NYC Environmental Protection

Delaware Aqueduct Repair Project

12-Month NYC Water Supply Management Plan to Complete $1 Billion Water Tunnel Fix Under the Hudson River

Agenda

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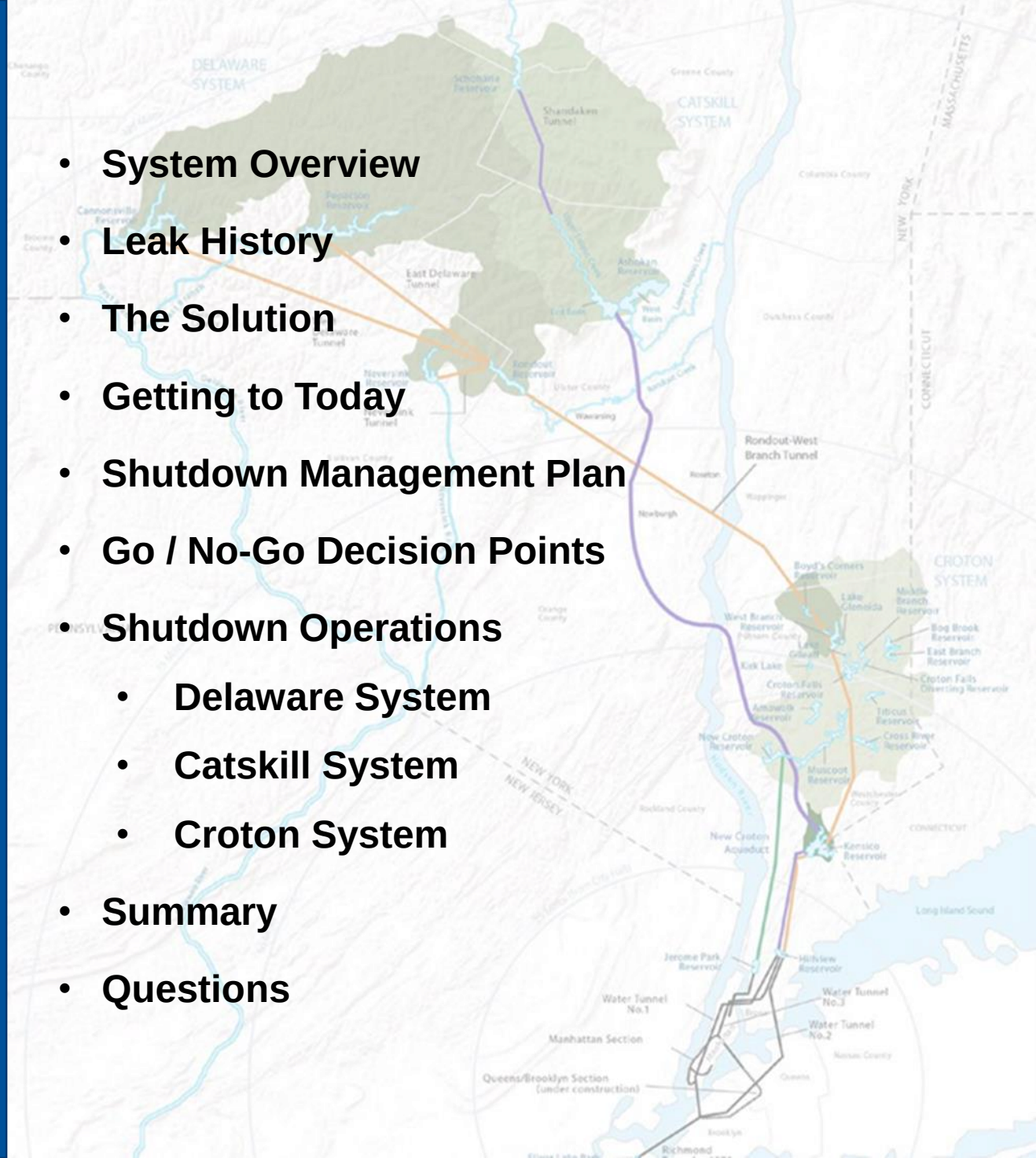
CHIEF OF STAFF
BUREAU OF WATER SUPPLY

NYC Environmental Protection

- System Overview
- Leak History
- The Solution
- Getting to Today
- Shutdown Management Plan
- Go / No-Go Decision Points
- Shutdown Operations
  - Delaware System
  - Catskill System
  - Croton System
- Summary
- Questions



System Overview

- Primarily a surface water supply
- 19 reservoirs & 3 controlled lakes
- System Capacity: 570 billion gallons
- Delivers approx. 1.1 billion gallons per day to 9.8 million people in New York City and 4 counties north of the City.
- Source of water is a 2,000 square mile watershed (the size of Delaware) spread across 8 upstate counties

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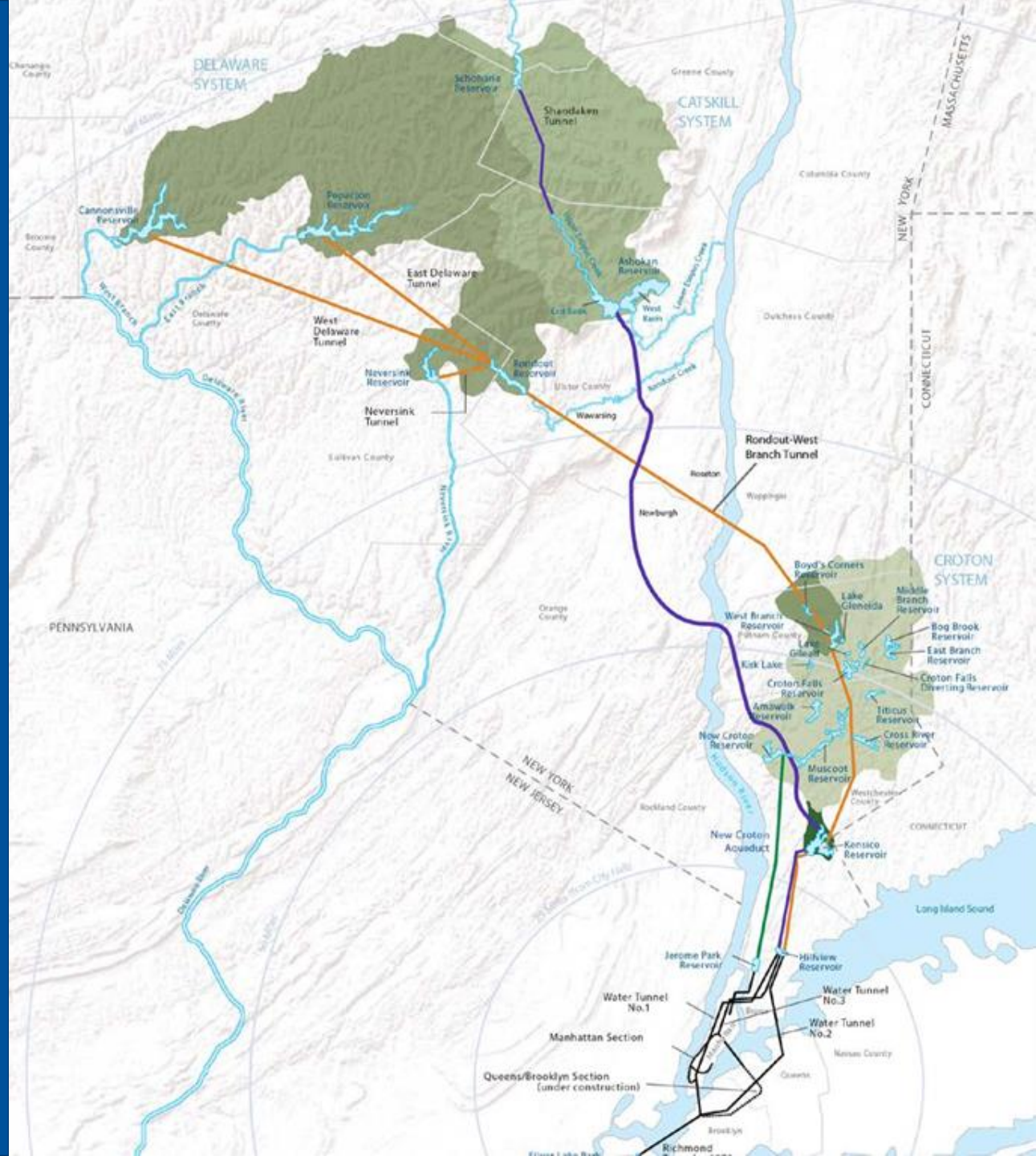
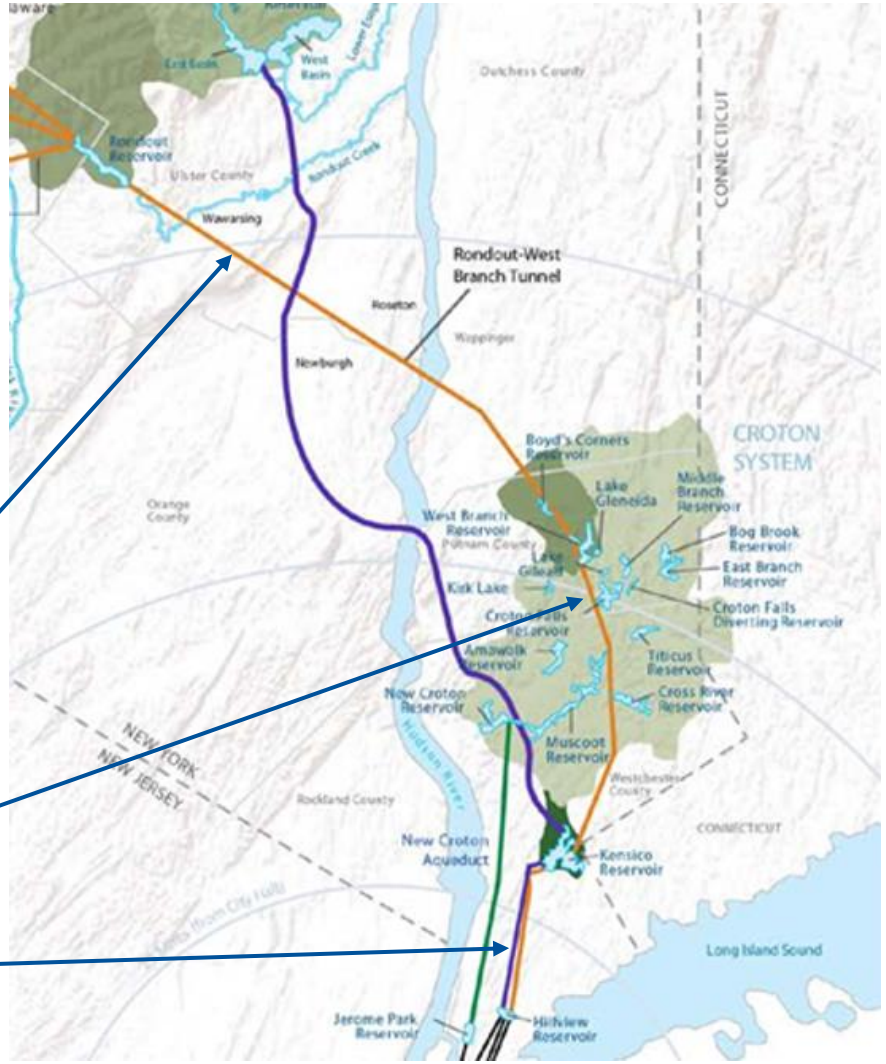


Delaware Aqueduct

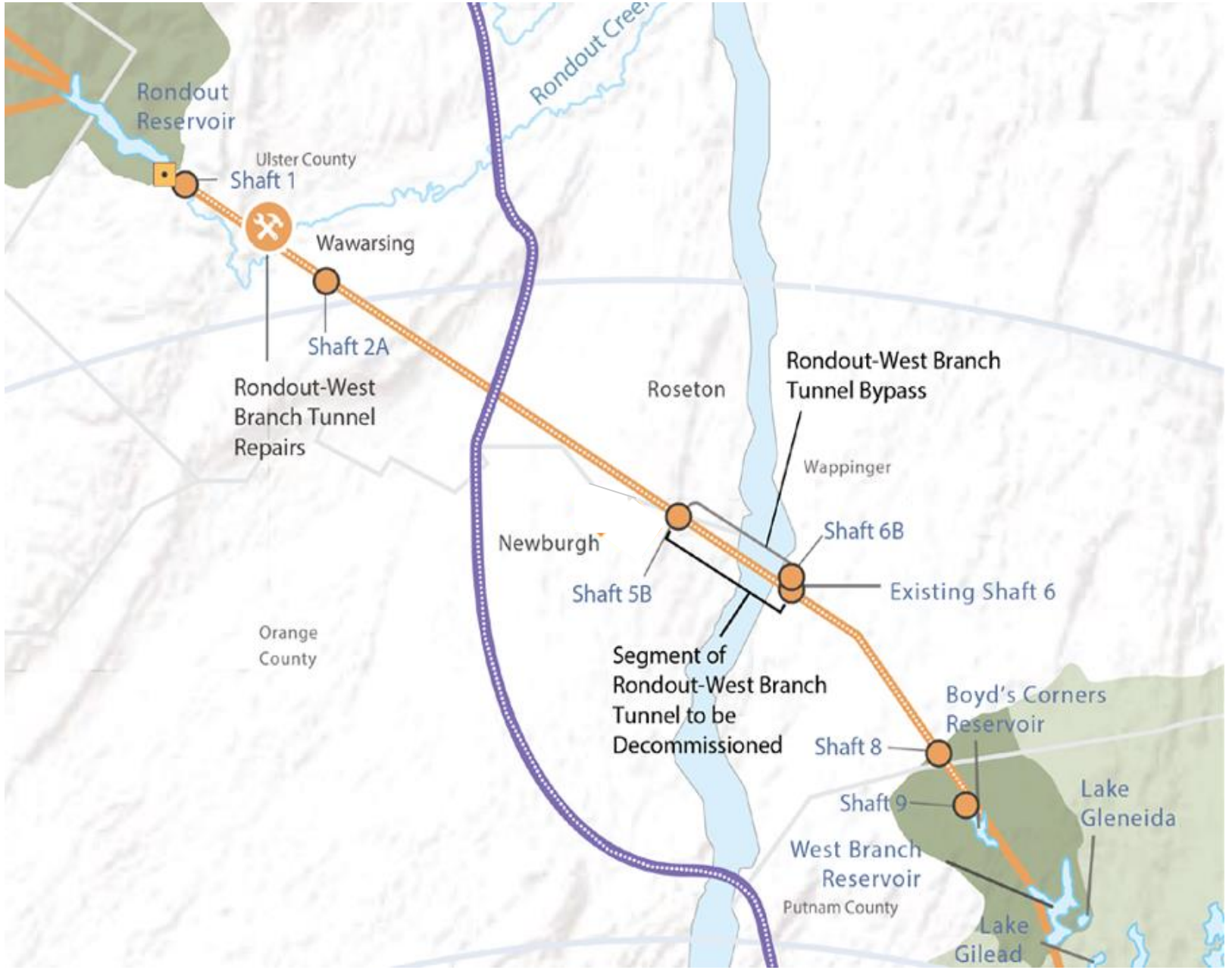
- 85 miles long from Rondout to Hillview Reservoir
- Longest tunnel in the world
- Conveys about 50 percent of NYC drinking water on average
- In service since 1944
- Last drained for inspection 1957-1958
- Critical system component
- Aqueduct consists of three segments
  - Rondout to West Branch (44 mi.)
  - West Branch to Kensico (27 mi.)
  - Kensico to Hillview (14 mi.)



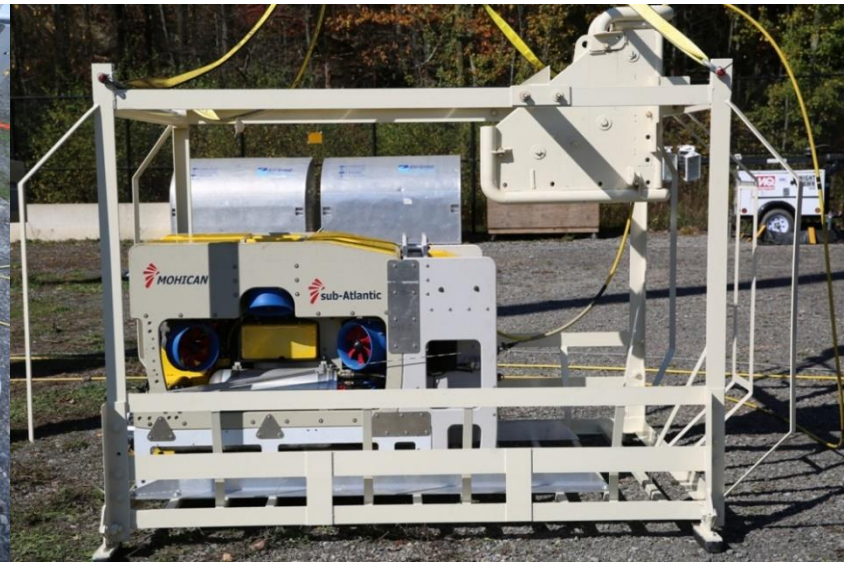
Leak Discovered

- Leak identified in late 1990 at CHG&E Roseton generating station north of Newburgh
- Leak identified in 1992 in the Ulster County Town of Wawarsing
- Total leakage rate estimated at more than 30 million gallons per day
- About 95 percent of the leakage is from the area at Roseton near Newburgh
- Difficult conditions encountered during aqueduct construction – faulted limestone
- Steel inter-lining installed through these sections to provide support for the tunnel

Primary Areas of Concern

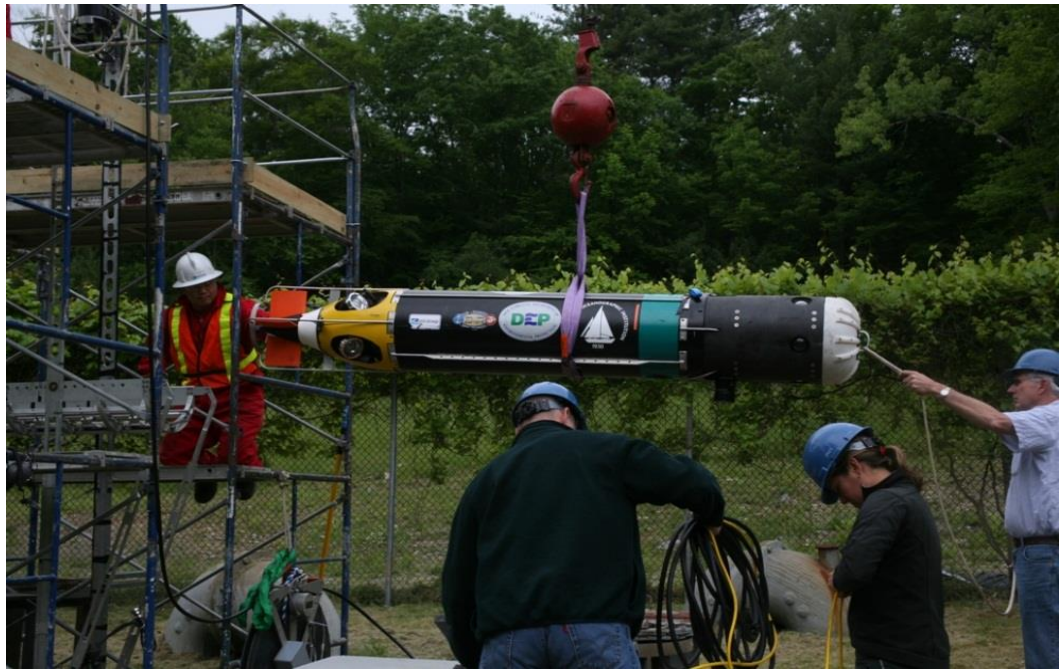


Leak Investigation

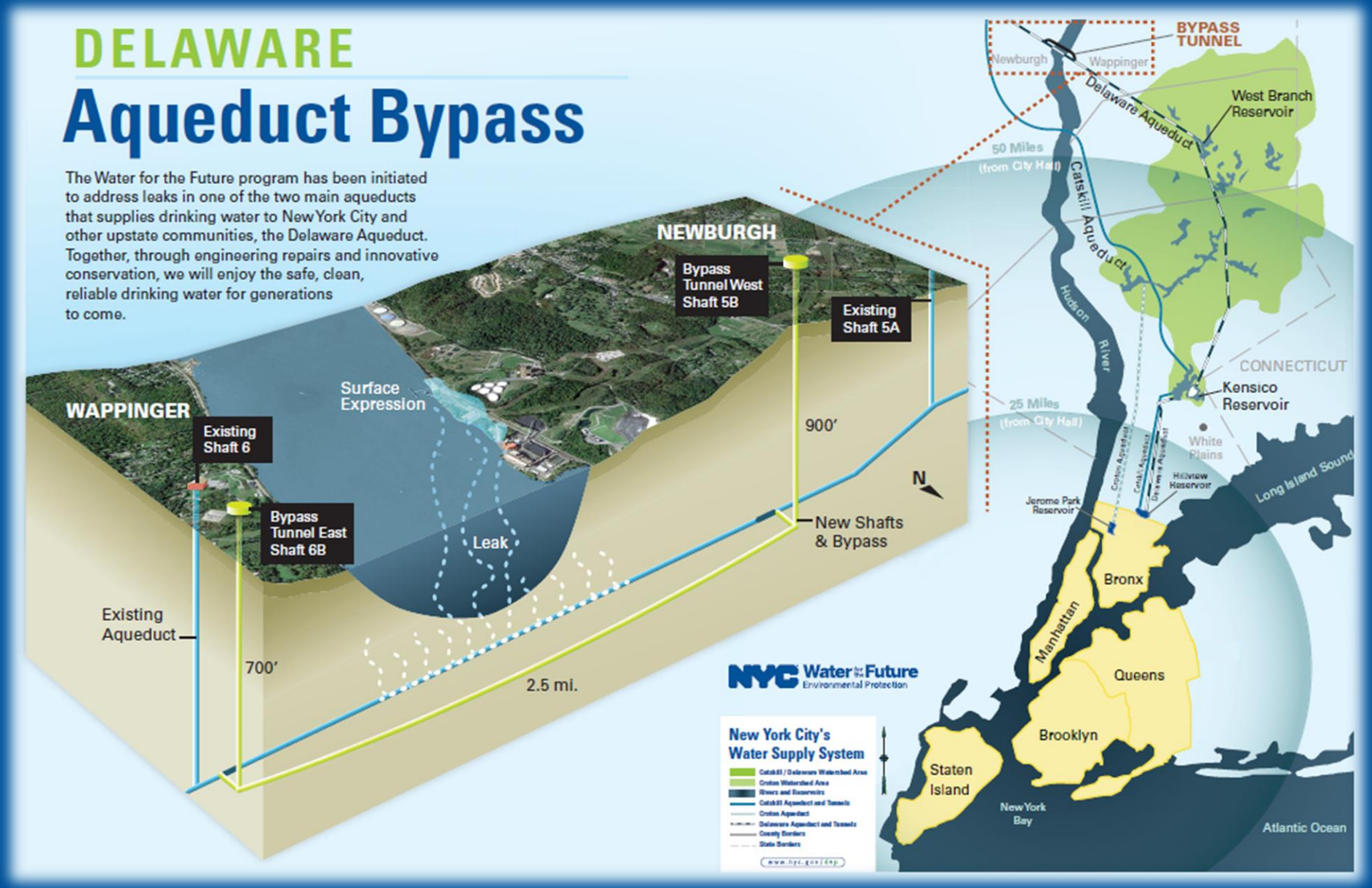


Top: Remotely Operated Vehicle (ROV) used in 2015 to investigate leak locations in Wawarsing

Bottom: Autonomous Underwater Vehicle (AUV) used in 2004, 2009, 2014 to investigate the Rondout-West Branch segment near Newburgh



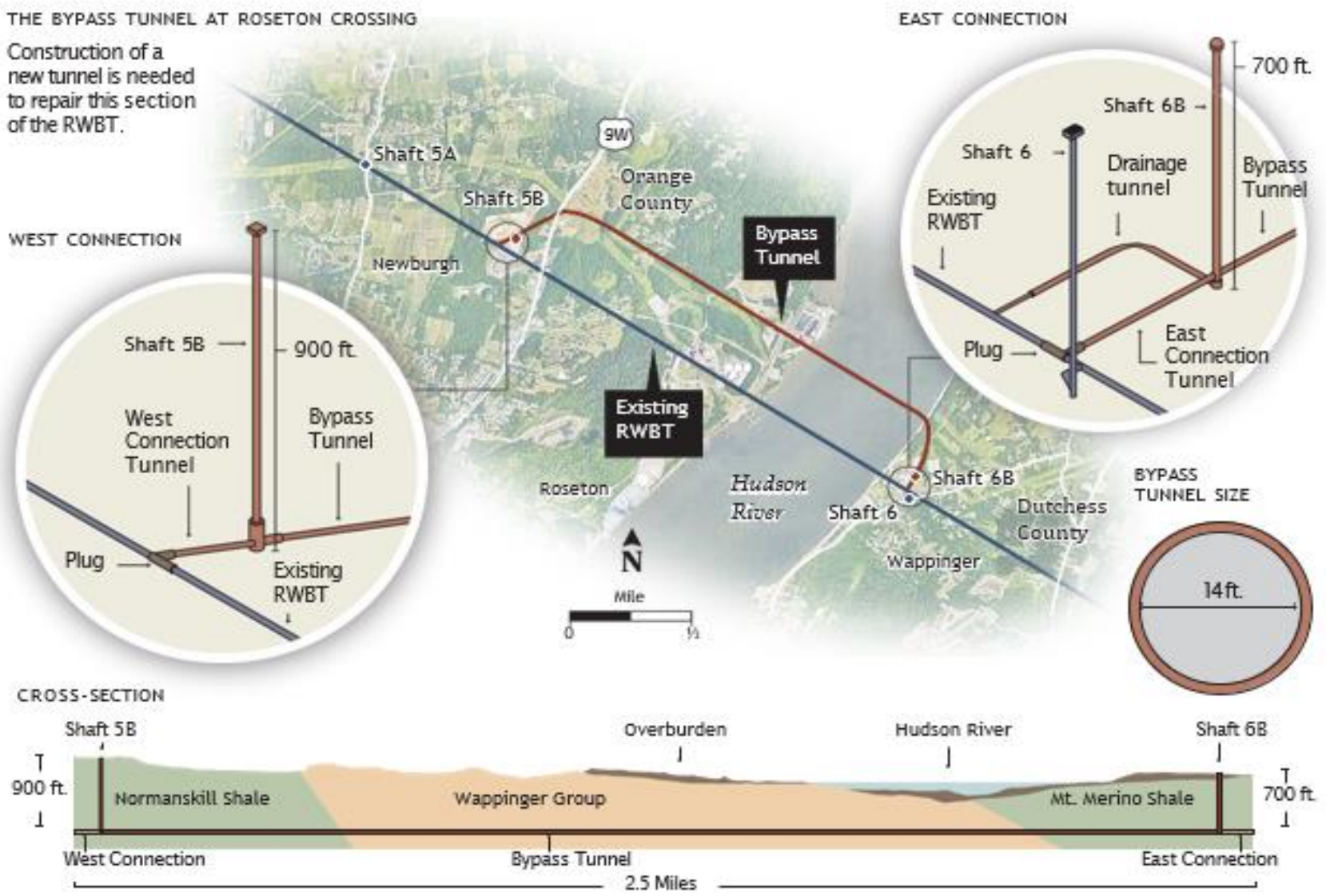
The Solution!



Delaware Aqueduct Bypass Tunnel

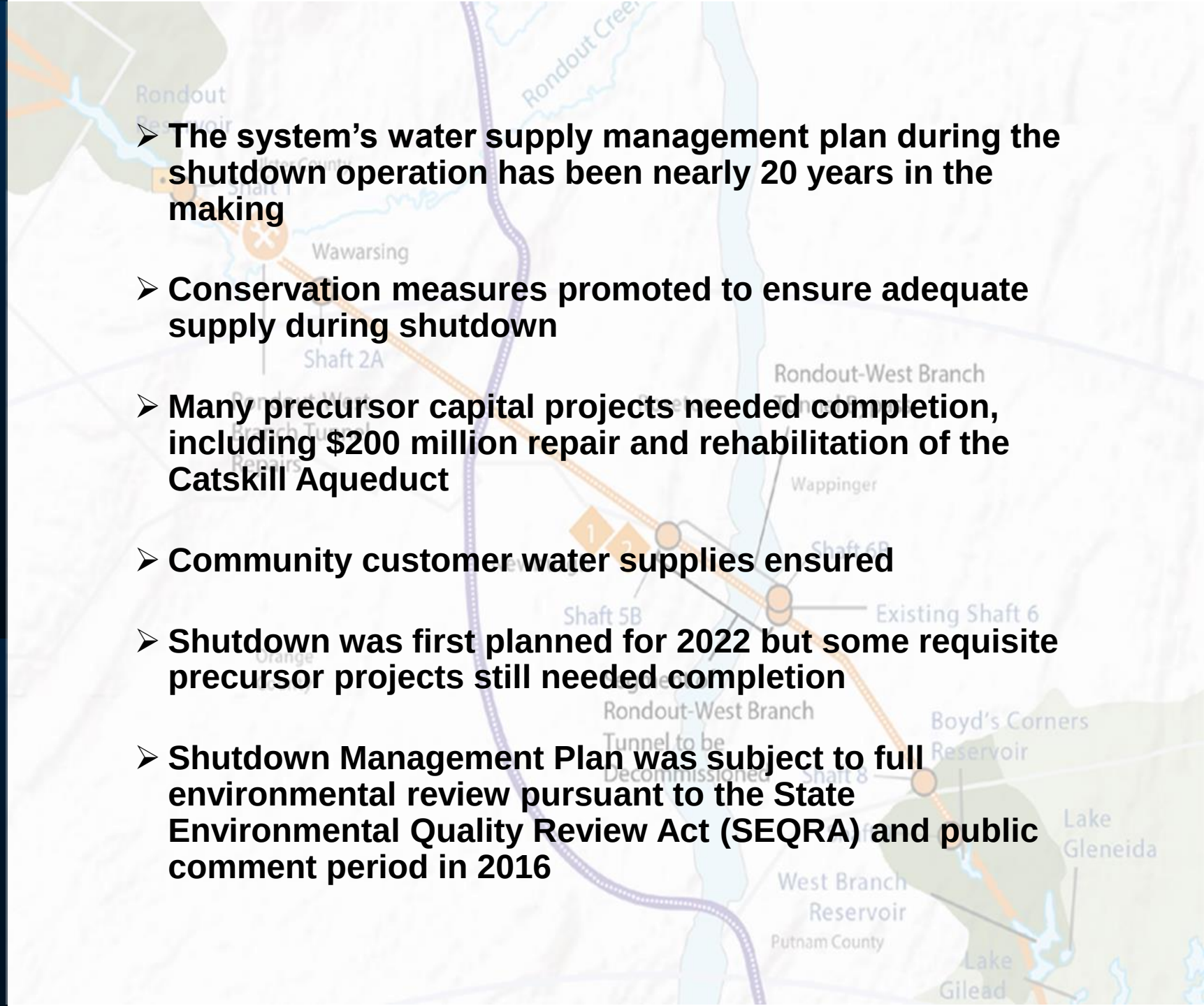
- Largest and most complex repair project in the 180-year history of NYC's municipal water supply
- Total program cost $1 billion
- Fixing or eliminating leaks in the Delaware Aqueduct
- Building and connecting a new 2.5-mile-long tunnel 600 feet below the Hudson River from Newburgh to Wappinger
- Expected completion in 2024
- Delaware water supply shutdown to connect bypass tunnel begins October 2023

Bypass Tunnel to Connect at Both Ends Under Hudson



Getting to Today

- **The system's water supply management plan during the shutdown operation has been nearly 20 years in the making**
- **Conservation measures promoted to ensure adequate supply during shutdown**
- **Many precursor capital projects needed completion, including $200 million repair and rehabilitation of the Catskill Aqueduct**
- **Community customer water supplies ensured**
- **Shutdown was first planned for 2022 but some requisite precursor projects still needed completion**
- **Shutdown Management Plan was subject to full environmental review pursuant to the State Environmental Quality Review Act (SEQRA) and public comment period in 2016**

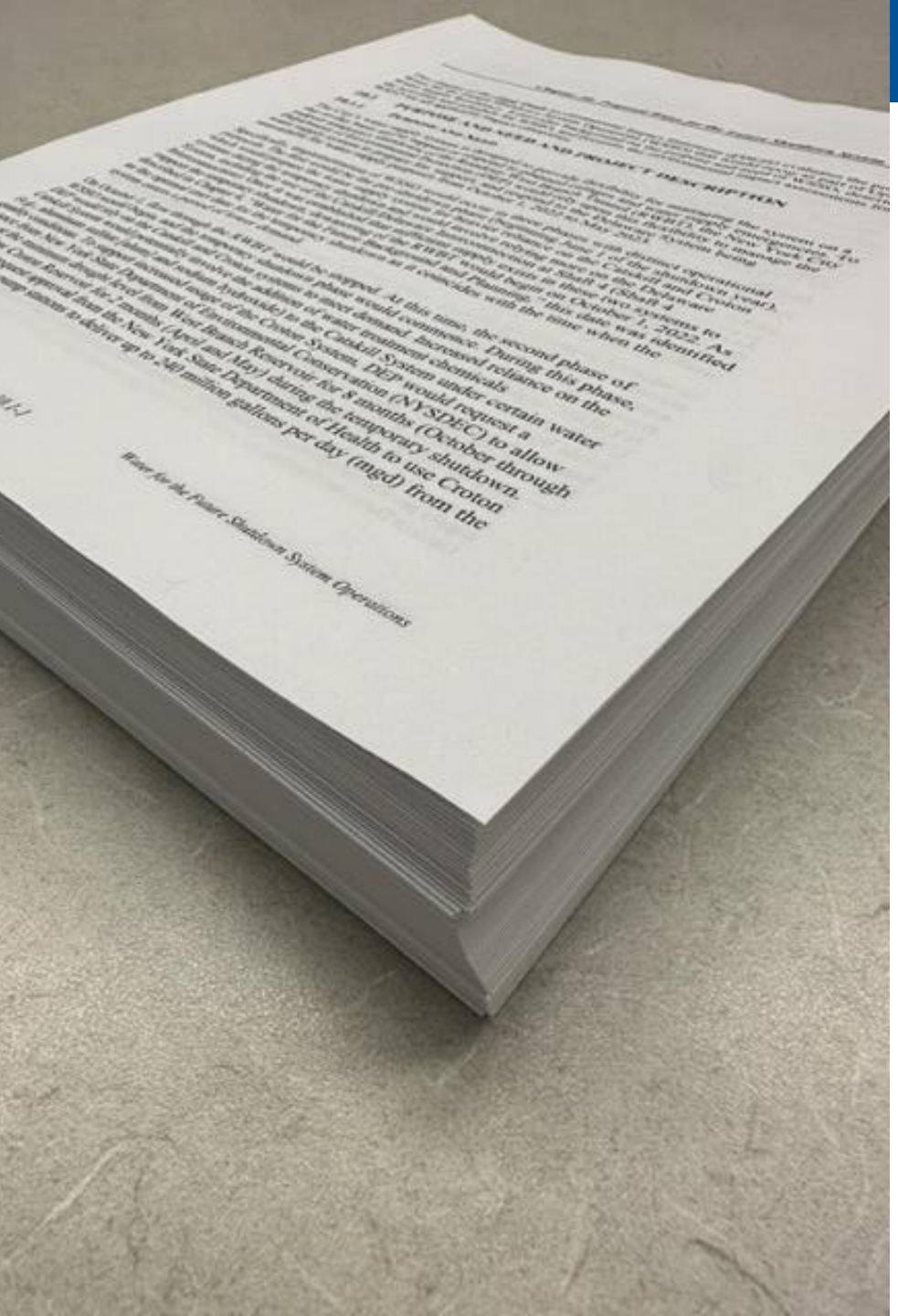


Getting to Today

- **The shutdown and bypass tunnel connection was originally planned for fall 2022 but will now be October 2023;**
- **To ensure redundancy of several water supply systems in communities north of the City;**
- **To finalize a new connection between the Croton System and the City water supply in the Bronx; and**
- **For upgrades and testing of pump stations in the Hudson Valley.**

Getting to Today

- **Precursor Projects Critical to RWBT Shutdown**
- **CAT-212D:** Shandaken Tunnel Intake Chamber Improvements
- **CAT-213E/F:** Chemical Addition Facilities for the Catskill System
- **BT-2:** Rondout Siphons
- **DEL-424:** Structural Stabilization of Honk Falls Dam
- **CAT-RR:** Catskill Aqueduct Repair and Rehabilitation
- **DEL-418C:** Town of Newburgh Backup Supply
- **CRO-346CF:** Upgrades at Croton Falls Pump Station
- **CRO-543:** Shoreline Stabilization at Kensico Reservoir
- **CRO-521:** Jerome Park Reservoir Work

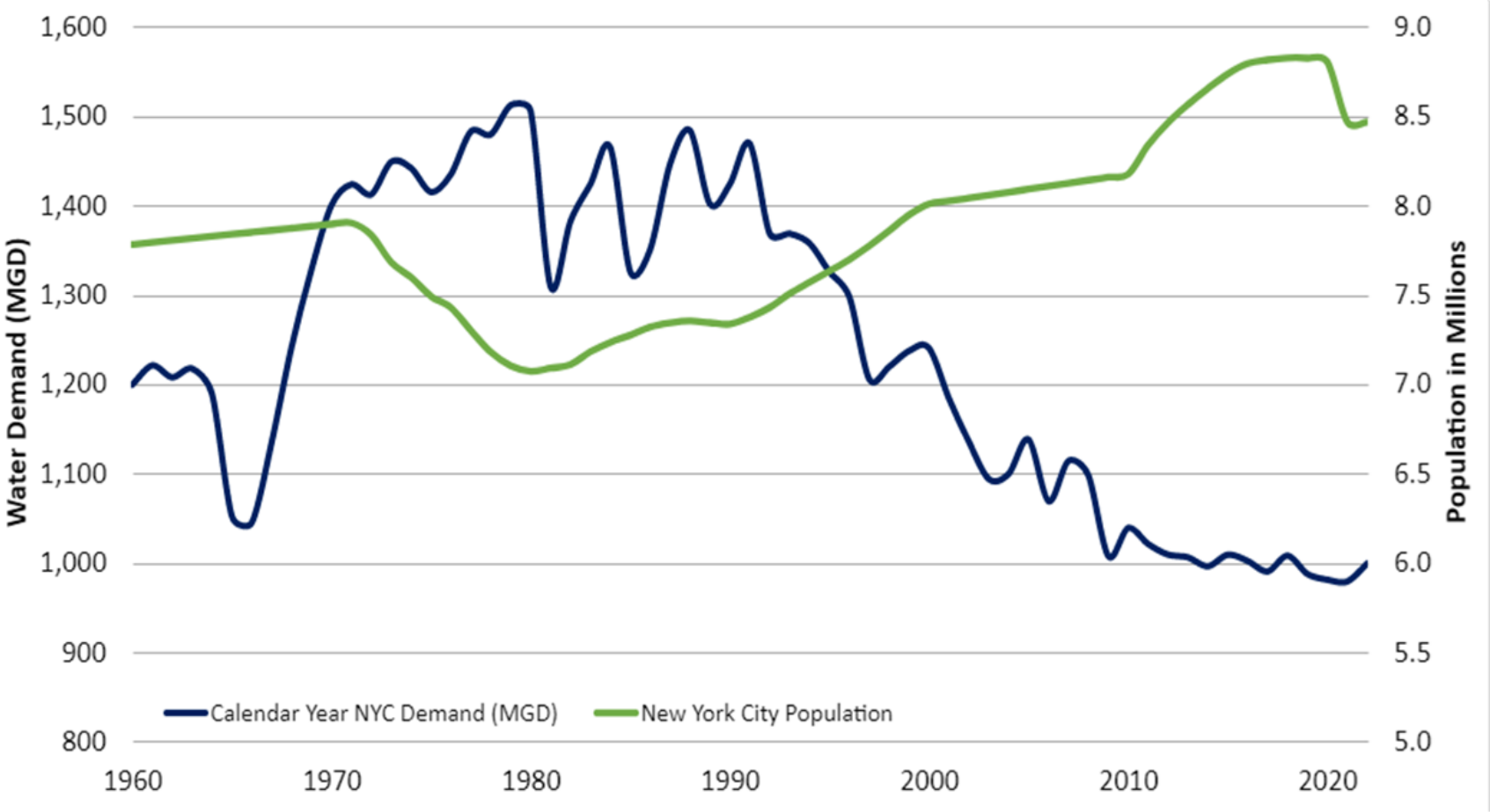


Getting to Today

- **Shutdown Management Plan was subject to a full environmental review process**
- Notice of Completion of Final Environmental Impact Statement was issued on December 15, 2017
- **Chapter 10: Proposed Water for the Future Shutdown System Operations 429 Pages**
- www.nyc.gov/assets/dep/downloads/pdf/environmental-reviews/upstate-water-supply-resiliency/chapter-10-wsso.pdf

Getting to Today

Conservation Savings



DEP instituted conservation strategies across residential, commercial, educational, industrial, and municipal customers that have reduced demand on the system to the lowest level in at least 60 years, even as population has increased.

Water Supply Augmentation

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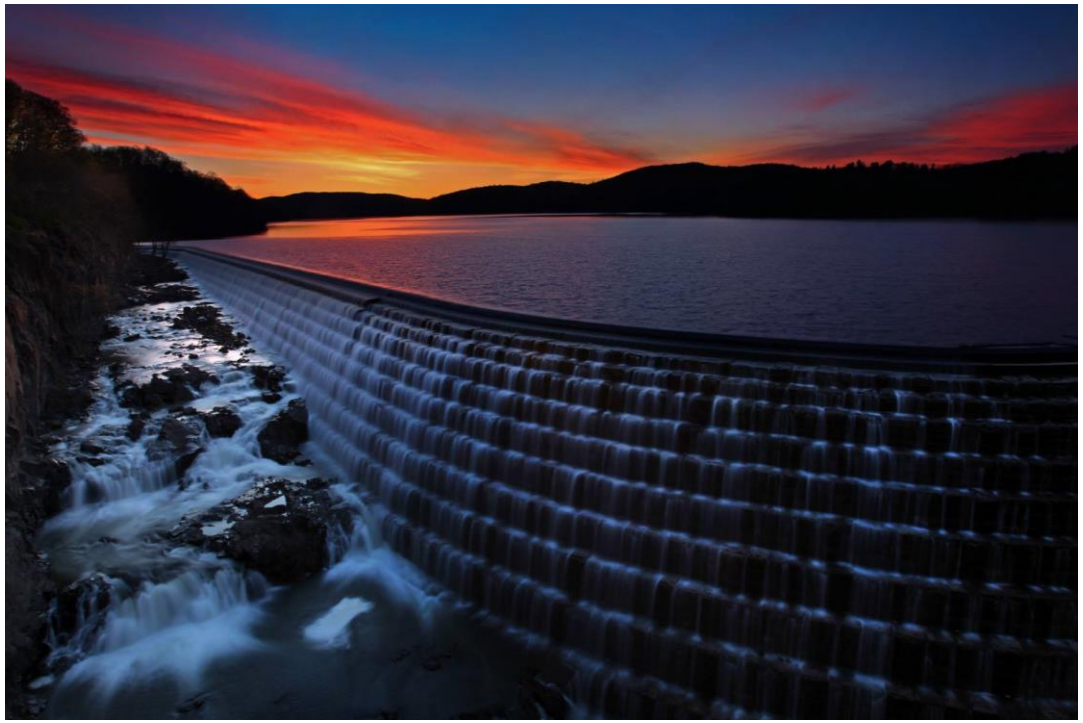
During the 8-month shutdown how will New York City meet demand?

Source	Yield
Catskill System	600 MGD
Croton Pump Stations	240 MGD
Croton System	290 MGD

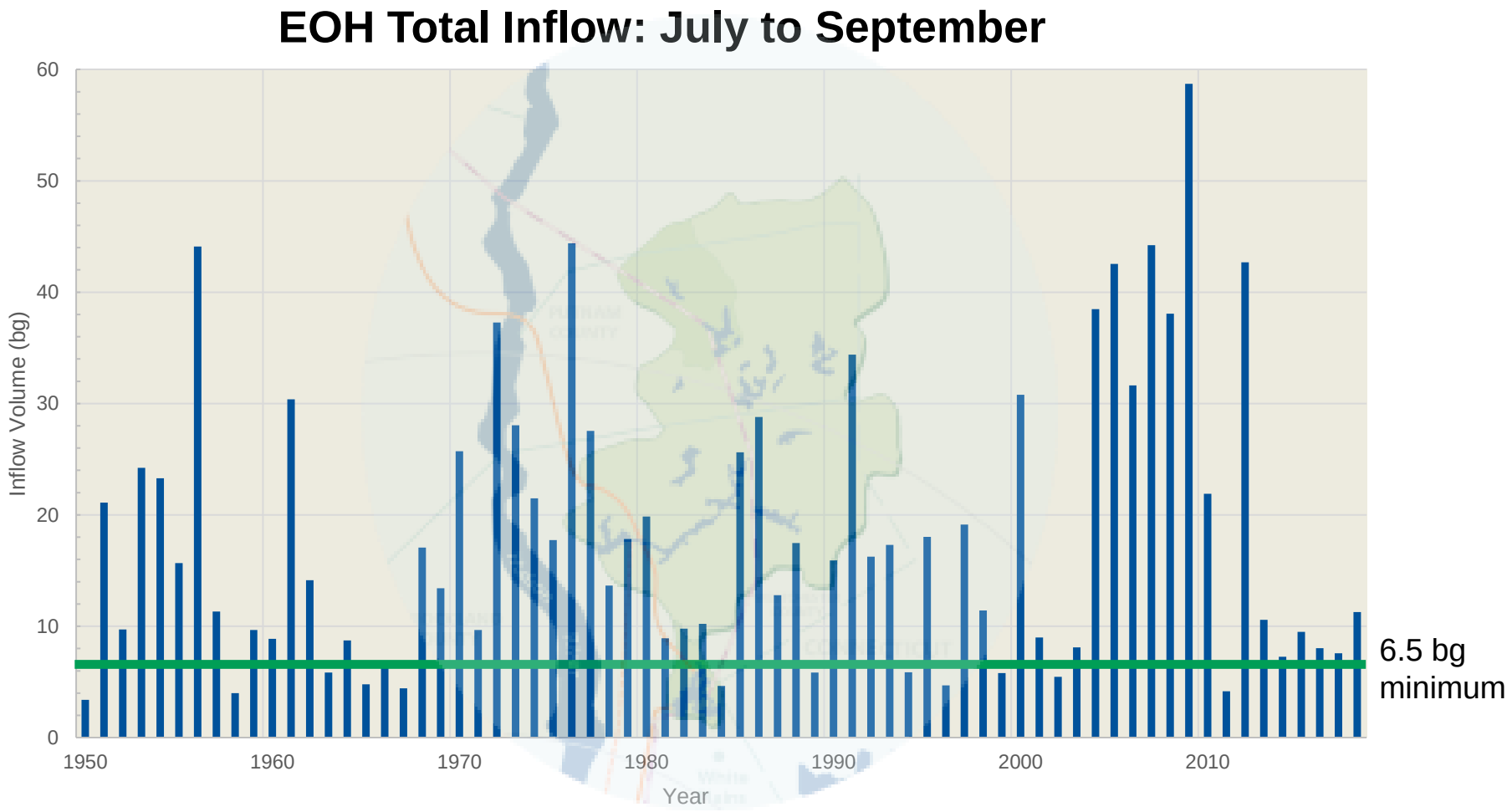


Go/No-Go Decision Points Leading to the October Shutdown

- Water supply hydrological conditions
- Infrastructure conditions
- If “no go” this season would plan for the same period next year

Go/No-Go Decision Points: Hydrologic Conditions

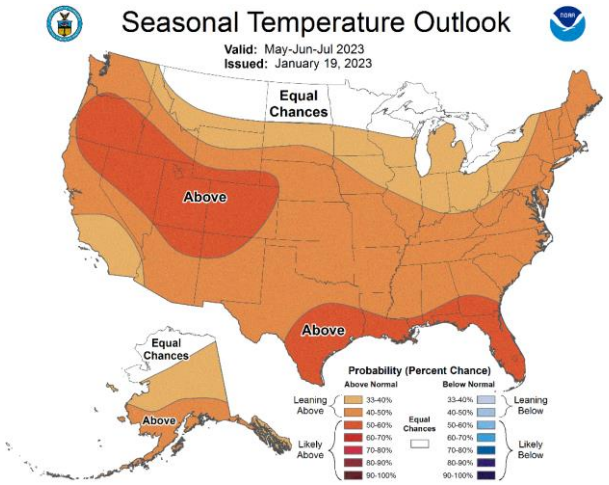
- **East of Hudson (EOH) inflow must be greater than 6.5 billion gallons** to commence shutdown.
- Historically, July-September EOH inflow was above 6.5 billion gallons 80% of the time.



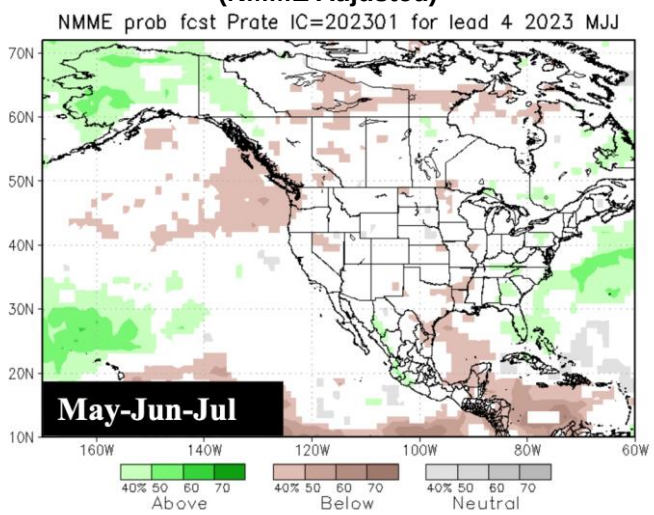
Go/No-Go Decision Points: Weather Prediction

Extended Temperature and Precipitation Forecast May 2023 – Jul 2023

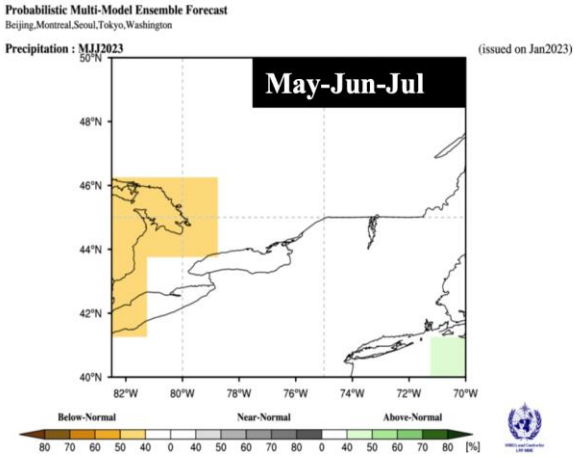
NOAA's Climate Prediction Center



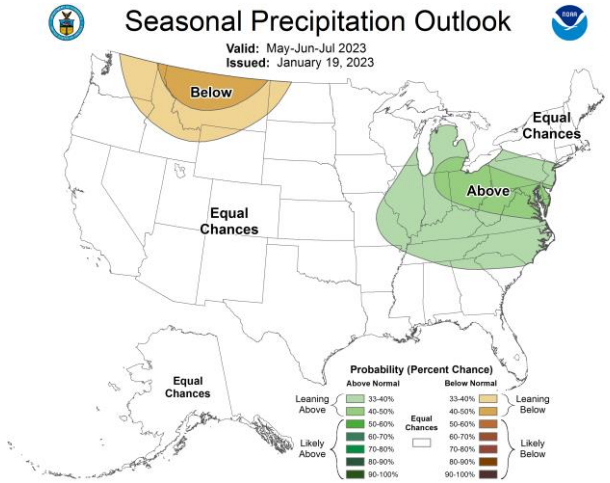
NOAA's Climate Prediction Center (NMME Adjusted)



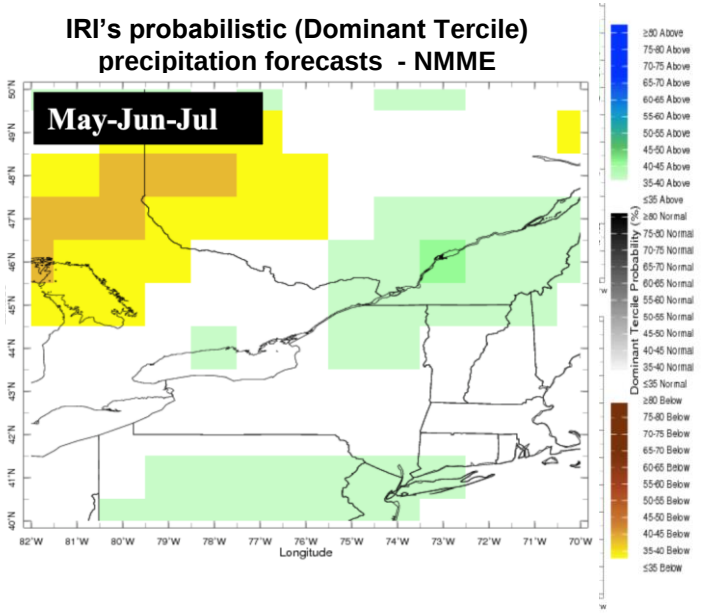
WMO Lead Centre



DEP is using multiple long-term weather prediction services to assist modeling shutdown operations



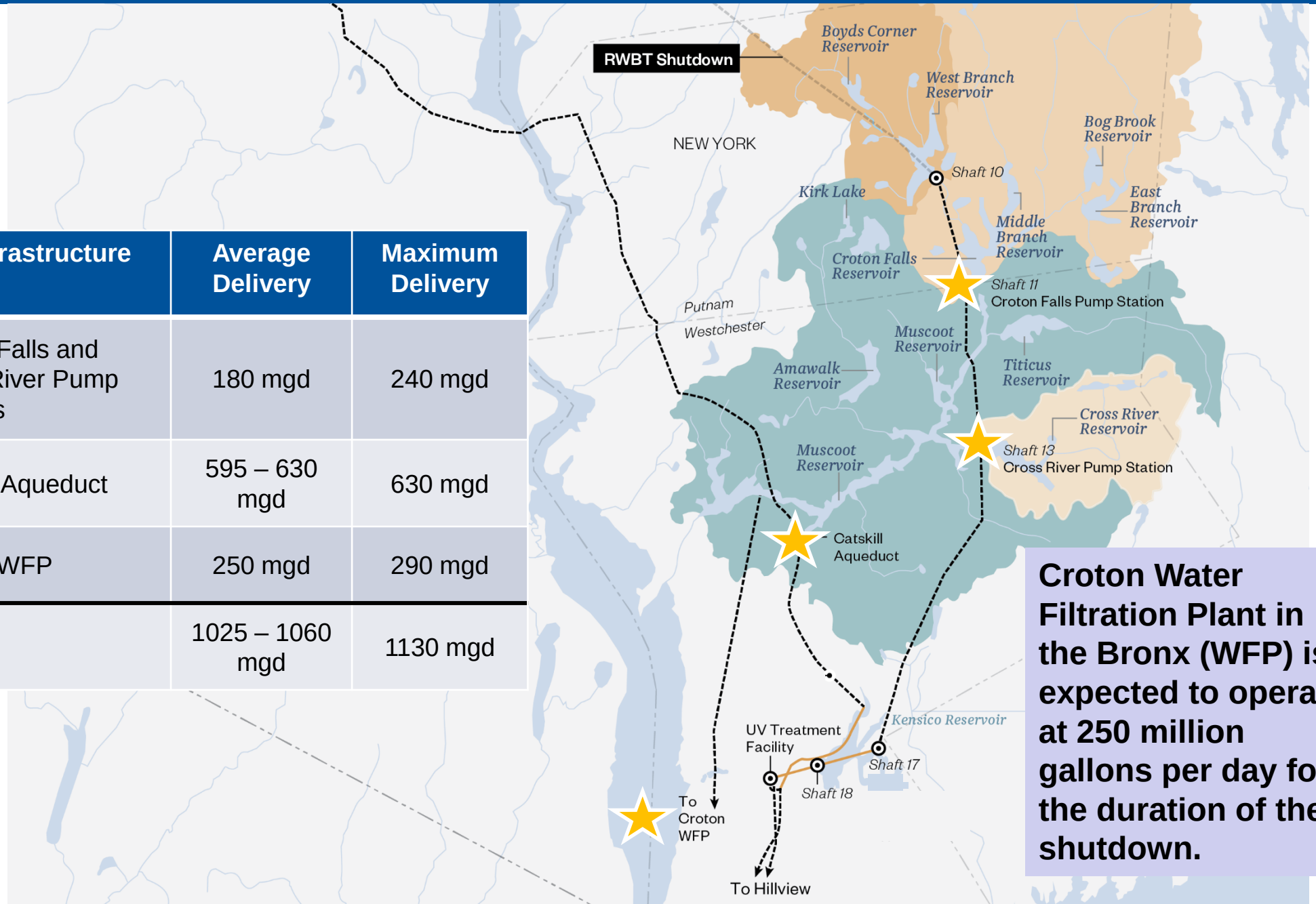
IRI's probabilistic (Dominant Tercile) precipitation forecasts - NMME



All "go" / "no go" and potential project bailout decisions are made in real time based on precision data and in coordination with expert and regulatory partners. Bailout return-to-service during shutdown can take between 1 and 9 weeks.

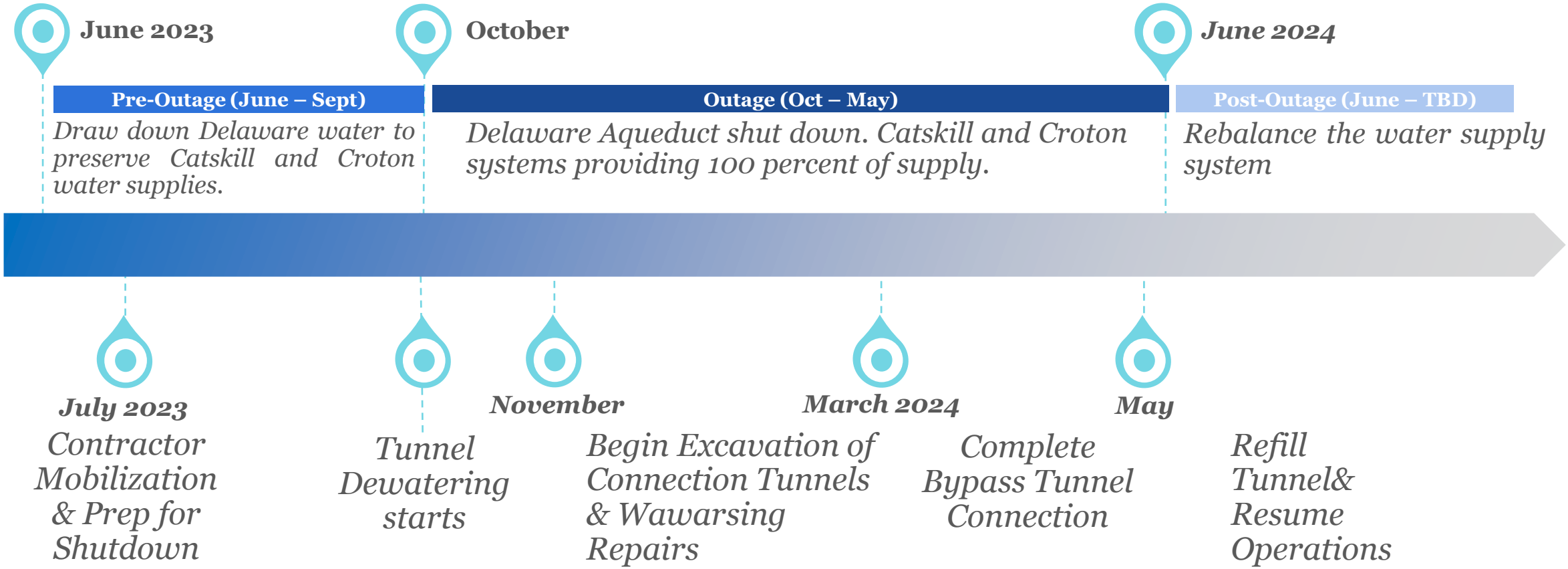
Go/No-Go Decision Points: Key Infrastructure

Key Infrastructure	Average Delivery	Maximum Delivery
Croton Falls and Cross River Pump Stations	180 mgd	240 mgd
Catskill Aqueduct	595 – 630 mgd	630 mgd
Croton WFP	250 mgd	290 mgd
Total	1025 – 1060 mgd	1130 mgd



Croton Water Filtration Plant in the Bronx (WFP) is expected to operate at 250 million gallons per day for the duration of the shutdown.

Go/No-Go Decision Points: Made in Real-Time



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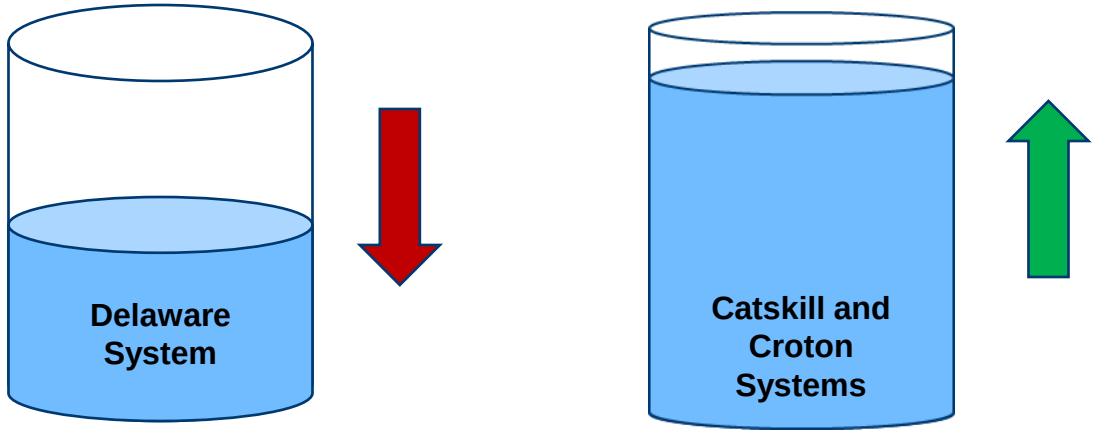
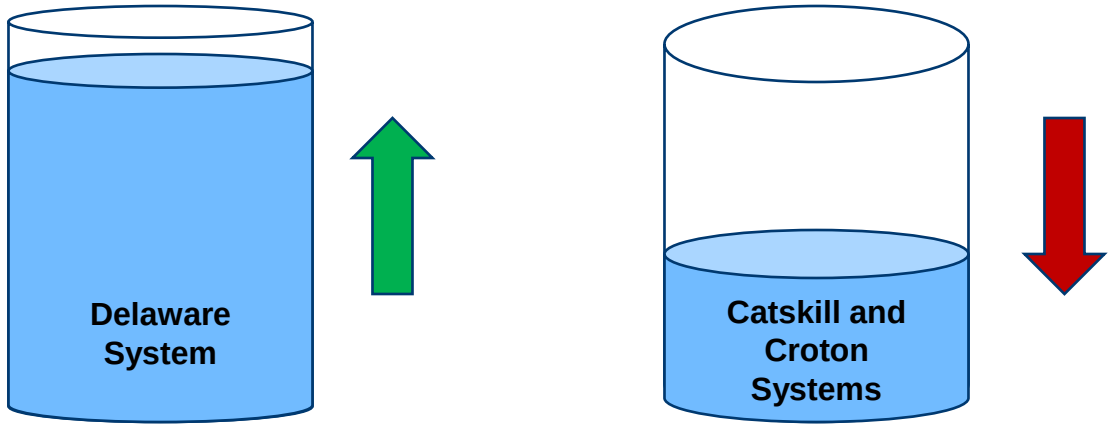
Shutdown Operations

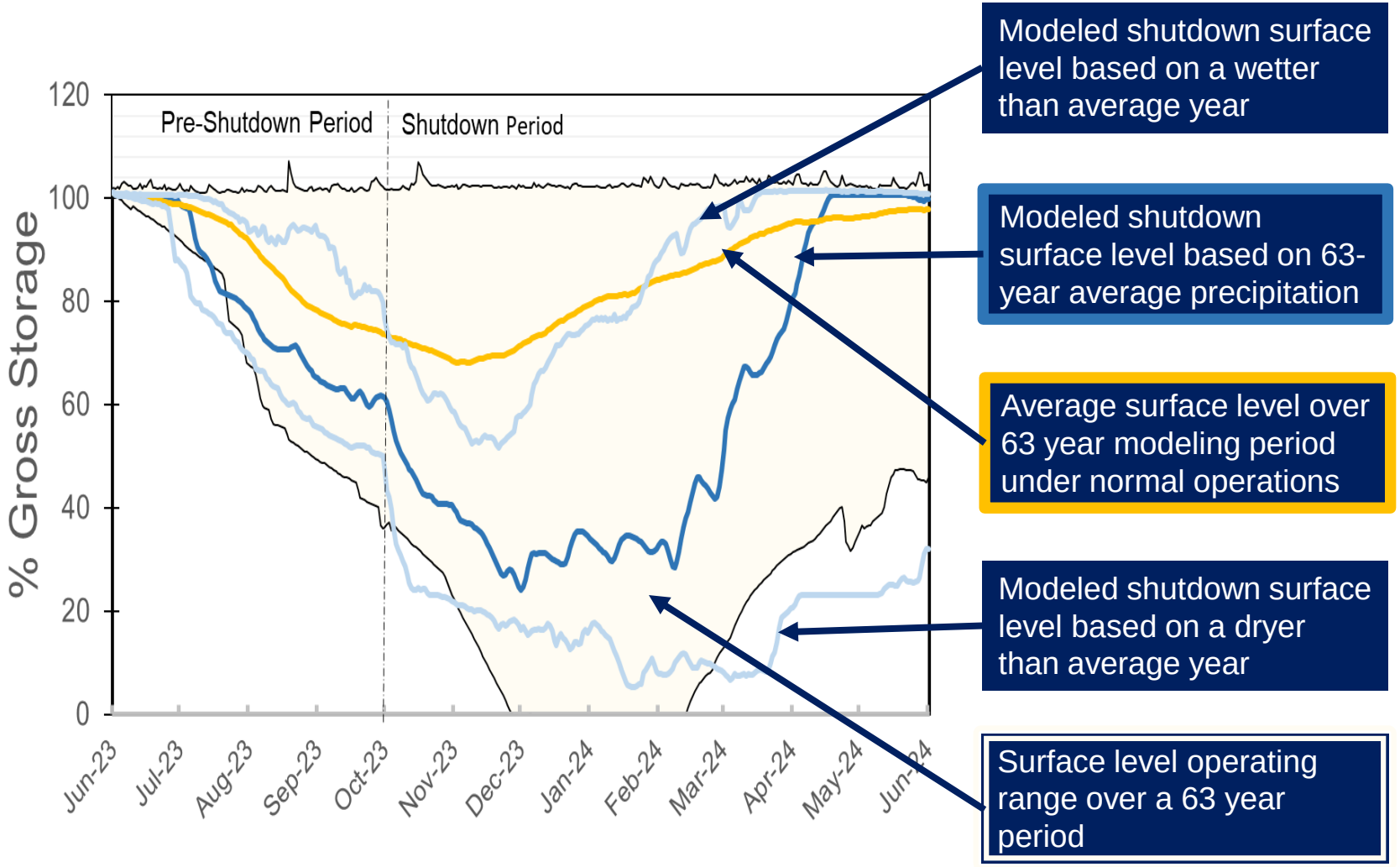
Before the aqueduct shutdown



During the aqueduct shutdown

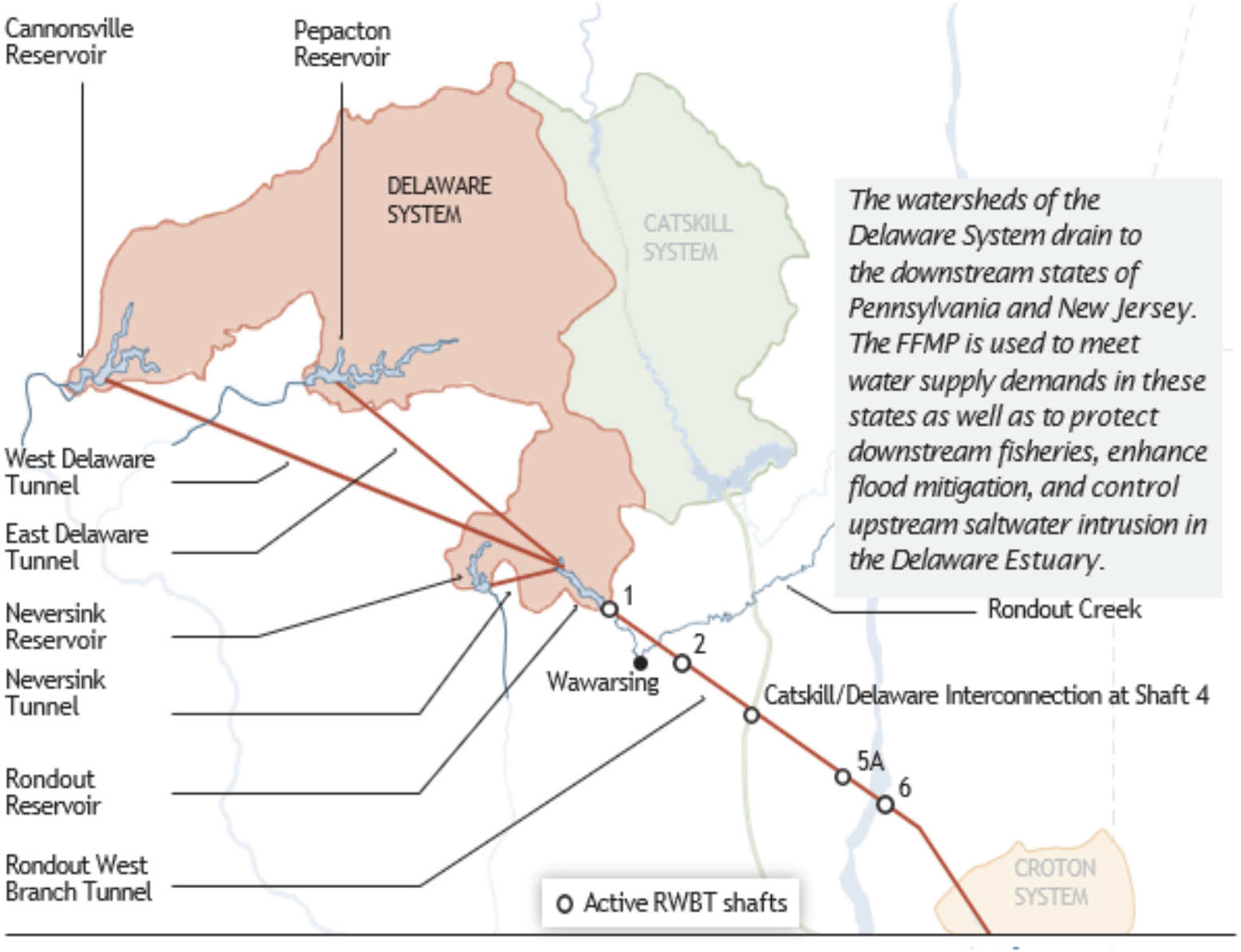


Reservoir Modeling



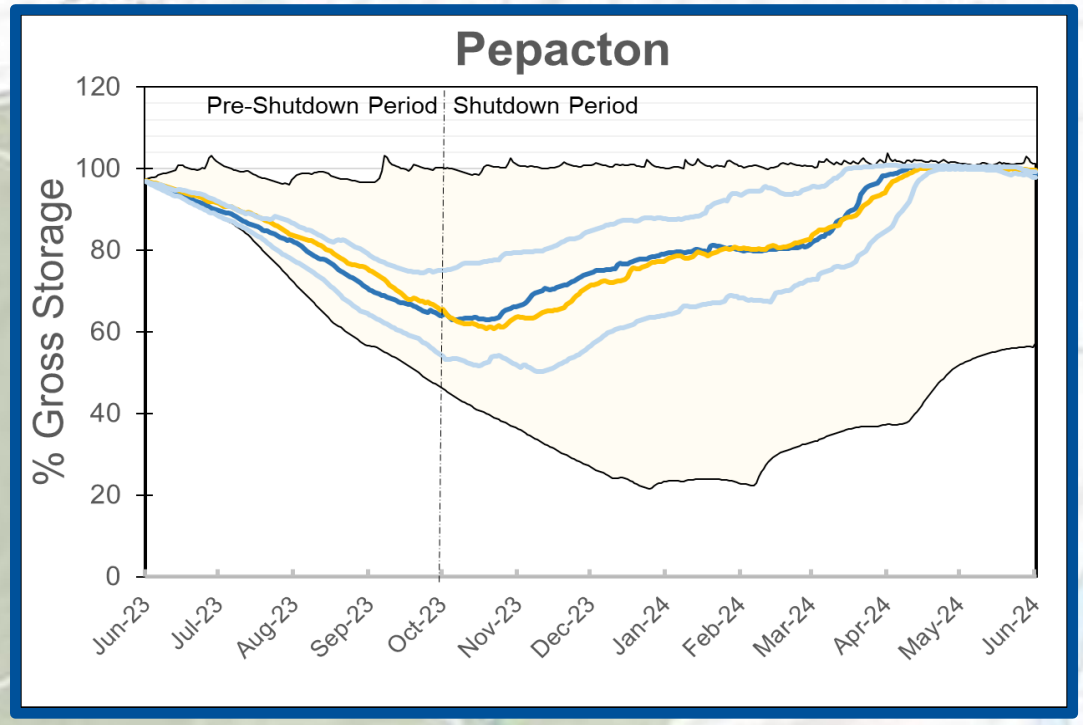
Delaware System Leading into the Shutdown

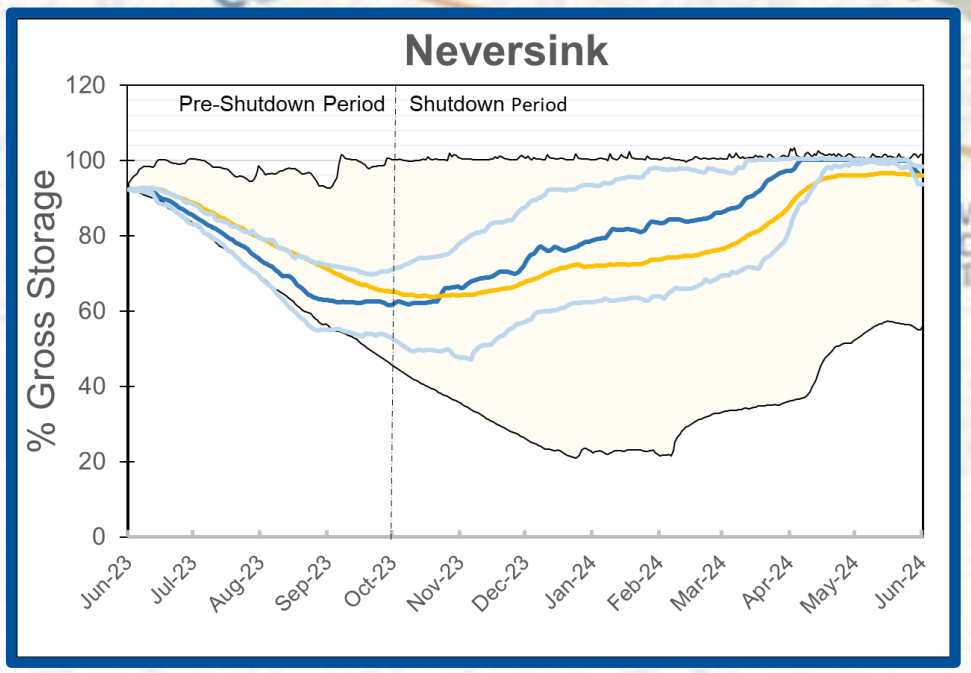
- Depending on rainfall, DEP expects to draw down the Cannonsville, Neversink and Pepacton reservoirs by 30 percent or more ahead of the shutdown
- Likely more cold-water releases downstream to the Delaware
- Preserve Catskill system water for the shutdown



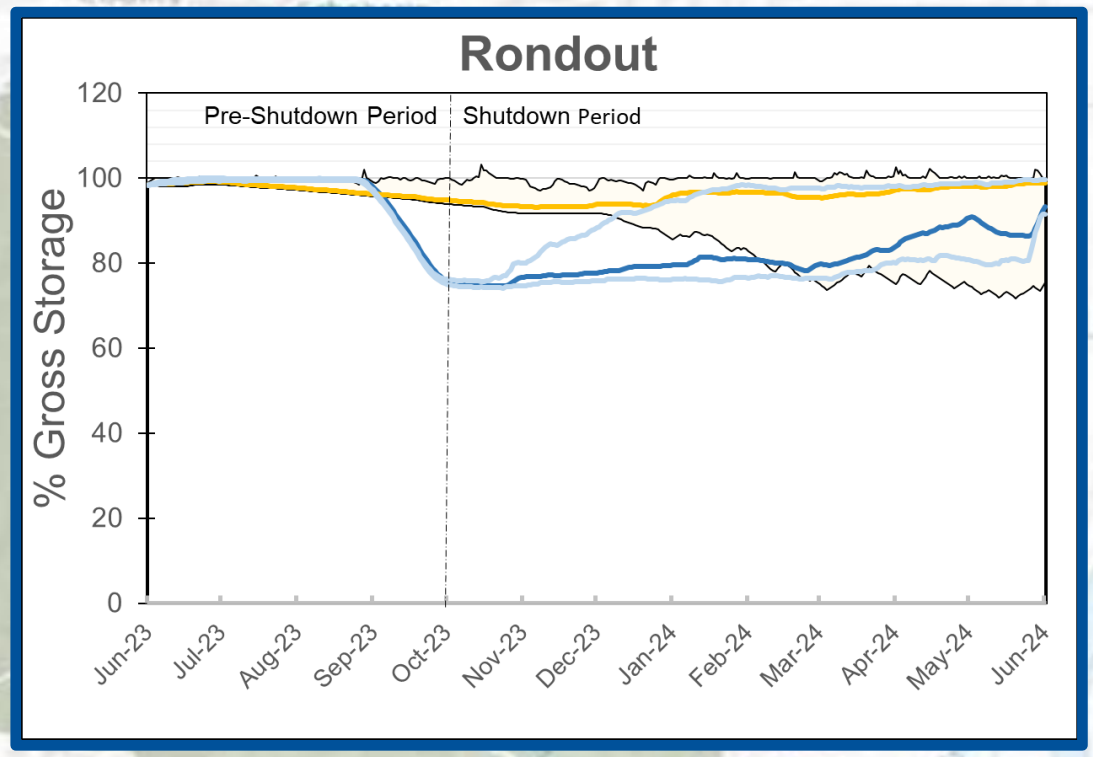
Prior to the shutdown, The Cannonsville, Pepacton and Neversink will be drawn down, leaving a substantial void for refill and spill attenuation

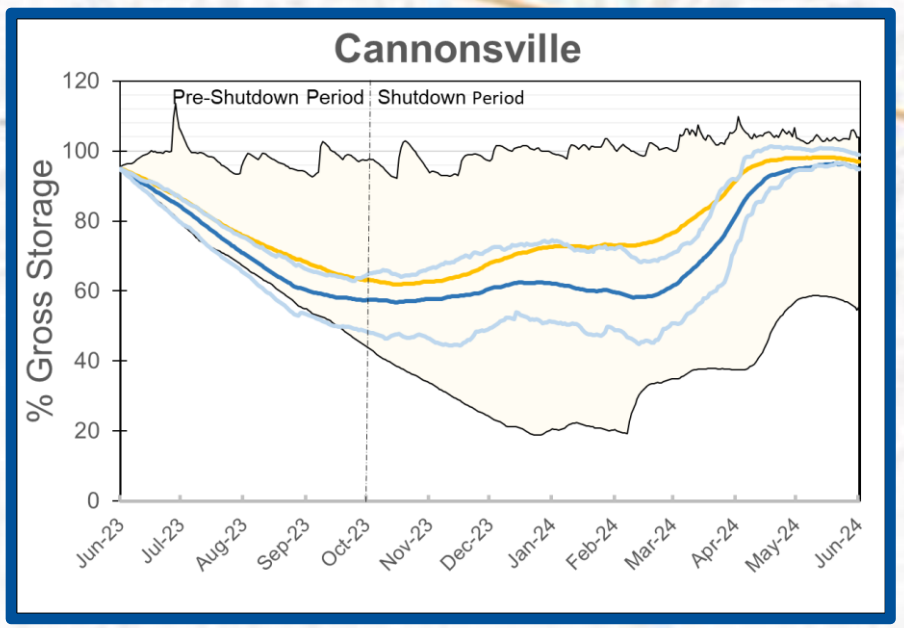
During shutdown operations, releases from each of those reservoirs into the Delaware River tributaries will continue pursuant to the Flexible Flow Management Program (FFMP)





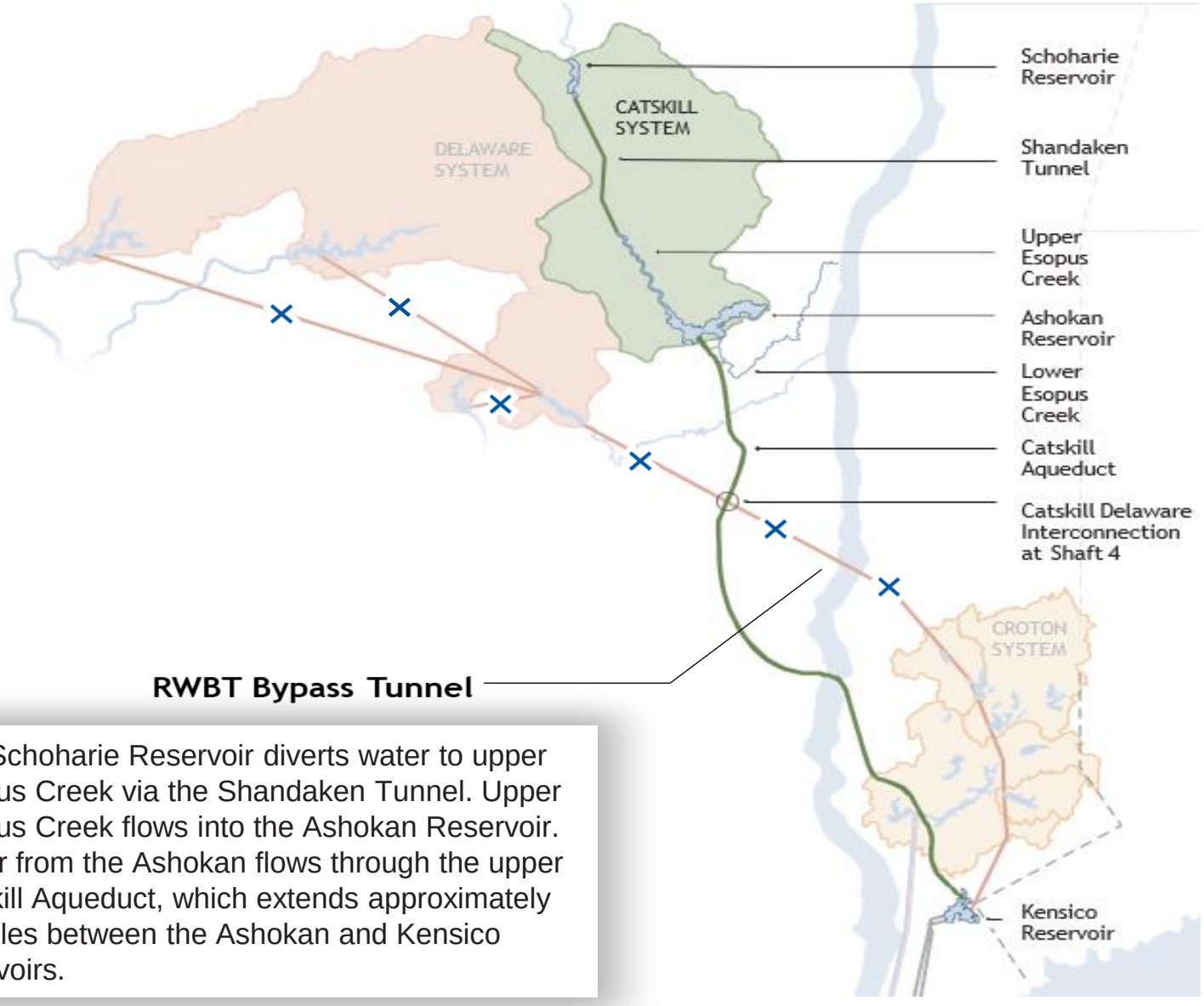
During Delaware Aqueduct shutdown operations three new temporary siphons will be used to help manage the Rondout Reservoir's surface elevation by enabling the release of as much as 260 million gallons per day (similar to the flow of a small creek) into the Rondout Creek. Siphons cease operations within 1 foot of flood action stage on Rondout Creek





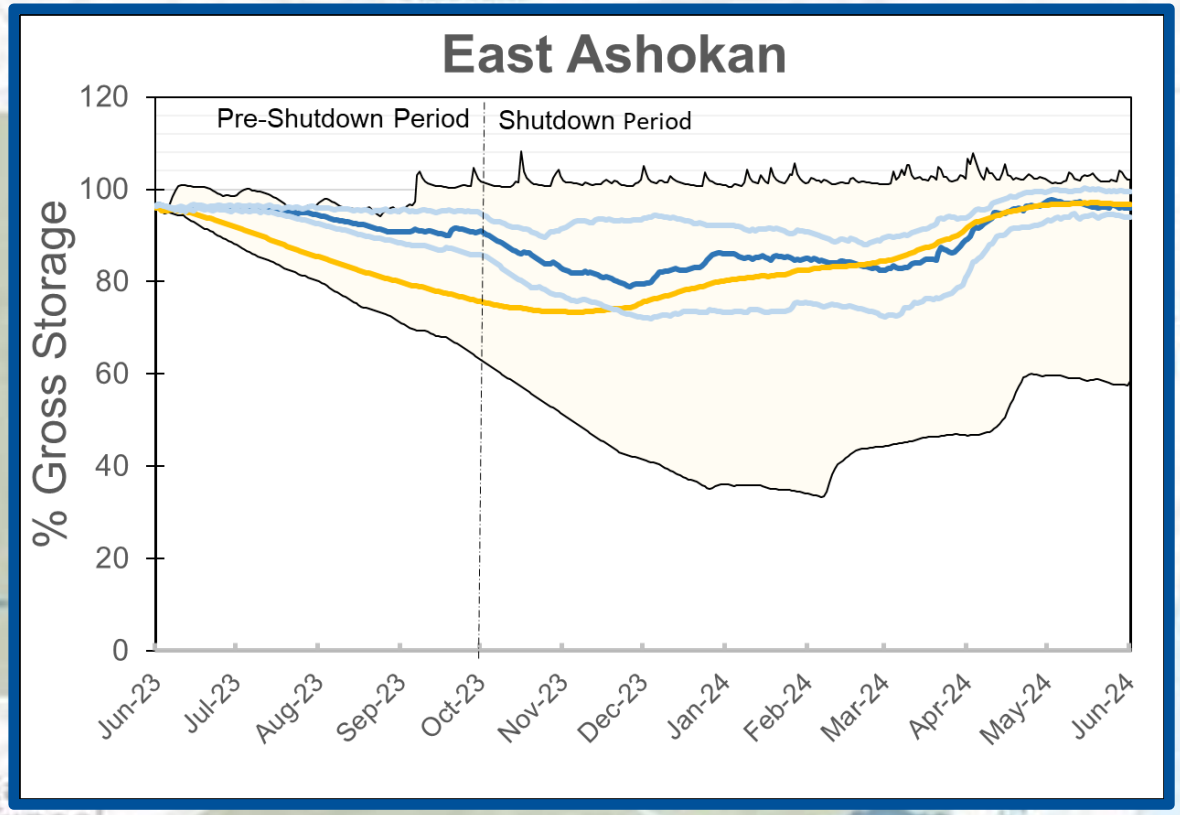
Catskill System During Delaware Shutdown

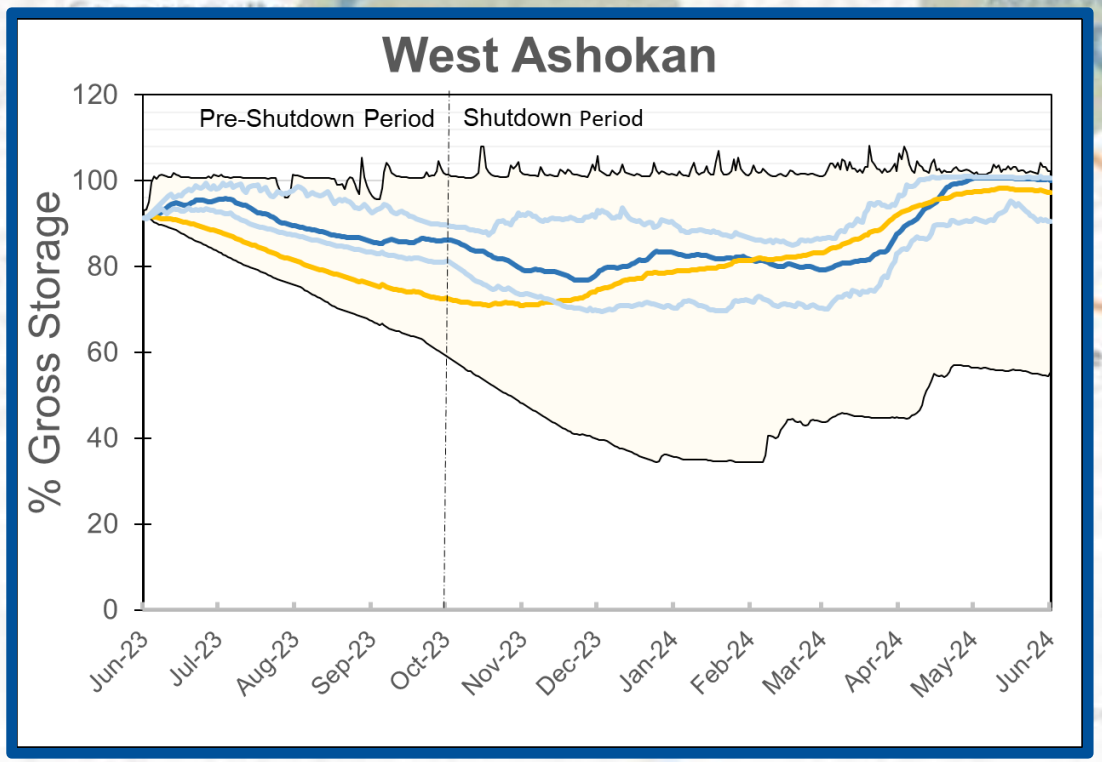
Starting October 1, the Delaware Aqueduct will shut down for up to eight months and the majority of the water supply will come from the Catskill System supplemented by the Croton System as contractors work to connect the bypass tunnel under the Hudson.

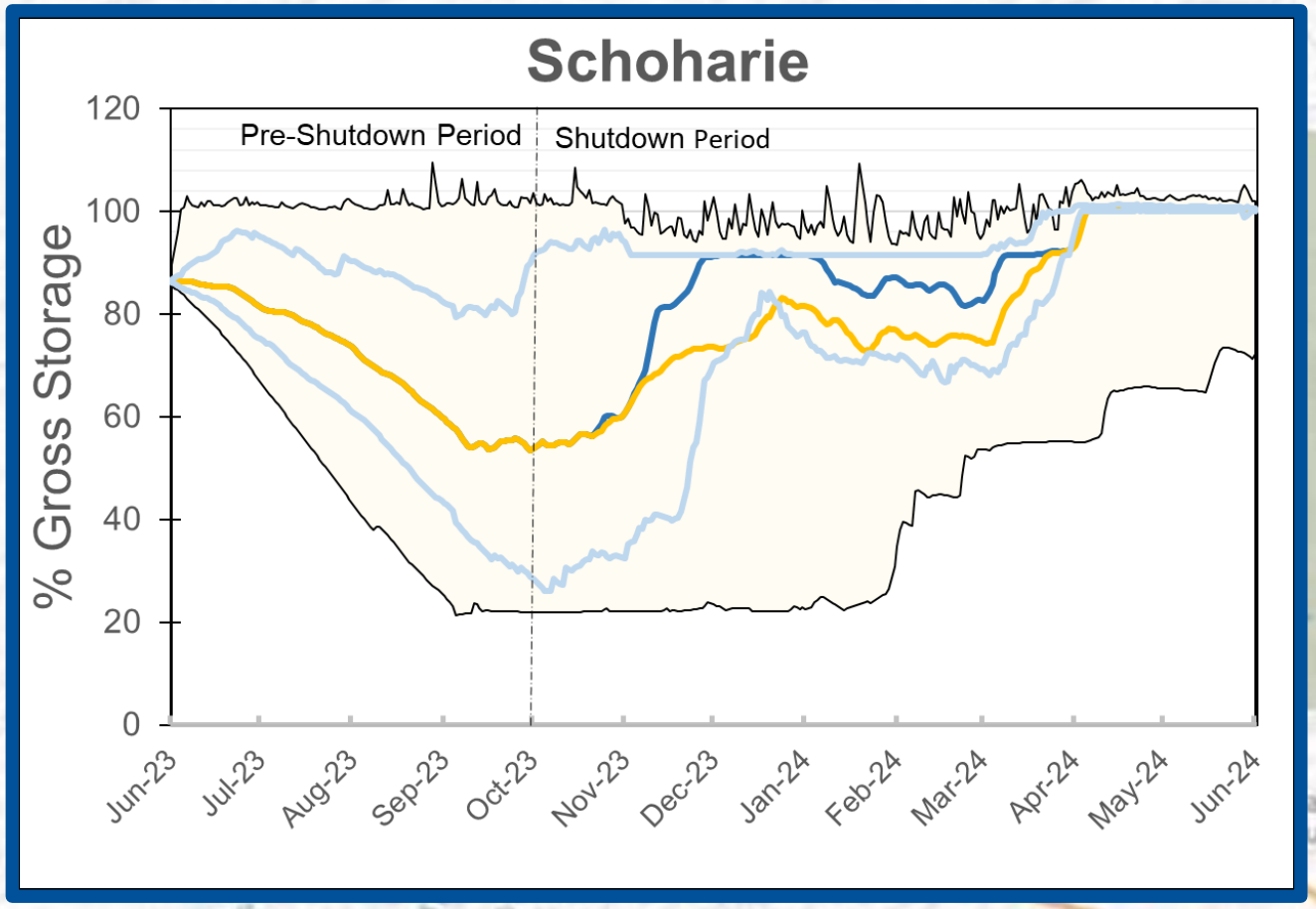


The Schoharie Reservoir diverts water to upper Esopus Creek via the Shandaken Tunnel. Upper Esopus Creek flows into the Ashokan Reservoir. Water from the Ashokan flows through the upper Catskill Aqueduct, which extends approximately 74 miles between the Ashokan and Kensico reservoirs.

Releases to the lower Esopus Creek leading up to and during the Delaware Aqueduct shutdown will continue pursuant to the Interim Release Protocol, but in the weeks leading into the shutdown the Ashokan will be operated at more than 90 percent capacity to ensure supply throughout the shutdown.



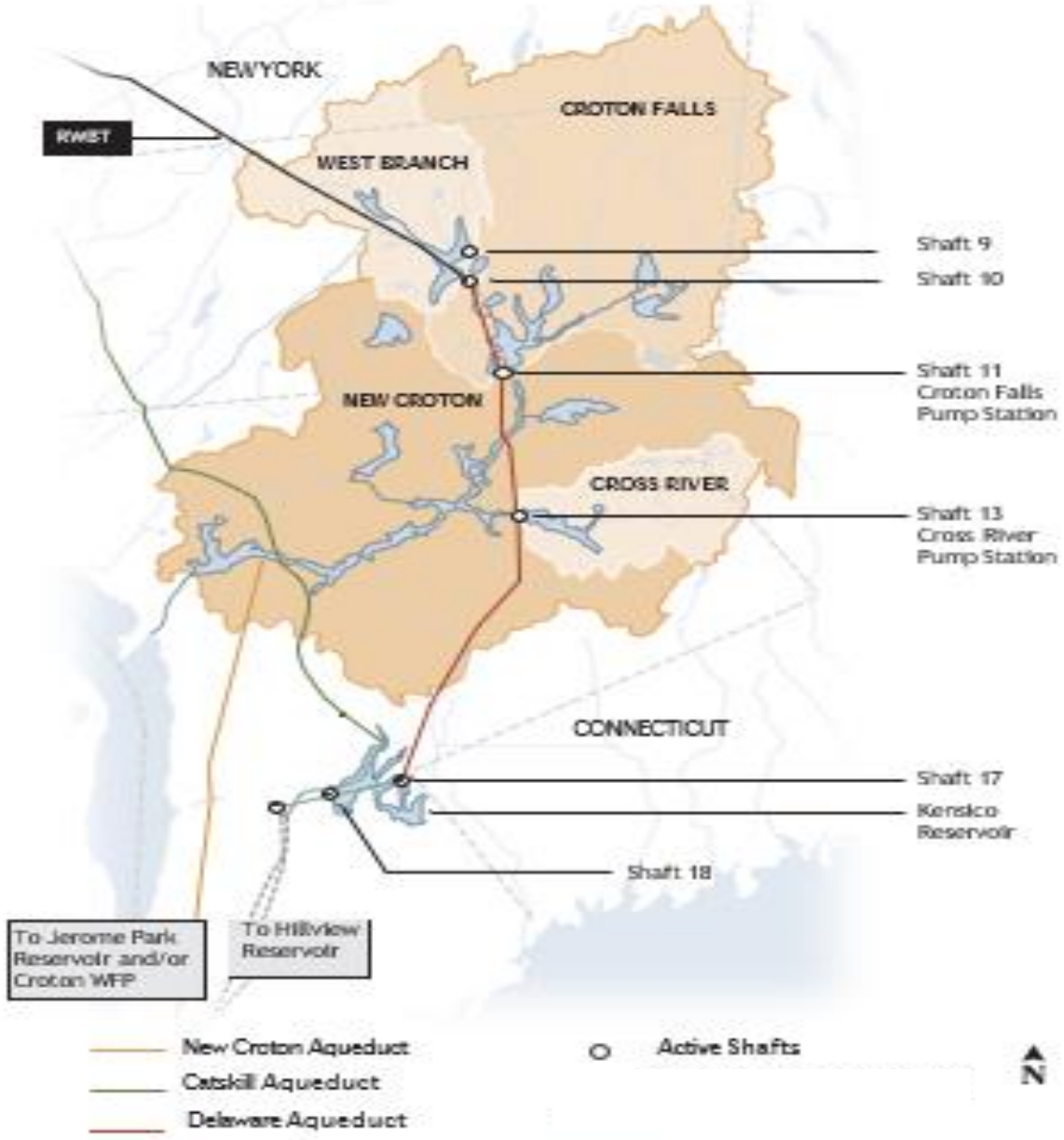




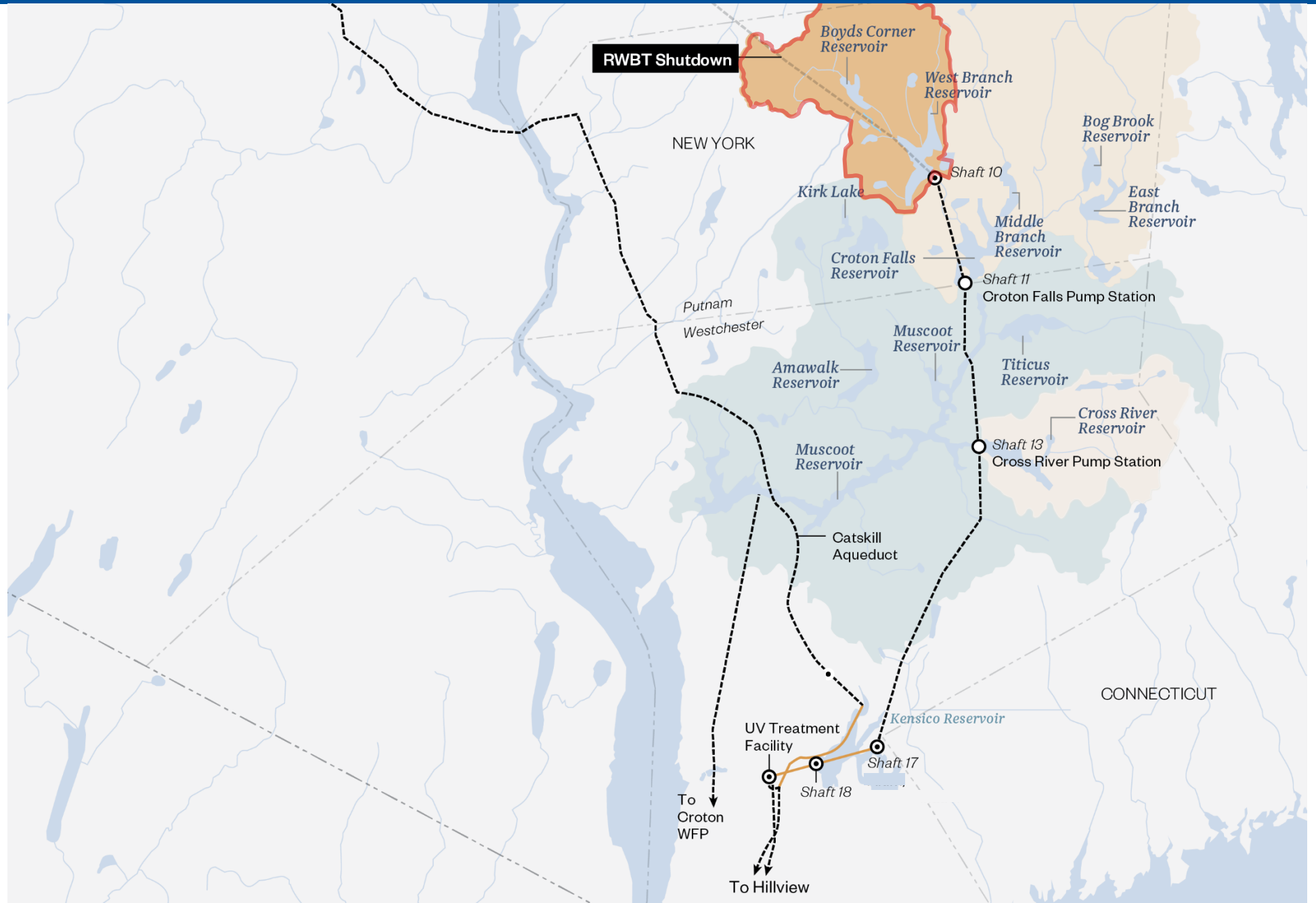
Diversions from the Schoharie through the Shandaken Tunnel to the Upper Esopus are expected to continue.

Outage Operations – Croton System

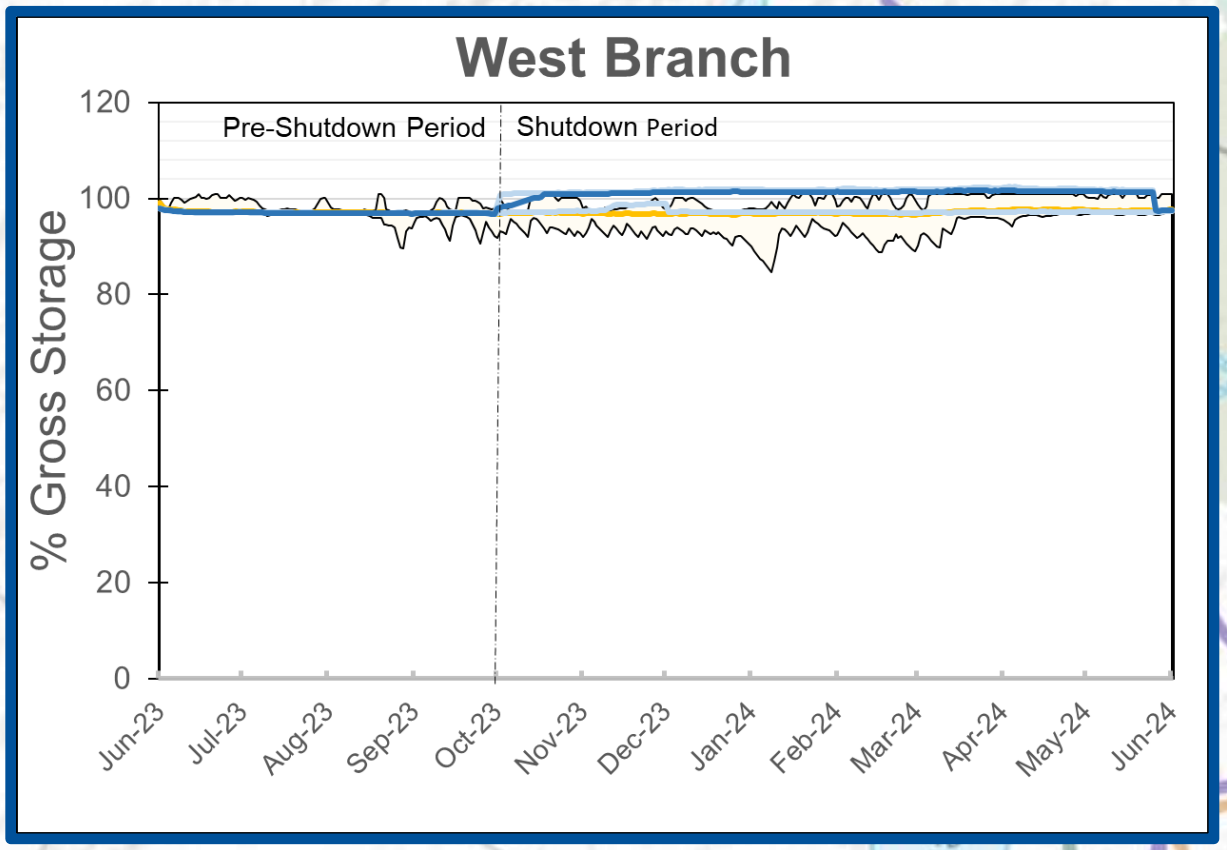
The Croton System, the oldest watershed in the City's supply system, will be tapped at full capacity during the Delaware Shutdown period and treated as four separate subsystems. Additionally, pump stations will supplement water into the lower Delaware Aqueduct

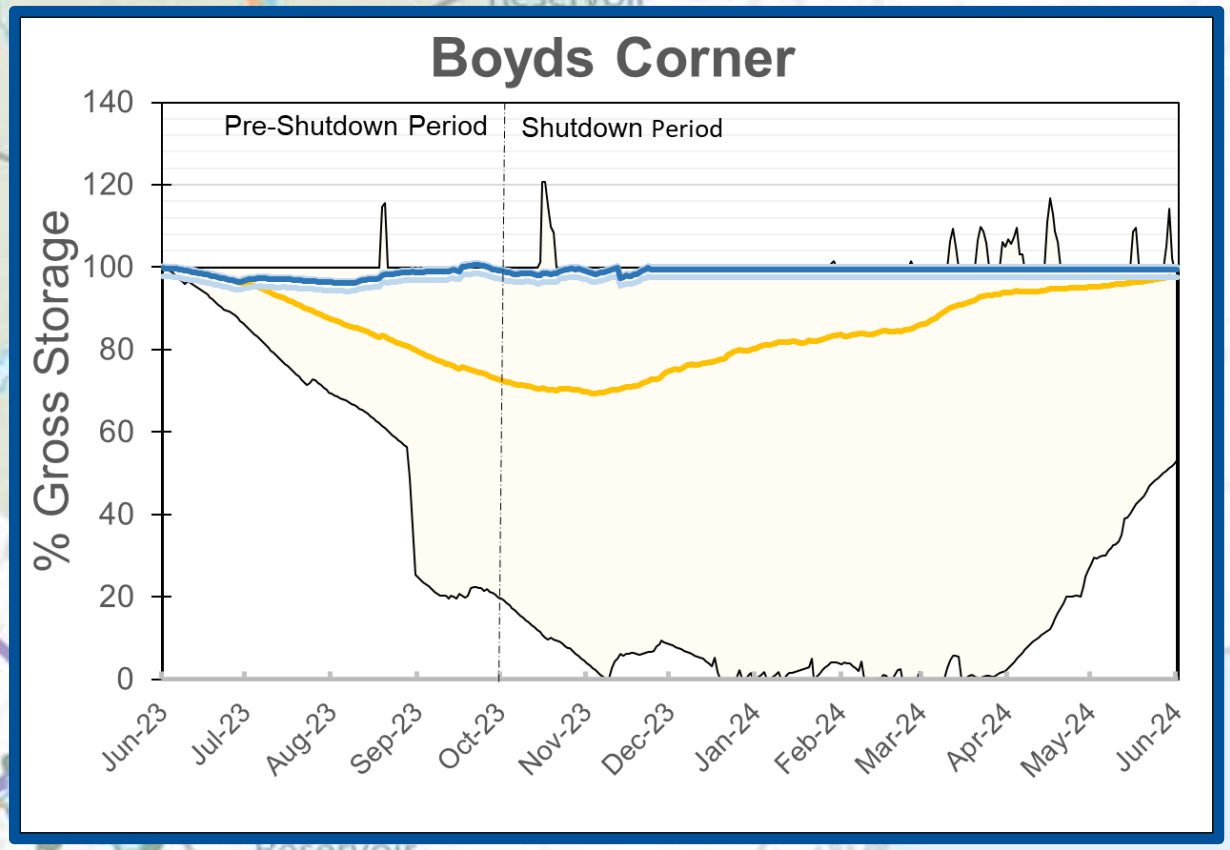


Outage Operations - Croton: West Branch Subsystem

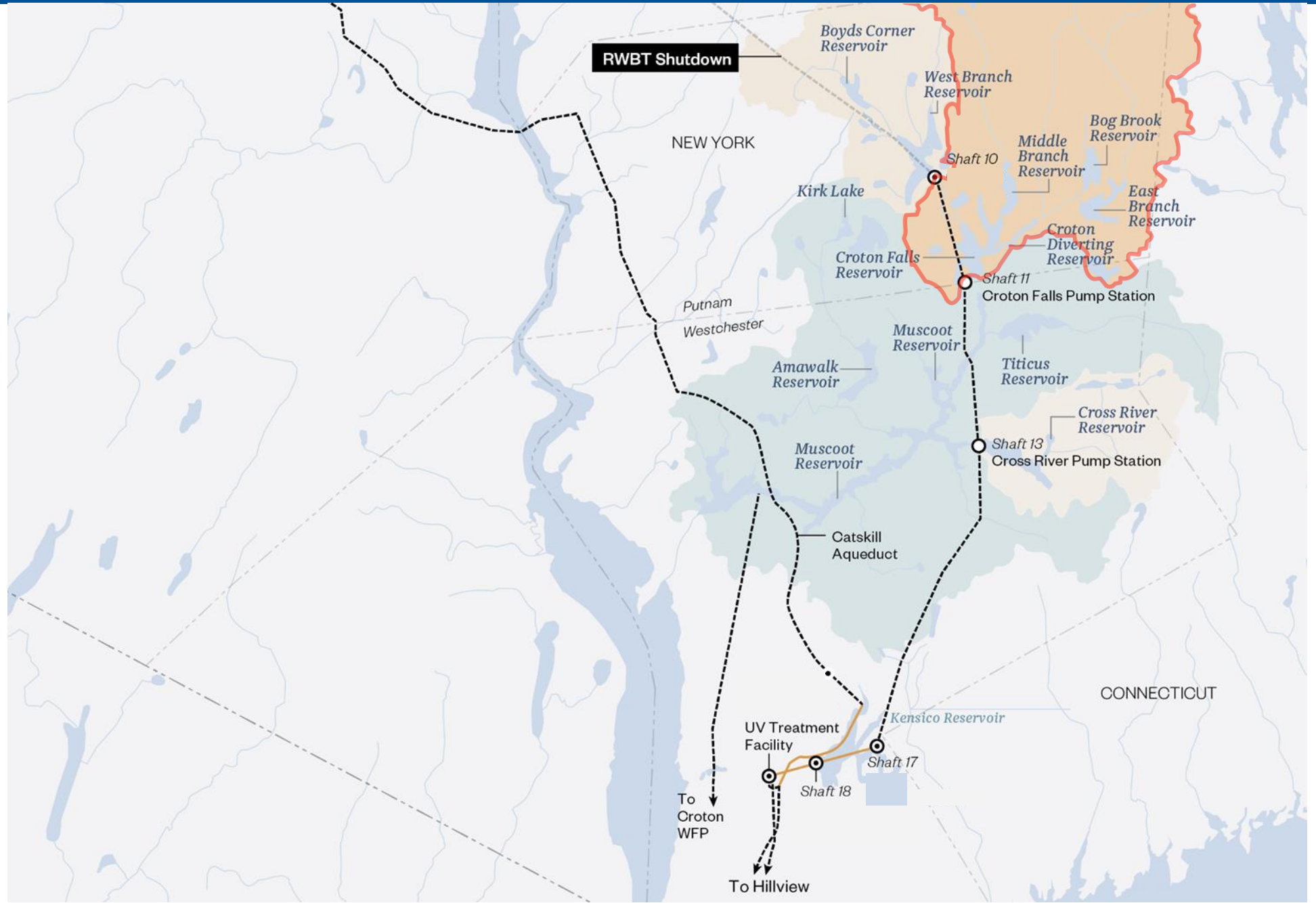


The Delaware Aqueduct will remain operational from the West Branch Reservoir to New York City throughout the shutdown and water in the West Branch and Boyds Corner reservoirs will be held as reserve during the shutdown period.

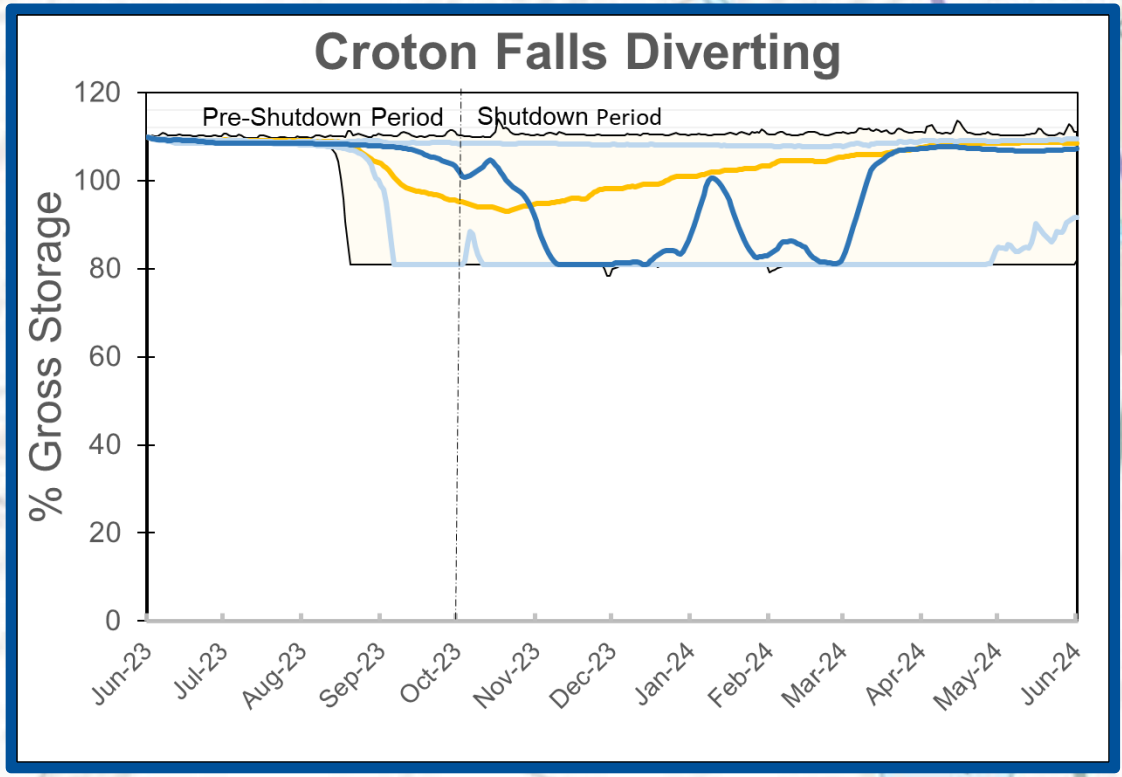


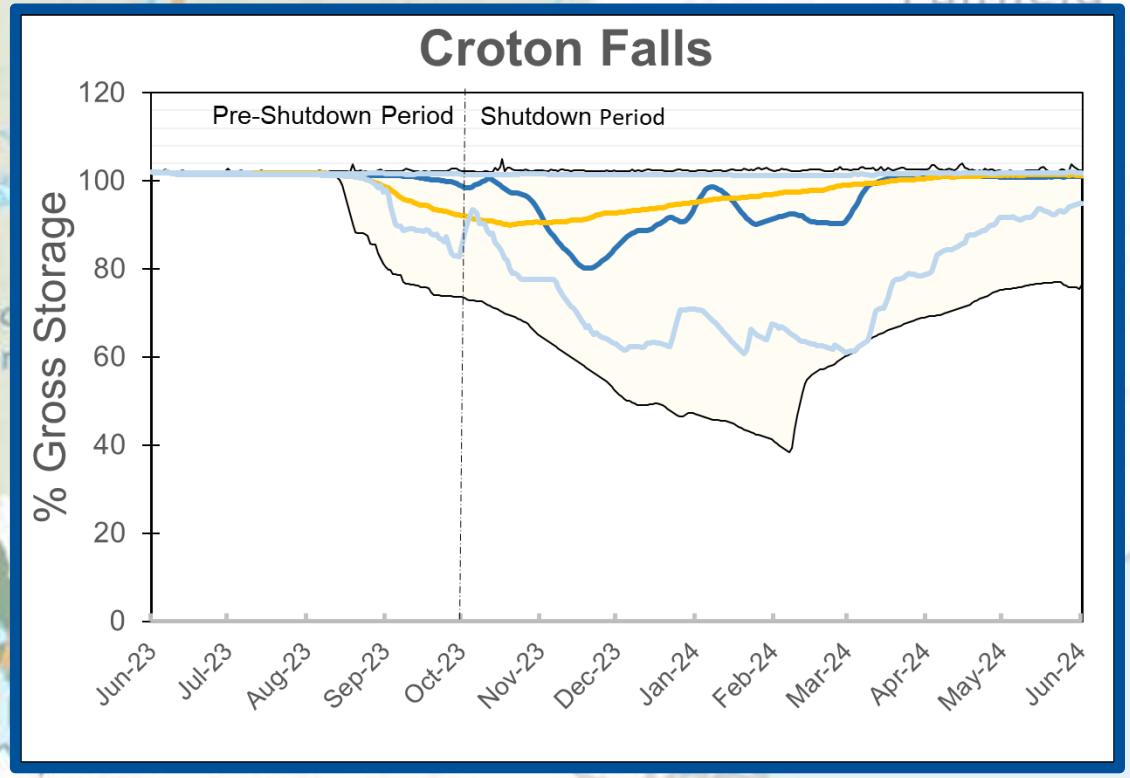


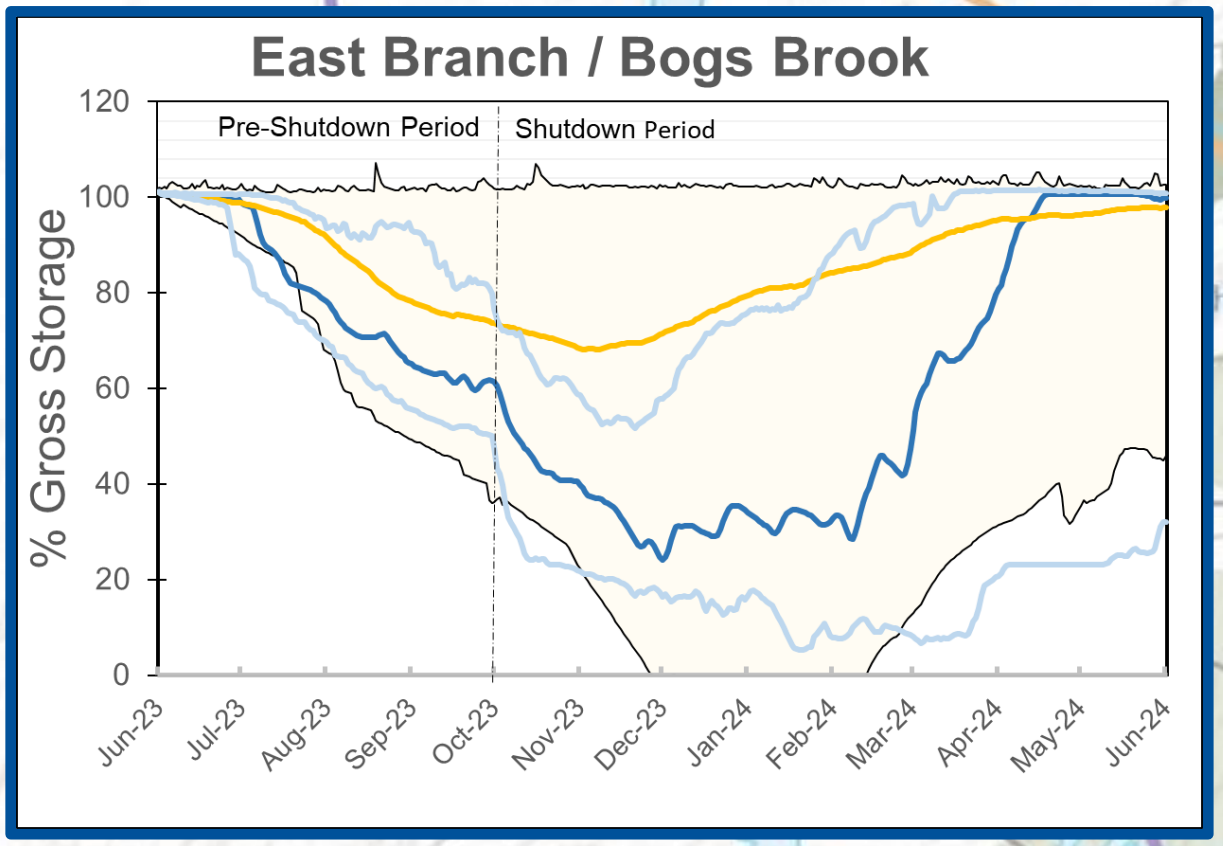
Outage Operations - Croton: Croton Falls Subsystem

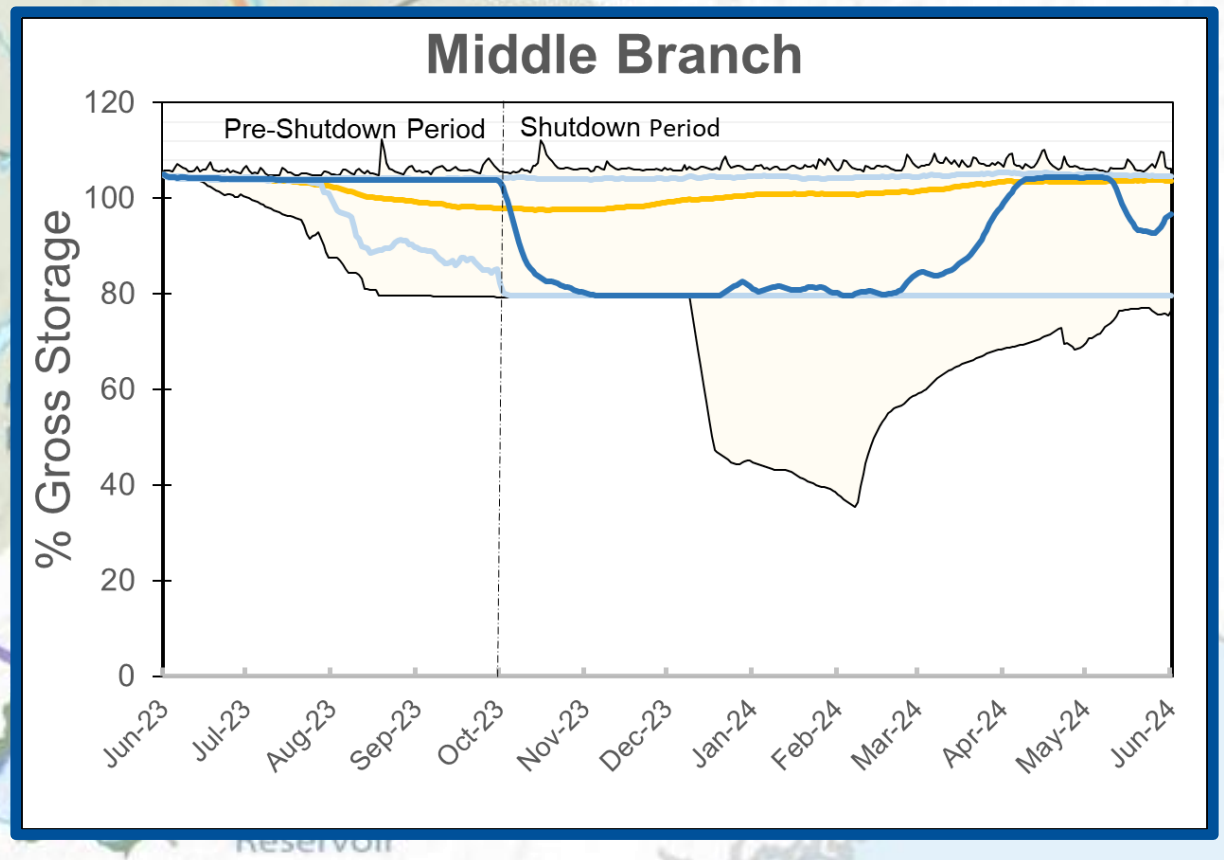


- **Pump an average 150 million gallons a day (mgd) from Croton Falls Reservoir into Shaft 11 (Delaware Aqueduct) and send water to Kensico Reservoir (pending NYSDEC and NYSDOH approval).**
- **Reduce downstream releases from the Croton Falls and Croton Diverting reservoirs to a minimum 5 mgd each to maintain surface elevation and maximize pumping efficiency (Per 6 NYCRR Part 672-3).**



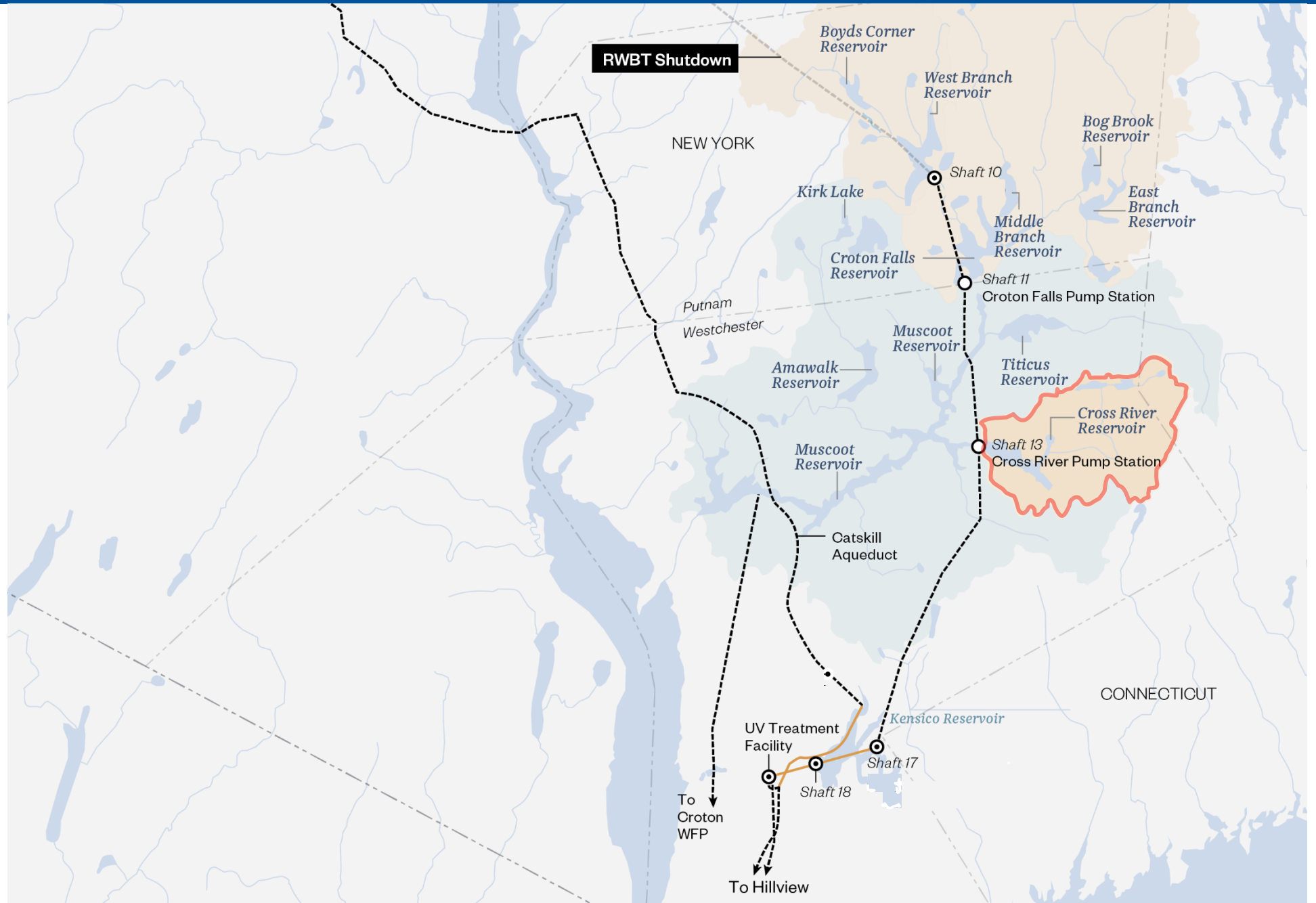


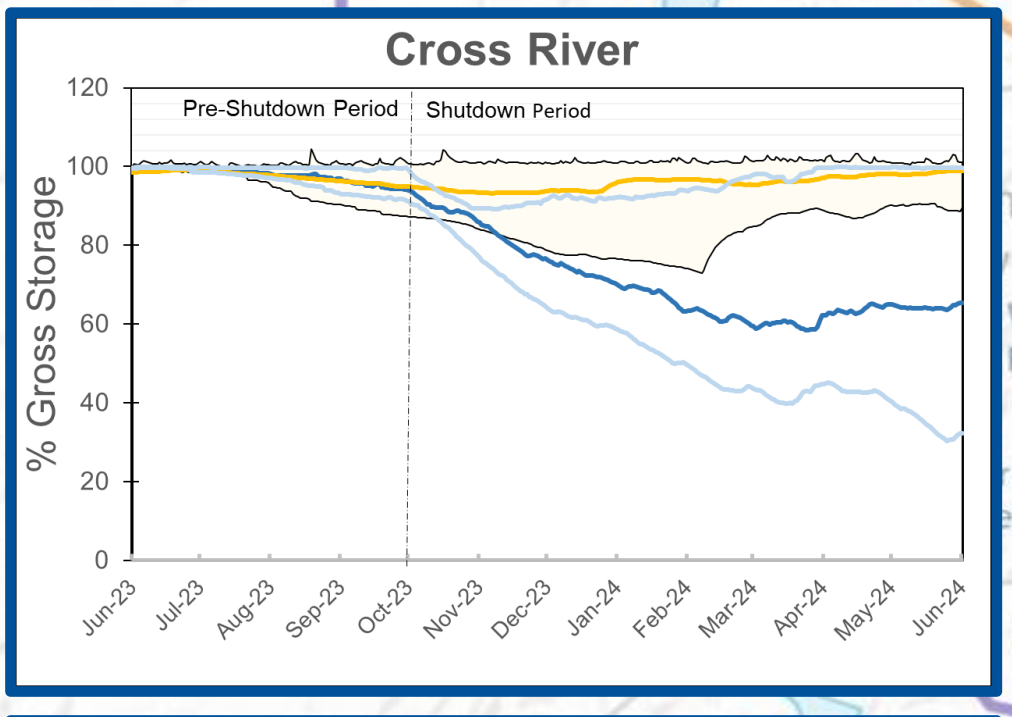


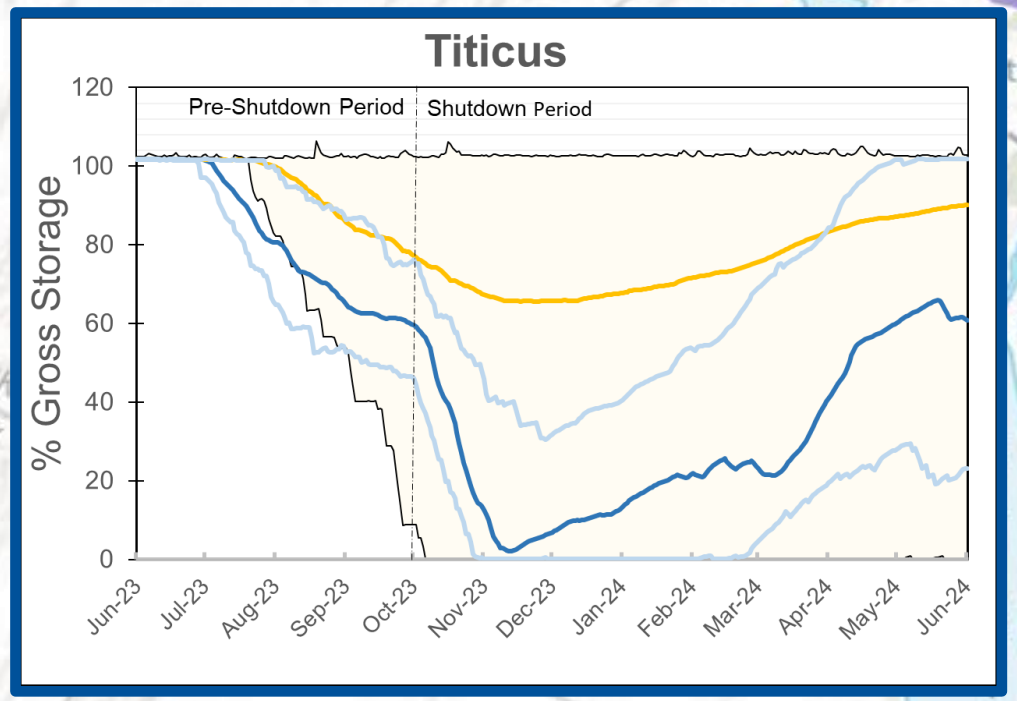


- **Downstream releases from Bog Brook, East Branch, and Middle Branch reservoirs will increase.**
- **Diverting elevation must stay above 305 ft to allow water flow from Bog Brook and East Branch to Croton Falls Reservoir.**

Outage Operations - Croton: Cross River Subsystem



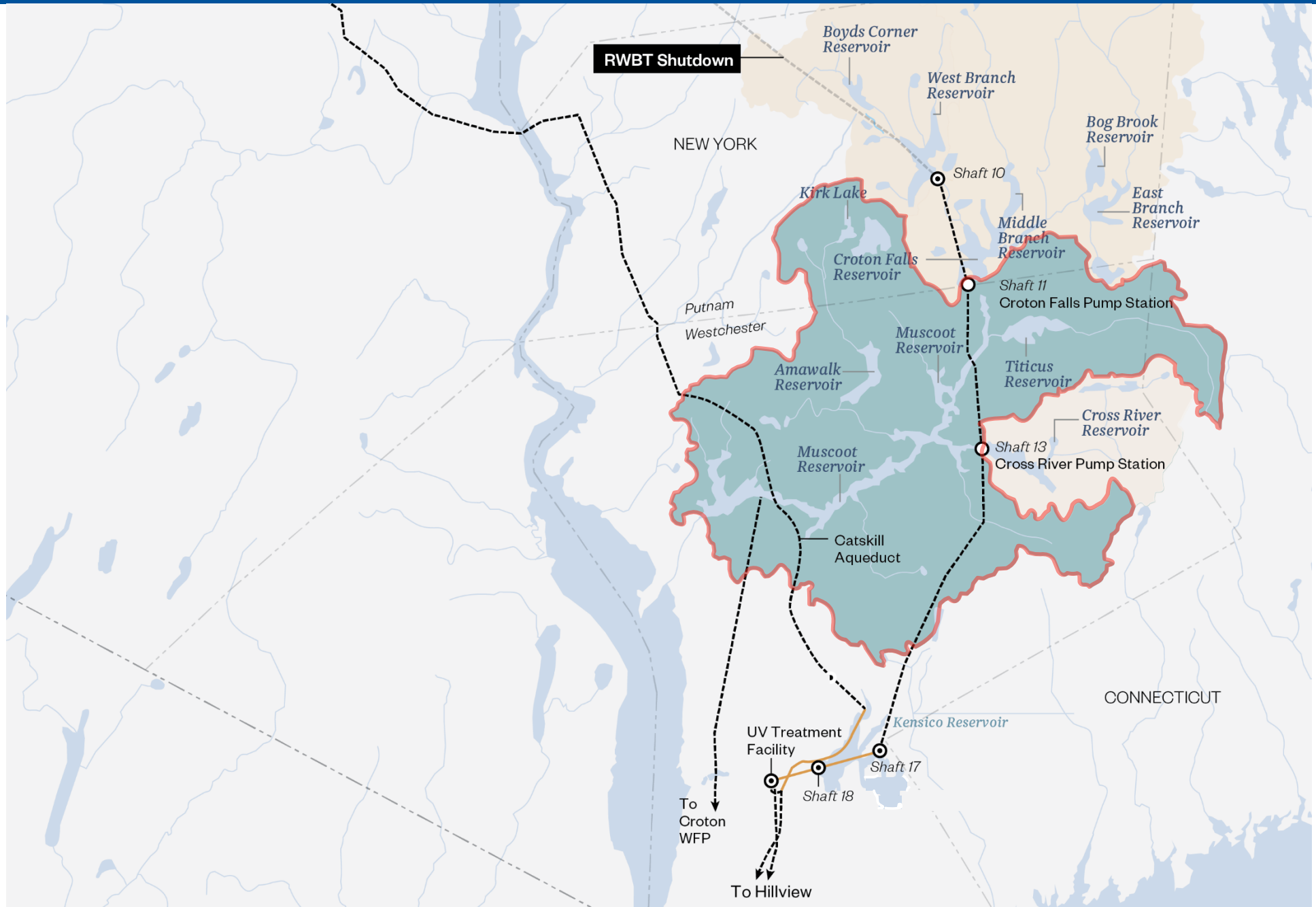


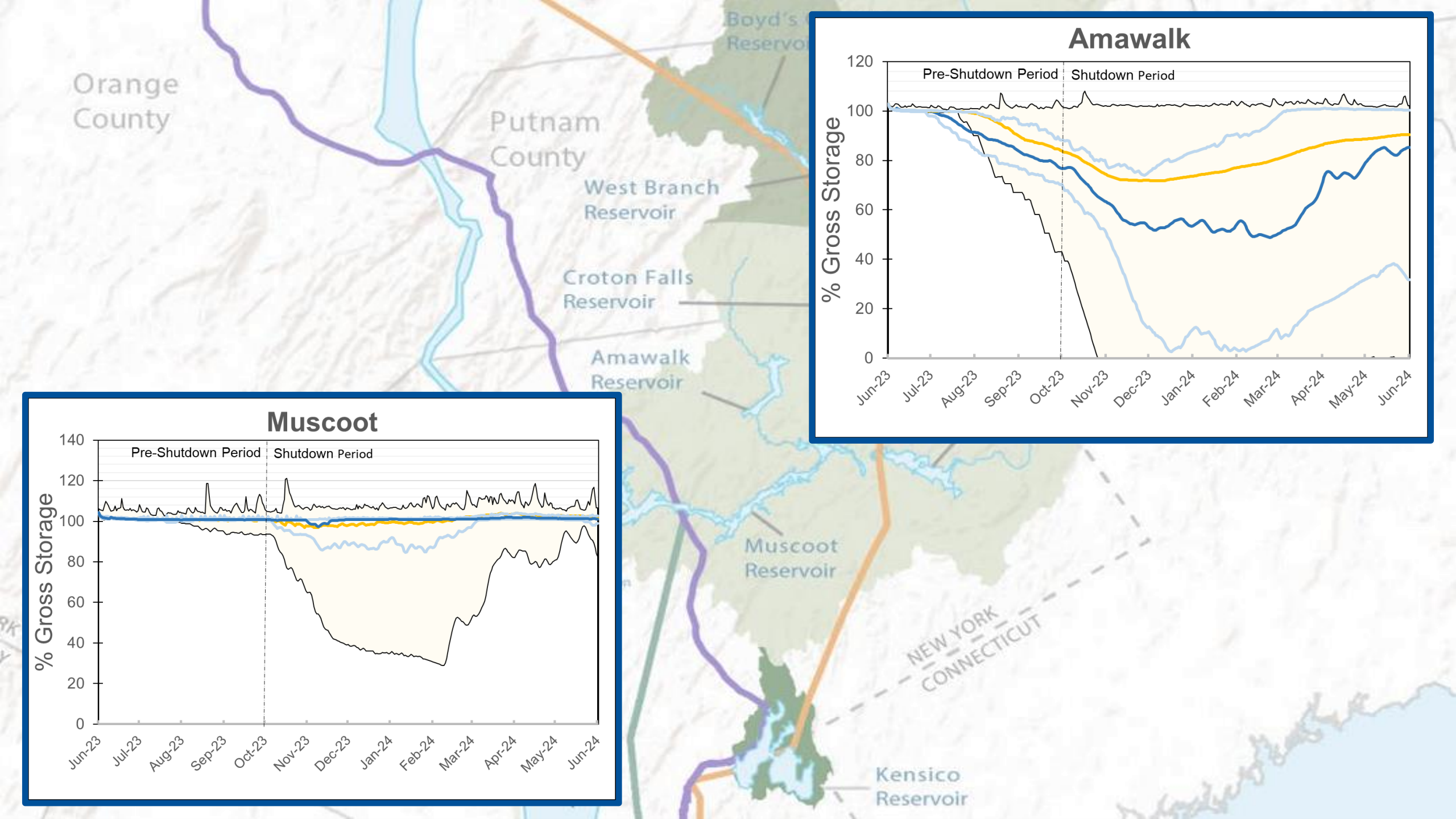


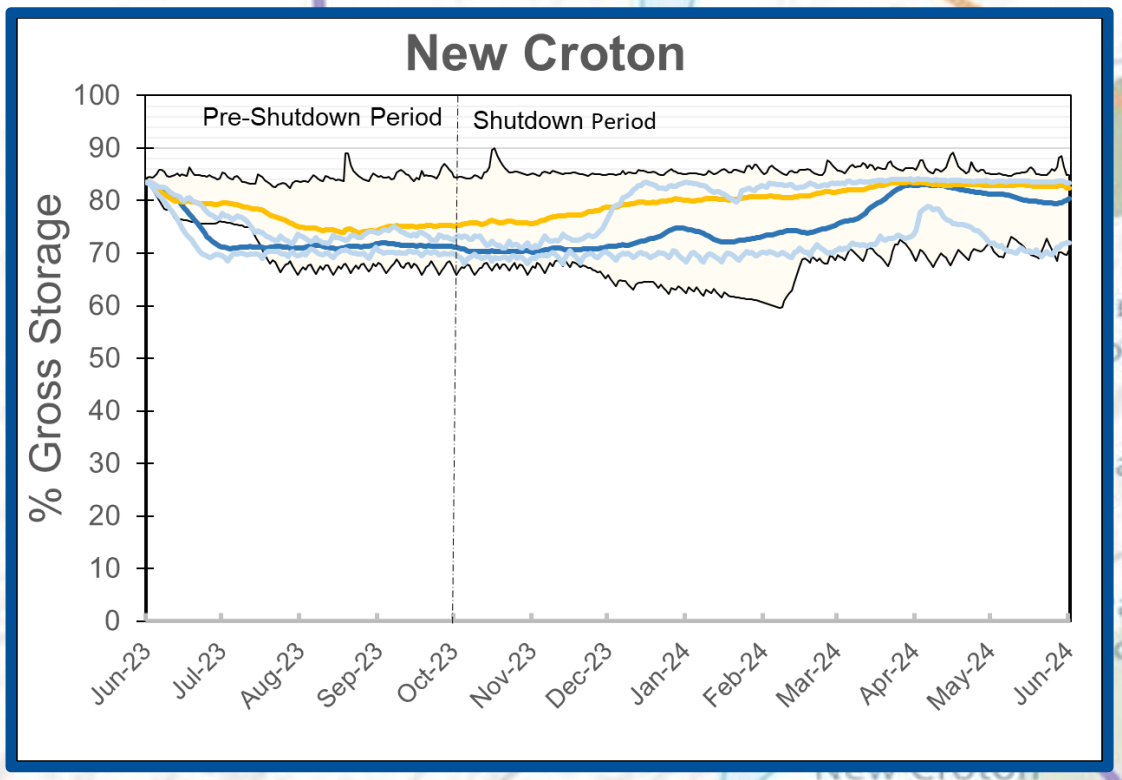
Boyd's Corners Reservoir
Middle Branch Reservoir
Bog Brook Reservoir
East Branch Reservoir
West Branch Reservoir
Croton Falls Diverting Reservoir
Titicus Reservoir
Amawalk Reservoir
Cross River Reservoir
Fairfield County
Muscoot Reservoir
Croton River

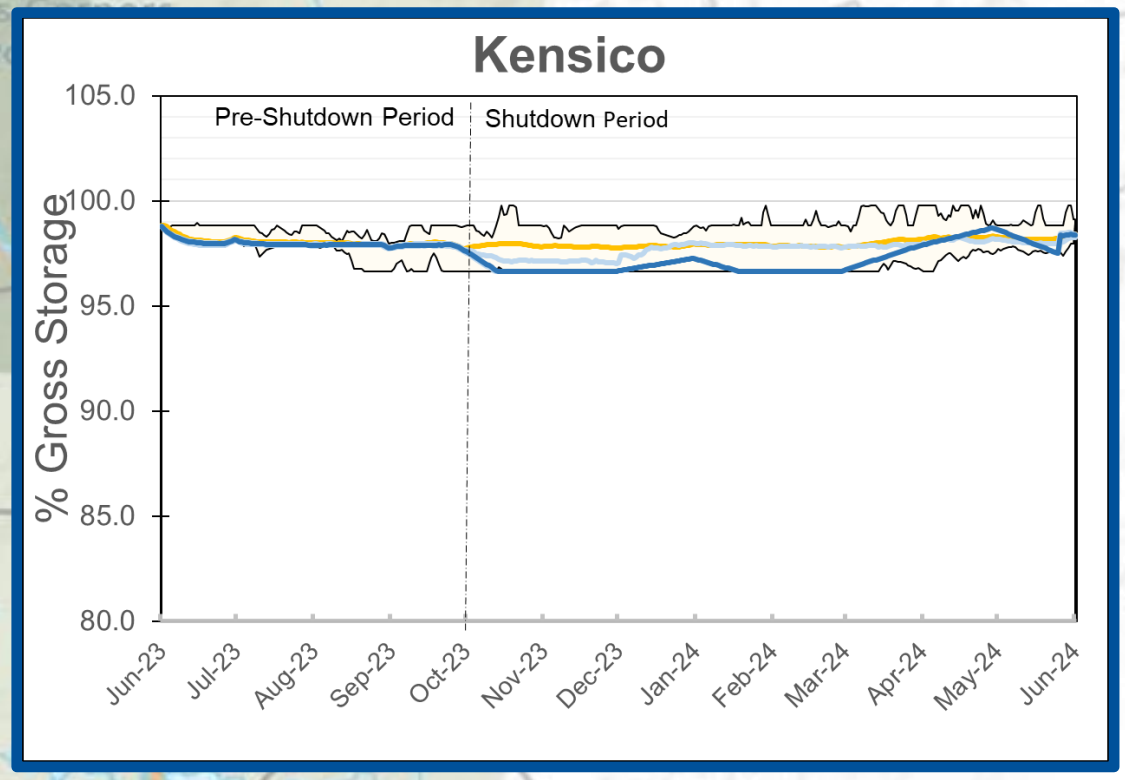
Pump up to 60 mgd from Cross River Reservoir into Shaft 13 (Delaware Aqueduct) and send water to Kensico Reservoir (pending NYSDEC and NYSDOH approval). Release the minimum regulated flow of 5 mgd from Cross River Reservoir (Per 6 NYCRR Part 672-3).

Outage Operations - Croton: New Croton Subsystem




Orange County
Putnam County
West Branch Reservoir
Croton Falls Reservoir
Amawalk Reservoir
Muscoot Reservoir
Kensico Reservoir
NEW YORK
CONNECTICUT
Amawalk
% Gross Storage
Pre-Shutdown Period
Shutdown Period
120
100
80
60
40
20
0
Jun-23
Jul-23
Aug-23
Sep-23
Oct-23
Nov-23
Dec-23
Jan-24
Feb-24
Mar-24
Apr-24
May-24
Jun-24
Muscoot
% Gross Storage
Pre-Shutdown Period
Shutdown Period
140
120
100
80
60
40
20
0
Jun-23
Jul-23
Aug-23
Sep-23
Oct-23
Nov-23
Dec-23
Jan-24
Feb-24
Mar-24
Apr-24
May-24
Jun-24

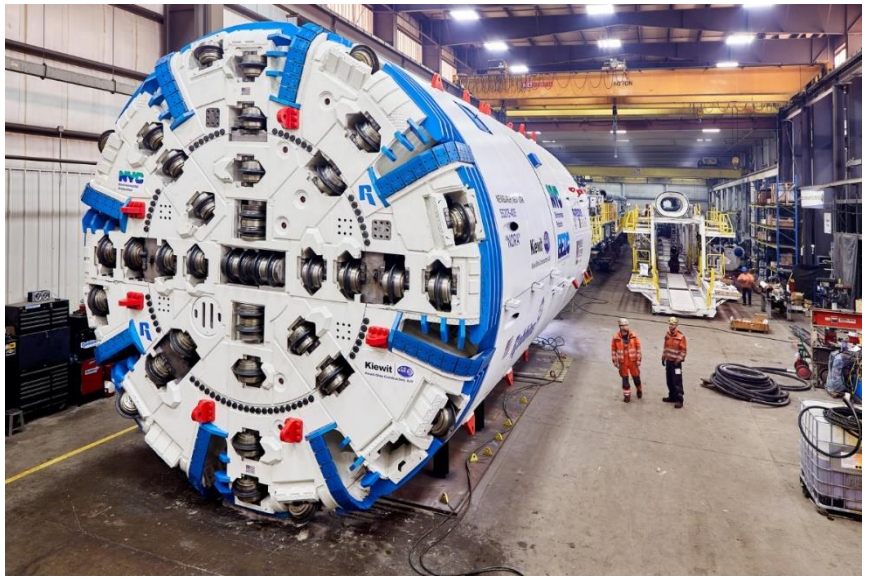


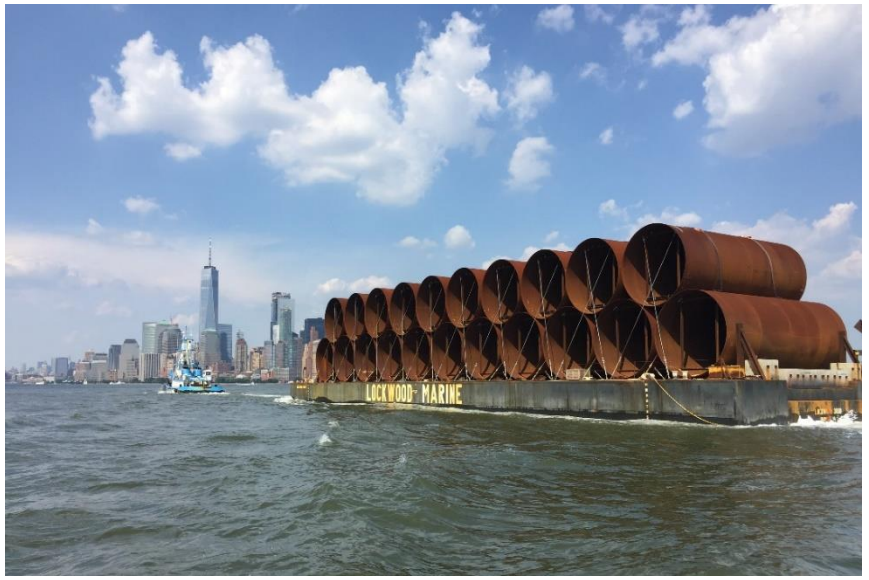


Release the minimum regulated flow of 5.5 million gallons a day (mgd) into the Croton River from the New Croton Reservoir from October to March and will seek a variance to release 11 mgd during April and May, down from 75 mgd (Per 6 NYCRR Part 672-3).

Summary

- The Rondout to West Branch Tunnel shutdown planning started more than 20 years ago
- Multiple required predecessor projects needed to be successfully completed prior to this point
- The water supply management plan is based on extensive computer modeling and engineering experience and is subject to state and federal regulatory review and oversight
- DEP will continue reviewing multiple data points and projections, and conduct continuous systems monitoring and testing up to and throughout the shutdown





Questions?

NYC Environmental Protection