



Resilience on Tap

A History of Water Reuse in the Occoquan and its importance to the Potomac Supply System

September 9, 2026

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Director, Planning and Water Resources

CREATION

Under the Virginia Water and Waste Authorities Act by the Fairfax County Board of Supervisors and chartered by the State Corporation Commission on September 26, 1957.

MISSION

To provide our customers with reliable and abundant water of exceptional quality and value.

VISION

Providing exemplary water service and enhancing water resources for a thriving community.





Griffith Water Treatment Plant



Corbalis Water Treatment Plant

What We Do

- Produce high-quality drinking water for 2+ million residents of Northern Virginia.
- Operate and maintain over \$2 billion of water infrastructure from the source to the tap.
- Operate two of the largest water treatment plants in the Commonwealth with 345 million gallons per day of capacity.
- Maintain a long-term focus on water supply, infrastructure, and financial planning.
- Work collaboratively with regional partners to ensure a robust water supply for Northern Virginia and the Washington Metropolitan area.

“Supplying potable water is an essential human activity, a great responsibility, and a **vocation of distinction.**”

J.B. MANNION, FORMER AWWA EXECUTIVE DIRECTOR

Existing Fairfax Water Supply Overview

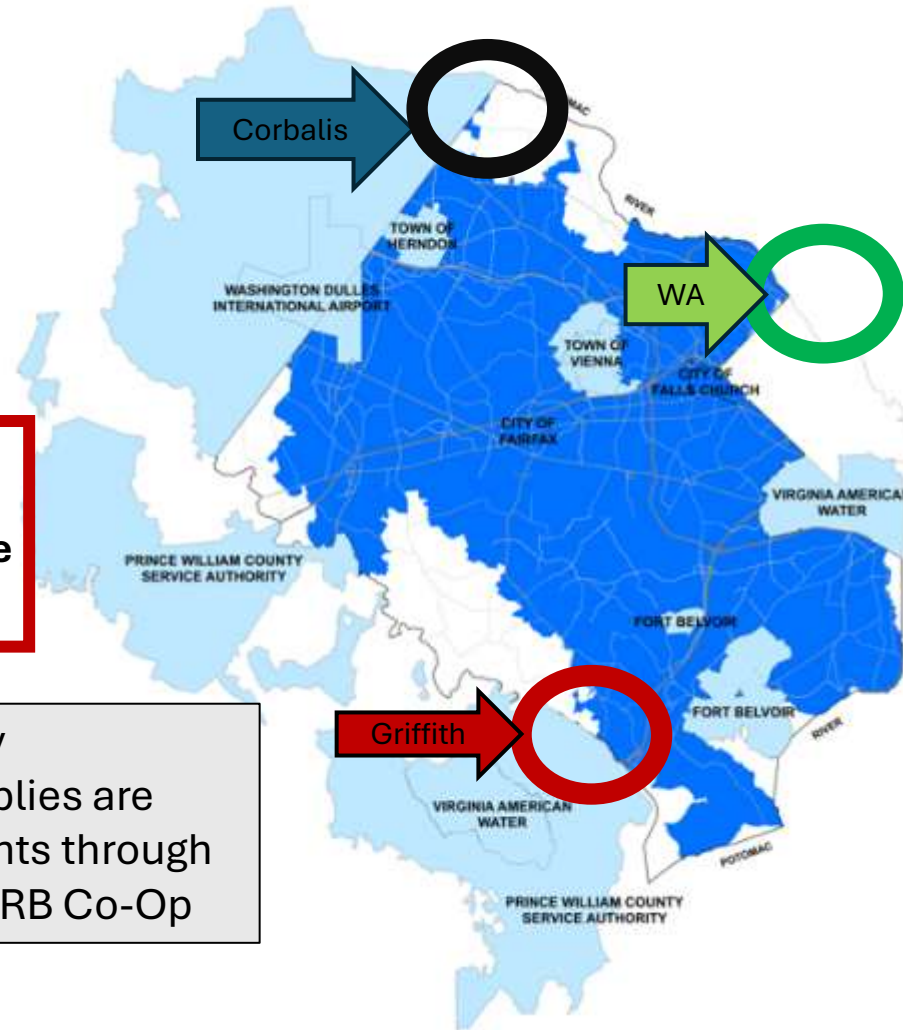
Potomac River

- 10,000+ sq. mile watershed
- Reservoirs – releases to augment
 - Jennings Randolph (13+BG)
 - Savage Reservoir (~6 BG)
 - Little Seneca (~4 BG)
- Corbalis WTP (Capacity – 225 MGD)
- Washington Aqueduct (purchase up to 31 MGD)

Occoquan Reservoir

- 590 sq. mile watershed
- 8.5 BG storage volume, **indirect reuse**
- Griffith WTP (Capacity – 120 MGD)

FW is a signatory to the Water Supply Coordination Agreement and all supplies are operated as a “system” during droughts through operating rules developed by the ICPRB Co-Op



Presentation Topics

- Early Years
- Protection Initiatives
- Role in Cooperative Water Supply System
- Need for Reuse Water
- Challenges
- Future Initiatives



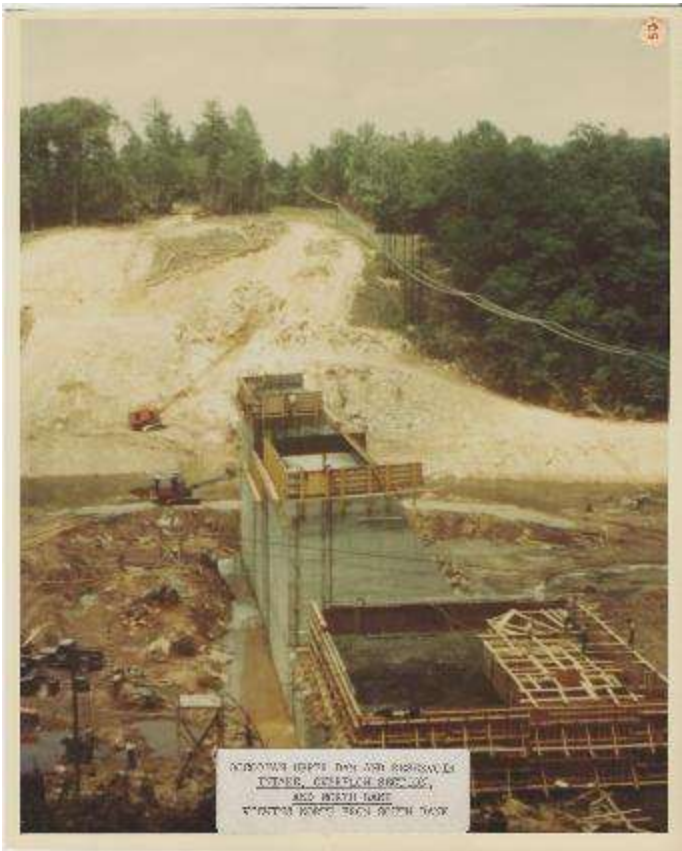
Occoquan Shoreline, Photo by N. Bellezza

Early Years (1950-1960) – Occoquan Supply



Construction of the Low Dam, 1950

55 MG volume



Construction of the High Dam, 1957



Full Reservoir at High Dam, 1960

8+BG volume

“The Occoquan Problem” – 1960s

- Rapid development, increasing wastewater discharges from 11 small, secondary treatment plants
- Frequent and intense algae blooms from excessive nutrients
- Increases in organic matter
- Oxygen loss and periodic fish kills
- Taste & odor problems
- Presence of human viruses
- Prompts major studies and State Water Control Board (SWCB) action
 - Metcalf and Eddy Study (1968-1969) led by Dr. Clair H. Sawyer

In 1967, FCWA obtains Occoquan Reservoir from the Alexandria Water Company

Algal Bloom at Jacob's Rock on 06/24/69

Presentation by T. Grizzard, 2014



Source: Metcalf & Eddy

Presentation by T. Grizzard, 2014

Source: DWML



Occoquan Reservoir Algae Bloom: Summer 1973

SWCB Options and Selected Alternative (1970- 1971)

1. Export all wastewater out of the watershed,
2. Apply advanced waste-treatment methods, reclaim water for direct potable reuse, and limit allowable population growth within the watershed to those willing to use the reclaimed water, or
3. Limit the population within the Occoquan Watershed to not more than 100,000 people and apply the highest level advanced waste-treatment technically achievable.

Newly formed EPA advised the SWCB that discharge of secondary-treated effluent within the Occoquan watershed was no longer acceptable and that a high degree of advanced waste treatment (AWT) would be required

Option 3 was selected with the **exception** of the limitation on population growth

Noman M. Cole, Jr. selected as Chairman of SWCB (1970)
Millard H. Robbins, Jr. served as an Engineer to the SWCB

The “Occoquan Policy”

“A Policy for Waste Treatment and Water Quality Management in the Occoquan Watershed” (adopted 1971) 9 VAC 25-410, administered by Virginia DEQ

- Establishes Occoquan Watershed Monitoring Subcommittee of State Water Control Board
- Stringent treatment & discharge limits
- Directly led to the formation of the UOSA (**Upper Occoquan Service Authority**) to Consolidate Older WWTPs
- Established Indirect Potable Reuse as Sustainable Water Supply for Northern Virginia (D.3 SWCB Minutes)



Millard H. Robbins Jr. Water Reclamation Plant
Centreville, VA

Upper Occoquan Service Authority
Leader in Water Reclamation and Reuse

Commonwealth of Virginia
STATE WATER CONTROL BOARD
P.O. Box 11183, 8010 W. Broad St., Richmond, Virginia 23230 (703) 770-2341
R. H. Pender, Executive Secretary

COESA'S MONITORING PROGRAM
S.E. ATTACHMENT C

RECEIVED
FAIRFAX COUNTY WATER AUTHORITY
SEP 7 1971

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TO THOSE THOUGHT TO HAVE AN INTEREST IN
A POLICY FOR WASTE TREATMENT AND WATER QUALITY
MANAGEMENT IN THE OCCOQUAN WATERSHED:

4. Experience in the last several years in the Northern Virginia area has indicated that major pipelines such as would be required for the massive waste collection and export system can create major siltation pollution problems; for example, data indicate that the building of the Accotink interceptor for the new Lower Potomac plant in Fairfax County caused siltation of the Pohick Bay at the rate of 1.6 feet per year. Such siltation pollution on the Occoquan could defeat the purpose of what we are trying to accomplish by this program, i.e., save the Occoquan Reservoir and maintain or improve the quality of its tributary streams.

D. ALTERNATE SOLUTION

Recently sufficient operating experience and data have become available from the new advanced waste treatment facility at Lake Tahoe to indicate that there is possibly an alternate solution to the export system proposed in Metcalf & Eddy's report. This system would involve a treatment approach with a discharge of high quality effluent into the Reservoir. This type of information on the Tahoe Plant was not available when Metcalf & Eddy made their studies starting in 1968.

Basically a Lake Tahoe type solution for the Occoquan would have the following advantages:

1. Solve the water quality problems due to sewage effluent in the Occoquan Reservoir and prevent further degradation of the Potomac estuary.
2. Major capital costs savings would be realized due to elimination of the expensive export system and possible reduction of the size of the major wastewater collection system.
3. Develop a new water supply resource for the Occoquan Reservoir which should extend its life and increase its capacity.
4. Greatly minimize the possibility of a major siltation pollution problem that could be associated with the installation of the export system and some of the major cross country collection lines.

E. WHAT A TAHOE-TYPE PLANT WOULD DO FOR THE OCCOQUAN RESERVOIR

A study using the data from the Metcalf & Eddy studies and from the Lake Tahoe Plant and Reservoir² did in fact indicate that a Lake Tahoe type plant could be used to solve the Occoquan Reservoir problems due to sewage, and would have the advantages described in D above. For example, the Occoquan Watershed is expected to require 10 and 40 million gallons a day of treatment capacity in the 1970-1975 period and 1970-1985 period respectively. The effects of 10 and 40 million gallons per day of the effluent from a Tahoe type plant on Occoquan Reservoir as compared to the present 4.3 million gallons per day from conventional sewage treatment plants are shown on table V.B.1, V.B.2, and V.B.3 from reference 3.

Major reductions (factors of 10 or more) in the BOD, COD, phosphorus and suspended solids even with these much higher effluent volumes can be expected. With regard to nitrogen, it will be about the same at the 10 million gallons per day level and a factor of 4-6 times higher at the 40 million gallons per day level. However, nitrification would be required to convert the nitrogen that is discharged into a form that minimizes the oxygen demand on the receiving stream.

With regard to the nitrogen, experience at Lake Tahoe, Lake Washington, and at Bloomington, Illinois indicates that if very high levels of BOD, COD, high levels of nitrogen removal. This

Occoquan Reservoir and Watershed

8.5 BG capacity
(based on 2020 bathymetric survey)

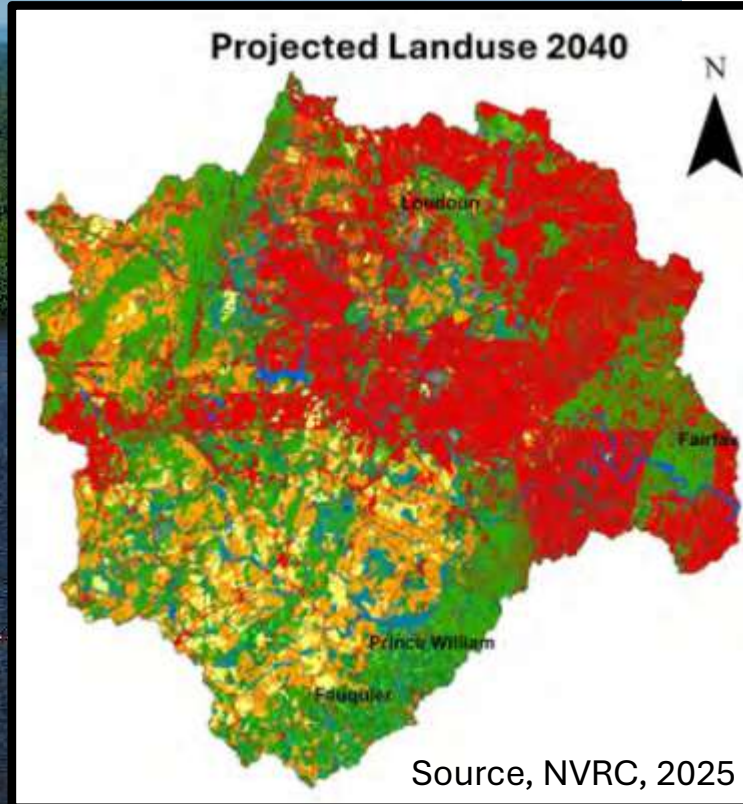
Watershed Land Use (2021), from NVRC

- 40% Forest
- 29% Urban/Developed
- 19% Pasture/Hay
- 6% Wetlands/Open Water
- 4% Cultivated Crops
- 2% Other

Urbanization impacts, about 600,000 watershed population

Indirect Potable Reuse

Future land use projections indicate a 10% increase in urban land cover from 29% in 2021 to 39% by 2040 (NVRC, 2025)



Fairfax Water

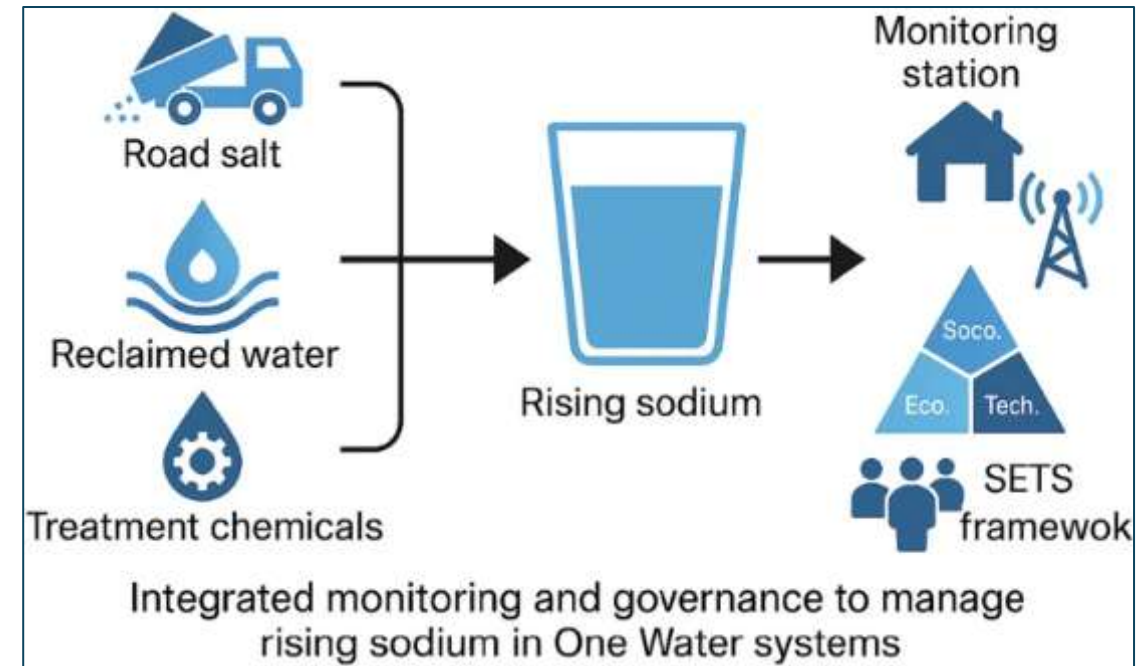
Raw Water Pumping

Griffith Water Treatment Plant

Occoquan Watershed Monitoring Laboratory

- Independent Lab monitors IPR system
 - Required by the Occoquan Policy
- Funded by Water Providers and Local Jurisdictions
 - 50% Fairfax Water
 - 50% Local (Watershed) Jurisdictions based on Population
- Extensive 50+ year monitoring period (1973-present)
 - Annual Budget (current) ~ \$1.86M
- Nutrients, Salt, PFAS

Example Issue: Long-Term Rising Sodium Levels



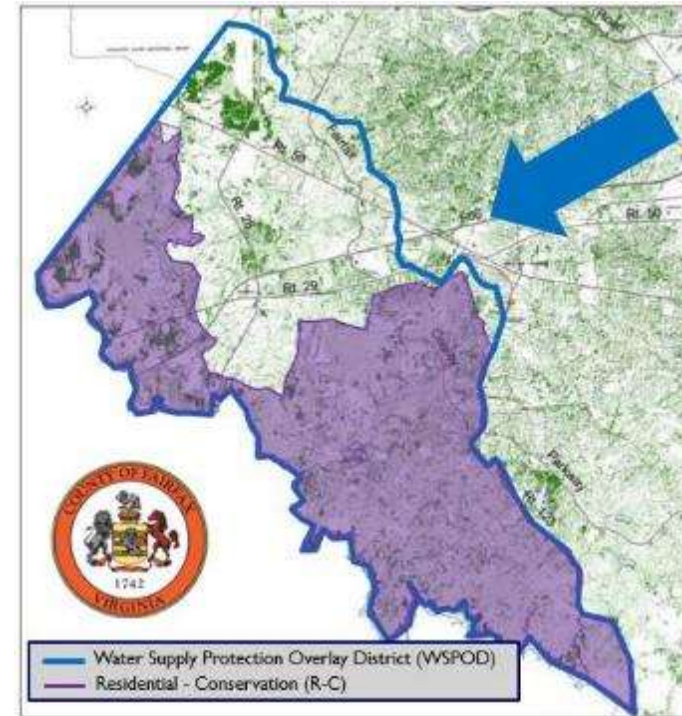
Social-ecological-technological drivers of freshwater salinization in the Occoquan Reservoir, United States

<https://www.nature.com/articles/s43247-025-03152-w>

Occoquan Source Protection Initiatives

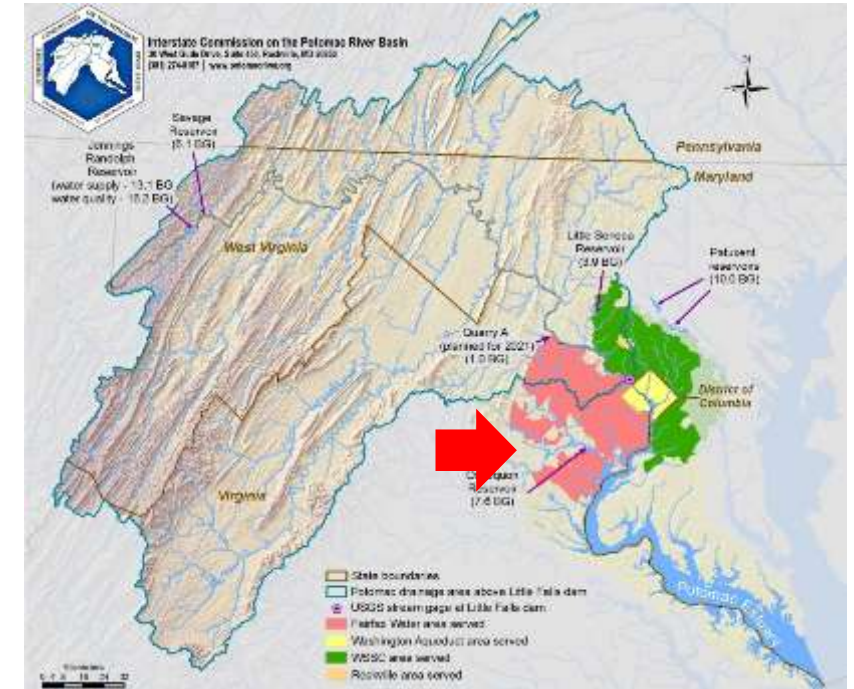
Occoquan Non-Point Source Program

- Non-Point Source Program Agreement
 - Funded by Water Providers (50%) and Watershed Jurisdictions (50%)
- Technical Investigations and Support
 - Land Use Inventory and Updates
 - Northern Virginia BMP Handbook
 - Nonstructural Urban BMP Handbook
- Occoquan Nonpoint Source Model
 - Model maintained by Virginia Tech / OWML
 - Supported Occoquan Downzoning by Fairfax County
 - Land use change and climate variability potential effects on reservoir
- Extensive 45+ year history
 - Annual budget (current): ~\$450,000



Why discuss Occoquan at Potomac Conference?

- Part of larger 14,670 sq. mile Potomac watershed
- An integral part of cooperative operations of Potomac River, administered by ICPRB CO-OP Section, providing regional flexibility during drought conditions to protect those in metro Washington area that rely on Potomac River (Maryland, DC, and Virginia)
- Article 1 and Article 2 of the Water Supply Coordination Agreement (WSCA) require “Off-Potomac” supply resources to be operated to maximize benefit of the Potomac Supply System

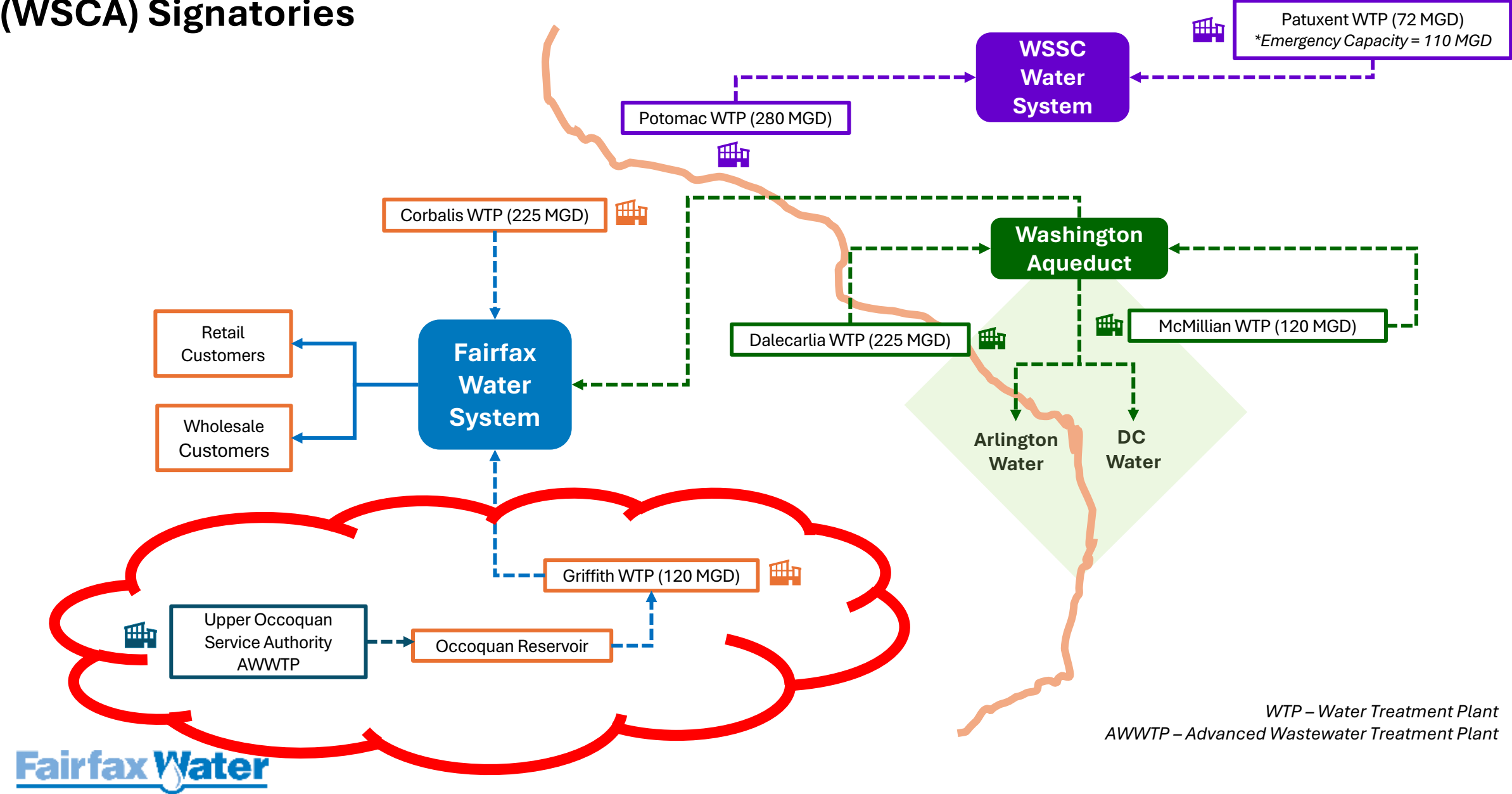


ARTICLE 1. - The suppliers agree to operate their respective water supply systems in a coordinated manner so as to provide the optimal utilization of all available water supply facilities for the benefit of the inhabitants of the Washington Metropolitan Area.



ARTICLE 2. - The Authority and the Commission agree to operate their non-Potomac water supplies (Occoquan River and Patuxent River) so as to maximize the availability of reservoir storage associated therewith for use during periods of low flows in the Potomac River.

Existing “Source to System” for Potomac Water Supply Coordination Agreement (WSCA) Signatories



Comparison of Reservoir Yields

Historic traditional yield analysis

“Historic” safe yield analysis (ICPRB, 1990)

20 Year Water Demand Forecast
and Resource Availability Analysis for
the Washington Metropolitan Area

Prepared by
K. John Holmes
and
Roland C. Steiner

August 1990

The Section for Cooperative Water Supply
Operations on the Potomac

Interstate Commission on the Potomac River Basin
6110 Executive Boulevard, Suite 300
Rockville, Maryland 20852-3903

Report No. 90-5

Table VI-2 Independent yields of major resources.

	Independent yield (mgd)
Occoquan Reservoir	5
Jennings Randolph Lake	158
Little Seneca Reservoir	9
Patuxent River Reservoirs	32
Potomac River (historic 120 day minimum flow)	585
Total independent yield	849

Current

~82

The Occoquan Reservoir is the 2nd Largest Reservoir by
“yield” in the Potomac Cooperative Water Supply System

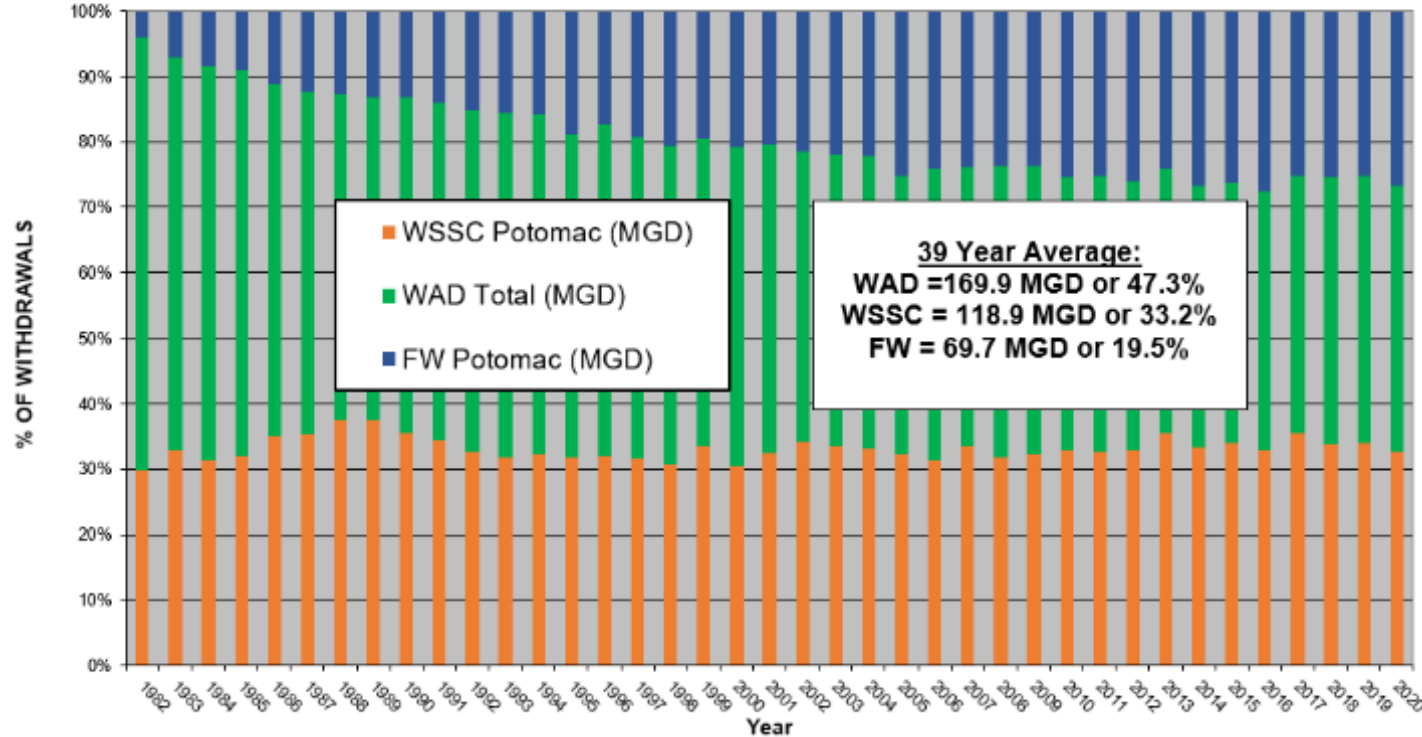
Reference: ICPRB, 1990

Occoquan Supply within Co-Op System

Long-term averages

“On-Potomac”

POTOMAC RIVER AVERAGE WITHDRAWALS* FROM CO-OP
WATER SUPPLIERS, 1982-2020



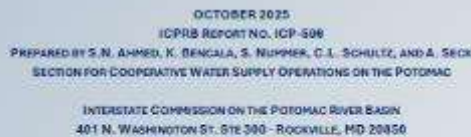
“Off-Potomac”

WSSC Patuxent Plant Production
(1982-2020 Average) = 45.1 MGD

FW Occoquan Plant Production
(1982-2020 Average) = 58.6 MGD

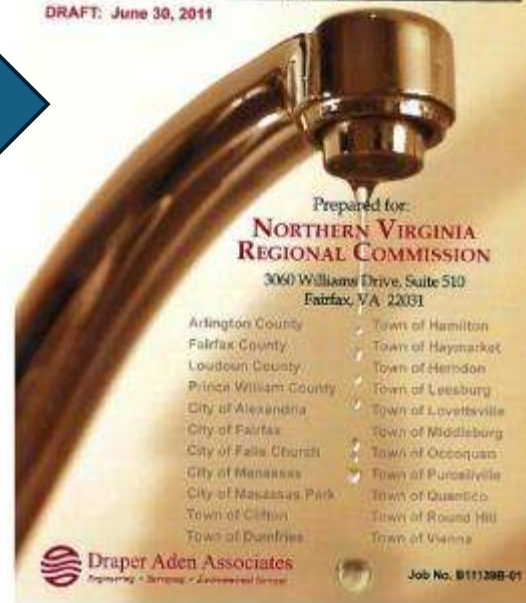
Fairfax Water

Demand and Resource Availability Forecast for the Year 2050



Northern Virginia Regional Water Supply Plan

DRAFT: June 30, 2011



9VAC25-780 Regional Planning Areas

Updated for reprint, approved manuscript as of June 10, 2013



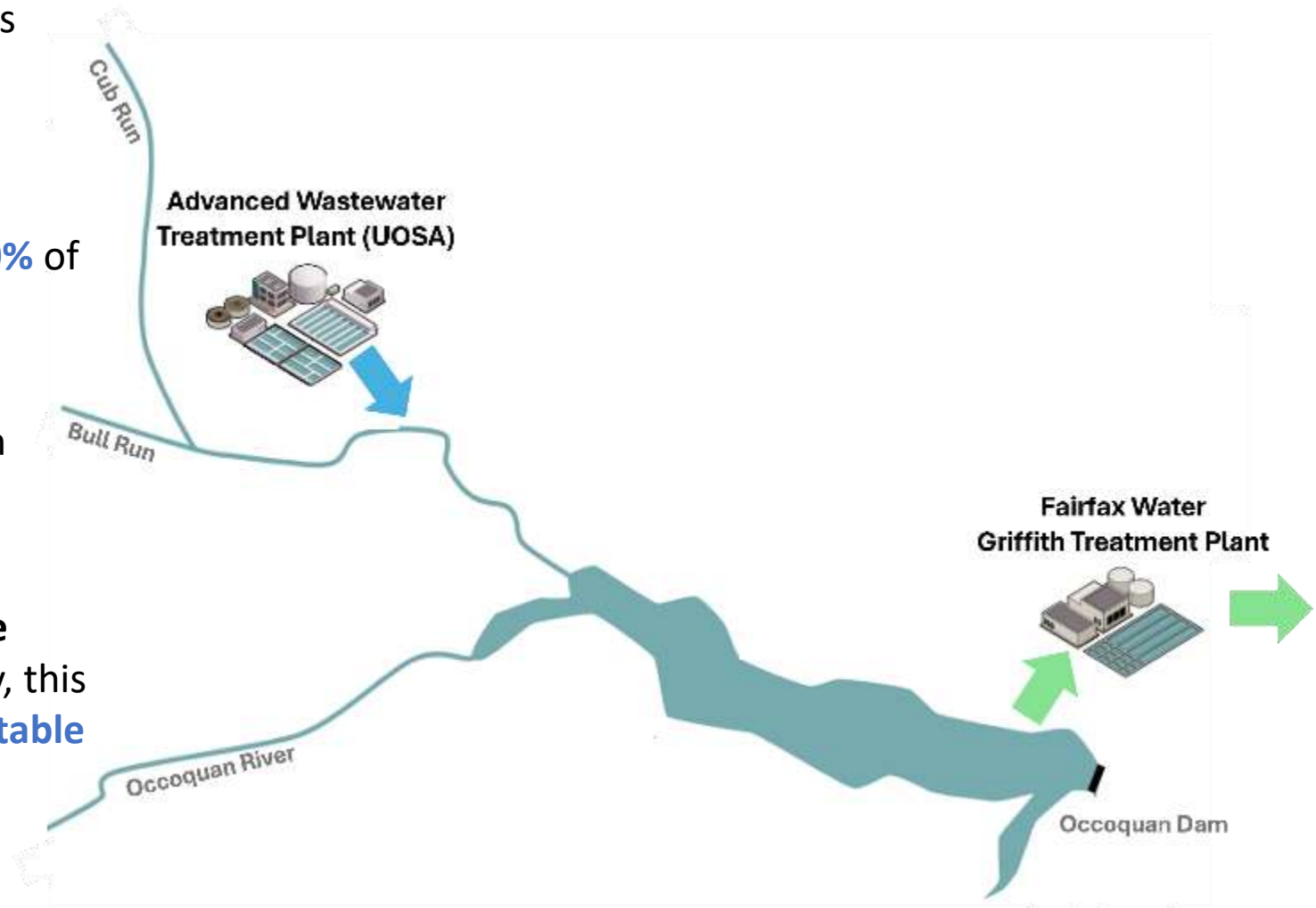
Indirect Potable Reuse in the Occoquan Watershed

Essential for Drinking Water: Upper Occoquan Service Authority's (UOSA) wastewater effluent is used to *supplement the Occoquan Reservoir for drinking water*.

Vital During Dry Periods and Droughts: In dry periods, *wastewater effluent can make up to 90%* of the reservoir's inflow.

Environmental Protection: UOSA's advanced treatment enhances the quality of the Occoquan Reservoir while *providing a sustainable water source*.

Nation's First Large-Scale Indirect Potable Reuse Program: Established under the Occoquan Policy, this system *set the standard for planned indirect potable water reuse* in the United States.

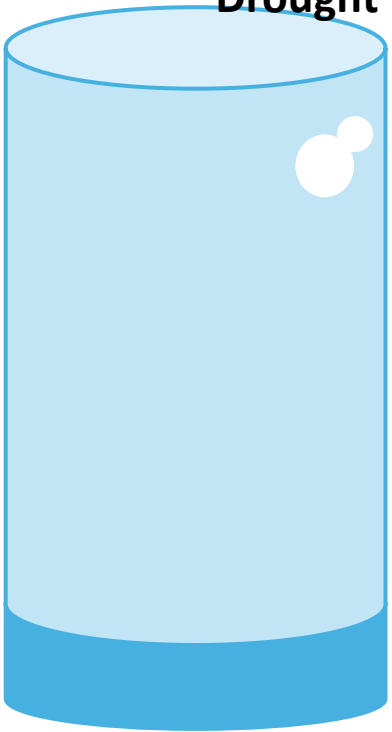


Indirect Potable Reuse & Occoquan Reservoir Supply



Fall 1977 Impact of Drought

Reservoir Inflows Dry Periods and
Drought



UOSA Effluent
(Up to 90%)

Natural Reservoir Inflow
(As low as 10%)

Occoquan Reservoir Diversion Considerations



- Consumptive uses permanently remove water from the watershed
- Highly evaporative, industrial cooling users are increasingly seeking reuse water
- Reduced flows may compromise water quality and have other impacts on the Occoquan Reservoir

Potential loss of these flows undermines decades of infrastructure and supply planning



Future Edgemon Reservoir

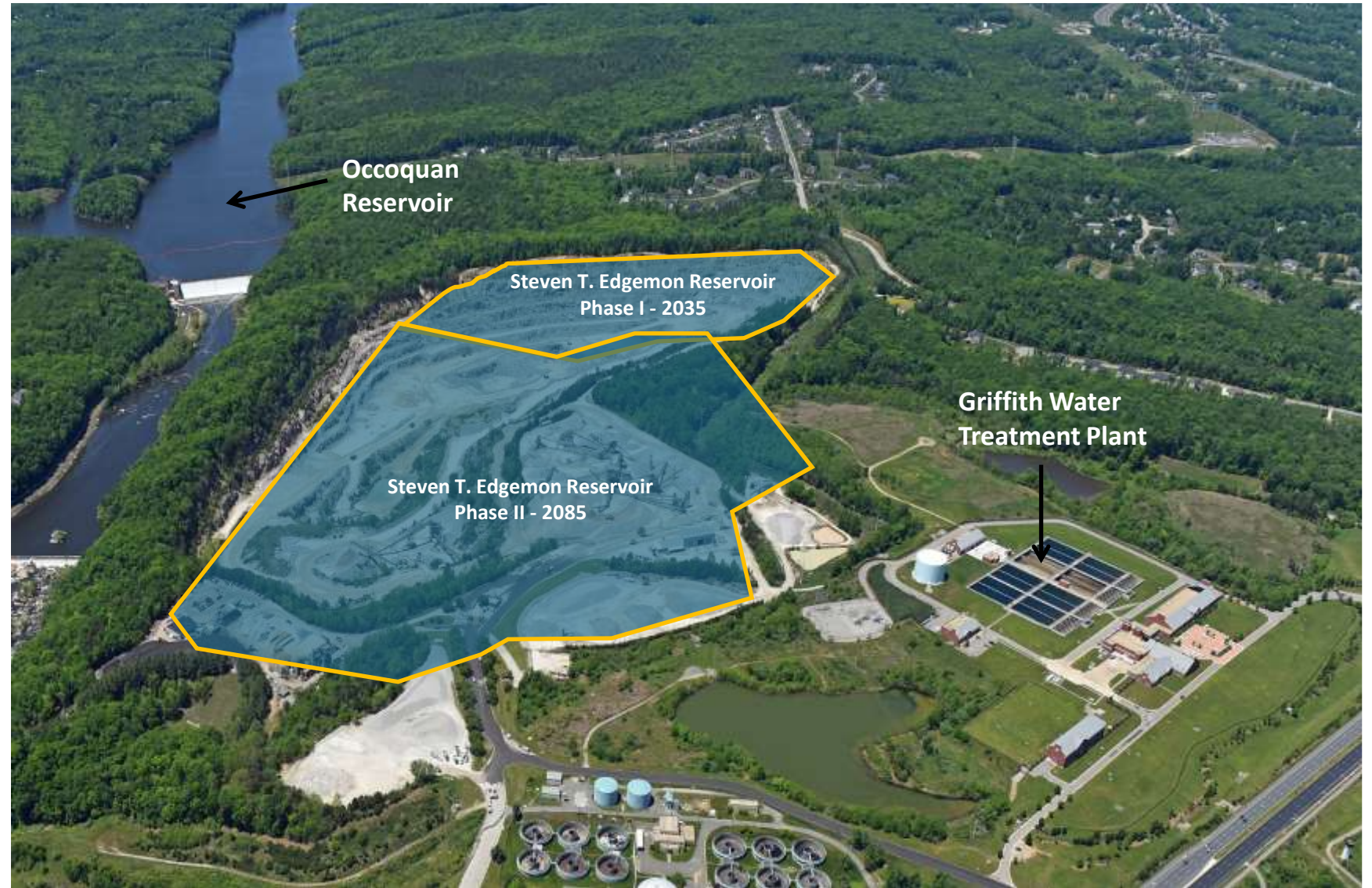
Regional Water Supply
Development Initiative

Phase 1 – 2035+

Phase 2 – 2085+

Land Use Entitlements
Obtained in 2015

Sales and Lease Agreement
Finalized in 2016



Key Takeaways

- Unique 75+ year water supply history in the Occoquan System.
- The Occoquan System indirect reuse is a foundational part of the regional water system and planning efforts.
- Fairfax Water infrastructure is highly reliant on UOSA reuse water, which composes up to 90% of Reservoir inflows during droughts.
- Loss of reuse flow to new consumptive users undermines decades of infrastructure and supply planning
- Fairfax Water remains dependent on the Potomac River for the majority of its drinking water. Other sources of water lack the capacity to replace the Potomac.



Questions?