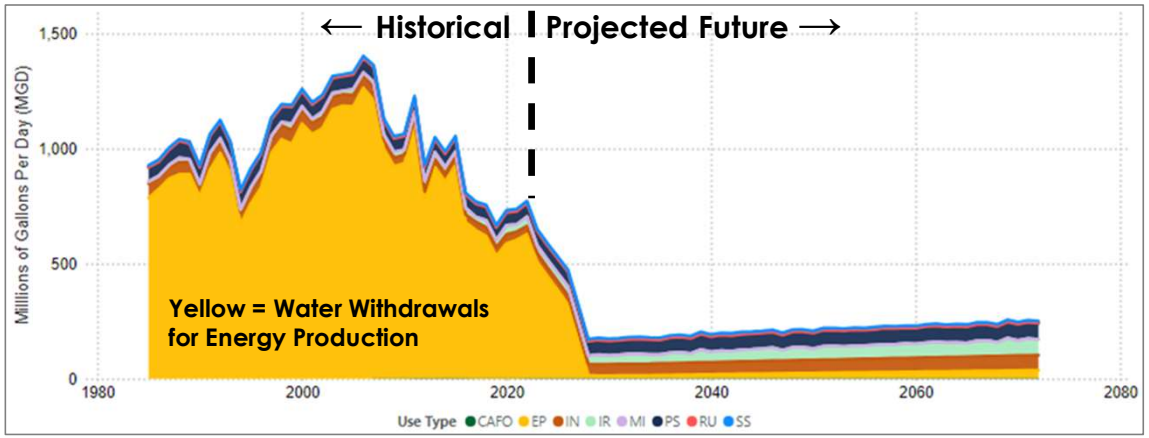
Historical and Projected Future Water Demand



Historical (1985-2022) and Future Forecast (2023-2072) Annual Water Demand, by Subbasin





Historical (1985-2022) and Future Forecast (2023-2072) Annual Water Demand, by Water Use Type

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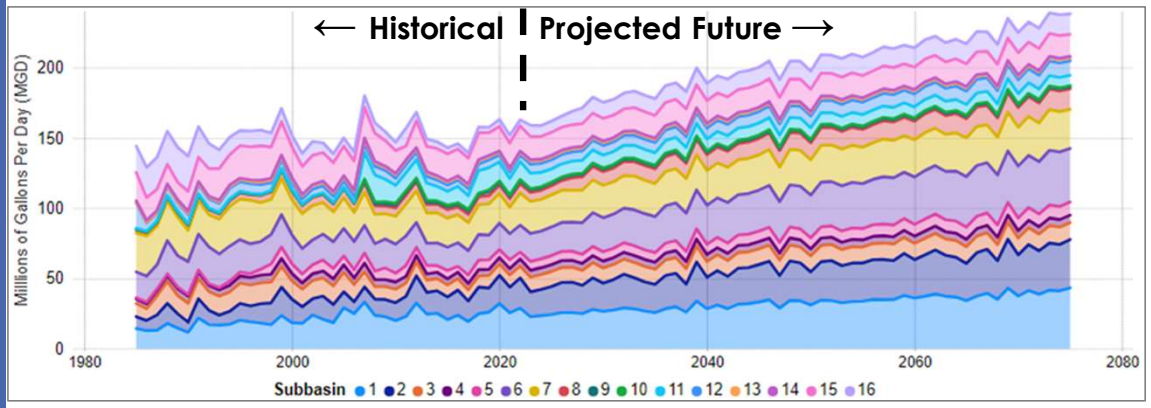
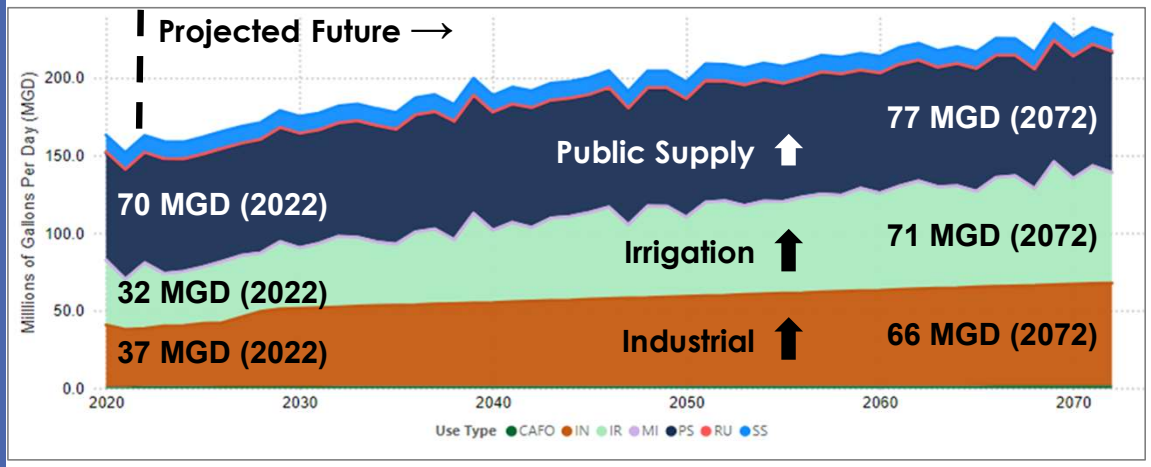
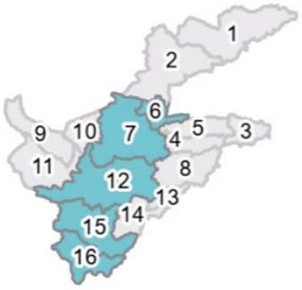
Historical and Projected Future Water Demand



Historical (1985-2022) and Future Forecast (2023-2072) Annual Water Demand, by Subbasin, ***Excluding Energy Production***





Future Forecast Annual Water Demand by Water Use Type, All Subbasins, ***Excluding Energy Production***

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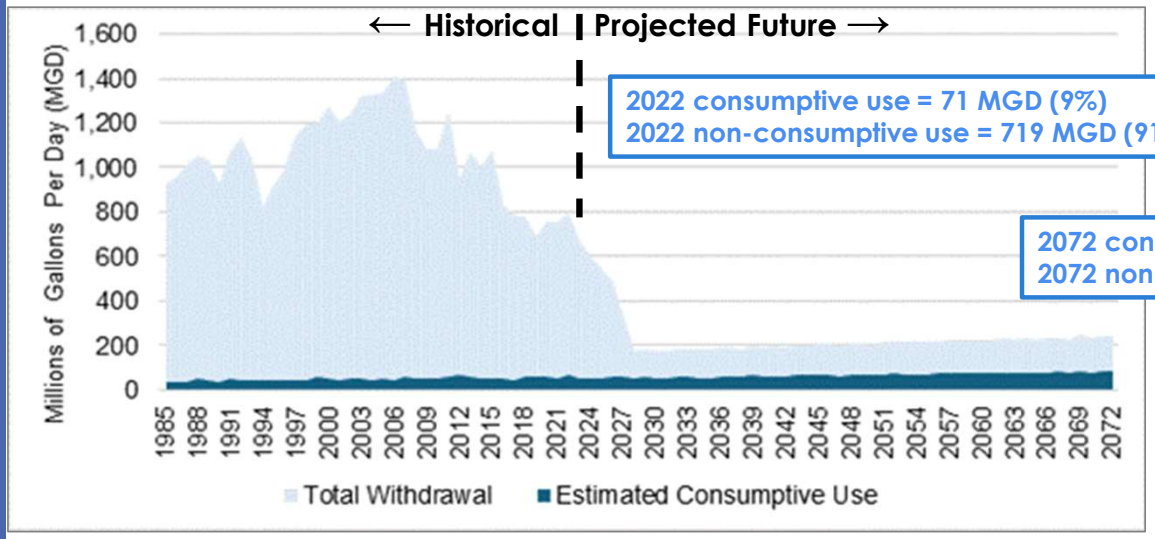
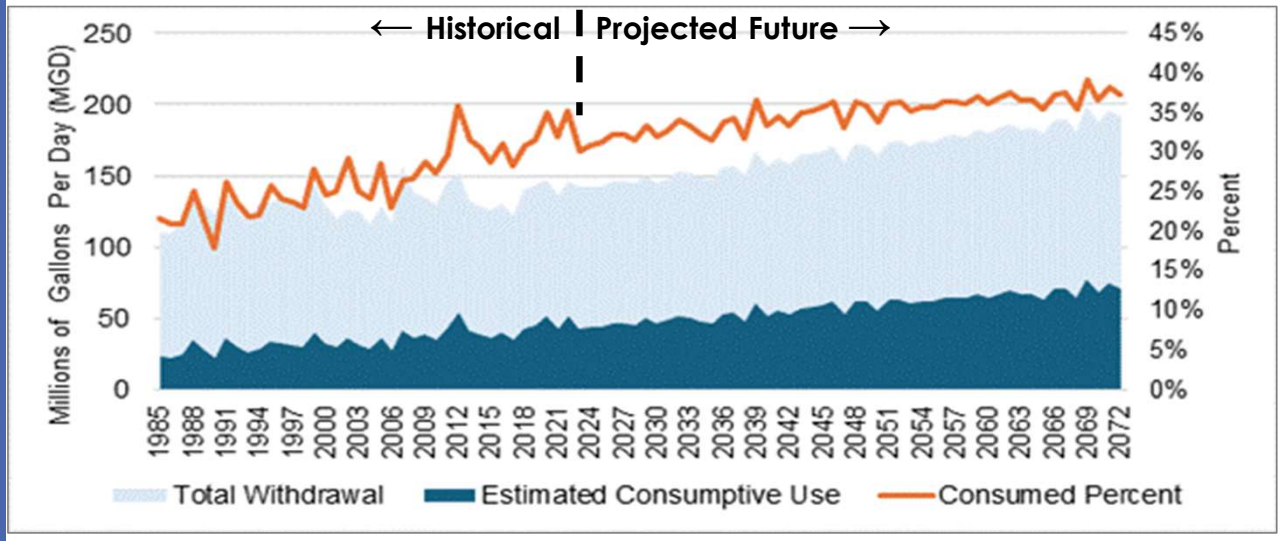
Consumptive Use



Annual Historical (1985-2022) and Future Forecast (2023-2072) Water Withdrawals and Consumptive Use



Annual Historical (1985-2022) and Future Forecast (2023-2072) Water Withdrawals and Consumptive Use, ***Excluding Energy Production***

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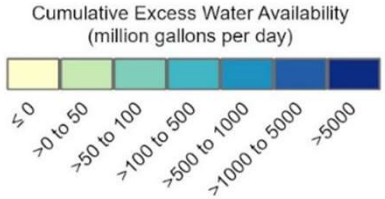
Historical Water Availability

Fall Historical Cumulative Excess Water Availability (MGD)



Subbasin	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Median
Upper Tippecanoe (01)	149	120	255	48	269	23	103	294	117	211	271	299	230	32	423	57	180
Lower Tippecanoe (02)	289	180	301	107	338	34	110	847	173	400	403	556	305	72	583	97	295
Wildcat Kokomo (03)	14	5	10	3	13	50	10	42	7	7	27	121	9	25	76	3	12
South Fork Wildcat (04)	13	12	21	11	25	20	9	59	16	20	36	81	13	17	74	6	19
Wildcat Lafayette (05)	44	30	86	29	76	90	26	195	49	56	95	339	46	60	198	10	58
Wabash Lafayette (06)	704	393	906	437	940	469	773	2,075	838	1,229	1,134	1,947	908	538	1,667	226	872
Wabash Covington (07)	756	616	1,086	509	1,076	495	707	2,357	1,073	1,341	1,337	2,245	980	491	1,850	134	1,027
Sugar (08)	16	17	48	18	35	37	16	39	24	45	64	155	28	24	135	7	32
Middle Vermillion (09)	12	52	128	9	5	31	4	95	67	61	34	75	13	8	121	14	33
North Vermillion (10)	11	16	48	9	3	25	3	71	78	57	58	84	18	16	85	8	22
Vermillion (11)	36	103	378	23	24	101	19	247	203	231	94	265	34	22	290	34	98
Wabash Montezuma (12)	1,045	823	2,018	699	1,374	739	766	3,077	1,164	1,770	1,672	3,337	1,148	597	2,785	255	1,156
Upper Big Raccoon (13)	2	3	22	1	13	8	8	23	6	29	6	60	9	7	38	1	8
Lower Big Raccoon (14)	109	122	160	99	83	55	113	118	123	151	102	246	134	149	184	111	120
Wabash Terre Haute (15)	1,158	1,077	2,100	606	1,284	758	834	3,486	1,809	2,108	1,740	3,884	1,392	714	2,976	322	1,338
Wabash Vigo (16)	1,155	999	2,247	623	1,214	673	907	3,641	1,667	2,138	1,838	4,058	1,366	749	3,309	311	1,290

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Historical Water Availability Key Findings

- Historical water supply exceeds historical water demand (including instream flow/ ecosystem needs) in most locations and most seasons
- Variations in natural baseflow (driven by climate and land use) are the main drivers of cumulative excess water availability
- Strong seasonal variation exists in cumulative excess water availability

SPRING > WINTER > SUMMER > FALL

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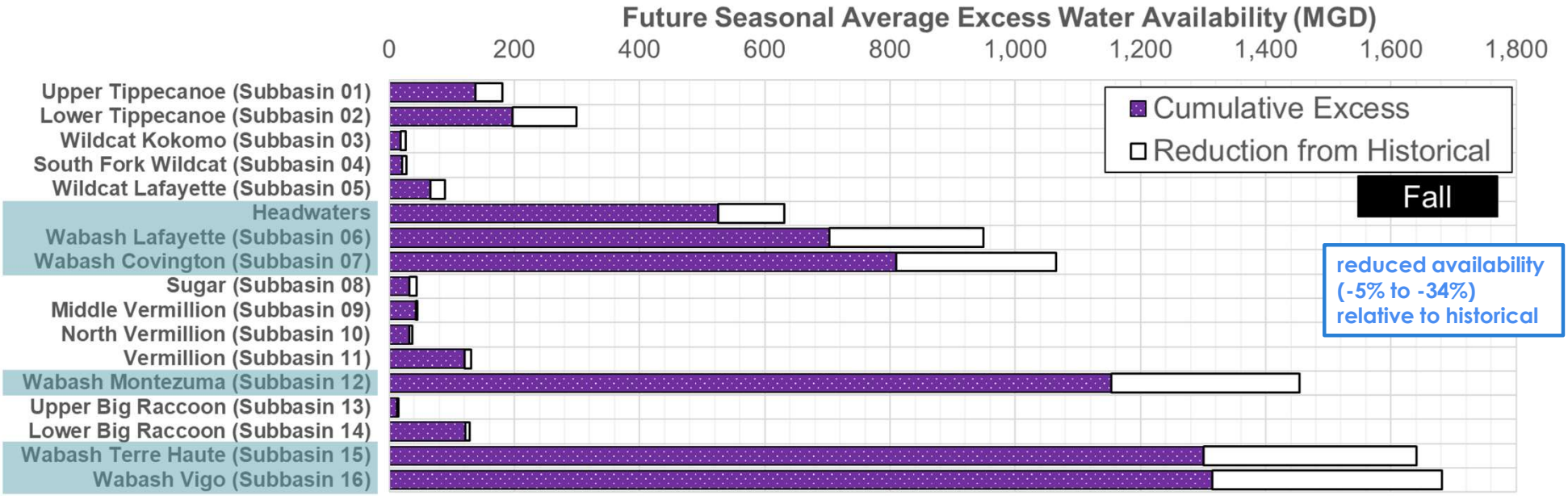
Projected Future Water Availability



Future Fall Season Cumulative Excess Water Availability, by Subbasin

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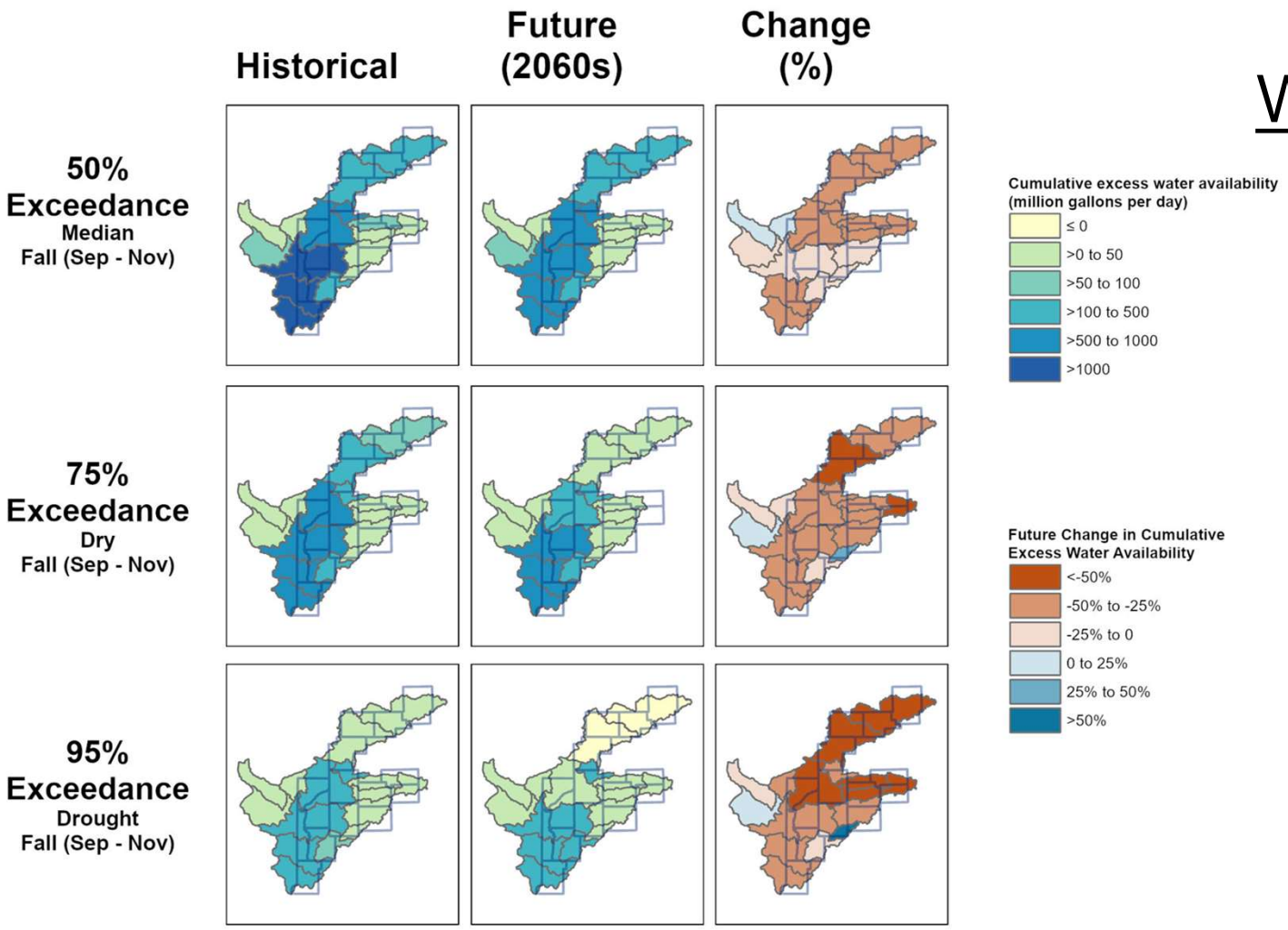
Projected Future Water Availability



Changes Between Historical and Future Fall Cumulative Excess Water Availability for: ***50% (Median), 75% (Dry), and 95% (Drought)*** *Exceedance Intervals*

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Future Water Availability Key Findings

- **Future water supplies are projected to nearly always exceed future demands (including instream flow/ ecosystem needs)**
- Projected higher natural baseflows in Winter and Spring, but lower natural baseflow plus higher demand in Fall
- Fall water availability is increasingly reliant on upstream reservoir operations

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Regional Water Resource Limitations

The North Central Indiana Regional Water Study identified some current and projected future water availability limitations:

- Spatial variability (i.e., certain subbasins)
- Seasonal variability (high demand, low baseflow in fall and summer)
- Interannual variability (wet vs. dry/ drought years)

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Recommendations

Enhance supply of surface and/or groundwater				Decrease demand for water	Better understand and manage water as a limited resource			
Groundwater Exploration and Development	Reservoir Storage Reallocation (for water supply)	Increased or Expanded Water Storage	Alternative Water Supplies (water reuse and regional collaboration/ water conveyance)	Water Conservation and Water Use Efficiency	Expanded Data Collection, Monitoring Networks, and Modeling	Enhanced Communication, Coordination, and Education	Water Policy and Practice (environmental flows, reuse, regional and state water planning)	Recommended Follow-On Analyses (exploration, data collection)

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Acknowledgements

Advisory Committee

DNR Indiana Department of Natural Resources

IDEM

INDIANA FARM BUREAU

INDIANA UNIVERSITY

PURDUE UNIVERSITY

USGS science for a changing world

WHITE RIVER ALLIANCE

Stakeholder Interviews (24)

- Cities of Frankfort, Greencastle, Lafayette, Lebanon, Tipton
- Economic Development/ Counties of Boone, Clinton, Crawfordsville, Fulton, Great Kokomo, Greater Lafayette, Greencastle/Putnam, Parke, Terre Haute, Vermillion, Warren, White, Montgomery
- Duke Energy, Eli Lilly, NIPSCO, Indiana American Water, Purdue University Agricultural Extension, and Indiana Farm Bureau

Additional Data & Technical Support

- Sally Letsinger (IU), Keith Cherkauer (Purdue), USACE, Illinois State Water Survey

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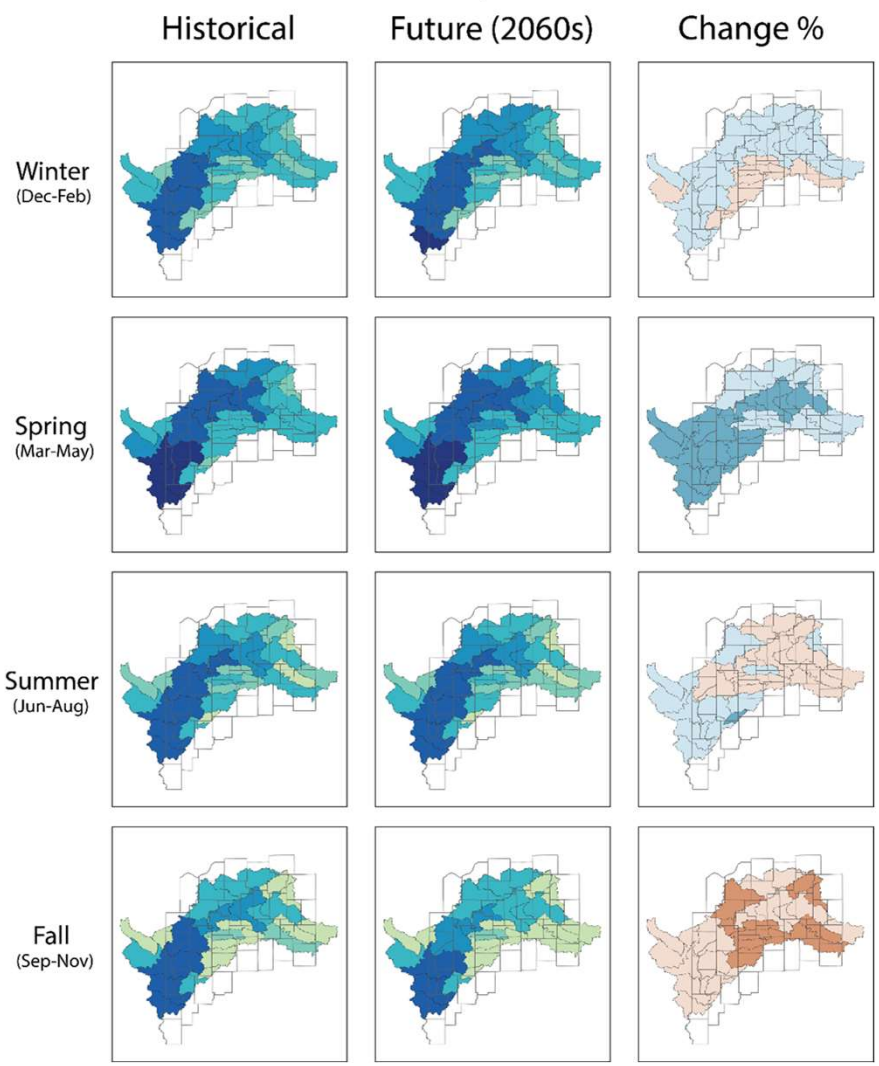
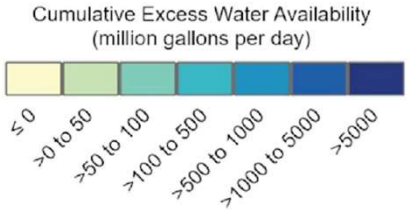
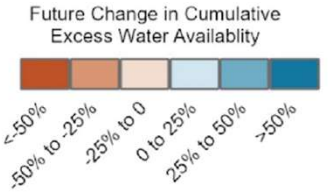


Cumulative Excess Water Availability

Historical and Projected (2060s)





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Indiana Regional Water Studies

Questions?

Regional water studies website:
https://www.in.gov/ifa/regional-water-studies

Please send questions or feedback about the studies to:
WaterResources@ifa.in.gov