The Future of Water in the DC Metro Area

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Overview

- Why do we do this study?
- What is the Washington metropolitan area’s “cooperative” water supply system?
- What is included in the study?
- What are the results?

Why do we do this study?

Conducted by ICPRB CO-OP on behalf of the three major water suppliers

- Fairfax Water
- Washington Aqueduct*
- WSSC Water

Required every 5 years by regional agreements

Alerts suppliers if new resources are needed

*A Division of the US Army Corps of Engineers (USACE)

Washington metropolitan area (WMA) cooperative water supply system

An interstate regional system

- Fairfax Water –> NoVA suburbs
- Washington Aqueduct* –> DC, Arlington
- WSSC Water –> MD suburbs

Cost-sharing for shared reservoirs

- Jennings Randolph Reservoir
- Little Seneca Reservoir
- Savage Reservoir

Water Supply Coordination Agreement

- Coordinated operations during drought
- Joint planning studies
- Technical & admin support by CO-OP

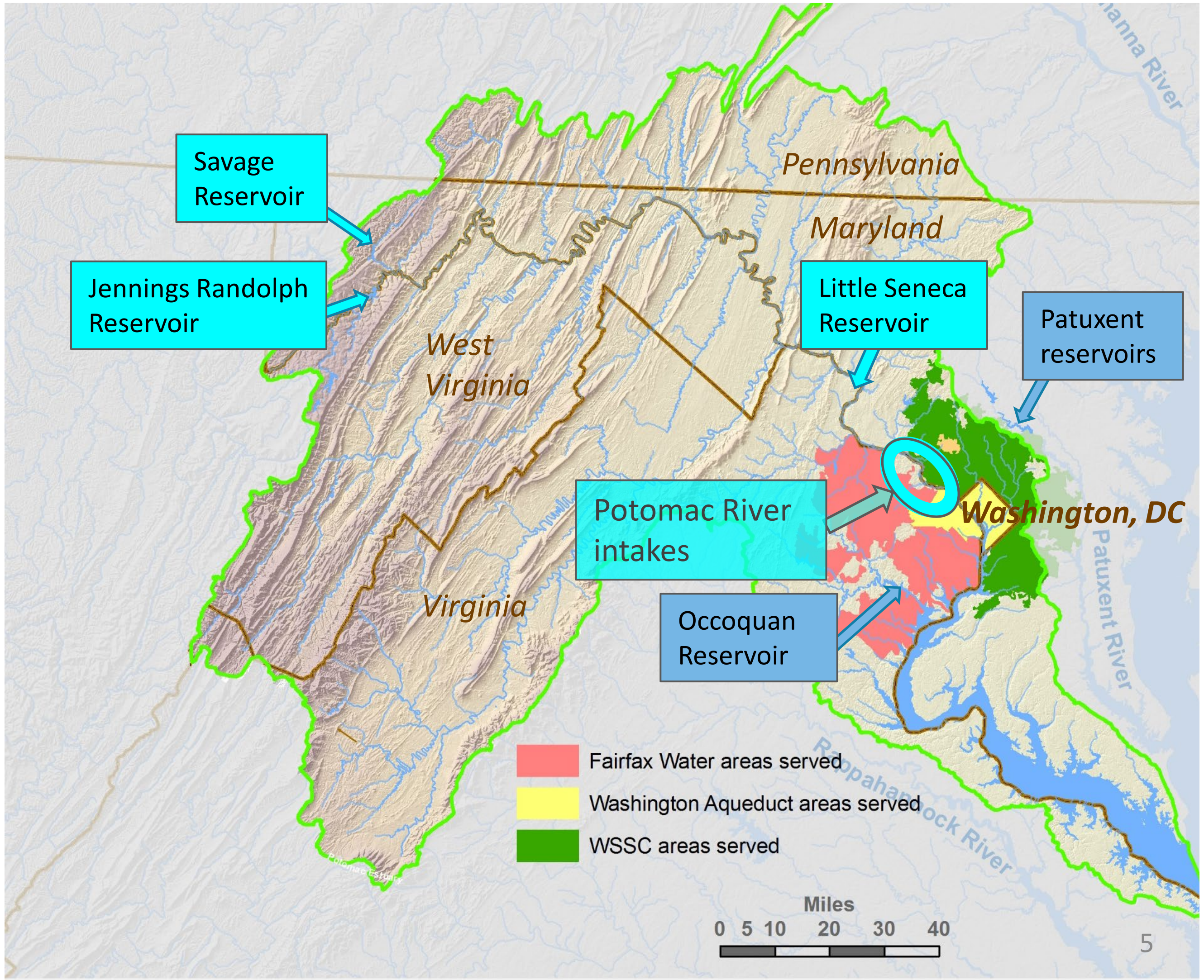
WMA cooperative water supply system

Water supplies

- 75% from Potomac River
- 25% from off-Potomac reservoirs
  - Occoquan (Fairfax Water)
  - Patuxent (WSSC Water)
- Additional water released from shared reservoirs to augment river flows if needed during drought

Environmental requirements

- 100 million gallon per day minimum flow-by just below Potomac River intakes (at Little Falls Dam)



Study objectives

Forecast water demands

Includes

Demographic projections

Adjustments for rising temperatures

Adjustments for water saving fixtures and appliances

Forecast water availability

Includes

Adjustments for upstream water users, ***including data centers***

Adjustments for impacts of rising temperatures on stream flows

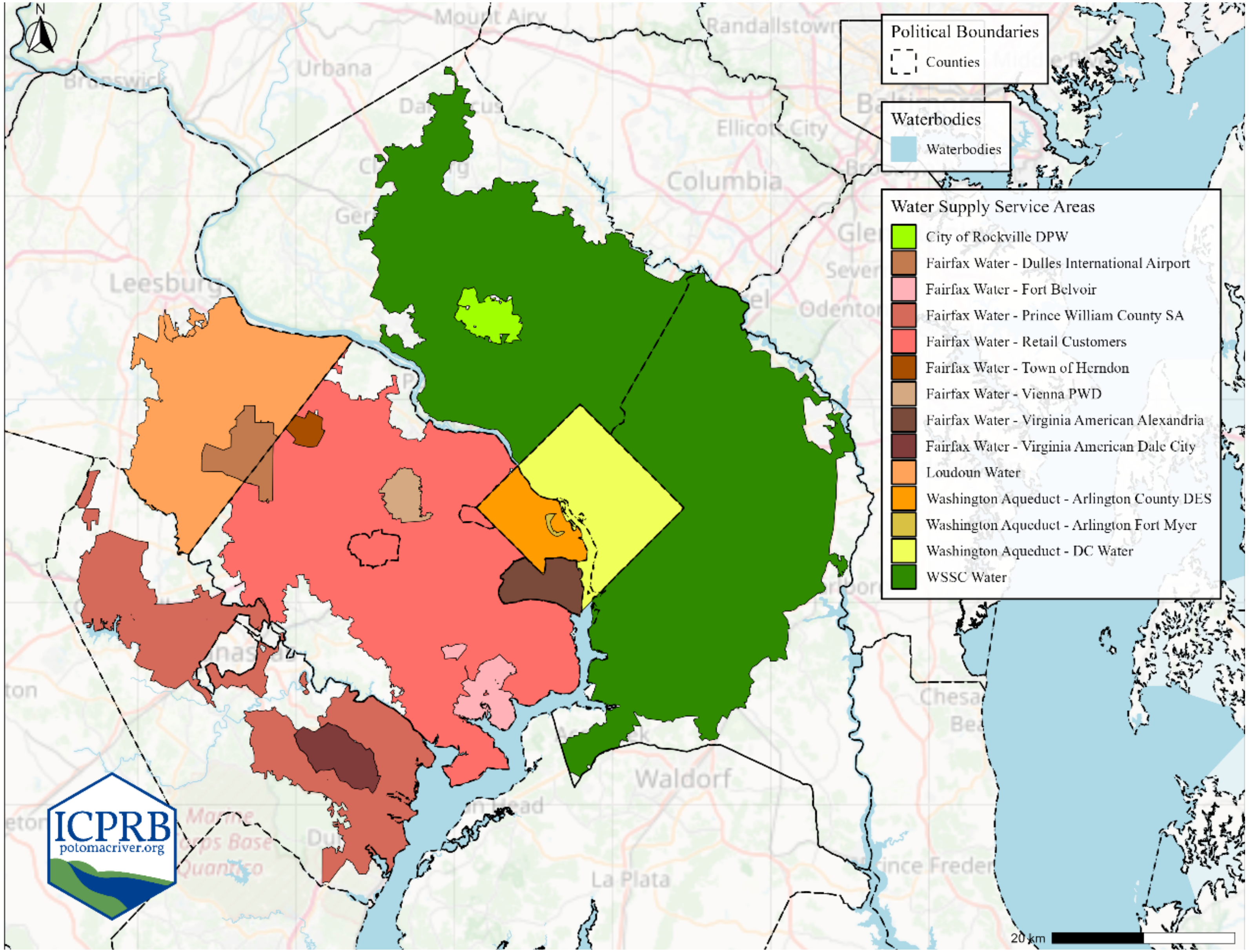
Assess future reliability of WMA cooperative system

Includes

Benefits of planned new reservoirs: Fairfax Water’s Edgemon and Loudoun Water’s Milestone

Forecasts of annual water demands

- Demographic forecasts available through 2050
- Two adjustments made
  - Estimates of increases in due to rising temperatures
  - Estimates of decreases from water-saving fixtures & appliances

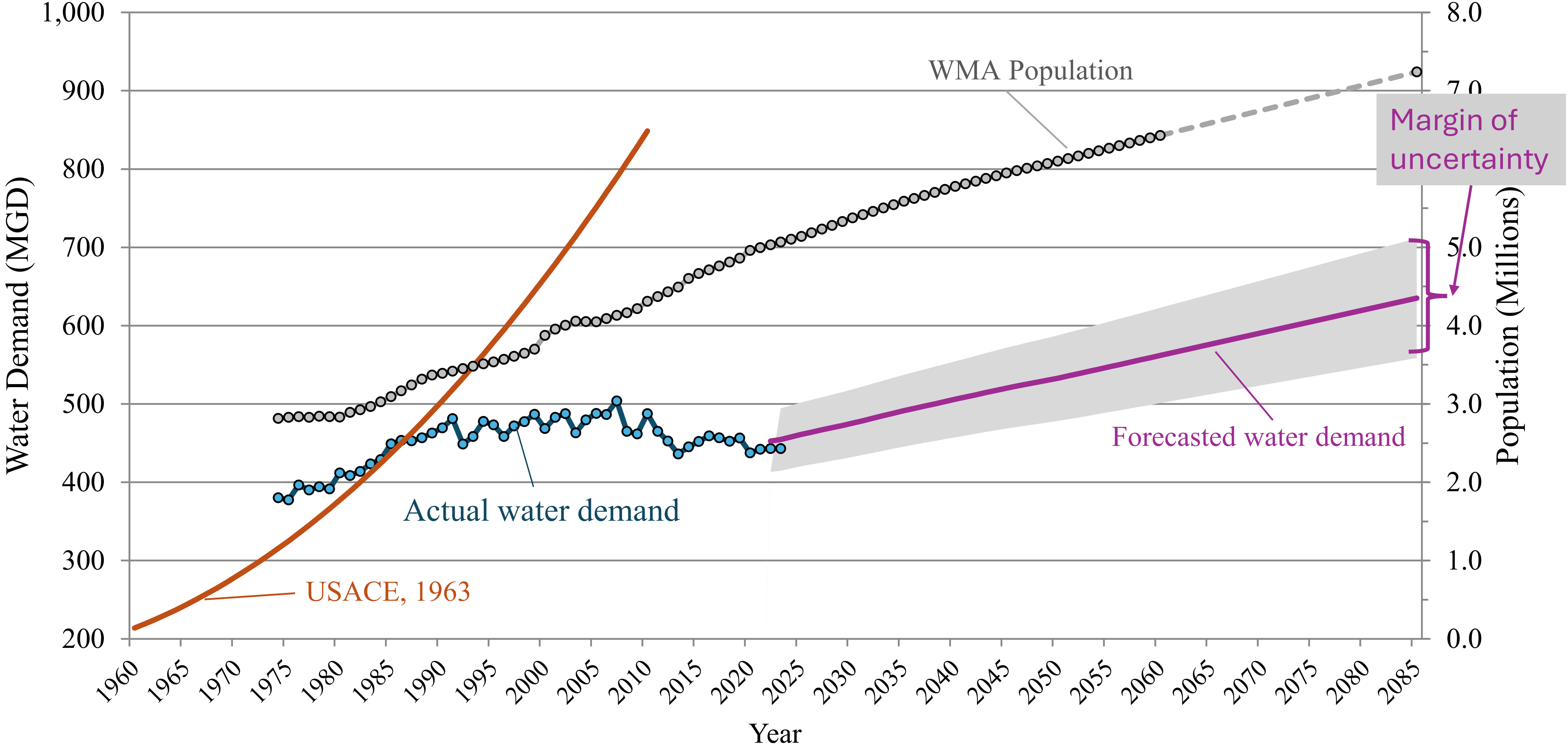


Forecasts of annual water demands

- Water use categories (units)
  - Single-Family Households
  - Multi-Family Households
  - Employees
- Data sources and inputs include
  - Supplier billing data → current unit use
  - Metropolitan Washington Council of Governments (MWCOG) demographic forecasts → number of households and employees
  - Dwelling unit ratios → single-family to multi-family households
  - GIS data → supplier water service areas
  - Unmetered water use (by supplier)

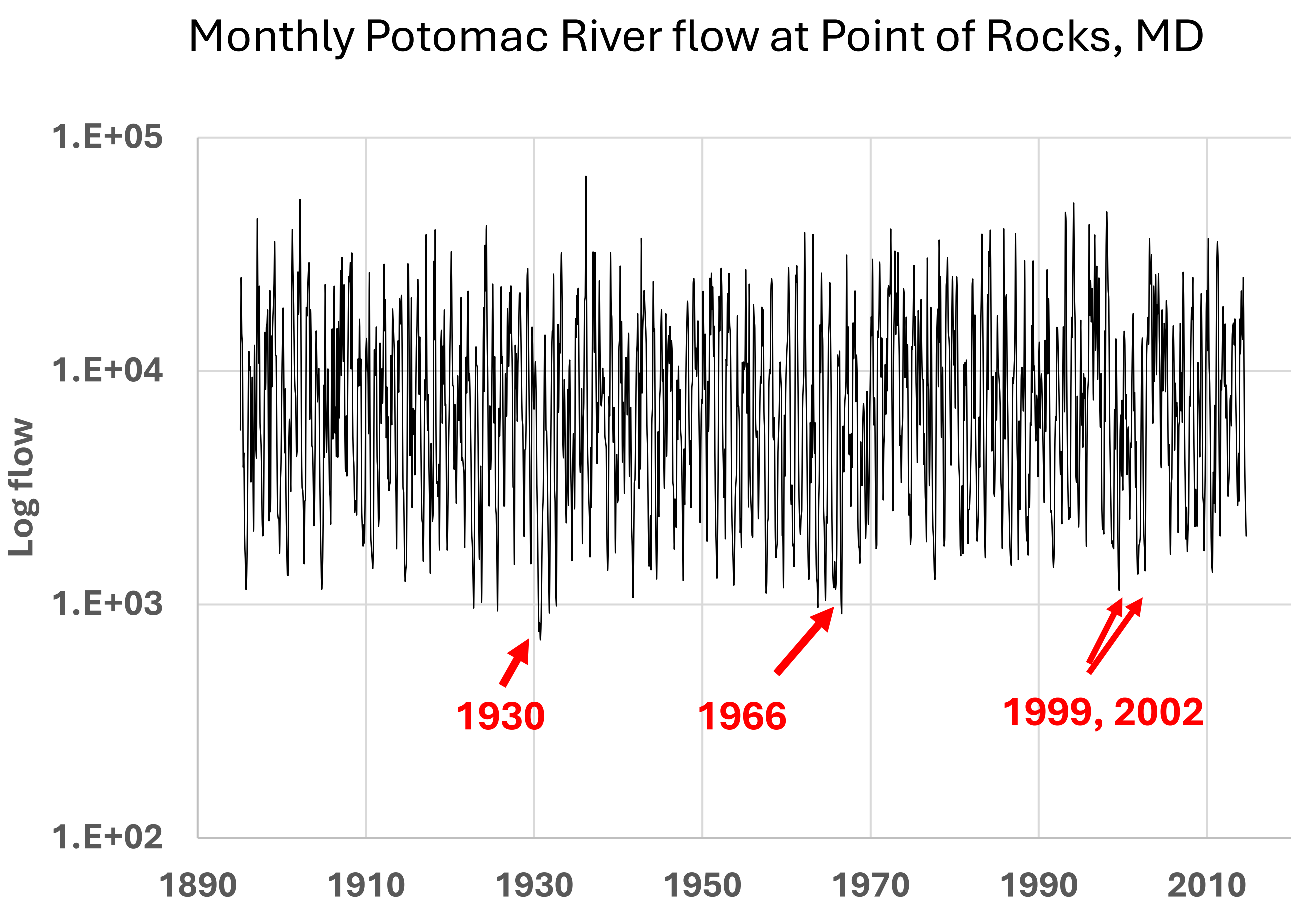
$$Forecasted\ annual\ demand = \sum_{use} (unit\ use * number\ units)$$

Water demand forecast - results



Forecasts of water availability

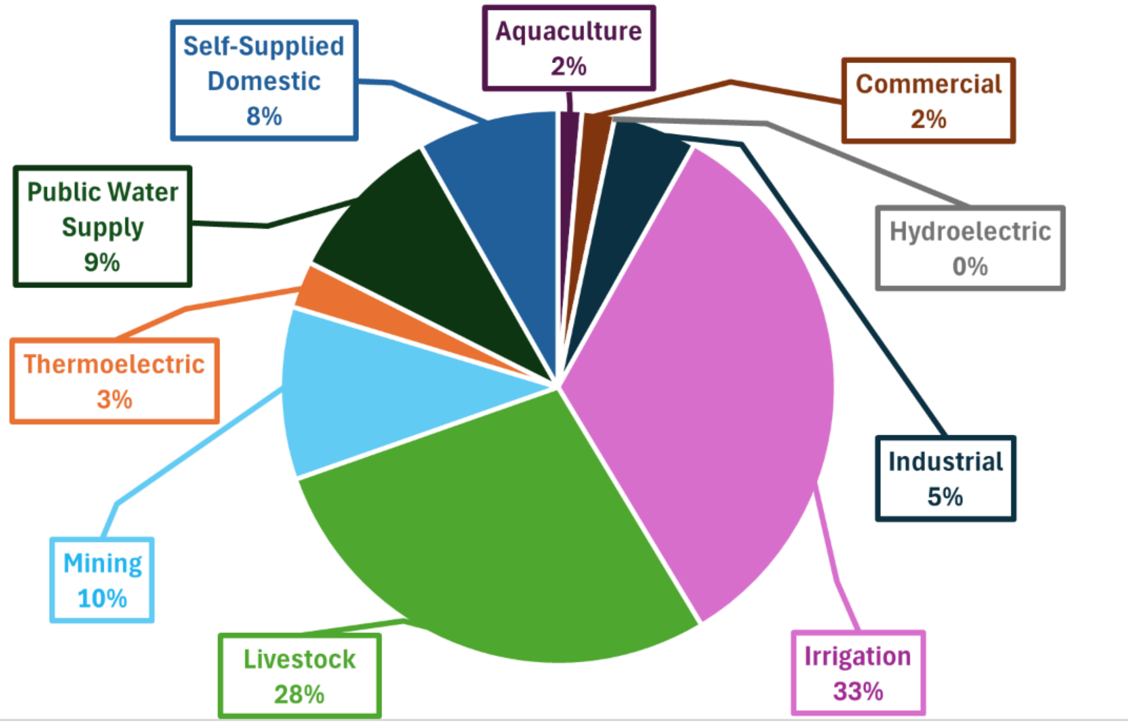
- Starting point is daily historic record of regional river & stream flows
  - Dustbowl era drought of 1930 is our “drought of record”
  - Lowest daily Potomac River flow occurred in summer of 1966
- Historic flows are altered to reflect potential changes
  - Reductions in flow at WMA intakes due to upstream “consumptive” use of water
  - Alterations in flow due to a changing climate



Impact of upstream consumptive use

- Consumptive use of water
  - Water withdrawn and not returned to watershed
  - Reduces downstream river flow at WMA intakes
- 2025 study updates
  - For non-data center use, starting point is most recent *ICPRB Withdrawal and Consumptive Use Database*
  - For data center use, based on data from suppliers, assumptions on cooling technologies, and regional energy forecasts

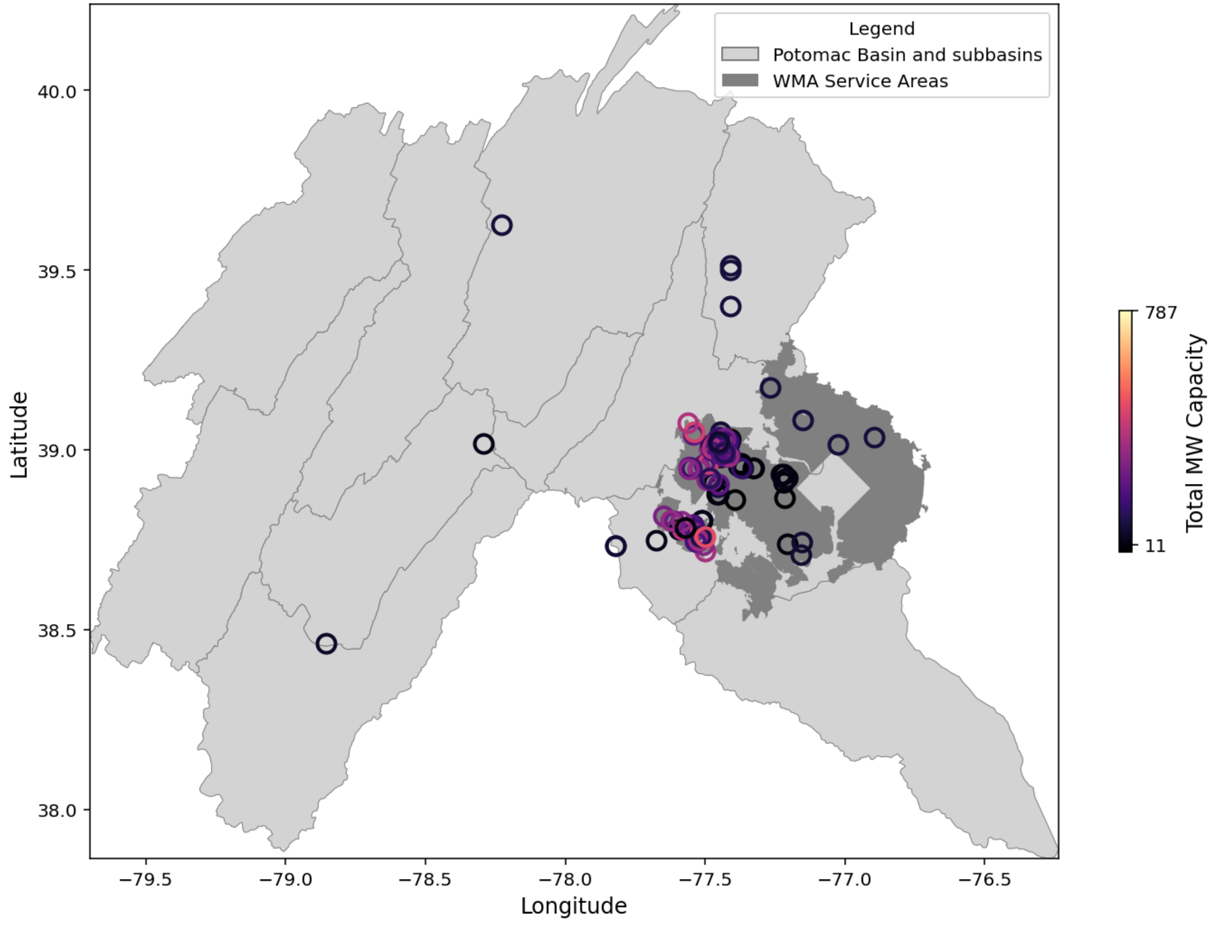
Estimates of current upstream consumptive use



Data centers in the Potomac Basin

- Key factors for siting
  - Power & cooling: reliable electricity, cooling water or cooler climates, low hazard risk
  - Connectivity: fiber networks, internet exchange points
  - Cost & incentives: affordable land, tax breaks, streamlined permitting
- Virginia
  - Loudoun County: "Data Center Alley"
  - Prince William County: active development
- Maryland
  - Frederick & Montgomery counties: upcoming developments

Current data center locations*



*Virginia *Joint Legislative Audit and Review Commission (JLARC)* consultant databases; vendor databases (e.g., Data Center Map)

Data center water use

- ICPRB study goal: quantify direct water use for cooling (excluding indirect use for power generation)
- Results sensitive to assumptions on cooling methods
    - Water intensive: includes evaporative & non-evaporative cooling
    - Non-water intensive: e.g. air cooling
    - Hybrid

Source: Google. Data center in The Dalles, Oregon.

Data center consumptive use

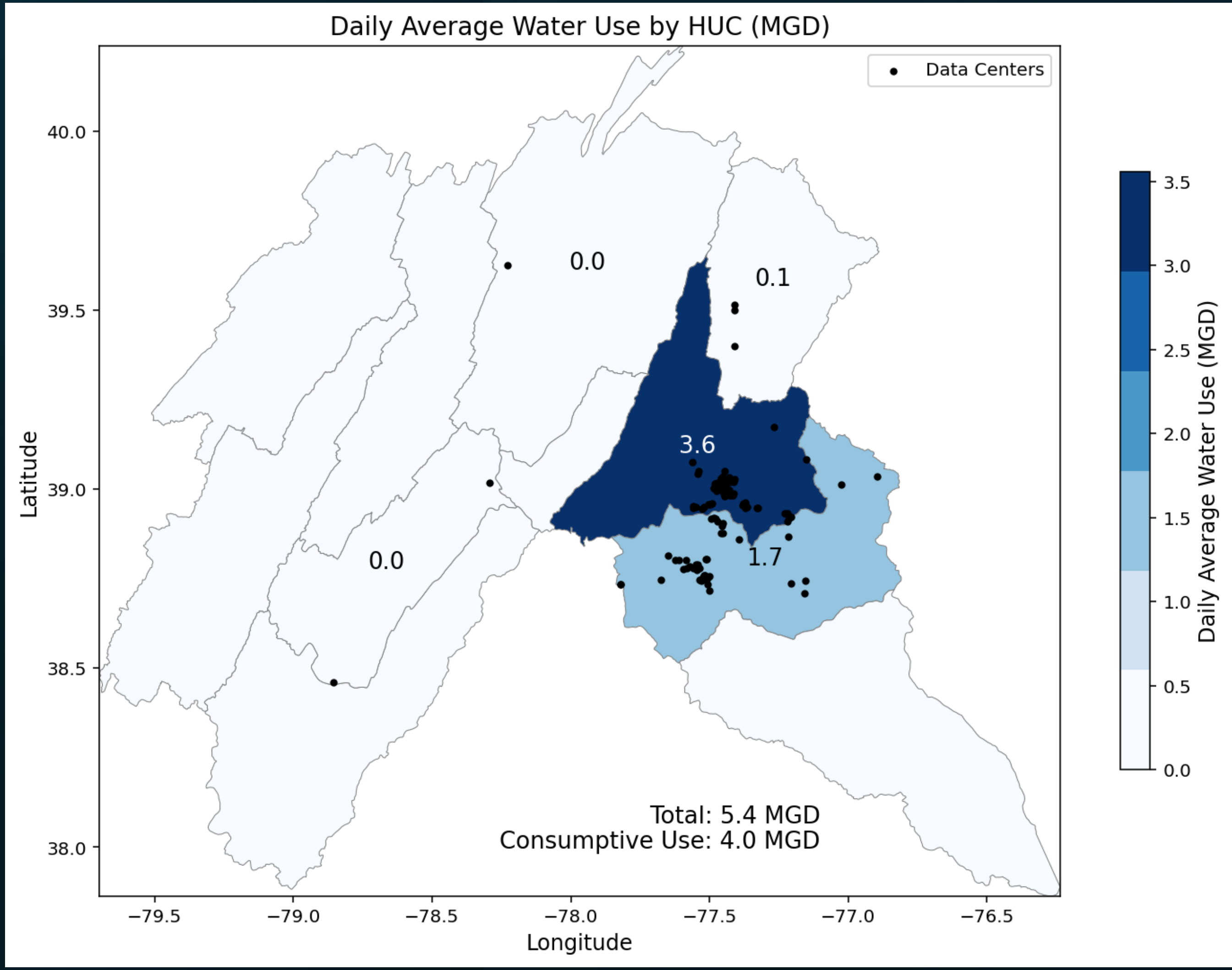
Our study uses power demand to forecast data center growth

- WUP = water use per unit power [gallons per day (gpd) per mega Watt (MW)] based on
  - Observed service-area withdrawals from suppliers
  - Backup generator capacities from Virginia database
- Effective Power Demand = redundancy factor * utilization factor
  - Assume backup generator redundancy factor = 0.5
  - Assume power utilization factor = 0.8 (EPRI)
- Consumptive use factor for water cooling: assume 75% based on supplier data

$$Consumptive\ Use = \\ WUP * Effective\ Power\ Demand * Consumptive\ Use\ Factor$$

Estimates of current data center consumptive use

- WMA
  - 4.0 MGD average
  - 14.3 MGD peak day
- Upstream areas
  - 0.1 MGD average
  - 0.3 MGD peak day



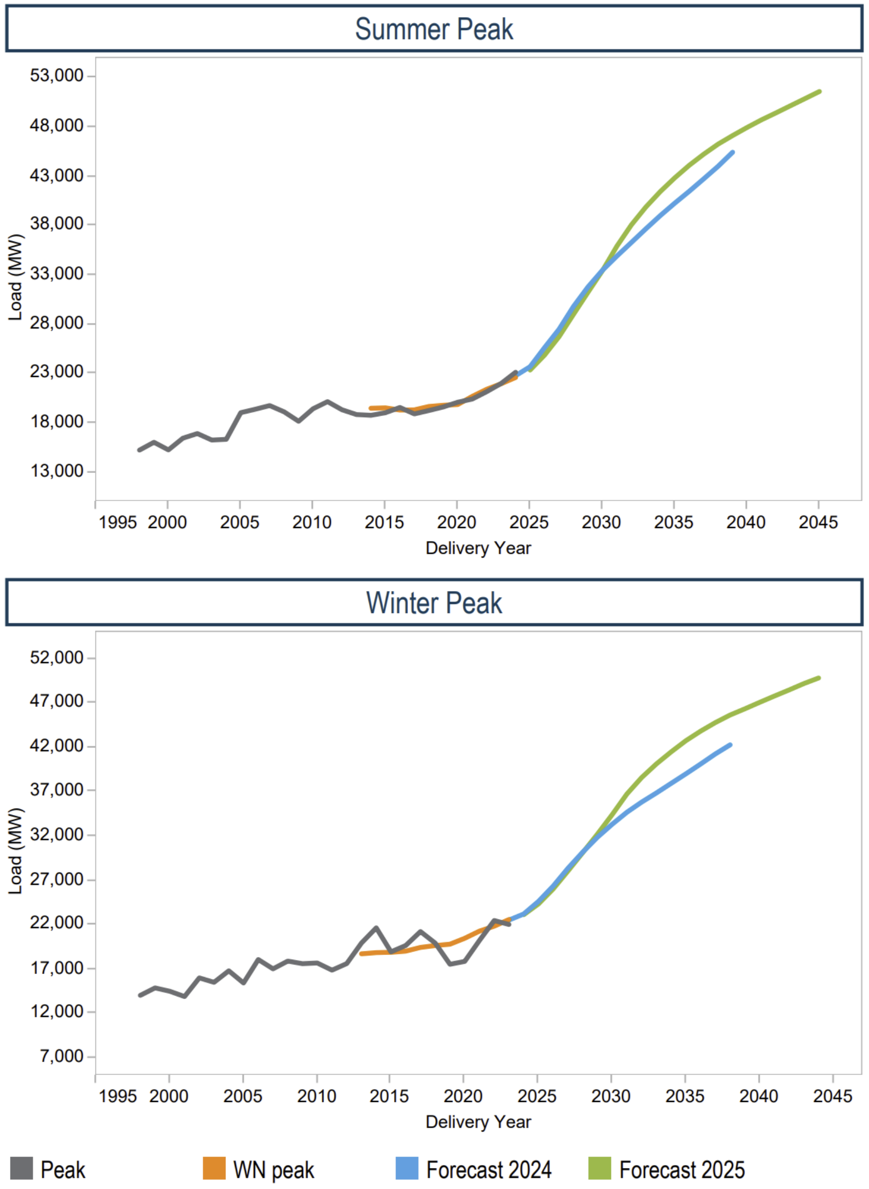
Future data center consumptive use

- Cooling technology scenarios for WUP are based on assumed future ratio of water cooling to air cooling:
  - 80-20 – High scenario
  - 60-40 – Medium scenario
  - 40-60 – Low scenario

  → *Reflects uncertainty in technology adoption*
- Future data center power usage from PJM forecasts
  - Allegheny Power Service: 35% growth
  - Dominion: 135% growth

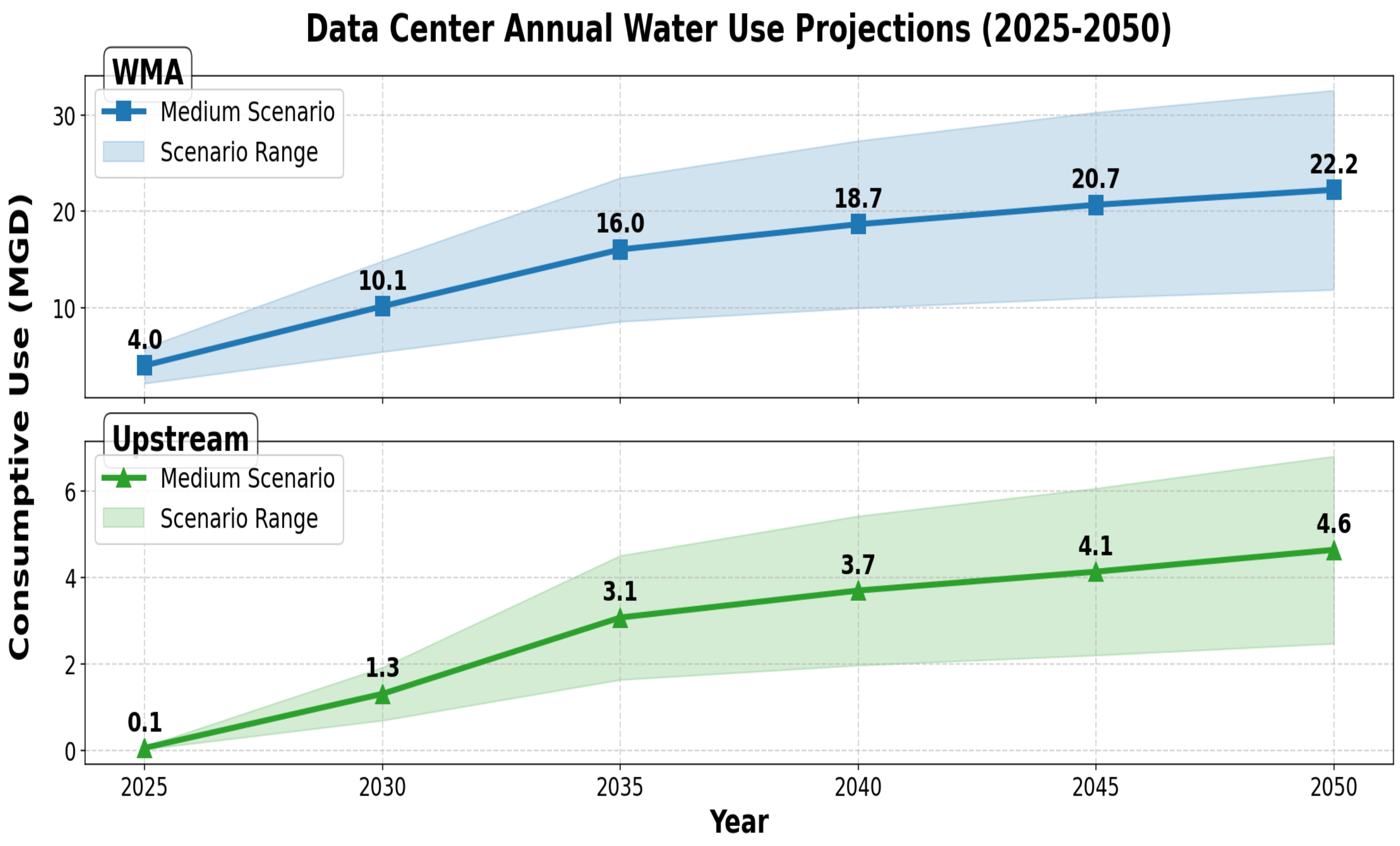
*PJM is our regional transmission organization

Dominion



Estimates of future data center consumptive use

- WMA in 2050
  - 22.2 MGD average
  - 80.5 MGD peak day
- Upstream areas in 2050
  - 4.7 MGD average
  - 16.8 MGD peak day



Outcomes of data center analysis

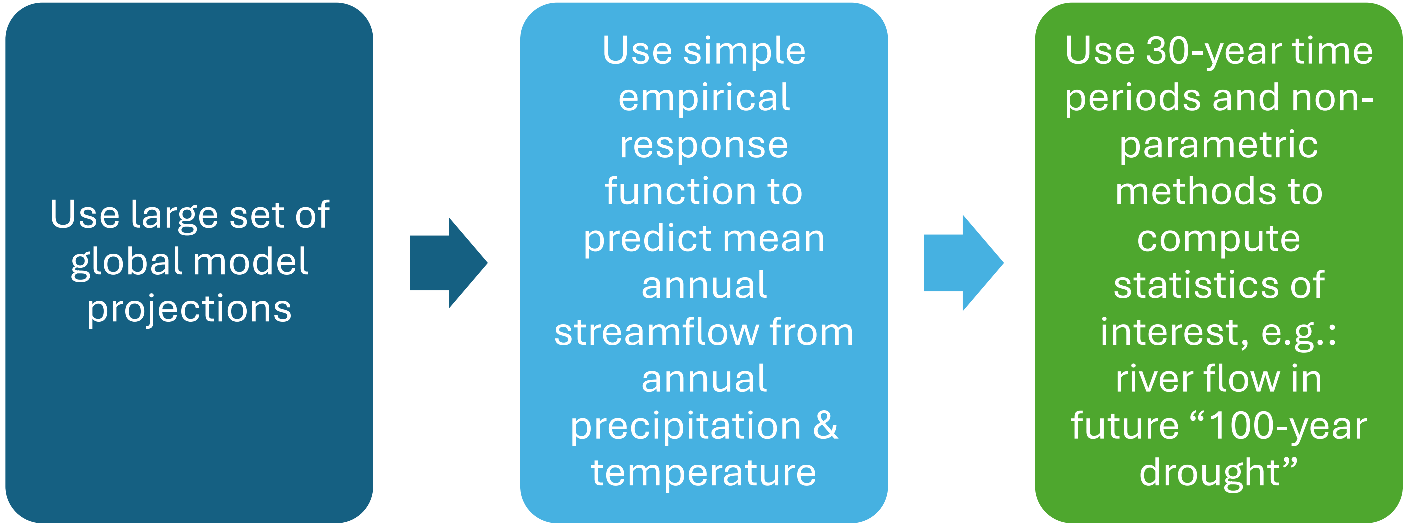
- Current impact:
  - Modest at basin scale but emerging as a distinct new water use sector
- Future impacts
  - Substantial growth likely by 2050, but still only ~5% of all consumptive use
  - Outcomes hinge on cooling technology adoption and power demand trajectories
- ICPRB recommendations include
  - Improved transparency: on-site consumptive use data at daily time scale
  - Discussion/investigation of mitigation options via on-site or off-site storage

Water availability forecast – impact of changing meteorological conditions

How will stream flow change?

- Rising temperatures are expected to increase variability
- Our results show <u>disparate impacts</u> on wet years versus dry years

CO-OP's approach* to changing temperatures and precipitation



**Is Hot Drought a Risk in the US Mid-Atlantic? A Potomac Basin Case Study*, by C. Schultz, S. Ahmed, A. Seck, *JAWRA*, *61*(3), p.e70031.

Annual precipitation in the Potomac watershed

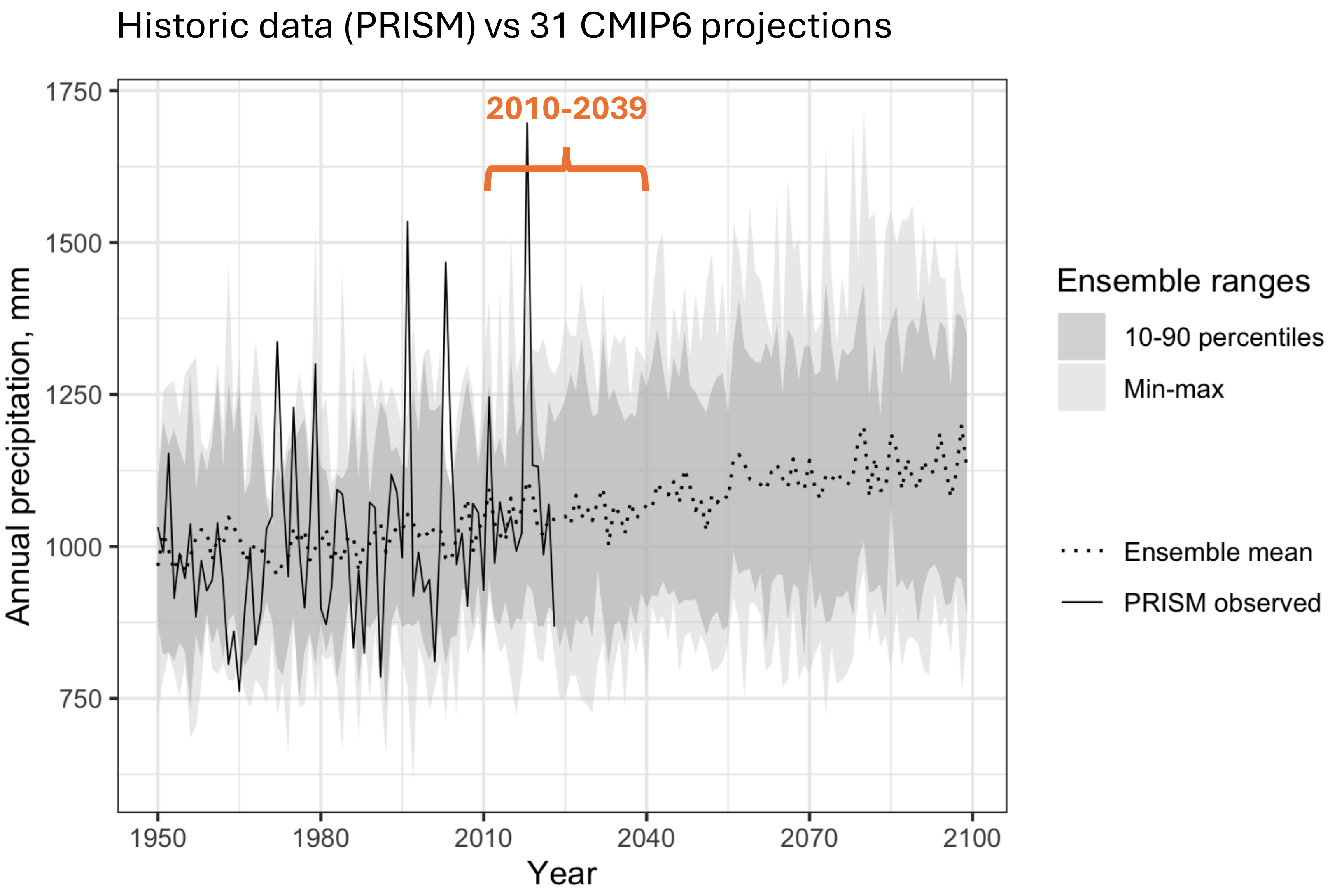
Observed data: statistically significant increase from 1950-2023

2010-2023 observed:

- +10%

CMIP6 "medium flow" scenario:

- +5.7% for 2010-2039
- +10.2% for 2040-2069
- +13.1% for 2070-2099



Annual temperature in the Potomac watershed

Observed data: statistically significant increase for 2010-2023

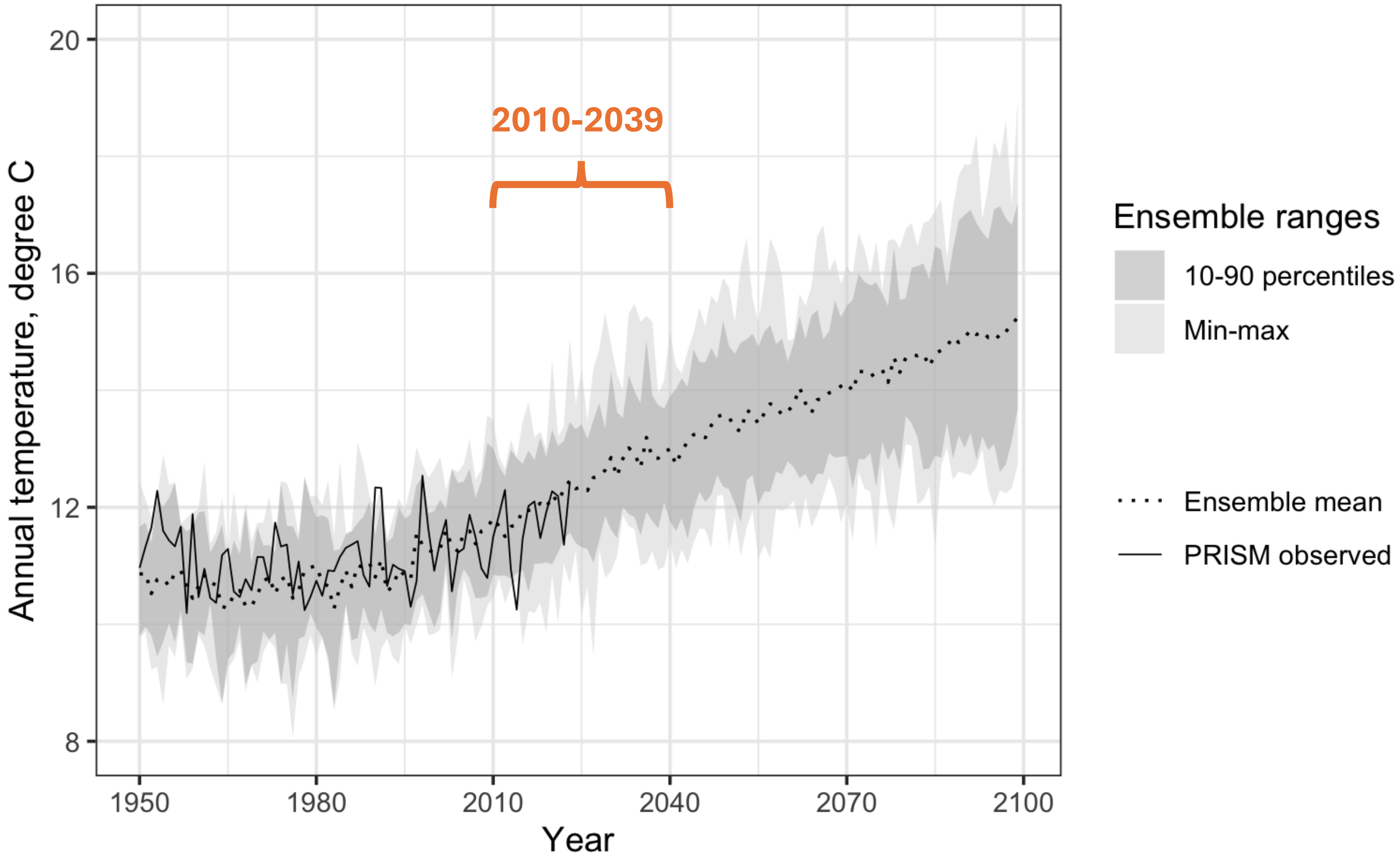
2010-2023 observed:

- +1.0 ºF

CMIP6 “medium flow” scenario:

- +3.1 ºF for 2010-2039
- +5.2 ºF for 2040-2069
- +7.2 ºF for 2070-2099

Historical data (PRISM) vs 31 CMIP6 projections



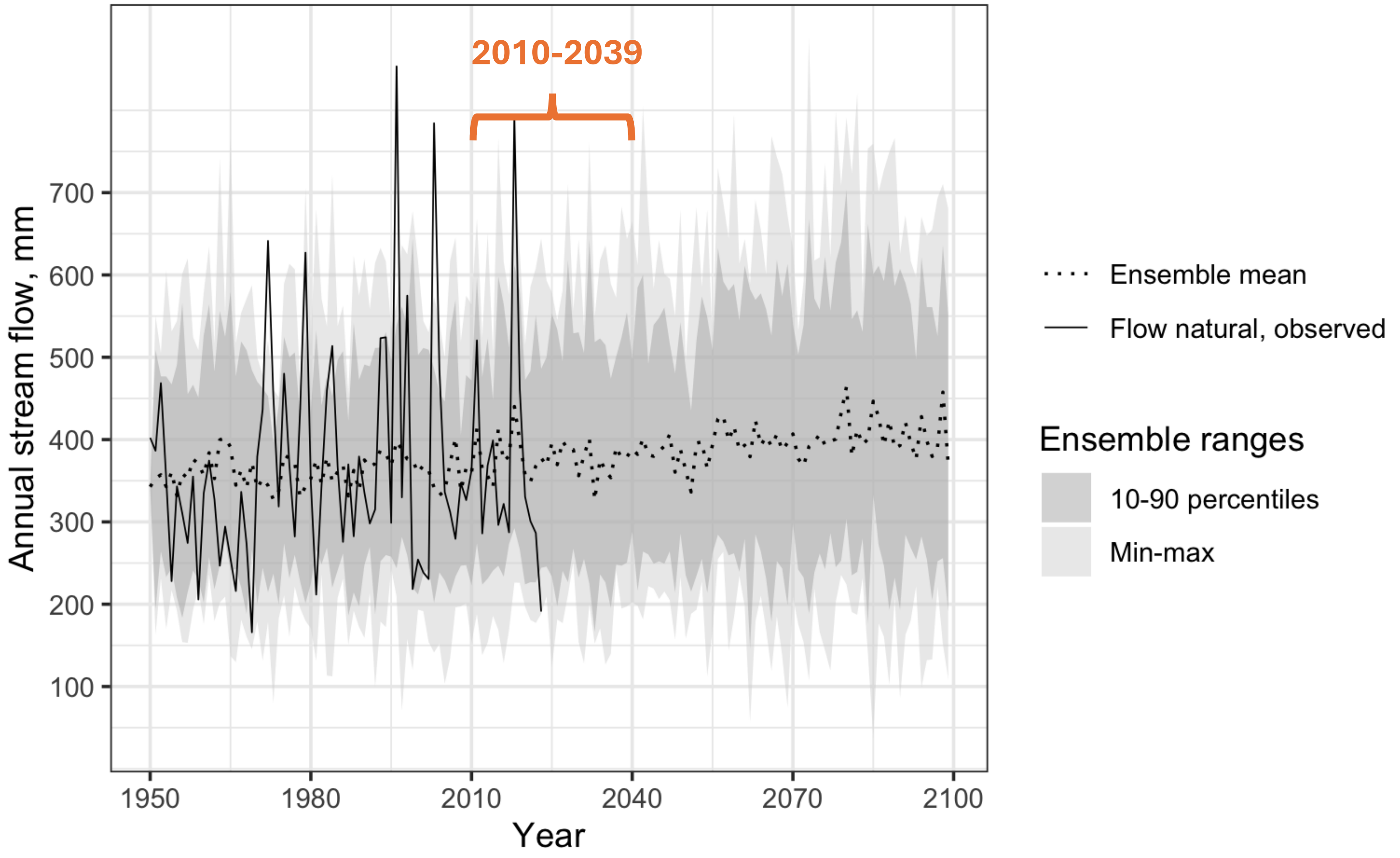
Projections of annual "natural" Potomac River flow

Observed data: no statistically significant change

CMIP6 "medium flow" scenario for future extreme drought year ("100-year drought"):

- -11% for 2010-2039
- -13% for 2040-2069
- -29% for 2070-2099

Historic data vs flows from climate response function with 31 CMIP6 temperature & precipitation projections



Outcome of meteorological change analysis

- Results indicate disparate impacts on future dry versus wet years, with
  - future flows lower in dry years than in the past
  - future flows higher in wet years than in the past
- Caveat: disappointing match between 2010-2023 temperature & precipitation data and climate projections for "near-term": 2010-2039
- Capturing uncertainty: streamflow response function is used to construct 3 scenarios
  - Higher Flow scenario: streamflow not very sensitive to rising temperatures
  - Medium Flow scenario: streamflow somewhat sensitive to rising temperatures
  - Lower Flow scenario: streamflow very sensitive to rising temperatures

Planning in the Face of Uncertainty

Planning scenarios

- Provide plausible range of results for vulnerability assessment
- Well-suited for adaptive management approach & CO-OP's 5-year planning assessments

Uncertainty in annual demands reflected by 3 scenarios:

- Low Demands
- Medium Demands
- High Demands

Uncertainty in impact of meteorological change reflected by 3 scenarios:

- Lower Flows
- Medium Flows
- Higher Flows

Results for nine scenarios *(3 x 3)*

Probability of WMA water supply system reliability in a given year

- 2030: 99 to 100 percent
- 2045: 95 to 100 percent
- 2050: 95 to 100 percent

Results: WMA system reliability in case of extreme drought

(GREEN - reliable, YELLOW - marginal, RED - system failure)

	Flows include projected alterations due to meteorological change									Historical flows		
	Higher Flows			Medium Flows			Lower Flows					
	Low Demands	Medium Demands	High Demands	Low Demands	Medium Demands	High Demands	Low Demands	Medium Demands	High Demands	Low Demands	Medium Demands	High Demands
2030												
2045												
2050												

Questions?

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Report available at:
https://www.potomacriver.org