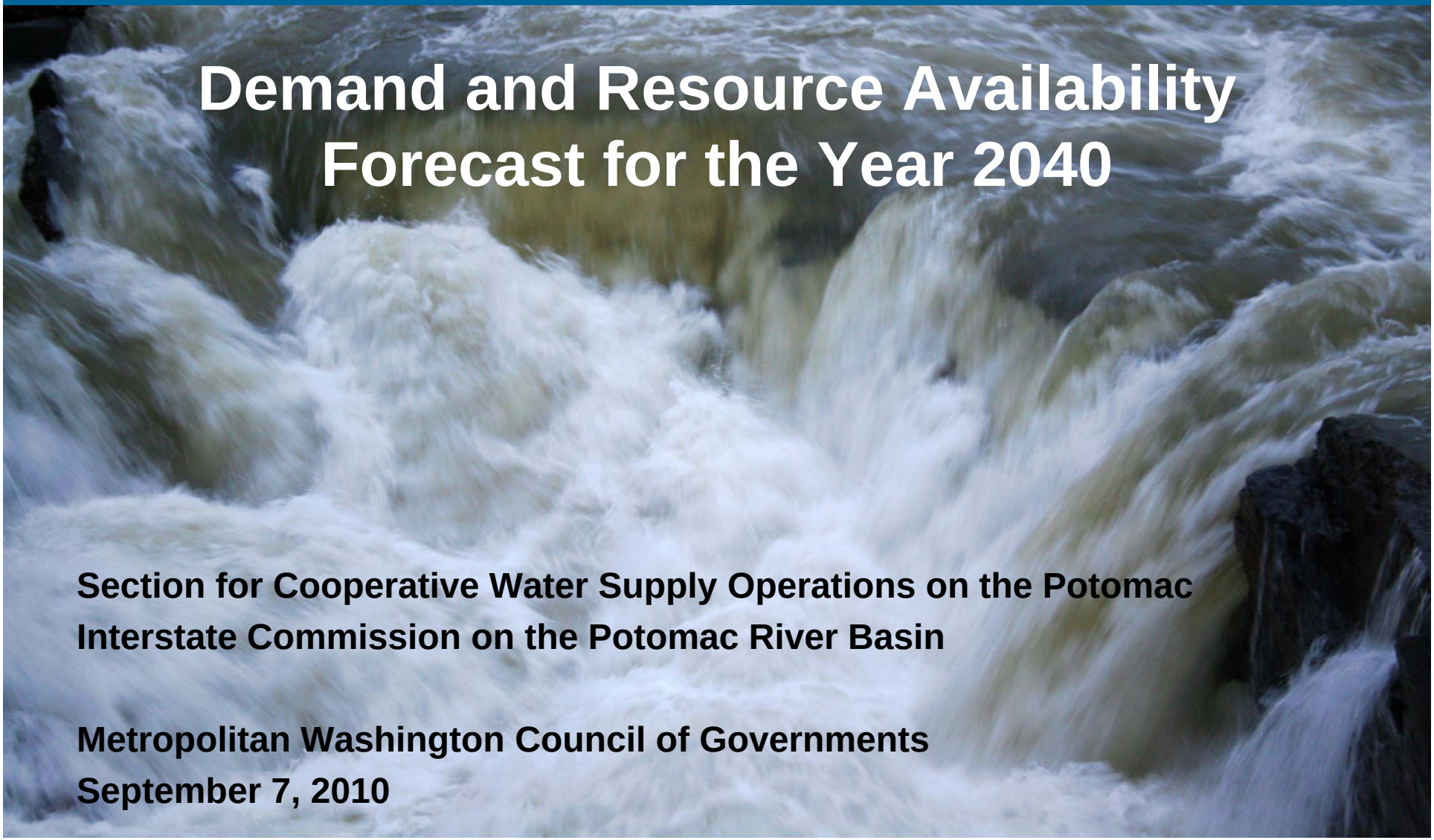
2010 Washington Metropolitan Area Water Supply Reliability Study – Part 1



Demand and Resource Availability Forecast for the Year 2040

Section for Cooperative Water Supply Operations on the Potomac
Interstate Commission on the Potomac River Basin

Metropolitan Washington Council of Governments
September 7, 2010

Cooperative Water Supply Operations on the Potomac (CO-OP)

- Droughts of 1960s led to fears of potential water shortages in WMA
- US ACE proposed structural solutions, including16 reservoirs
- ICPRB and JHU researchers created interactive simulation models and demonstrated value of cooperative approach
- Agreements in 1978 and 1982 led to formation of CO-OP

Cooperative Water Supply Operations on the Potomac (CO-OP)

- CO-OP utilities:
  - WSSC
  - Washington Aqueduct
  - Fairfax Water
- ICPRB's CO-OP Section:
  - Water demand/availability forecasts every 5 years since 1990
  - Coordinates management of resources during droughts
  - Other technical support

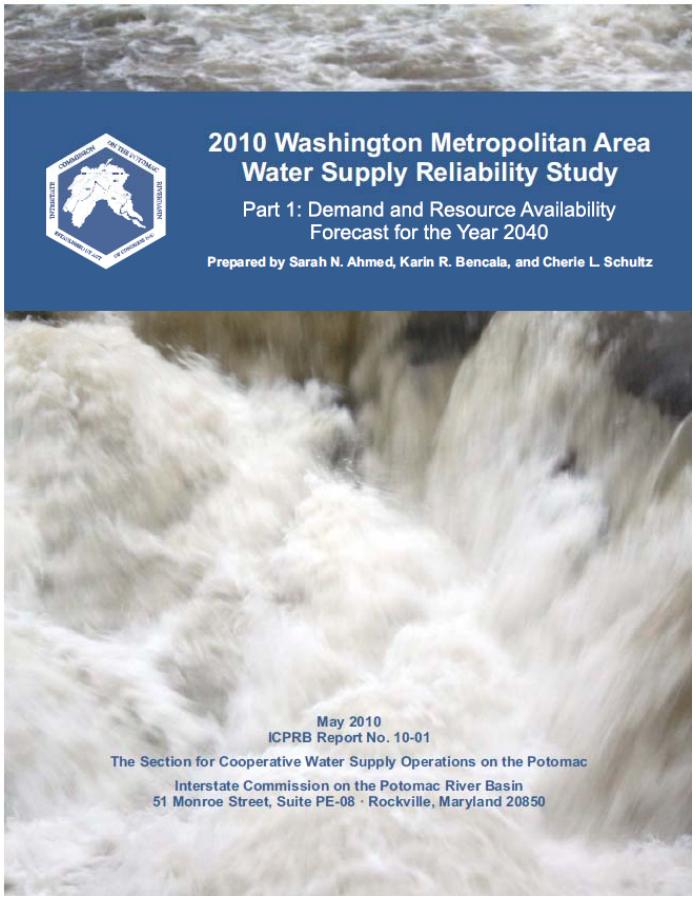
From the Low Flow Allocation Agreement*

"*In April 1990 and in April of each fifth year thereafter … the Aqueduct, the District, the Authority, and the Commission shall* ***review and evaluate the adequacy of the then available water supplies to meet the water demands in the Washington Metropolitan Area*** *which may then be expected to occur during the succeeding* ***twenty year period***."

*as amended by Modification 1

Study Objectives

- Provide CO-OP water suppliers with 20-year demand/availability forecast
- Provide Northern Virginia Regional Commission with 30-year forecast



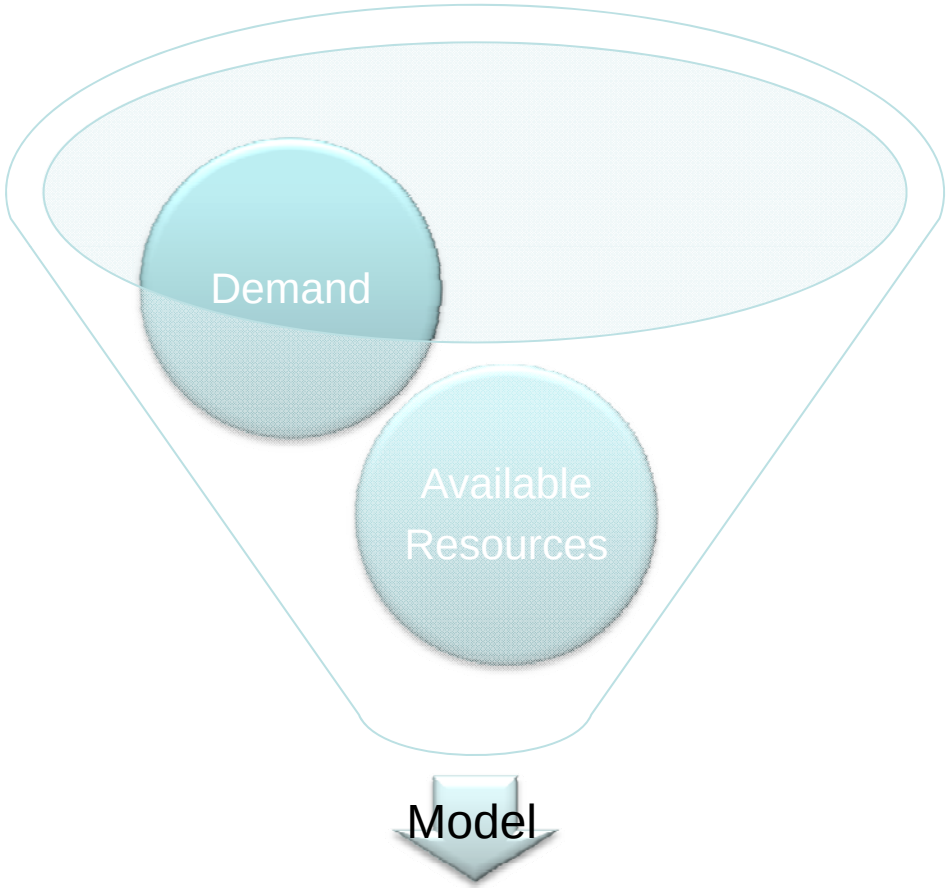
Study Components

Part 1:

- Demand forecast - 2010 through 2040
- Resource analysis - 2010 through 2040
- Summary of potential water supply alternatives

Part 2:

- Assessment of impact of global climate change on projected demands and resource availability



Can the current system meet future demands?

Current Unit Use

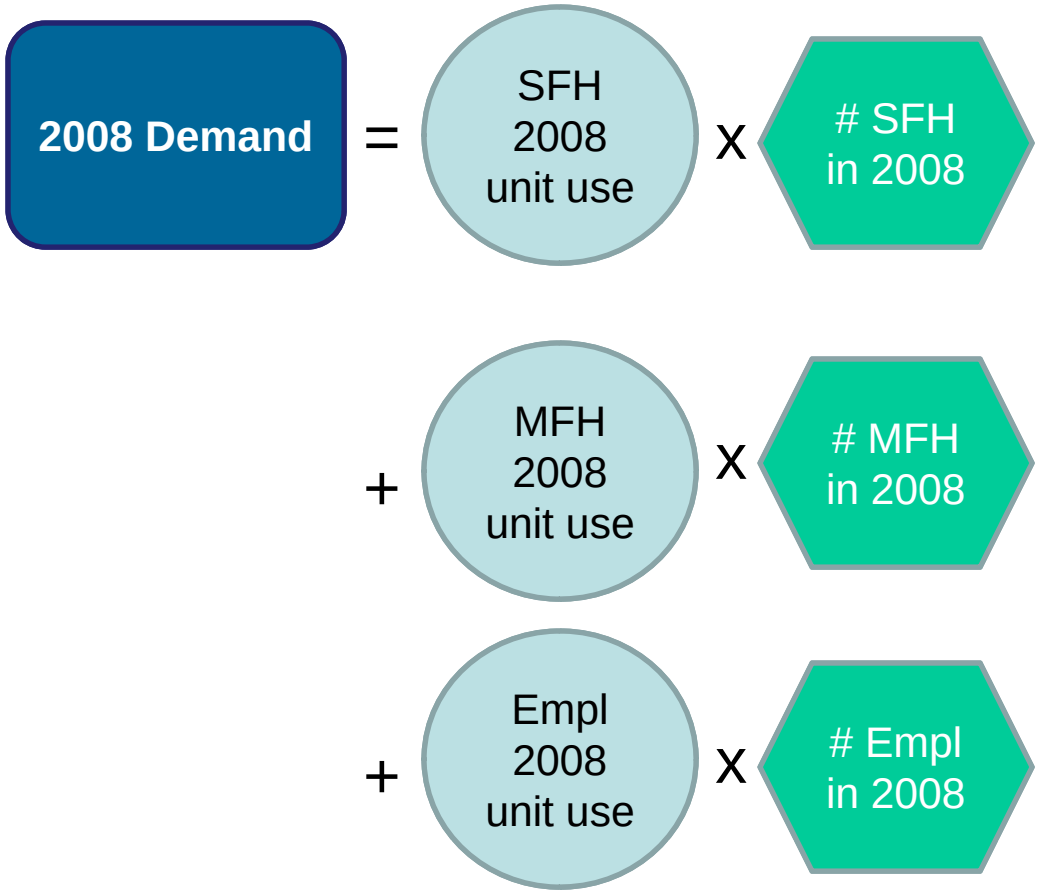
Unit use = (annual use)/(# customers)

for each customer category, for each service area

Based on:

- Current area served delineations
- Annual water use from 2008 billing data
  - Single family households
  - Multi-family households
  - Employees
- # of customers in each service area in 2008 from GIS analysis of
  - county 2008 data by TAZ, if available, or
  - MWCOG Round 7.2 2010 forecasts by TAZ, and DURs
- Current Dwelling Unit Ratios (DUR) = (# SFH/# MFH) from county data

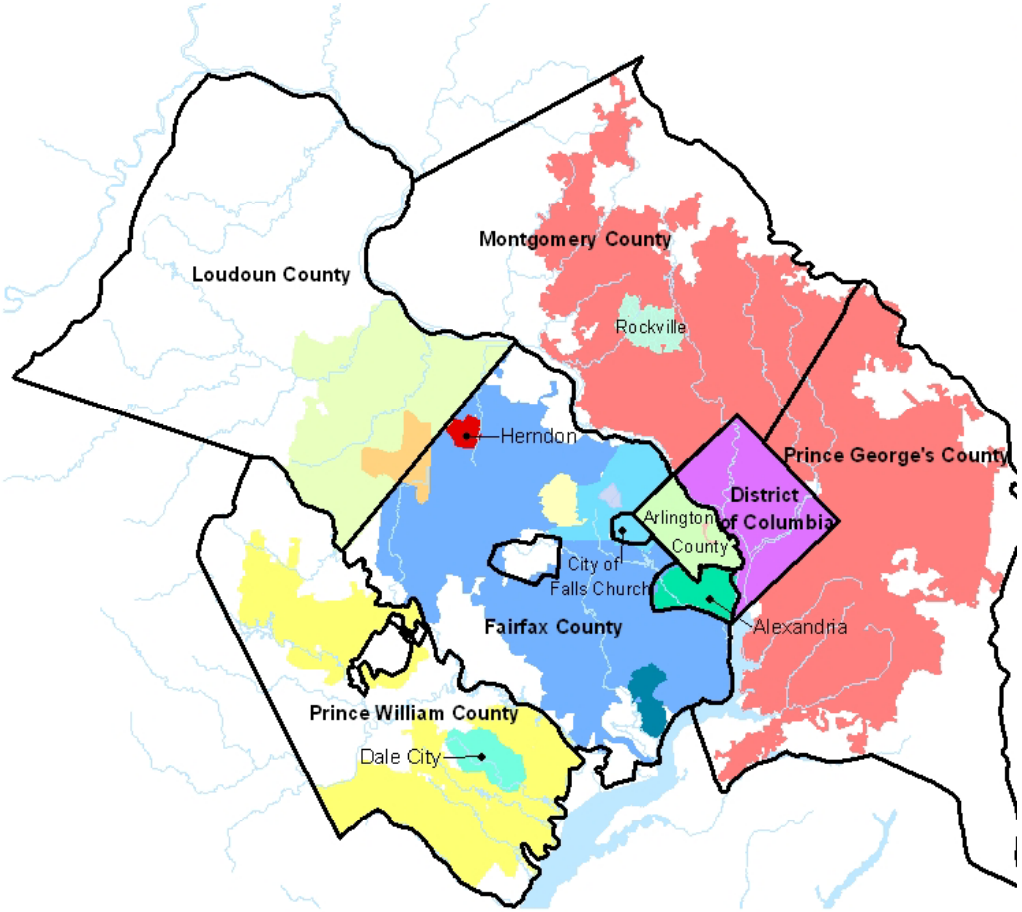
Current Average Annual Demand



Forecast of Average Annual Demand

Based on:

- Future service area
- Future unit use by customer category, by service area
- Future # customers:
  - GIS analysis of MWCOG Round 7.2 forecasts
  - Future DURs



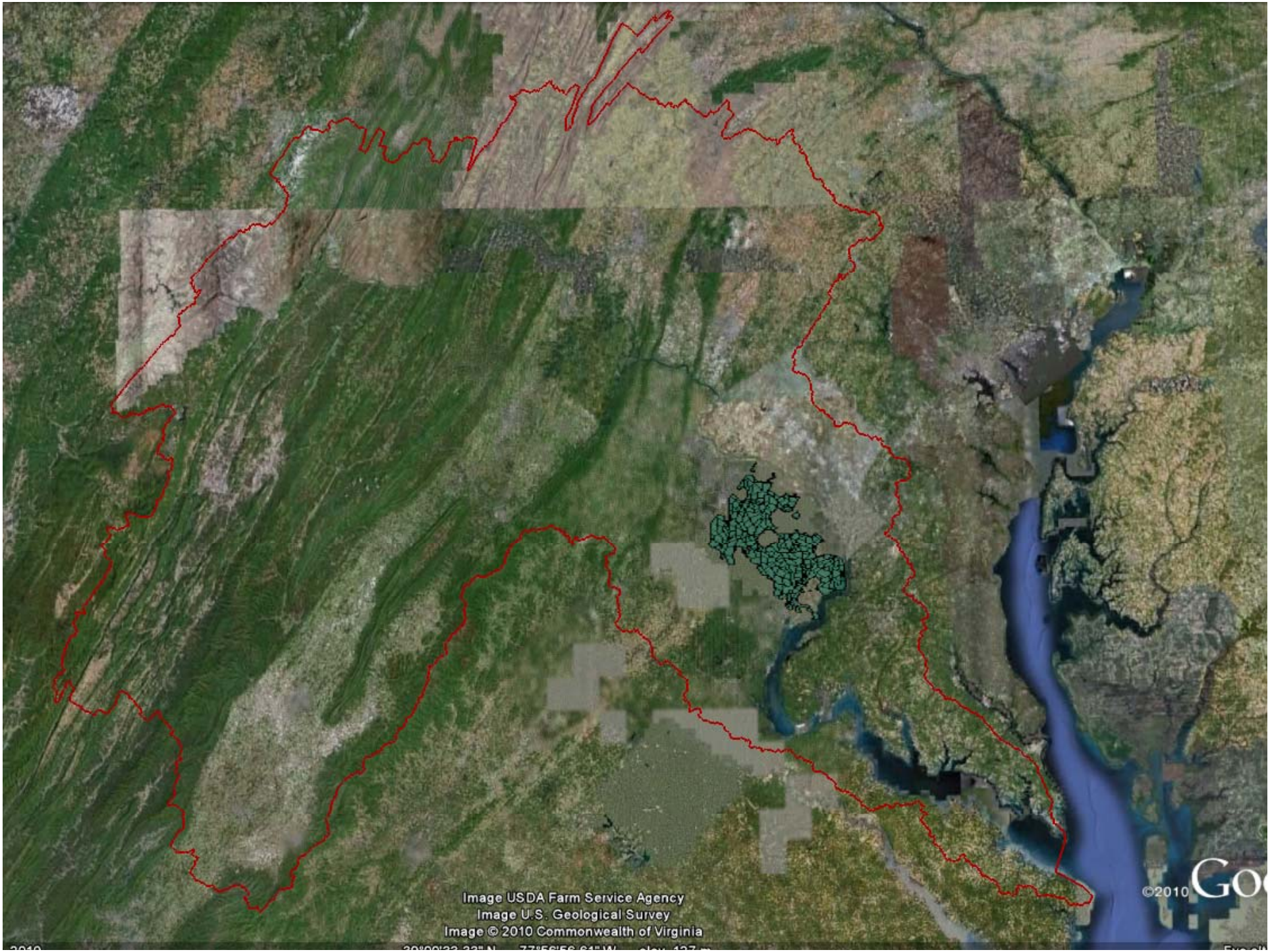


Image USDA Farm Service Agency
Image U.S. Geological Survey
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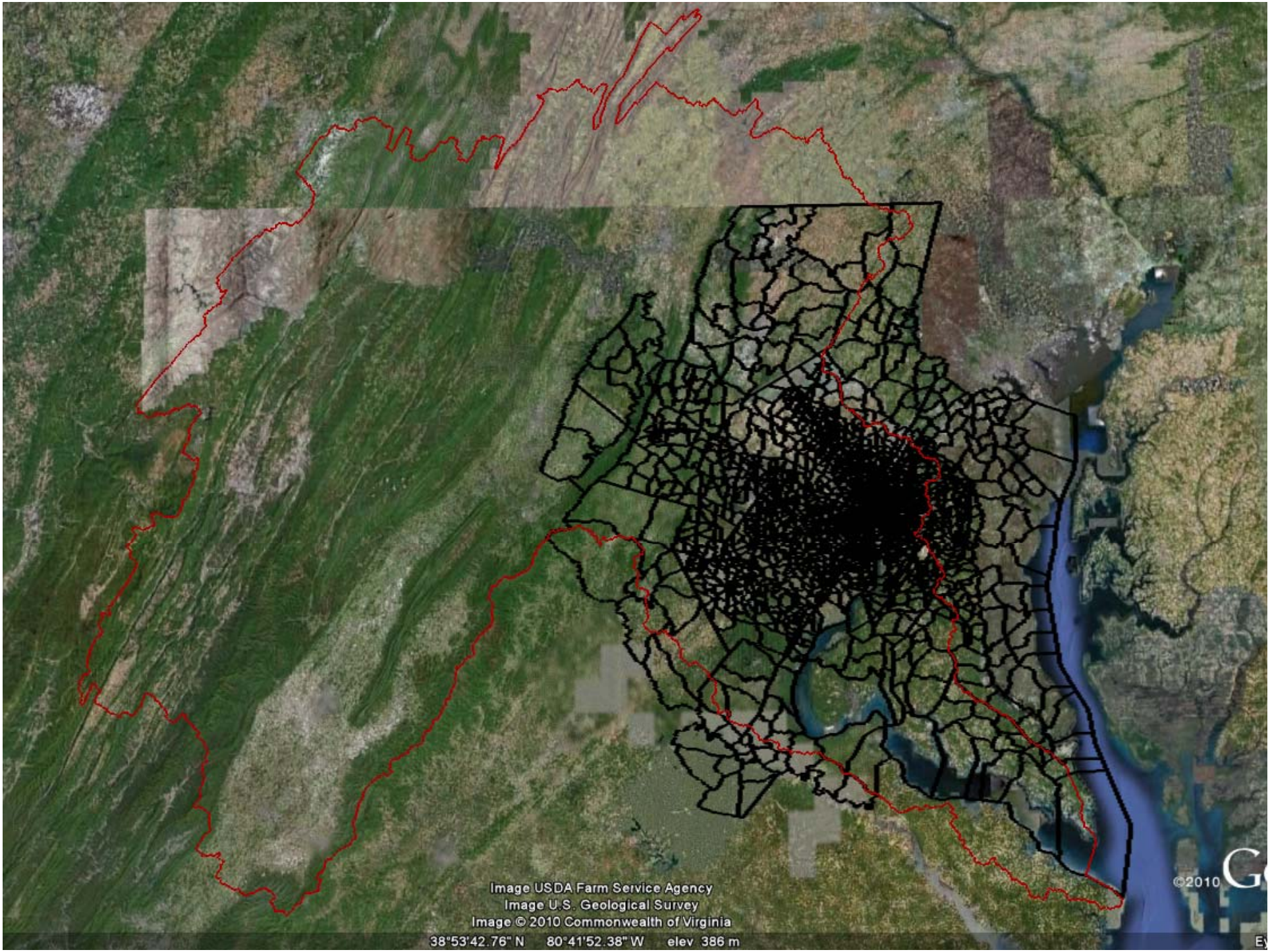
Image USDA Farm Service Agency
Image U.S. Geological Survey
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38°53'42.76" N 80°41'52.38" W elev 386 m
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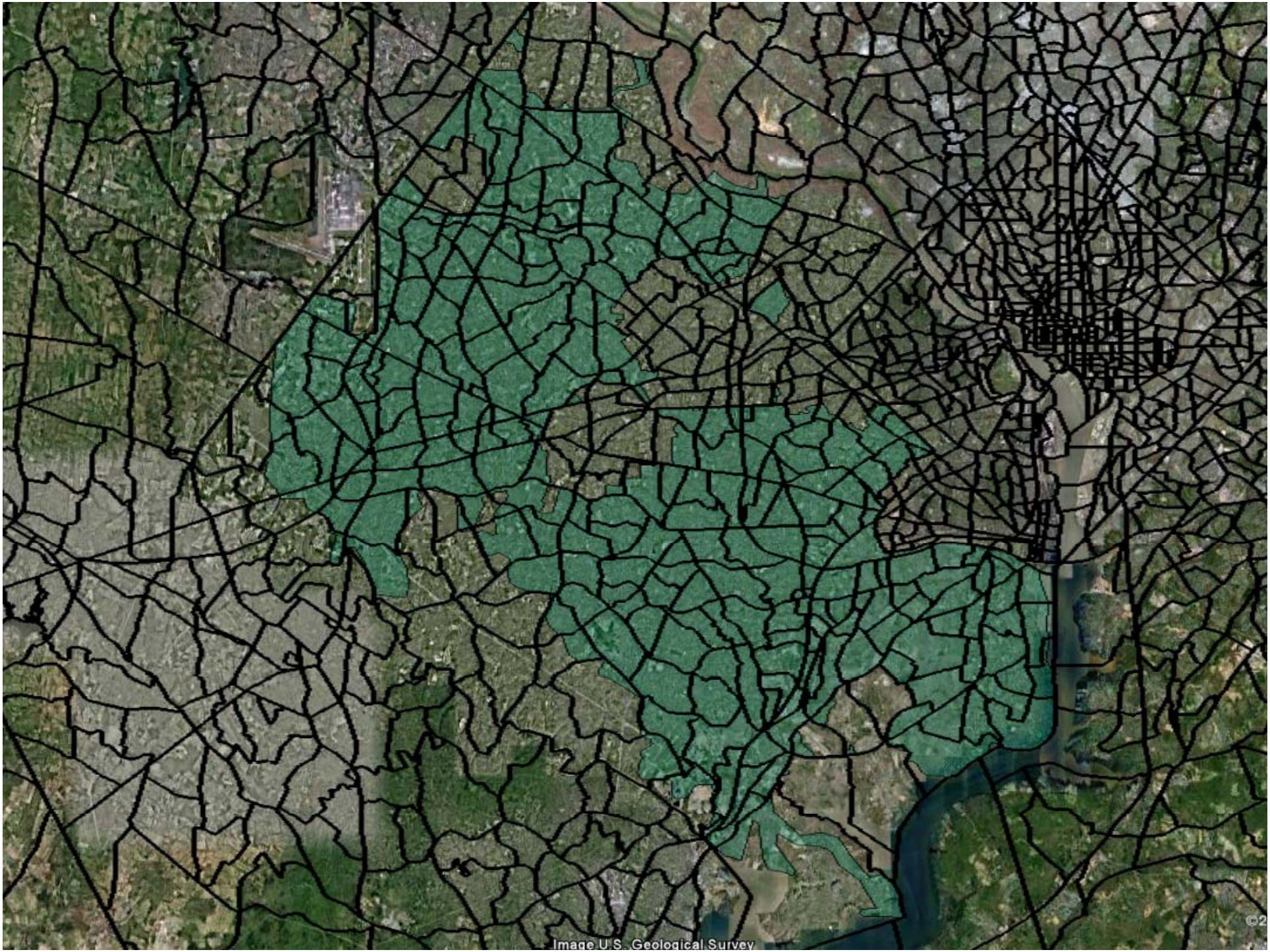
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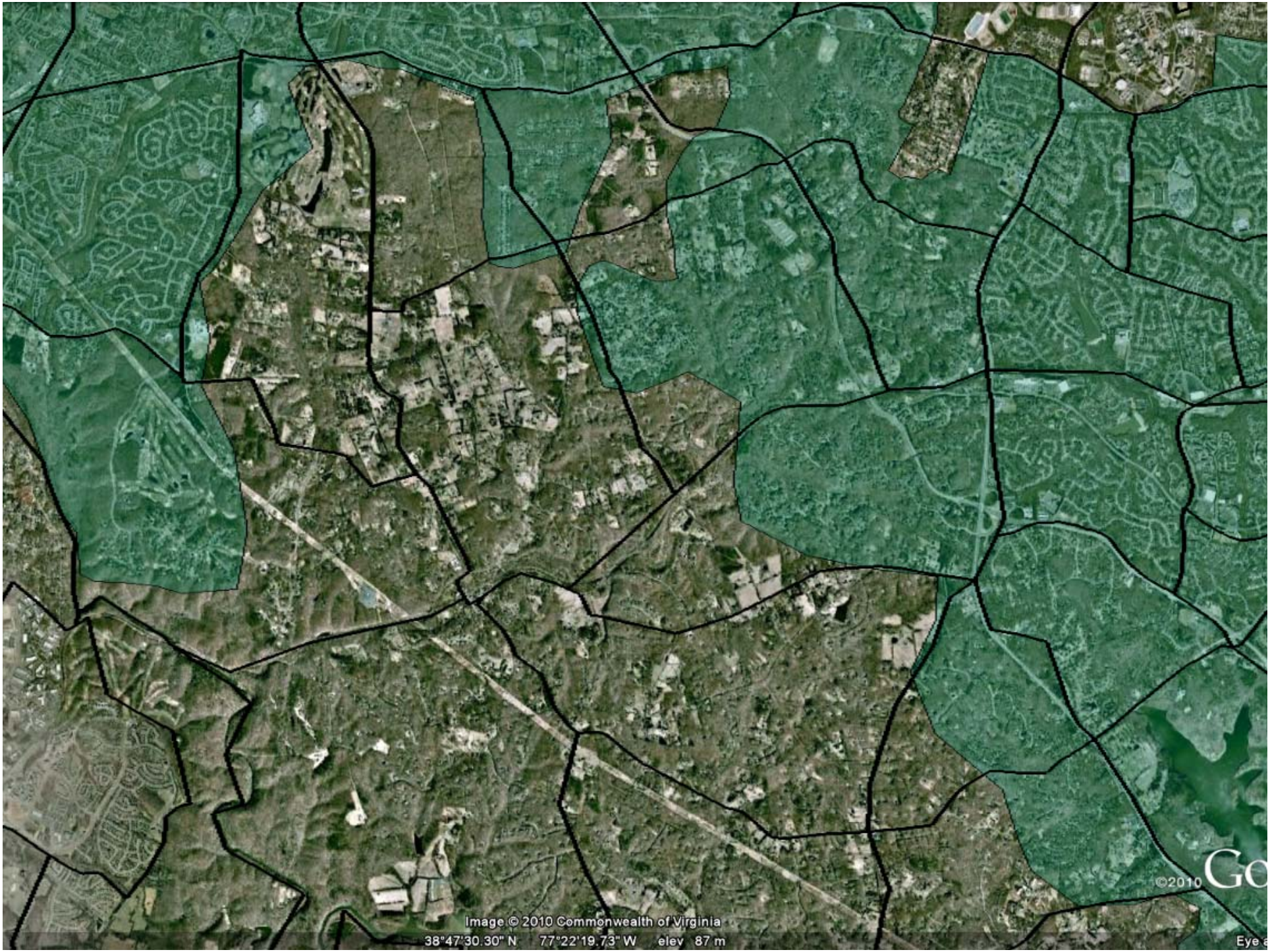
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38°47'30.30" N 77°22'19.73" W elev 87 m
Eye a

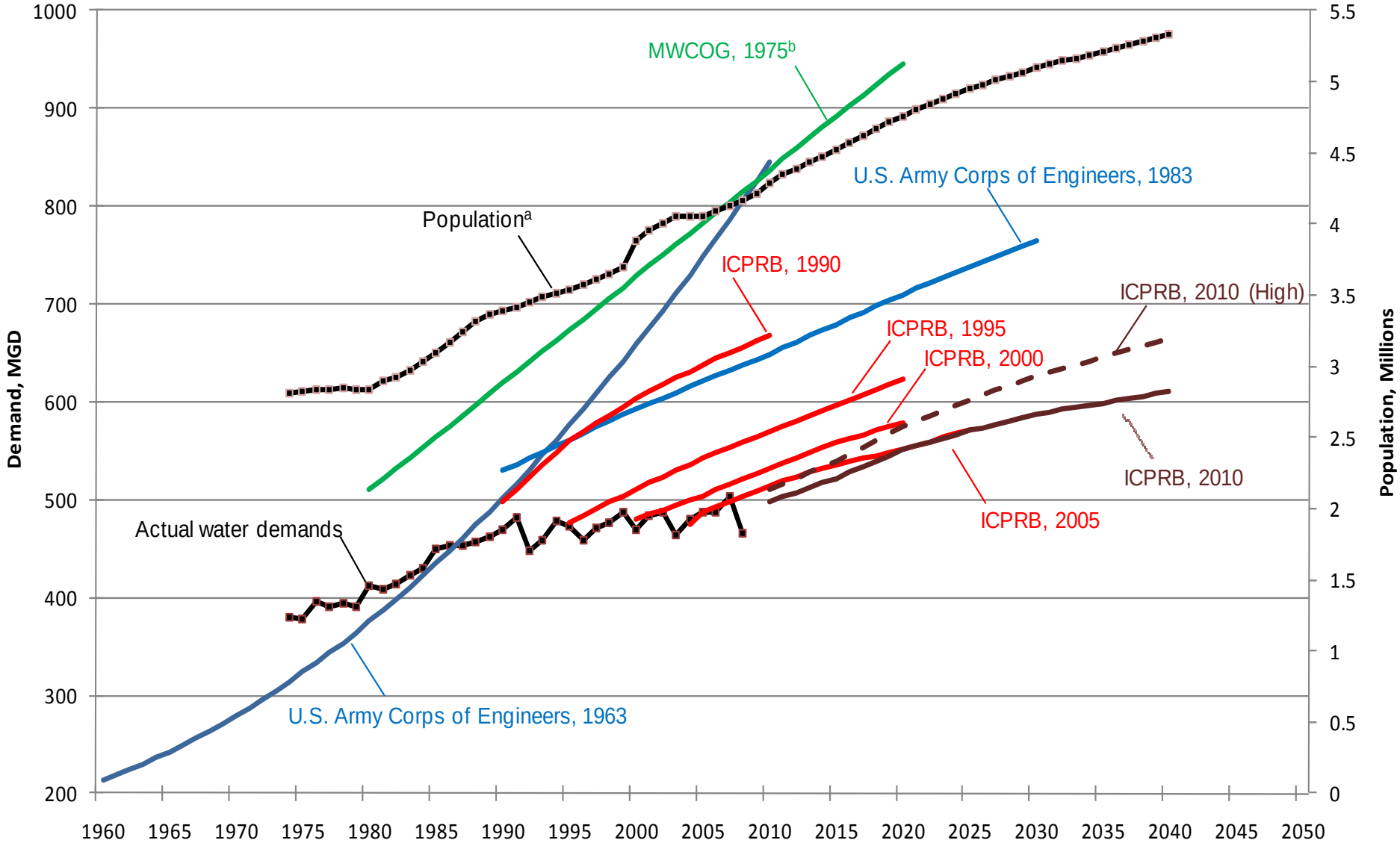
Forecast of Average Annual Demand

- Two forecast scenarios:
  - Scenario 1 (S1) – most likely: assumes future decreases in both single and multi-family household unit use
  - Scenario 2 (S2) – higher: assumes potential additional growth and no future decrease in single family household unit use

Special Growth Areas

- Fort Belvoir BRAC Initiated Development
  - Lorton – South Rt. 1 Suburban Center
  - Richmond Highway Corridor
  - I-95 Corridor Industrial Area
  - Beltway South Industrial Area
  - Springfield Central Business District
  - Kingstowne Central Business District
- Urbanization & Redevelopment
  - Baileys Crossroads Revitalization Area
  - Reston – Lake Anne Village Center Redevelopment Area
  - INOVA Fairfax Hospital Special Study Area
  - Merrifield Revitalization Area
- Transportation Oriented Development
  - Tysons Corner Urban Center
  - Reston – Herndon Suburban Center
  - Huntington Metro Transportation Study Area
  - Franconia – Springfield Metro Transportation Study Area
  - Van Dorn Street Metro Transportation Study Area
  - Fairfax-Vienna Metro Transportation Study Area

Washington metropolitan area average annual water demand, forecasts and actual demands



[a] Population is a sum of the populations within Montgomery, Prince George's, Prince William, Loudoun, Fairfax, and Arlington Counties, as well as the District of Columbia, according to data provided by the U.S. Census Bureau.

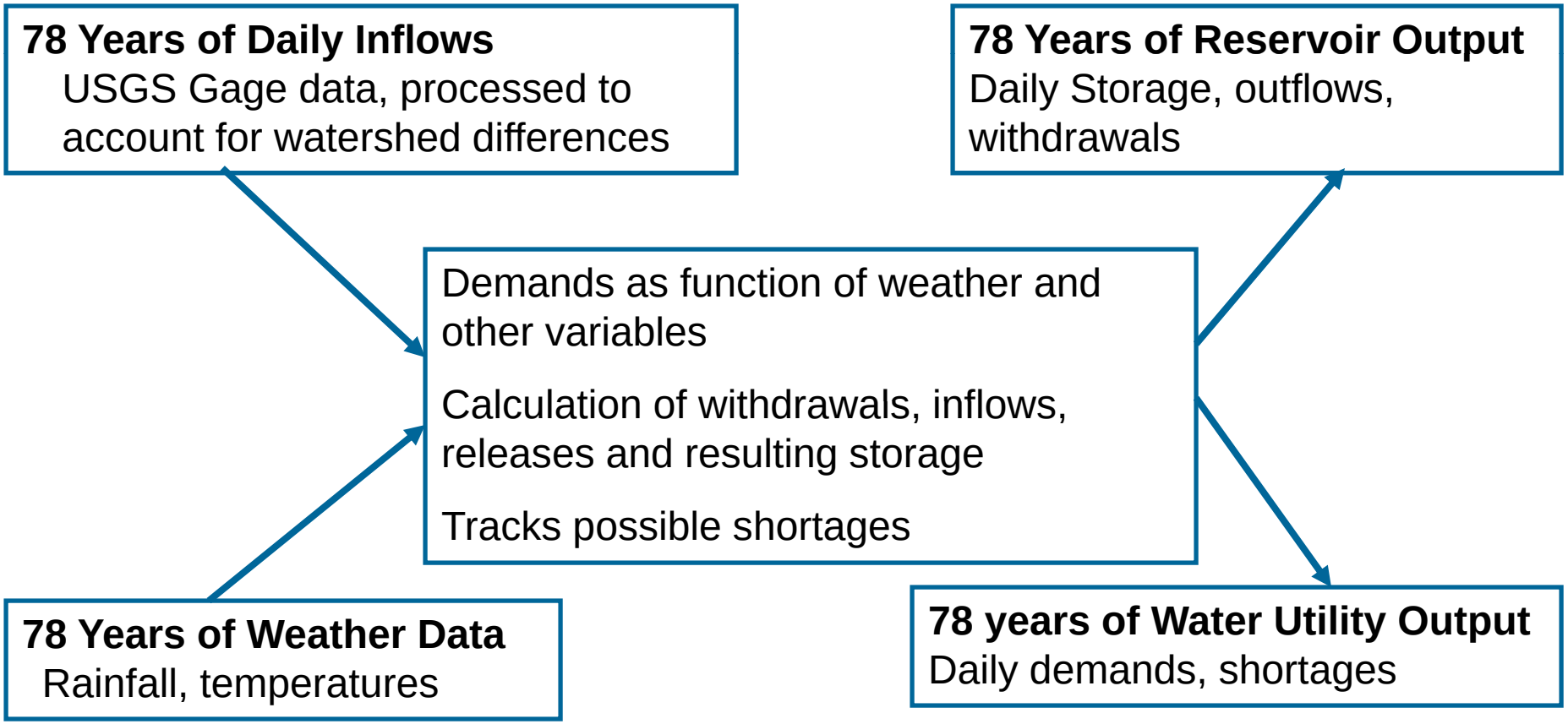
[b] As cited in U.S. Army Corps of Engineers, 1975

Resource Analysis

- Evaluates whether current WMA system can meet forecasted demands
- Uses Potomac Reservoir and River Simulation Model (PRRISM)
  - Based on:
    - 78-year historic record of stream flows & meteorology (1929 – 2007)
    - Daily operating rules for the WMA system of reservoirs:
      - Jennings Randolph Reservoir
      - Savage Reservoir
      - Little Seneca Reservoir
      - Occoquan Reservoir
      - Patuxent Reservoir

PRRISM: Schematic

- Utilizes a water balance at each reservoir and simulates flows over the period of record



PRRISM: Measures of System Performance

- **Reliability** – one minus the frequency of failures
  - Percentage of years with no Potomac deficits
- **Vulnerability** – unmet demand, or shortages
  - Maximum amount of deficit allocated in single day, MGD
  - Average amount of deficit allocated, MGD
  - Total amount of deficit allocated, MGD
- **Resiliency** – average duration of failures
  - Maximum number of days in a row of Potomac deficits
  - Number of days in which Potomac deficits must be allocated
  - Number of Patuxent water supply shortfalls
  - Number of Occoquan water supply shortfalls
- **Percentage of years with restrictions**
- **Minimum reservoir storage**, BG
- **Minimum average flow in the summer and fall of 1930**
  - Natural flow
  - Flow downstream of intakes

	2005 Study	Current Study	
	2025	2030	2040
	Likely – High Demands	Likely – High Demands	Likely – High Demands
Voluntary restrictions	4.1% – 5.5%	3.8% – 3.8%	3.8% – 4.5%
Mandatory restrictions	0.0% – 0.3%	0.1% – 2.9%	3.4% – 3.8%
Emergency restrictions	0.0%	0.0% - 0.0%	0.0% – 2.3%
Potomac deficits (days)	0	0 – 0	0 – 0
Occoquan deficits (days)	0	0 – 0	0 – 5
Min L Seneca + JRR WS (BG)	7.4 – 6.0	5.4 – 3.6	3.5 – 0.8
Min JRR WQ (BG)		0.5 – 0.5	0.0 – 0.0
Min system storage (BG)	12.0 – 10.3	9.2 – 5.7	7.4 – 2.9

The WMA's current water supply system will **continue to meet demands through 2030**, under a range of hydrologic conditions similar to the 78-year period of historical record, with **no water supply shortfalls** and **no emergency water use restrictions**.

By the year 2040 the current system may have difficulty meeting the region's demands during periods of drought without water use restrictions, and/or the development of additional supply resources.

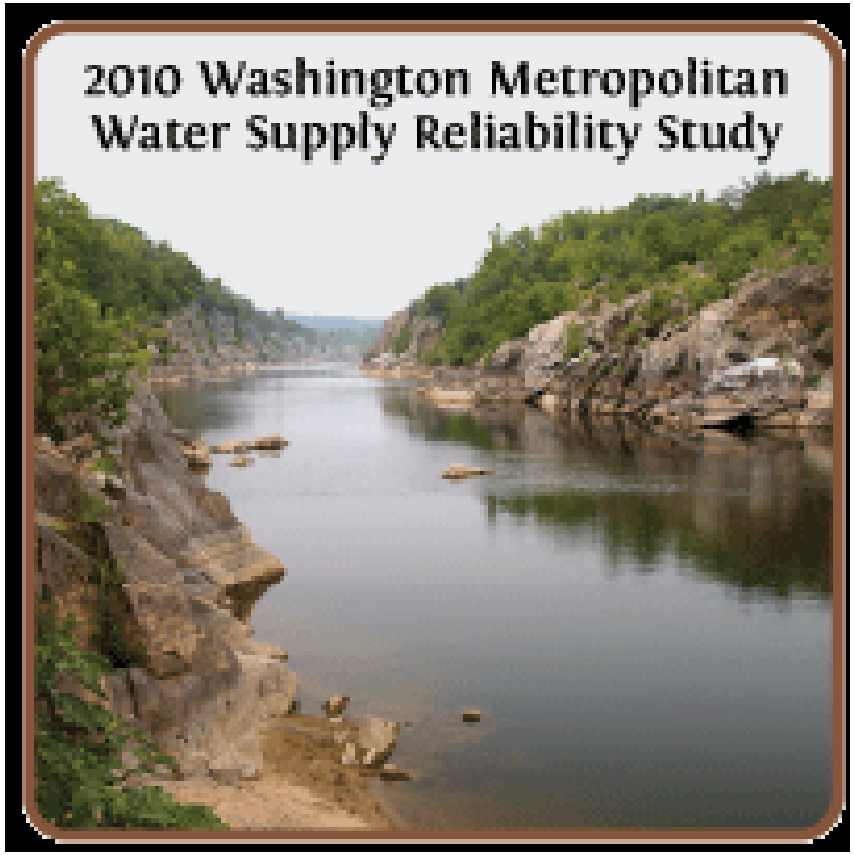
Summertime outdoor water use may be increasing in some areas of the WMA, offsetting the benefits of the adoption of more water efficient indoor fixtures and appliances.

The system's largest reservoir, Jennings Randolph, appears to be **losing storage capacity due to sedimentation** at a higher rate than previously estimated.

Recommendations

- Complete evaluation of water supply alternatives:
  - Occoquan estuary membrane treatment plant
  - Estuarine pumping station below Little Falls, discharging to Dalecarlia
  - Fairfax County quarries
  - Loudoun County quarries
  - May also consider Travilah quarry in Montgomery County
- Conduct new hydrographic survey of Jennings Randolph Reservoir
- Give consideration to new watershed protection measures to address sedimentation – potentially via DWSPP
- Investigate summertime water use in next demand study

www.potomacriver.org



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Resource Reliability Studies

Forecast of Average Daily Demand

Based on:

- Average annual demand
- Monthly water production factors
- Linear regression model of daily departures from the monthly average demand
- ARIMA model of remaining non-random variation
- Normal distribution model of random variation