Lower Savannah-Salkehatchie Water-Demand Projections

Lower Savannah-Salkehatchie RBC meeting
March 7th, 2024

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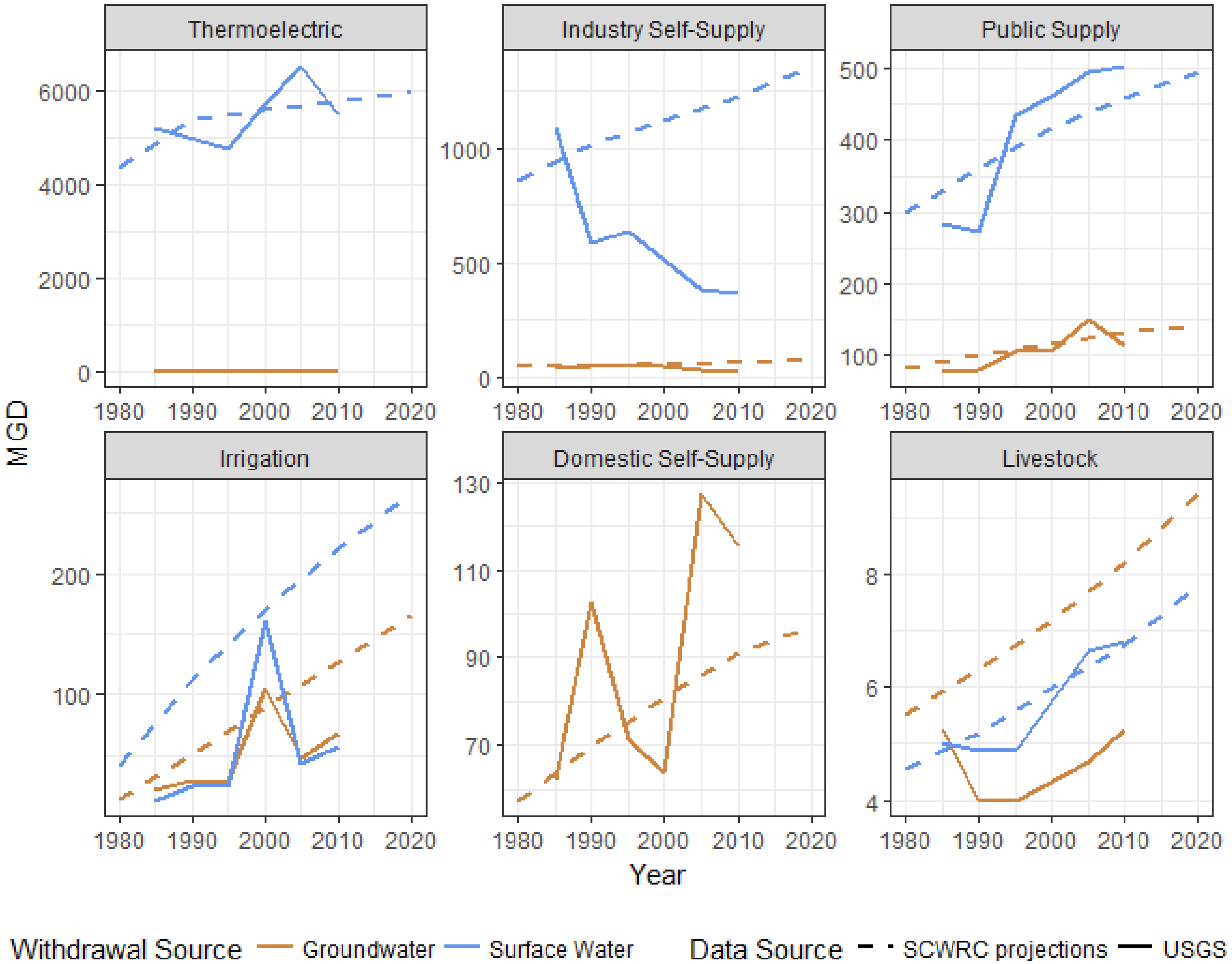
Is It Possible to Predict the Future?



A 1970's edition of water demand projections can be compared with historical water use.

Can we expect to perform any better?

Projections are not forecasts

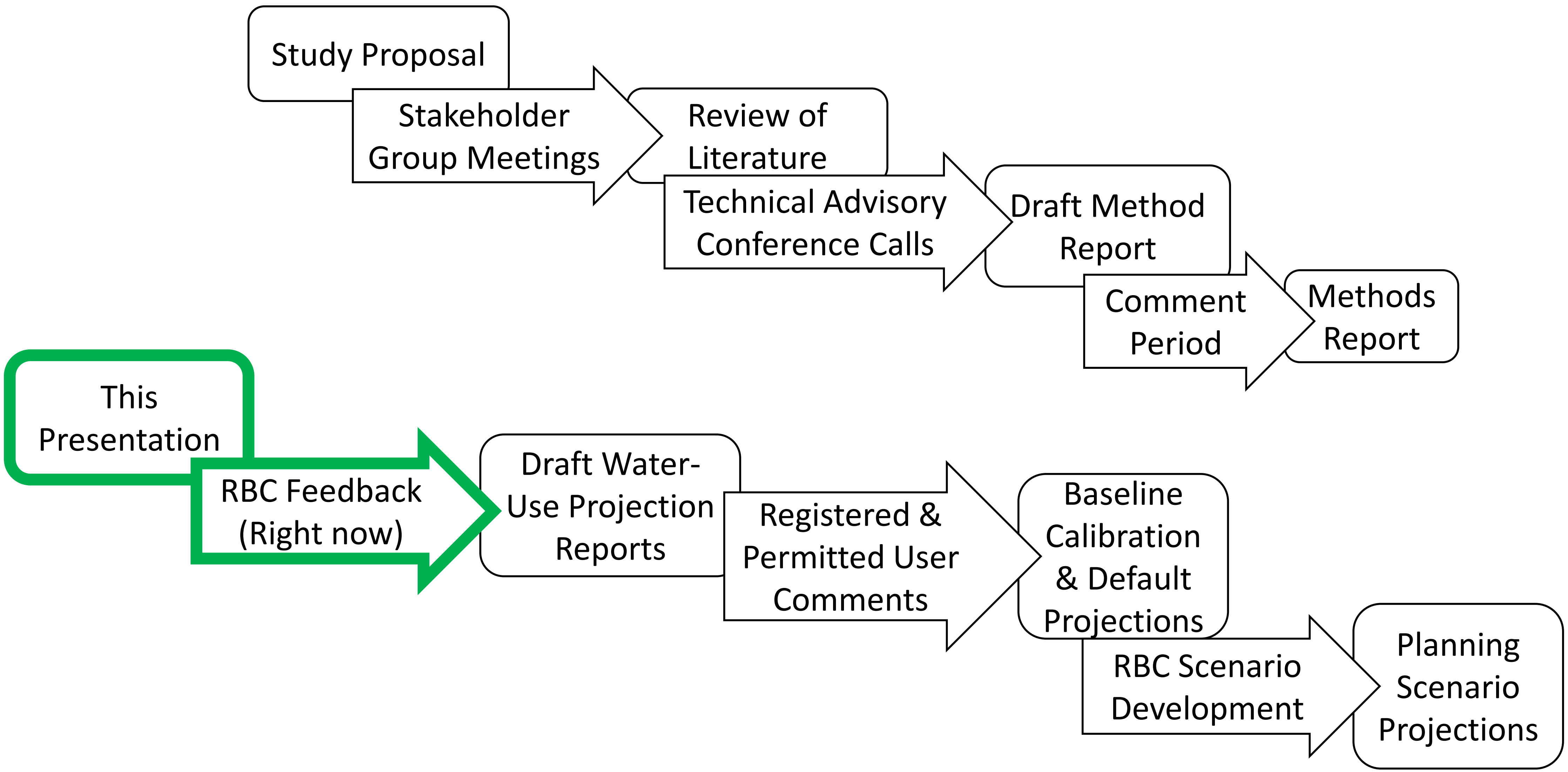
Forecast

- Educated guess.
- Based on expected conditions and actions.
- Timeframe limited by predictability of future conditions.
- Aim to be accurate.

Projection

- Extrapolation of trend.
- Based on hypothetical scenarios.
- Timeframe can extend beyond the limits of effective forecasting.
- Aim to be informative.

Stakeholder Input Throughout the Process



Development of the Methods

2016 -2017 - meetings with stakeholder interest groups for input on water-demand projection methods and data sources.

- SCAWWA Water Utility Council
- SC Water Quality Association
- SC Farm Bureau Water Committee
- Chamber of Commerce Environmental Technical Committee
- SC Water Planning Process Advisory Committee (PPAC)

Stakeholder Feedback

- Water Works Association, Utility Council
  - Use weather and demographic variables for long term forecasts.
  - Consider impacts of outdoor use restrictions.
- Chamber of Commerce, Environmental Committee
  - Provide information on a reach scale for real-world application.
  - Guarantee privacy of survey responses.
- Farm Bureau, Water Committee
  - Agricultural return flows can be significant.
  - Not all cropland can be profitably irrigated.
  - Vegetables and hemp production could increase.
- Water Quality Association
  - Some systems are highly interconnected.
  - Inflow and Infiltration can be significant.

Development of the Methods

2018 - technical advisory conference calls with representation from a variety of fields of experience.

- Public water supply (17)
- Thermo-electric power (5)
- Manufacturing (5)
- Government (22)
- Consultants (4)
- Legal (2)
- Golf (2)
- Agriculture (5)
- Environment (4)
- Research & education (11)

Acknowledgments to Chrissa Waite and Stuart Norvell of USACE and Dr. Jeff Allen and Dr. Tom Walker of the SCWRC for their collaboration in developing the water demand projection methods.

Technical Advisory Committee Feedback

- General recommendations:
  - provide draft projections to local stakeholders.
  - provide an opportunity for feedback.
  - do not rely on overly complex methods.

- Sector specific recommendations:
  - **Thermo-electric**: Contact the utilities directly
  - **Public supply**: Do not rely on complex statistical methods which may underestimate demand.
  - **Industry**: Use economic output, not employment as the driver variable.
  - **Agricultural Irrigation**: A more technical method may be appropriate for projecting irrigated acreage.
  - **Golf**: A simpler projection method was recommended due to the relatively low volume of water use.

Development of the Methods

2018 – Publication of "Water Users' Perspectives: Summary of Withdrawal Survey Responses and Commentary" in *Journal of South Carolina Water Resources.*

2019 – Projection Methods for Off-stream Water Demand in South Carolina published online by SCDNR following reviews by an editorial board, the PPAC, and technical advisory conference call participants.

Pellett, C. Alex (2020) "Mapping Center Pivot Irrigation Fields in South Carolina with Google Earth Engine and the National Agricultural Imagery Program," *Journal of South Carolina Water Resources*: Vol. 7 : Iss. 1 , Article 4. Available at: https://tigerprints.clemson.edu/jscwr/vol7/iss1/4

Pellett, C. Alex (2024) "Review of Agricultural Water Use in South Carolina," *Journal of South Carolina Water Resources* (In Review)

Equations to Define the Terms

Equation 1: Water Demand Mass Balance

Demand = Withdrawal + Purchase + Reuse – Sales – Loss – ΔStorage + Shortage

Where:

Demand	:	Off-stream water demand
Withdrawal	:	Total water withdrawal from source water bodies
Purchase	:	Total purchases of water from distributors
Reuse	:	Total reuse of water previously used for another purpose
Sales	:	Total wholesale transfers of water to another user or distributor
Loss	:	Total losses of water preventing it from being put to use
ΔStorage	:	Net change in off-stream storage
Shortage	:	Water not available to meet the objectives of water users

Equation 2: Return Flow Mass Balance

Return Flow = Discharge - Inflow & Infiltration

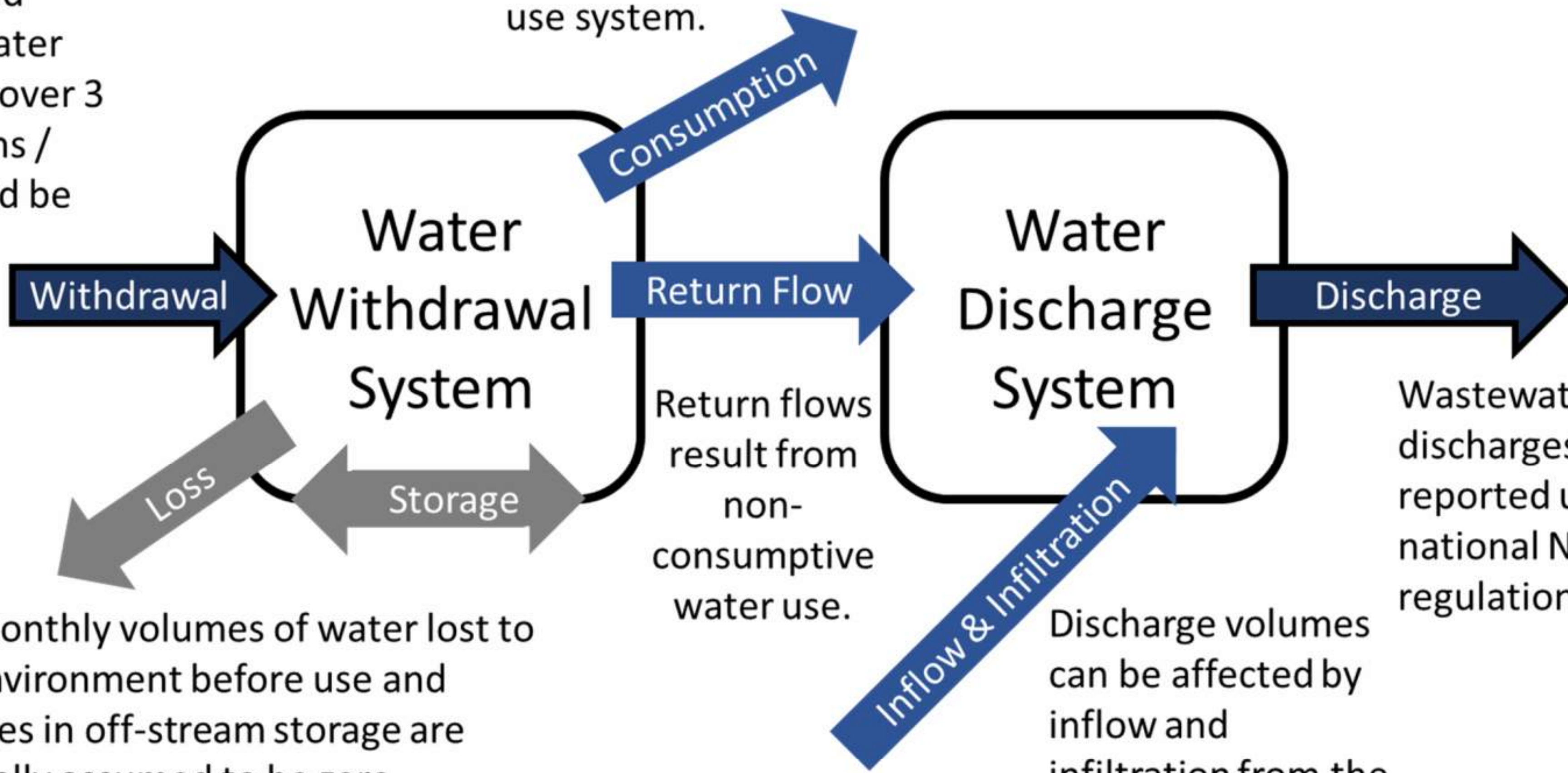
Where:

Return Flow	:	Water returned to the environment after non-consumptive uses
Discharge	:	Concentrated discharges to surface water bodies (NPDES data)
Inflow & Infiltration	:	Waste-water resulting from inflow and infiltration (I/I)

Mass Balance Illustration

Water that is used and evaporates or transpires to the atmosphere is *consumed* from the water use system.

Permitted and registered water withdrawals over 3 million gallons / month should be reported to SCDHEC.



Return flows result from non-consumptive water use.

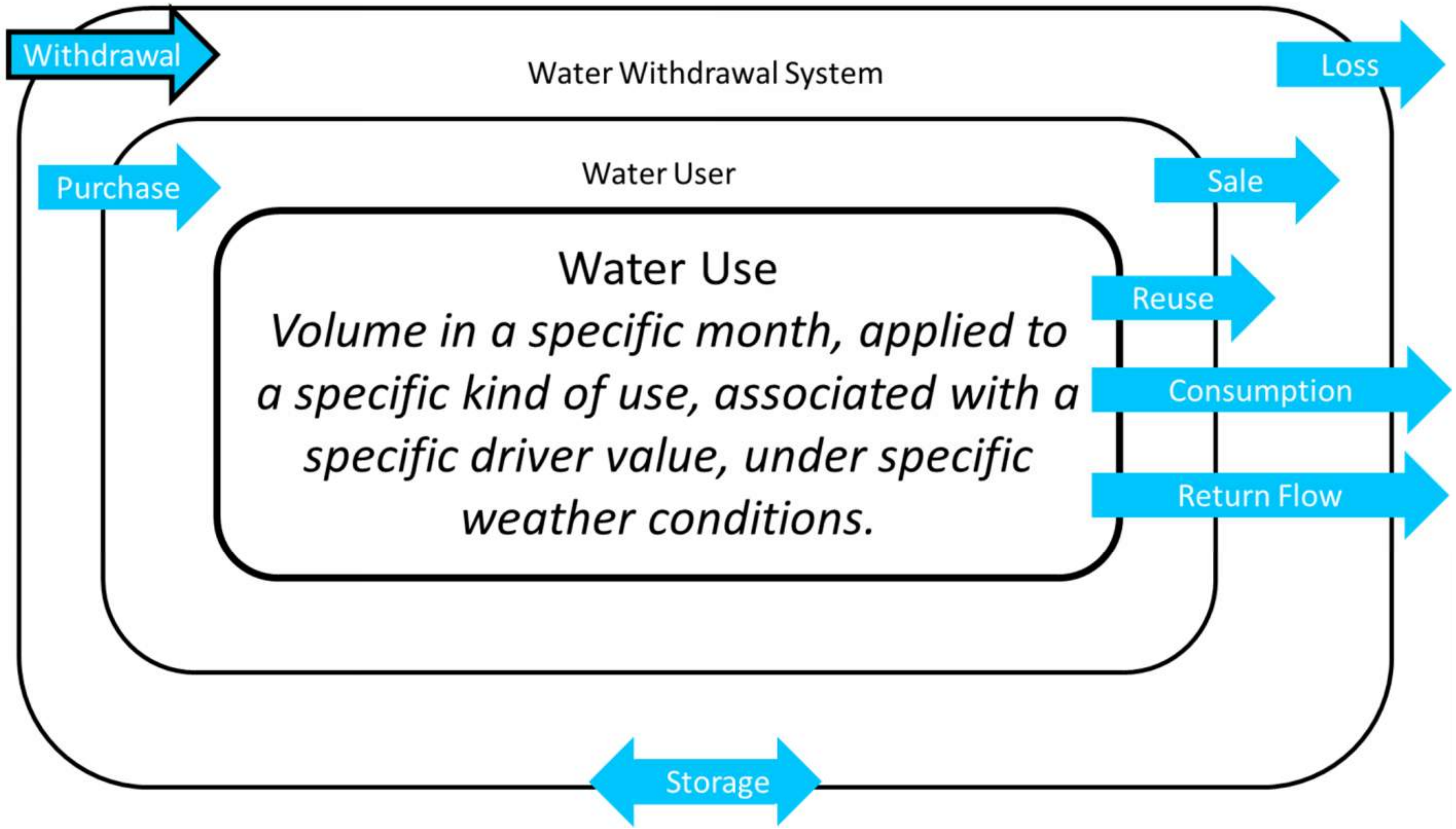
Wastewater discharges are reported under the national NPDES regulations.

The monthly volumes of water lost to the environment before use and changes in off-stream storage are generally assumed to be zero.

Discharge volumes can be affected by inflow and infiltration from the environment.

Consumption, return flow, and inflow & infiltration are estimated over the baseline period to project future non-consumptive use.

A More Detailed Model



- Withdrawal only
- Withdrawal Distribution
- Distribution only

Projections

- Water demand models are calibrated for each water user, with water withdrawal data from 2012-2021.
- Moderate calibration is based on the median water demand for each month.
- High calibration is based on the maximum water demand for each month.
- Projections of county population and industrial sector economic growth drive long-term water demand projections.

Table 1.1: Drivers of Water Demand

Category	Primary driver
Thermo-electric power	Electricity production
Public and domestic supply	Population
Manufacturing	Economic production
Agriculture and Golf Courses	Irrigated acres

From the projection methodology report.

Draft Water Demand Projections

- Preliminary draft results, not yet vetted.
- For demonstration purposes only.
- Modifications to these draft projections will be made based on continued stakeholder feedback.
- All values are plotted as Million Gallons per Month

Draft Water Demand Projections

Thermoelectric Water Demand

<u>Calibration</u>
Moderate Scenario is Monthly Median
High Scenario is Monthly Maximum

<u>Projections</u>
According to utility company Integrated Resource Plans and feedback.

Golf, Mining, Other

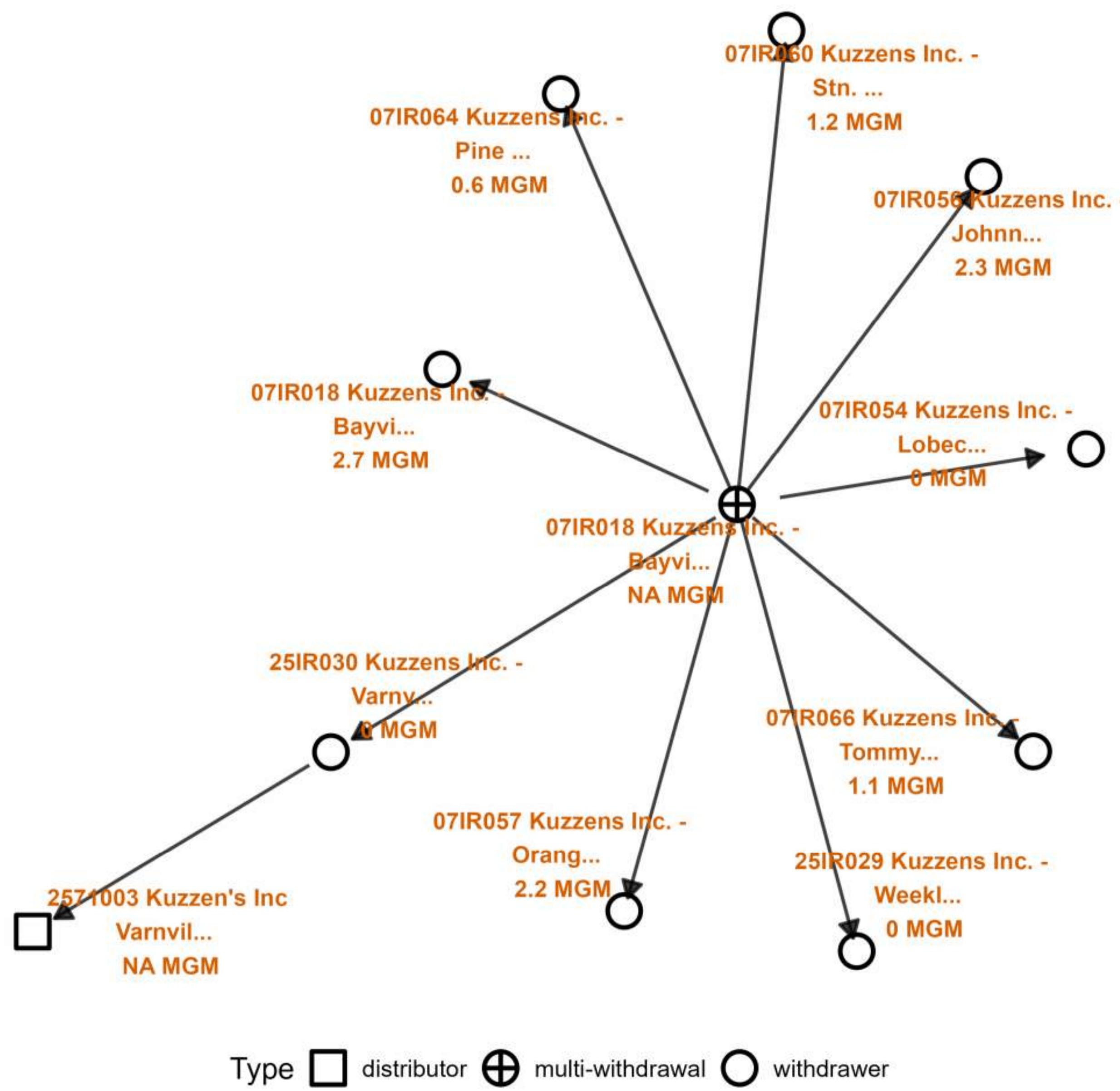
<u>Calibration</u>
Moderate Scenario is Monthly Median
High Scenario is Monthly Maximum

<u>Projections</u>
No change.

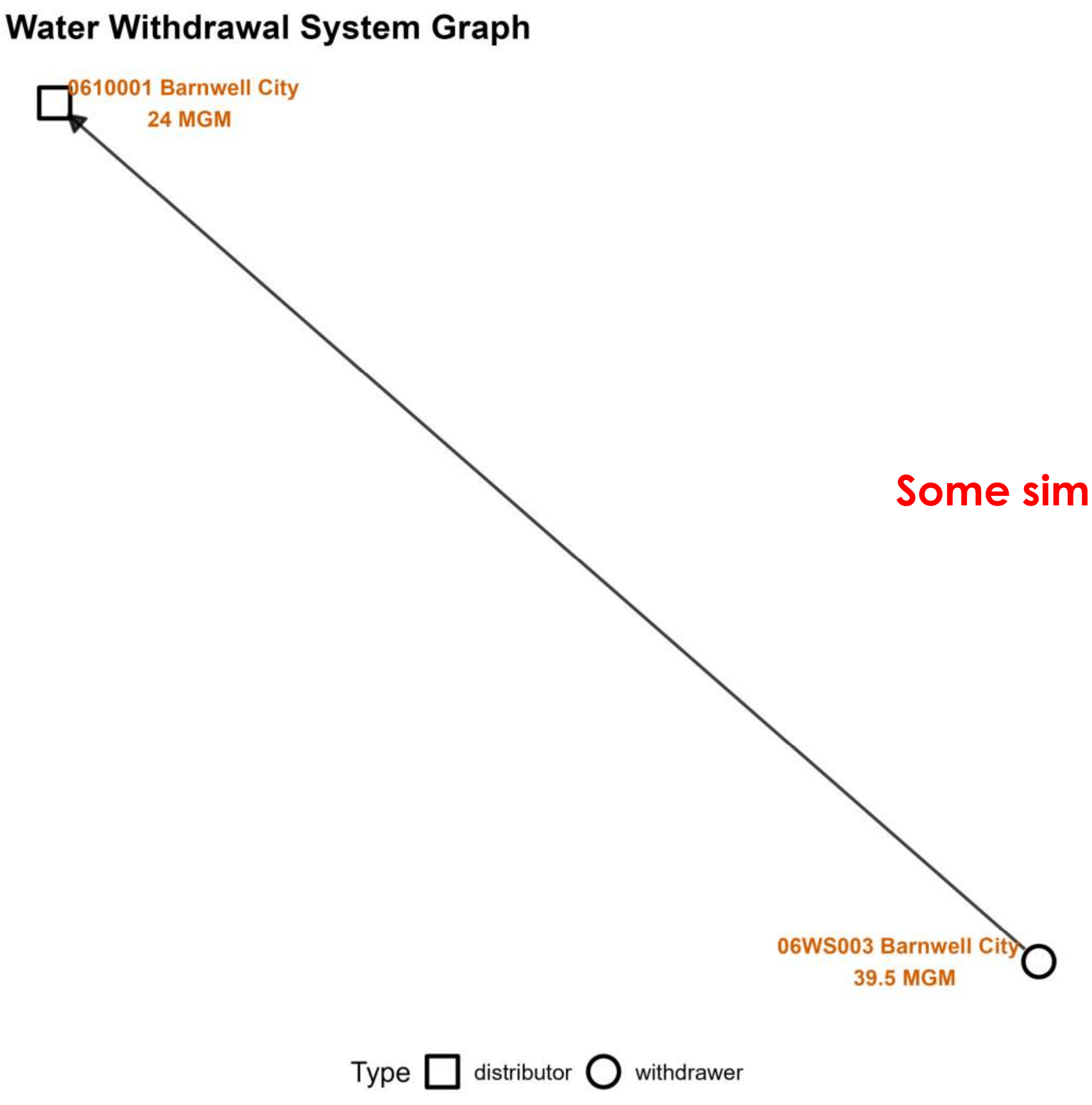
Public Supply

- Many Drinking Water Distributors are interconnected by wholesale purchases and sales.
- Public Supply Systems are represented as the total of all interconnected withdrawal and distribution permits.
- The population served by each distributor is projected based on the county listed on the distribution permit.

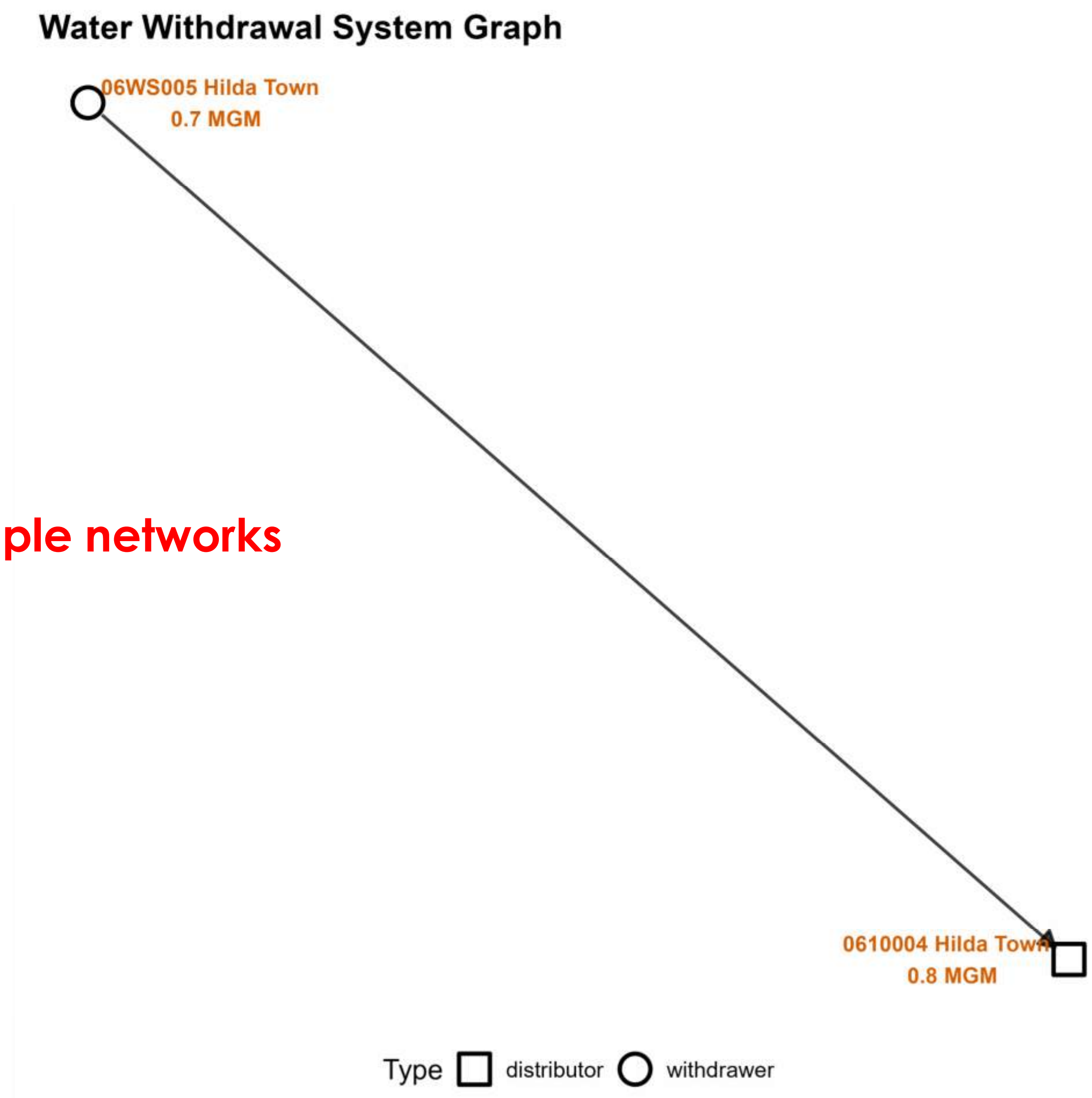
Water Withdrawal System Graph



Public Supply



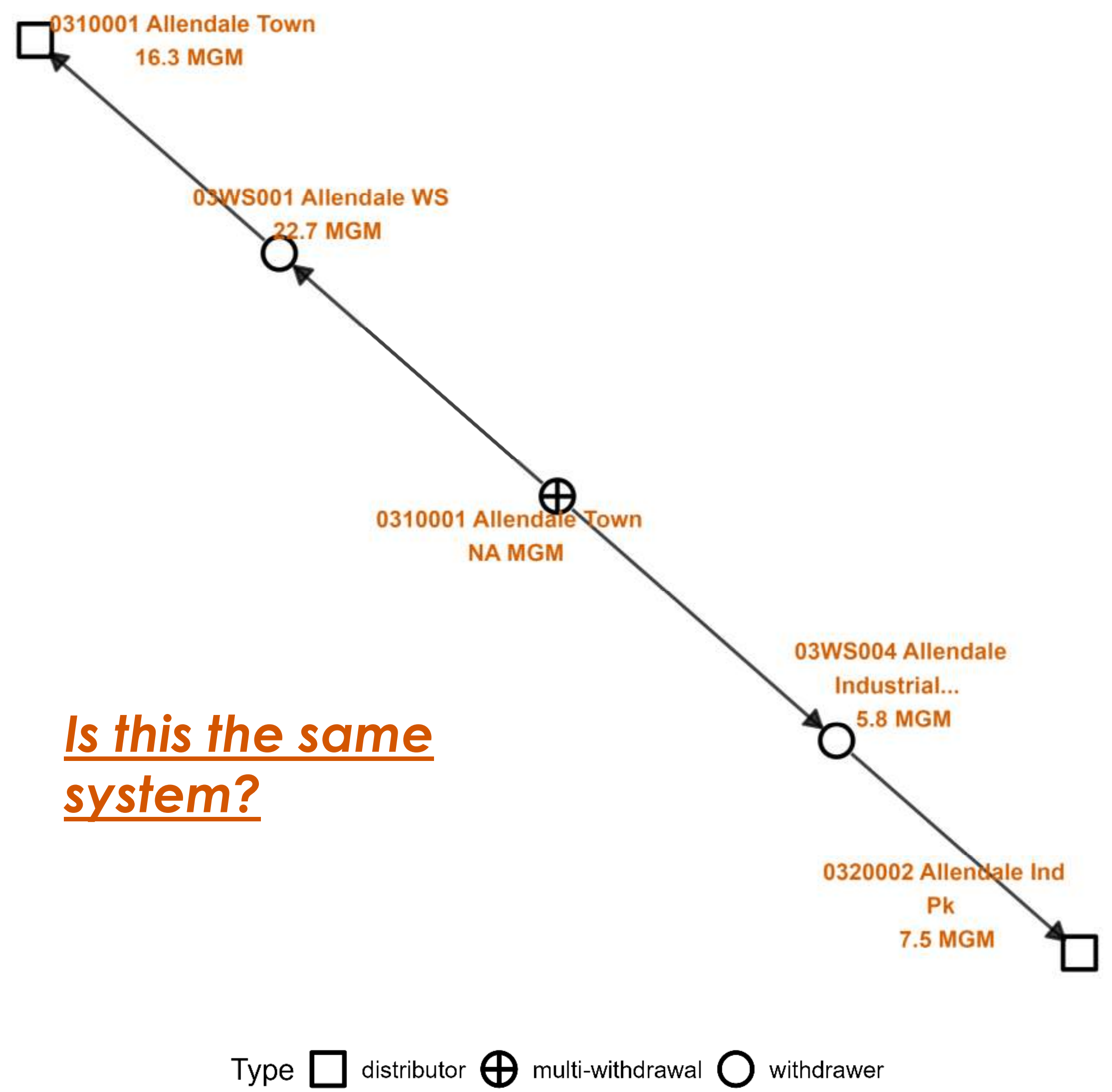
Some simple networks



Public Supply

CLEMSON

Water Withdrawal System: 0310001 Allendale Town

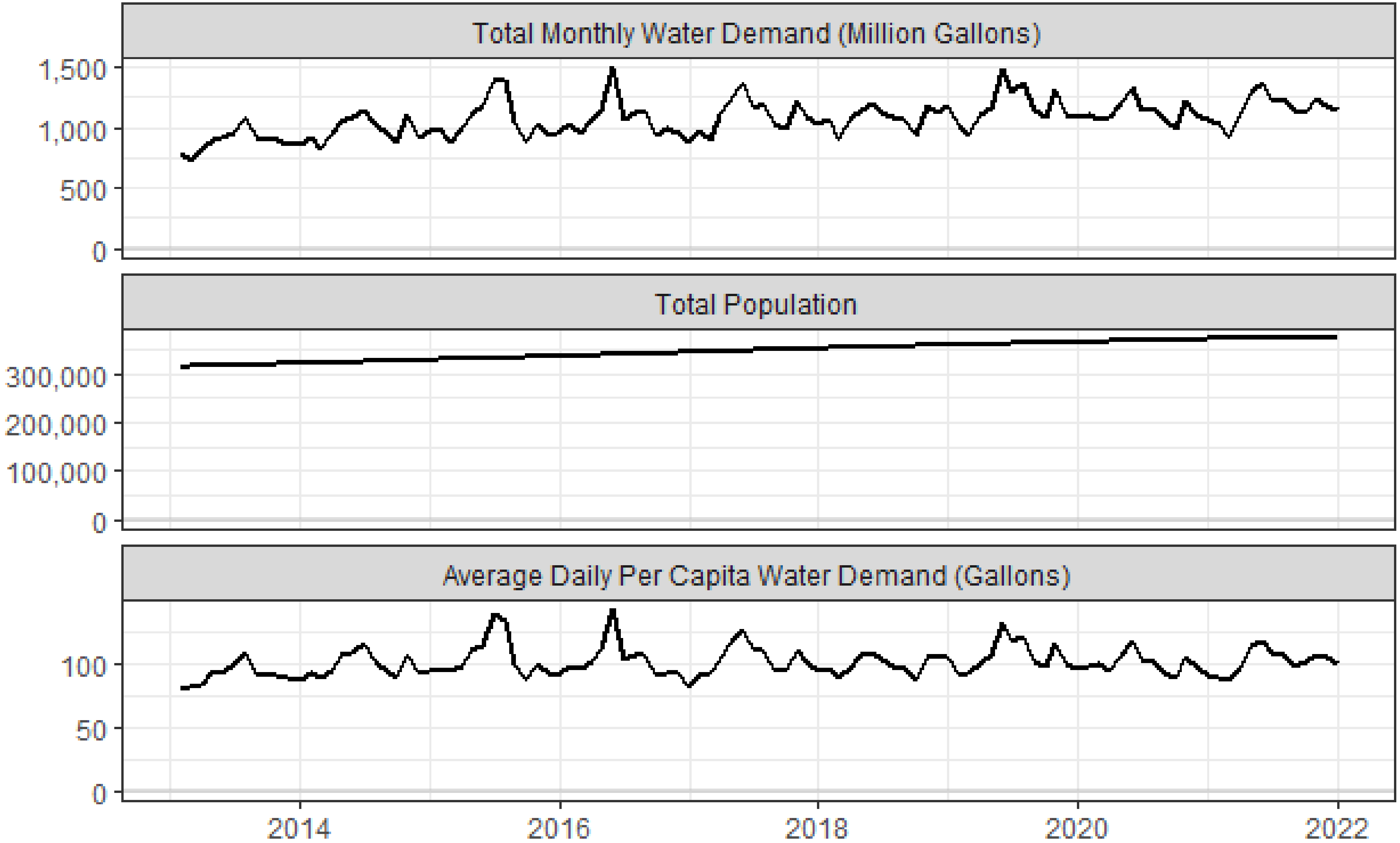


Is this the same system?

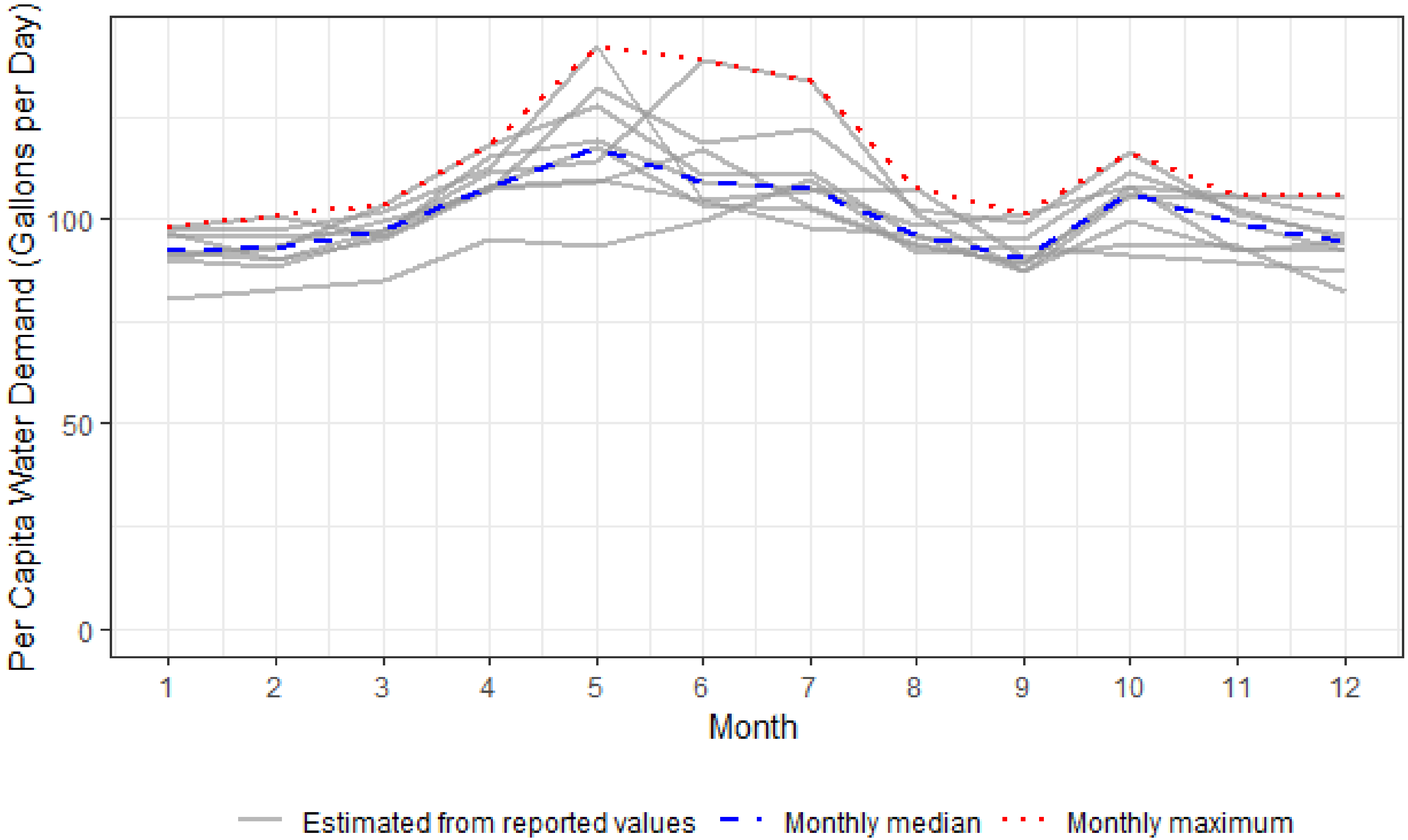
Water Withdrawal System: 0720002 Fripp Is. PSD

Is wholesale missing?

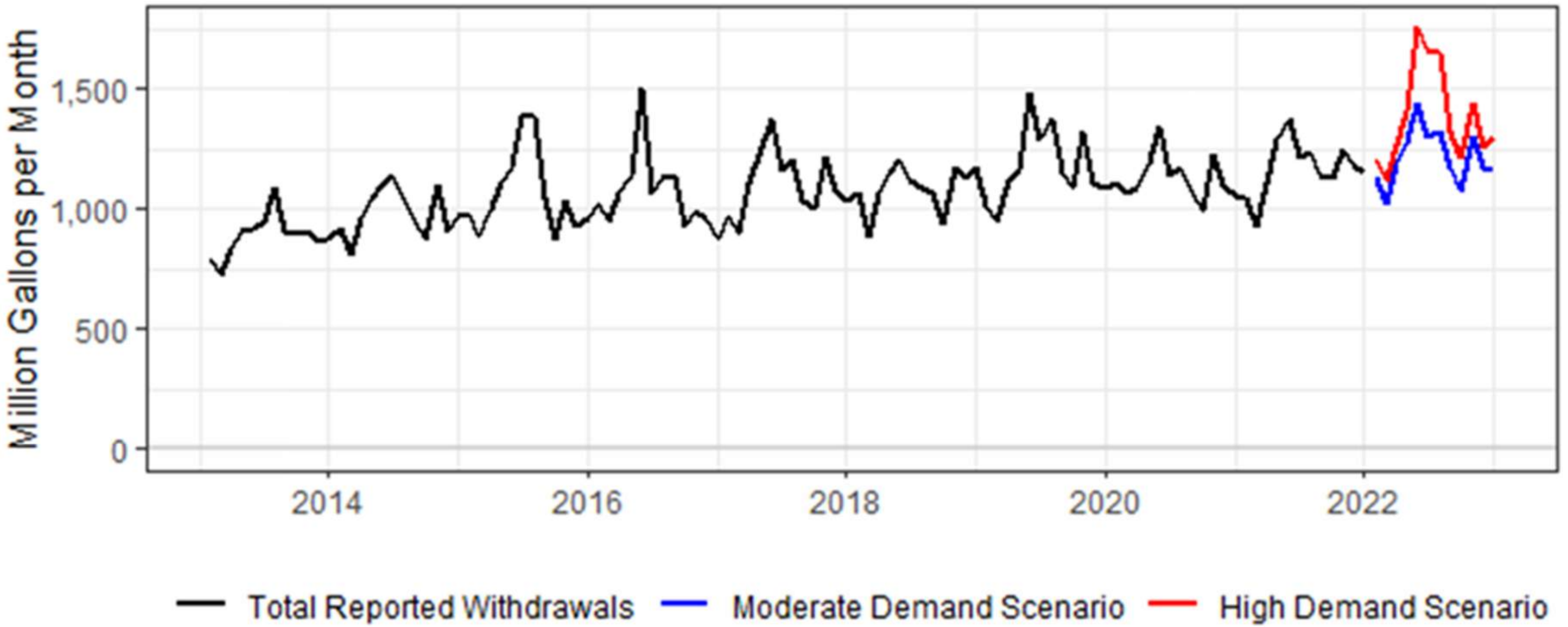
Public Supply - EXAMPLE



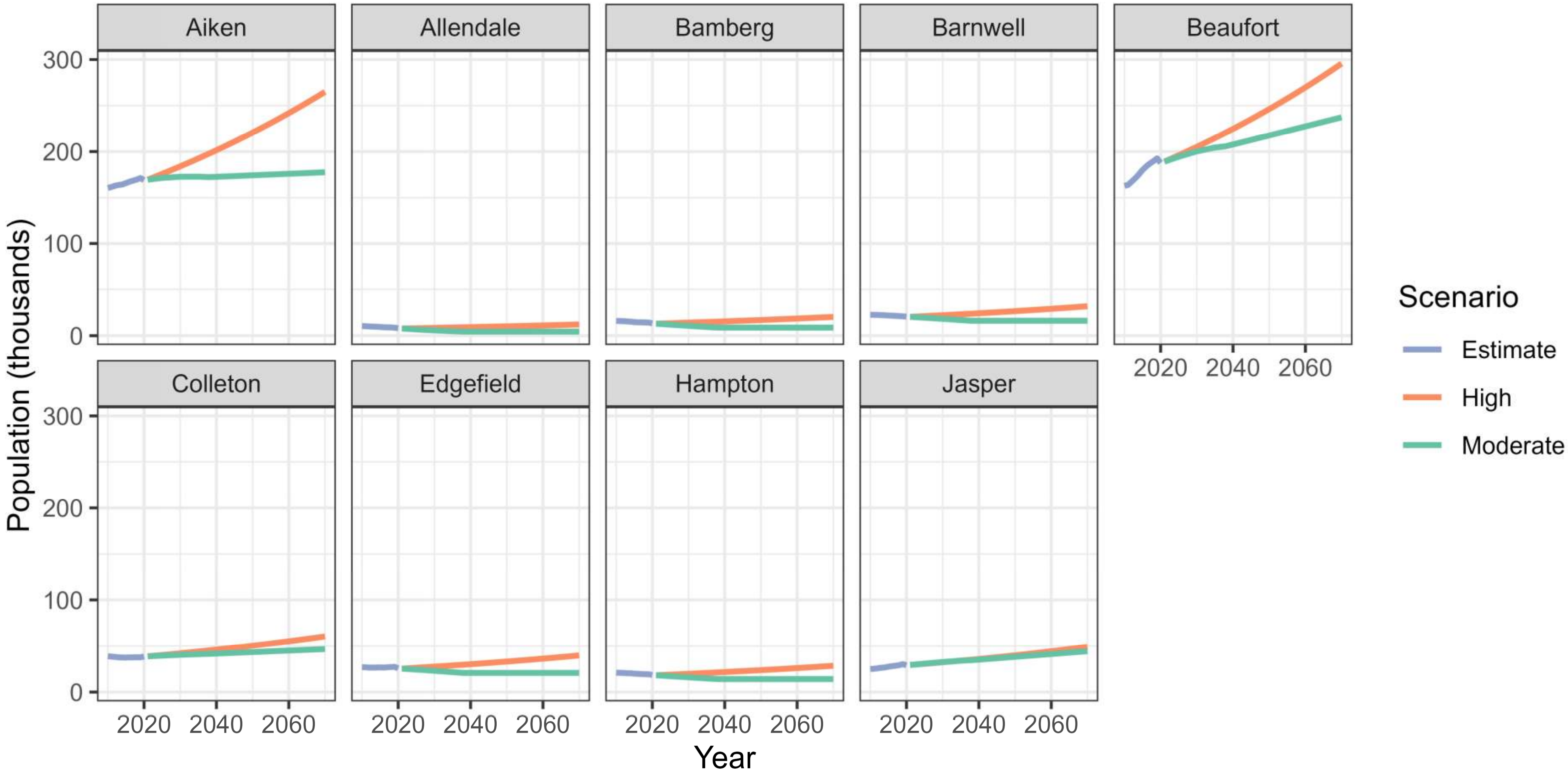
Public Supply – EXAMPLE



Public Supply - EXAMPLE



Population Drives Water Demand for Public Supply



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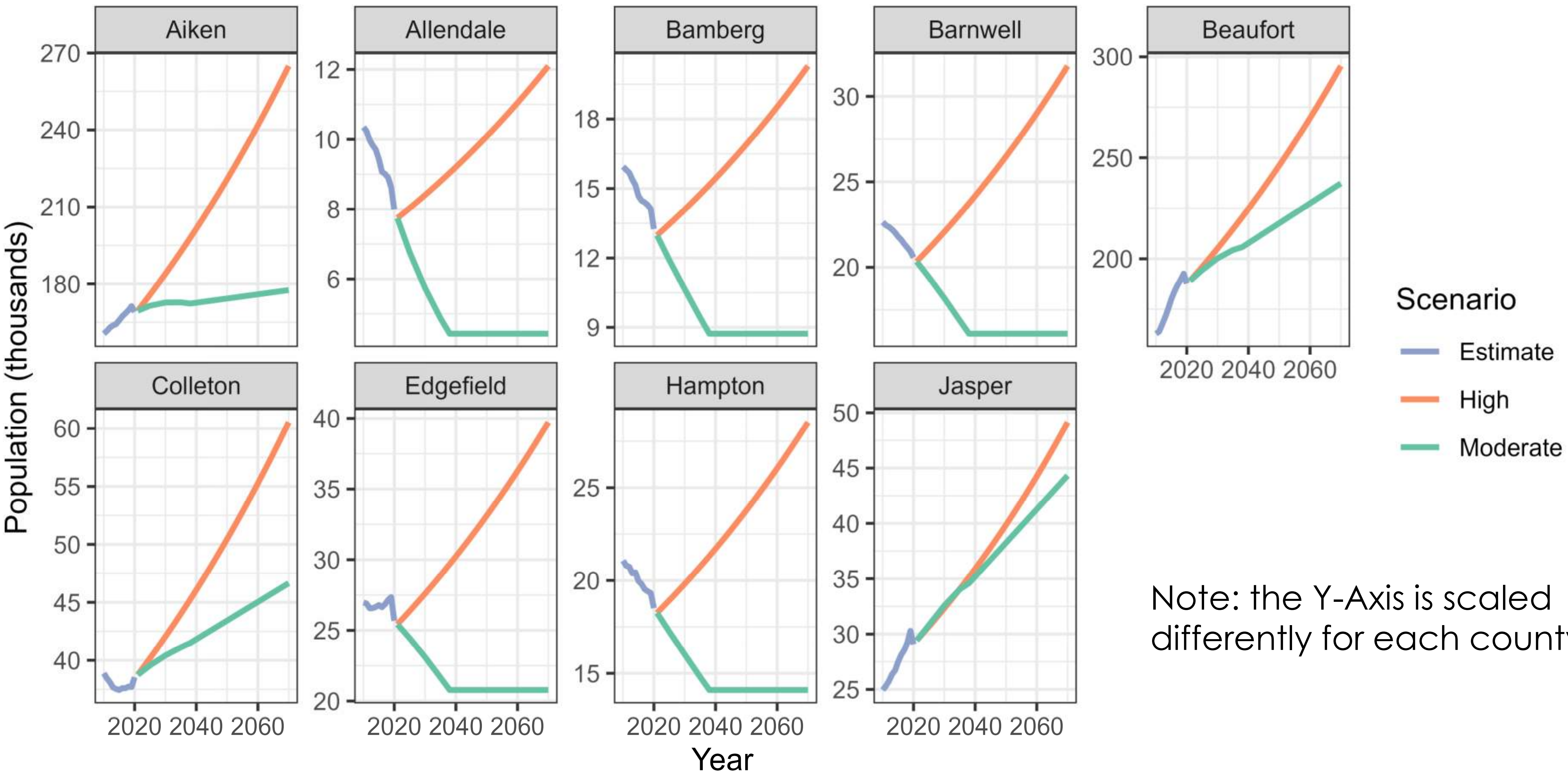


Note: the Y-Axis is scaled differently for each county.

Manufacturing

Projected Annual Economic Growth Rates from the US Energy Information Agency

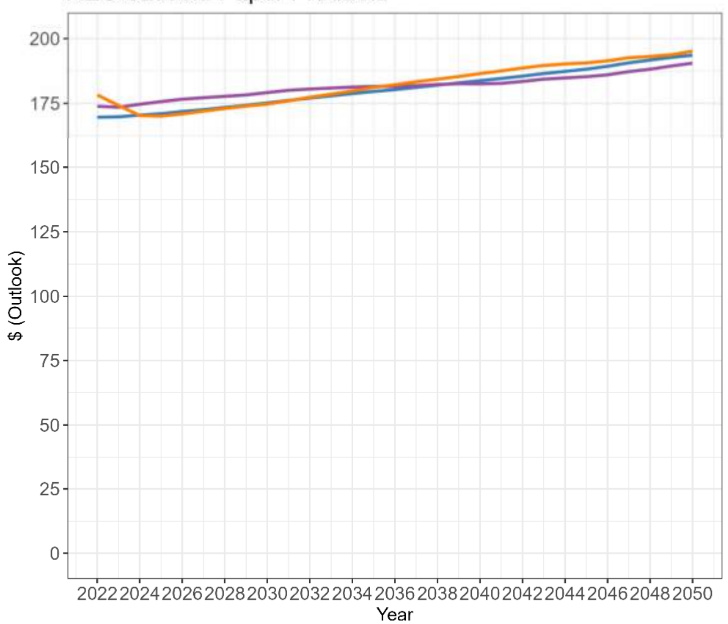
Food Products	0.9%
Beverages and Tobacco Products	0.2%
Textile Mills and Products	-0.2%
Wood Products	0.0%
Furniture and Related Products	1.3%
Paper Products	0.5%
Printing	0.2%
Chemical Manufacturing	1.6%
Bulk Chemicals	1.5%
Inorganic	0.3%
Organic	1.6%
Resin, Synthetic Rubber, and Fibers	1.7%
Agricultural Chemicals	1.0%
Other Chemical Products	1.6%
Petroleum and Coal Products	0.8%
Petroleum Refineries	0.8%
Other Petroleum and Coal Products	1.1%
Plastics and Rubber Products	1.7%
Stone, Clay, and Glass Products	1.1%
Glass and Glass Products	1.0%
Cement and Lime	1.4%
Other Nonmetallic Mineral Products	1.1%
Primary Metals Industry	0.9%
Iron and Steel Mills and Products	0.1%
Alumina and Aluminum Products	1.3%
Other Primary Metal Products	1.6%
Fabricated Metal Products	1.5%
Machinery	1.8%
Computers and Electronics	2.5%
Transportation Equipment	1.7%
Electrical Equipment	2.5%
Miscellaneous Manufacturing	2.8%

Basin specific manufacturing

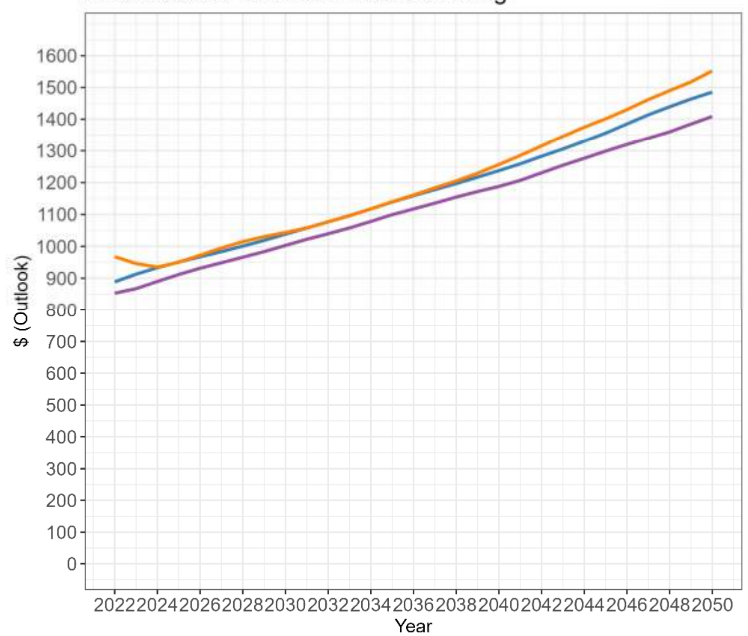
Industry	Name	Projected Annual Economic Growth Rates
Paper Products	Kimberly Clark	0.5%
Chemical Manufacturing	Archroma Us Inc	0.3% (inorganic)
Miscellaneous Manufacturing	Resort, Recycled Group	2.8%
Plastics and Rubber Products	Bridgestone	1.7%
Wood Products	Georgia-pacific Wood Products Llc	0%

Basin specific manufacturing

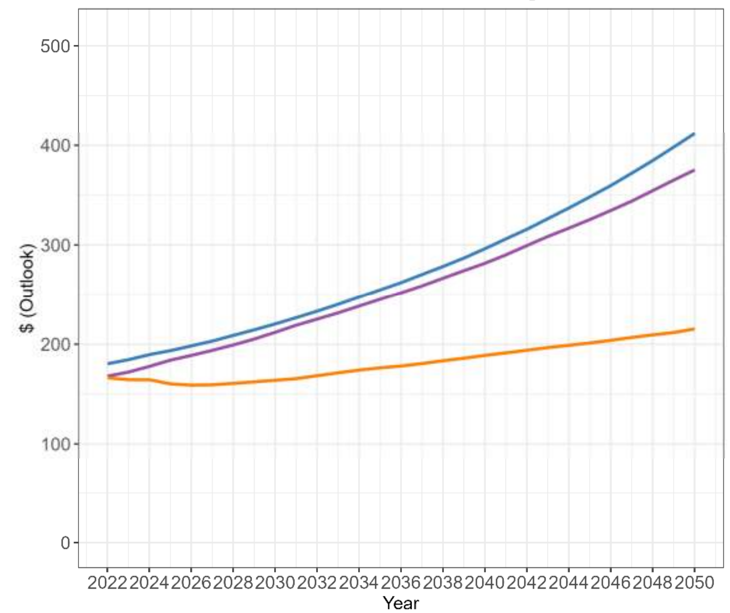
AEO outlook: Paper Products



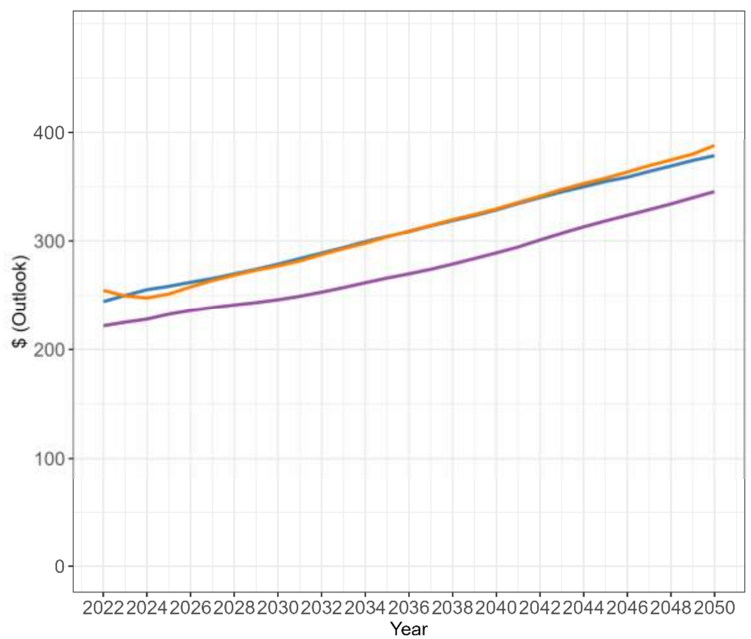
AEO outlook: Chemical Manufacturing



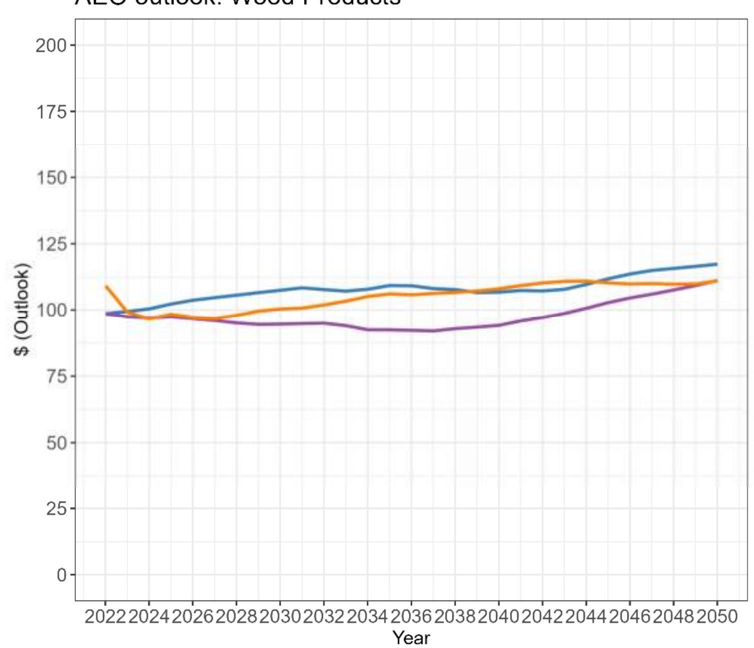
AEO outlook: Miscellaneous Manufacturing



AEO outlook: Plastics and Rubber Products



AEO outlook: Wood Products



- 2020 data
- 2021 data
- 2023 data

Manufacturing

- Projected annual growth rates range from 0.3% to 2.8%, depending on the economic sector.
- Over 50 years, that leads to a total increase from 5% to over 267%.
- In reality, water demand for manufacturing has declined as industrial processes become more efficient and manufacturers develop higher-value products.

Agricultural Irrigation

- Projected to grow from 38% (Moderate Scenario) to 44% (High Scenario) over the 50-year planning horizon (roughly 0.7% annual growth rate)
- Data indicated the recent growth of about 7% annually.
- The projected surface water growth is assigned to placeholder irrigators at HUC10 confluence nodes.
- The projected groundwater growth will be distributed regionally according to available land and proximity to existing irrigation

Possible Research

Industrial Water Purchases from Public Suppliers:

- *Per-capita modeling:* Acknowledge that while residential and commercial use can scale per capita, industrial purchases typically do not follow this trend.

Breakdown of Water Systems: Indoor vs Outdoor and Residential vs Commercial Use:

- *Availability of relevant data:* Explore what relevant data is currently available that could be leveraged.
- *Data limitations:* Address the current insufficiency of data for detailed breakdowns of water systems *and* Propose an investigation into the volume and type of data required for robust analysis.

Agricultural Demand:

- Examining shifts in agricultural practices and the resulting changes in water demand.
- Integrating precision agriculture data into demand projections to account for more efficient irrigation techniques.

Socioeconomic Factors:

- Understanding the impact of changing lifestyles and consumer behavior on water demand.
- More diverse set of socio-economic water productivity measures to ensure that a broader set of values are represented in water allocation policies.

Acknowledgement

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- Dr. Thomas C Walker III, SC Water Resource Center, Clemson University
- Dr. Prakash Khedun, SC Water Resource Center, Clemson University

Discussion Questions

What trends are currently happening or on the horizon?

What magnitude of impact can we expect?

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