



NYC Reservoir Operations: Opportunities for Meeting Multiple Objectives with an equitable, Conjunctive Use, Safe Yield Based Optimization Plan



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NJDEP Goals/Objectives

- Reassess quantity of water available when derived from a Conjunctive Use, Safe Yield Based Operating Plan using Realistic Demand Conditions to:
 - Optimize Reservoir Ops for Sustainable Water Uses for All Parties that will:
 - Provide & Protect Water Supply & Water Quality
 - Support & Sustain Aquatic Ecology and Recreation
 - Enhance Flood Mitigation
 - Ensure Salinity Repulsion in Delaware Basin
 - Restore Equity of Water Apportionments



Safe Yield Based Operations Design Premise

➤ ***What Safe Yield Is.....***

- **Sustainable supply of water that meets all uses & flow goals, without curtailments of diversions or releases, during a repetition of the drought of record.**

➤ ***What a Realistic Conjunctive Use Safe Yield Based Operating Plan Does....***

- **Better meets competing uses and needs by:**
 - Equitably considering conjunctive effects of NYC reservoirs
 - Using realistic demands to reflect existing & ultimate build-out needs and demand patterns
 - Equitably prioritizing the risks and benefits between the Parties relative to the selected uses and objectives
 - Sustaining an ultimate build-out water supply quantity and quality
 - Optimizing the opportunity for more effective fishery & other releases
 - Enhance flood mitigation; and,
 - Eliminating or reducing unnecessary drought declarations.



Expected Benefits of Safe Yield Based Optimization Plan

- Yearly Montague flow goals tiered more effectively to sustain lower basin reservoirs through drought, protect water supplies and salinity, without a significant reduction in NYC's ultimate water supply reliability.
- An alternate tiered Montague flow may possible be correlated to tributaries above Montague to better sustain tailwater fisheries through drought periods.
- A realistic annual average safe yield of 520 mgd to serve NYC's peak needs of up to 800 mgd in peak season and also periodically, as needed, without curtailments.
- True drought rule curves in event of drought exceeding 60's drought in severity with modest (5 & 10 %) cutbacks of NYC normal seasonal diversion rate. (Current curves are operating curves that cause drought rather than mitigates it)
- More beneficial use of available water than modeling an unsustainable and counter-productive, flat, constant 800 mgd diversion assumption.
- Improved probability of significant flood mitigation by chasing void spaces via use of an OST or similar advance warning system.



Effects of the Over-Draft Program

- In 1983, the Good Faith Agreement resulted in Docket D-77-20-CP, Revision 1 (REV 1). It entails application of an Over-Drafting Model to allow the Safe Yield of NYC's Delaware reservoirs to be exceeded by:
 - Applying rules derived from assumption that NYC must attempt to divert 800 mgd at all times to exceed a minimum assumed safe yield of 480 mgd (actual safe yield under FFMP is about 590 mgd) while maintaining Montague at 1,750 cfs.
 - Causing a repeat of the drought of record conditions & many lesser droughts, by promoting low storage levels that trigger:
 - Reduced releases & Montague flows, as low as 1,100 cfs;
 - Severe Reduction of temporary fishery augmentation releases.
 - Reduced NYC Diversions to as low as 520 mgd.(Results in NYC Draft "curtailed" to greater than annual average need)



Effects of the Over-Draft Program (cont'd)

- The high range of fishery releases are designed to hasten drawdown, hasten low reservoir storage and trigger severe reductions of fishery & Montague releases. This conserves storage & increases NYC's safe yield to approximately 590 mgd, or 110 mgd greater than the 480 mgd obtained by parsing the safe yield of the Delaware reservoirs, alone & maintaining Montague at 1,750 cfs.
- The FFMP augments fishery releases when needed the least, are a minor temporary improvement & are unsustainable in any dry year.
 - The FFMP, whether assuming a draft of 800 mgd or 765 mgd, results in unnecessary limits on water availability, especially during “normal” precipitation years when much excess storage is rendered unusable by the restrictions built into the unrealistic need to over-draft. This “inflexibility” was not solved by the Flexible Flow Management Program, but further ensconced.



Effects of the Over-Draft Program (cont'd)

- With the currently under-estimated safe yield, 480 mgd, the value of the *Excess Release Quantity (ERQ)* *remains under-estimated.*

- The assumption of over-drafting continues as per the Good Faith Agreement's REV 1 & the FFMP. ***This assumption....***
 - *Requires reservoirs to be fully charged to prepare for a theoretical over-drafting that NYC no longer can, will or should make on an annual average basis.*

 - ***Increases flood risk***, adversely impacts fisheries & recreation ***by causing frequently full or surcharged reservoirs*** for greater durations than is safe or ***necessary*** under an appropriate ***safe yield based program.***



The Obsolete Over-Draft Premise

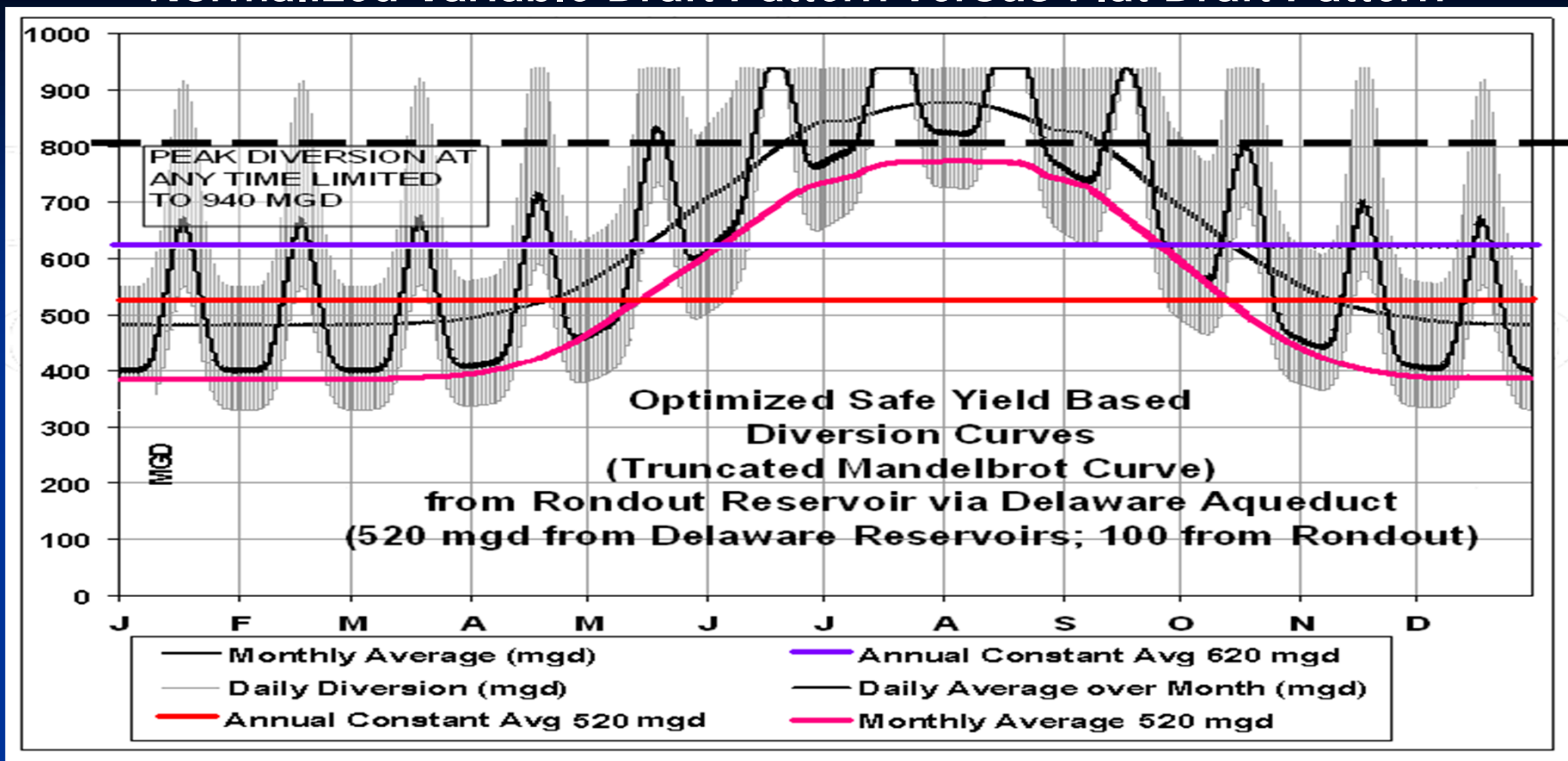
- **27 years after 1983 Good Faith Agreement, there are significant changes in NYC's demand, advances in hydrologic modeling, a longer dependable flow record, and better understanding of natural resource requirements.**
- **Current basin management decisions are not based on use assumptions representative of NYC's existing or future demand.**
 - NYC's demand pattern now varies seasonally to a normal 1.35 to 1 ratio as opposed to nearly a flat, 1 to 1 demand typified by an inefficient system.
 - Unrealistic demand patterns & need result in unrealistic operating criteria & less credible results. E.G., prediction of drought days is no longer based on realistic operating conditions and is an unreliable "metric."
- **Historical safe yield estimates are incomplete & inconsistent.**
 - USGS, NYSDOH (1967-68) – 481 & 510 mgd respectively, with Montague at 1,750 cfs at all times
 - Flow management Technical Advisory Committee (1983) –safe yield still only 481 mgd even with Montague reduced to as low as 1,100 cfs



Risks of Over-Draft Plan

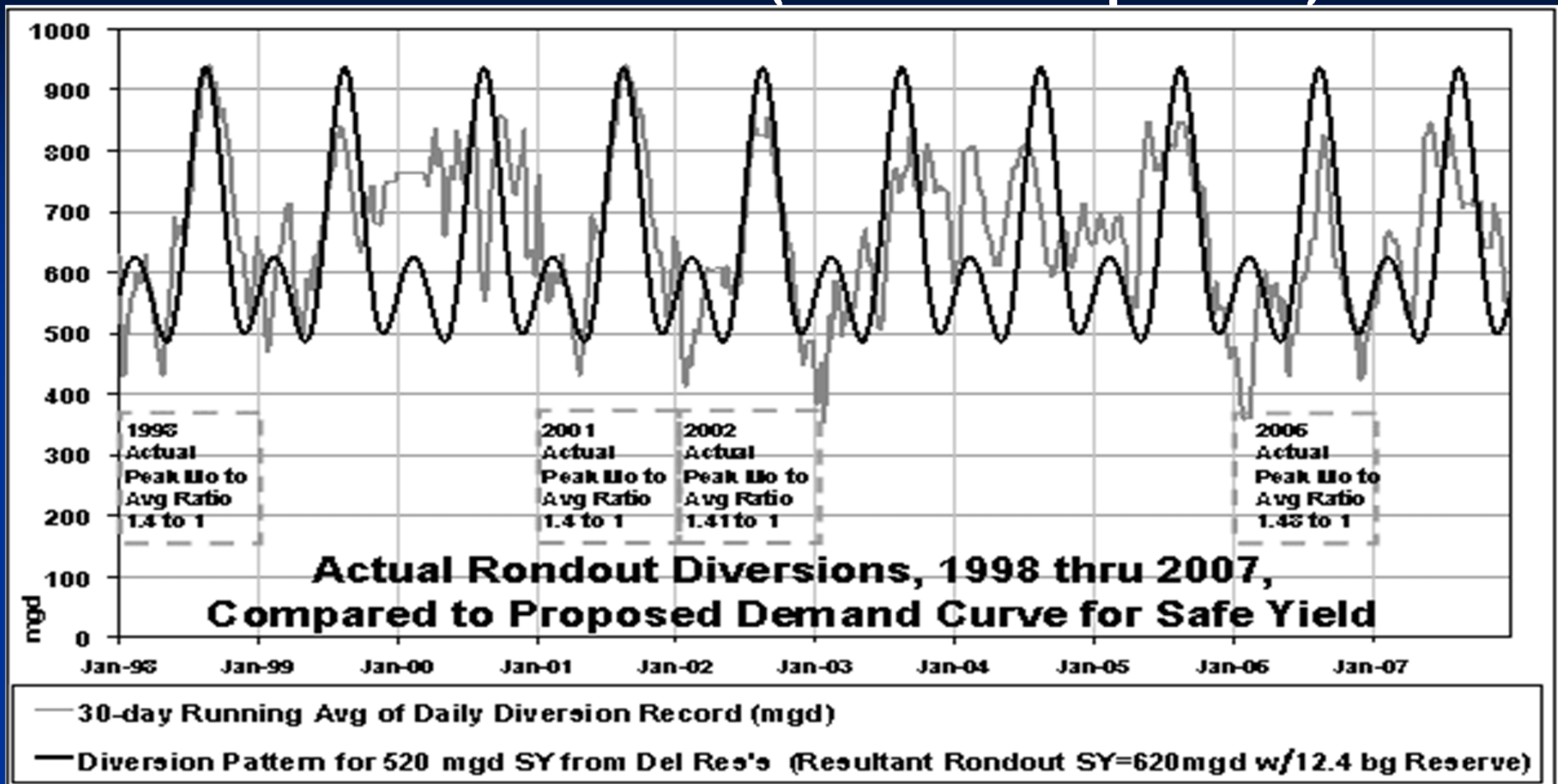
- **The FFMP over-draft plan is derived from an unrealistic, flat 800 mgd demand and results in billions of gallons of storage being rendered unusable by the Delaware Basin.**
 - The over-draft plan is not responsive to actual or ultimate demand and is inflexible because it is designed on a refill imperative resulting in:
 - A tendency to be near-full, full or surcharged with greater frequency and for longer durations.
 - Less effective attenuation of peak flow which exacerbates flooding, unnecessarily.
 - Wasted spillage and inefficient releases.
 - Unnecessary drought declarations
 - **Why is there so Much Excess Spill & Unusable Storage?**
 - Simply put; the normalized demand pattern. An example of a normalized demand pattern is shown next:

Normalized Variable Draft Pattern versus Flat Draft Pattern



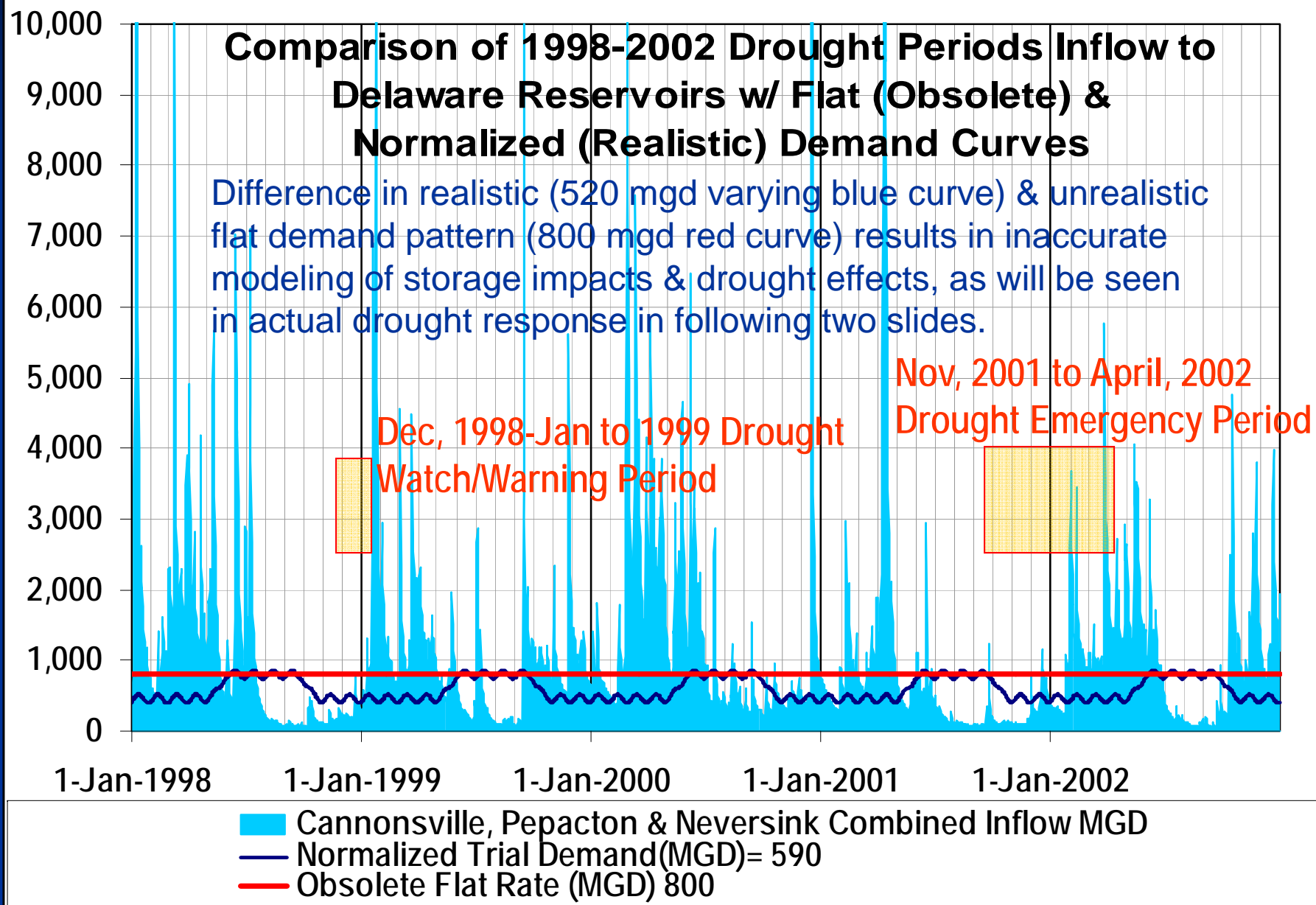
Comparison of realistic normalized variable demand curves to an 800 mgd flat rate demand (heavy dashed black line) used in FFMP & OASIS Model. The NJDEP estimates NYC's ultimate build-out need from the Delaware reservoirs at about 520 mgd, (*flat red line*) but under a normalized variable seasonal demand (*purple curve*), 520 mgd can easily serve peak-day seasonal demands of over 850 mgd and peak-months of 765 mgd from the Delaware Reservoirs, alone. When conjunctive use is considered, over 890 mgd in peak-day (gray), and 860 mgd in peak-month (heavy solid black) can be sustained in peak demand season from the Delaware System (includes West Branch & Rondout). Running average of 620 mgd for Delaware System is thin black line.

10-Year (1998-2008) NYC Diversion Record from Rondout Reservoir (Delaware Aqueduct)



Comparison of actual 30-day running average diversion (gray line) from Rondout Reservoir via Delaware Aqueduct with trial normalized draft pattern with a Rondout withdrawal safe yield of 620 mgd (**heavy black line**), of which only 520 mgd need be provided by Delaware reservoirs average annual safe yield. Peak month needs of over 890 mgd could easily be met without curtailments.

1999-2002 Inflow Compared to Draft Patterns



1998-1999 Drought Watch/Warning Period

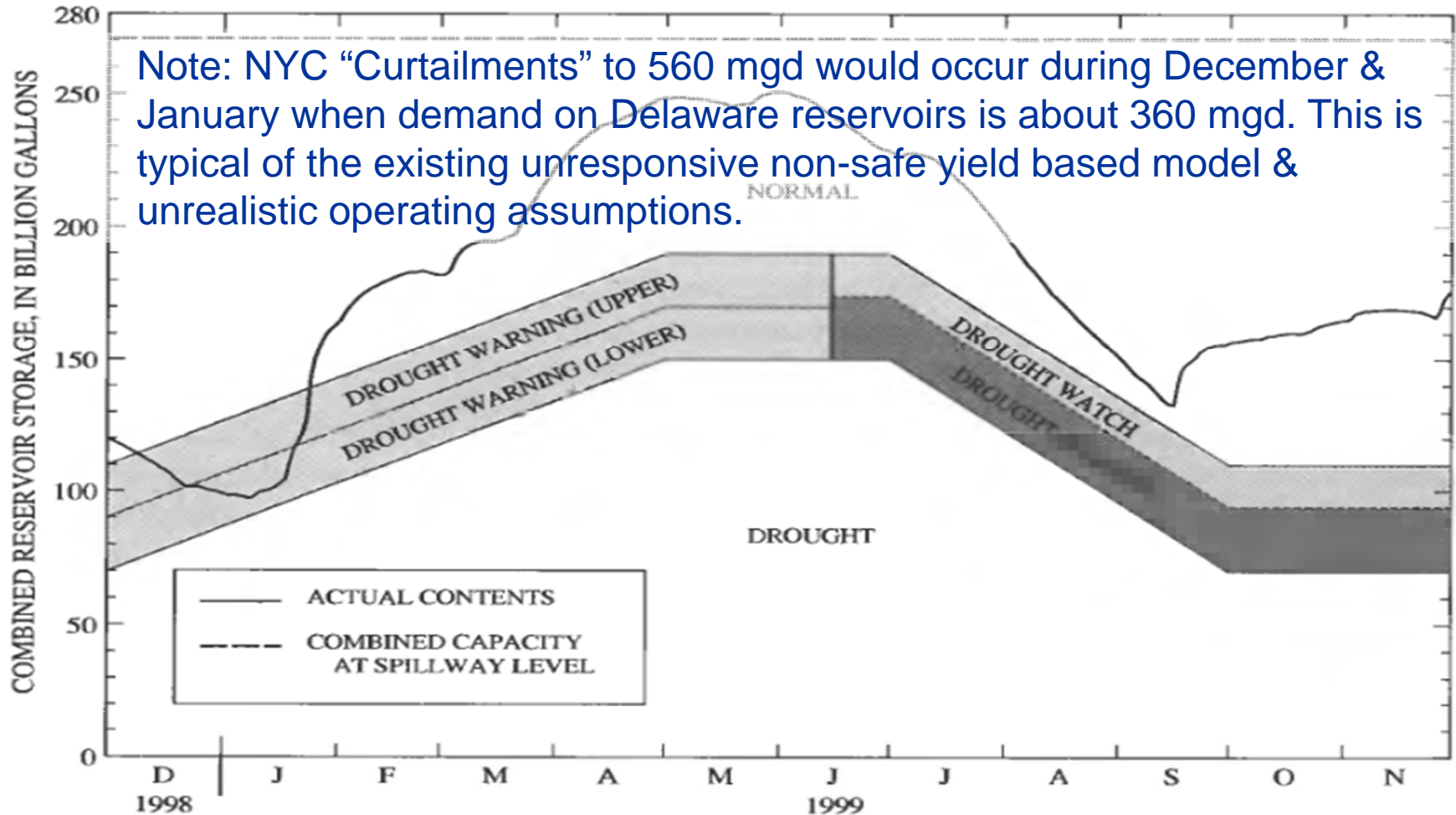


Figure 2. Operation curves and actual contents for New York City reservoirs in the Delaware River Basin, December 1, 1998 to November 30, 1999. (Sources: Operation curves from Interstate Water Management Recommendations of the Parties to the U.S. Supreme Court Decree of 1954 and DRBC Docket No. D-77-20-CP (Revision No. 4); reservoir contents from New York City Bureau of Water Supply data).

2002 Drought Emergency

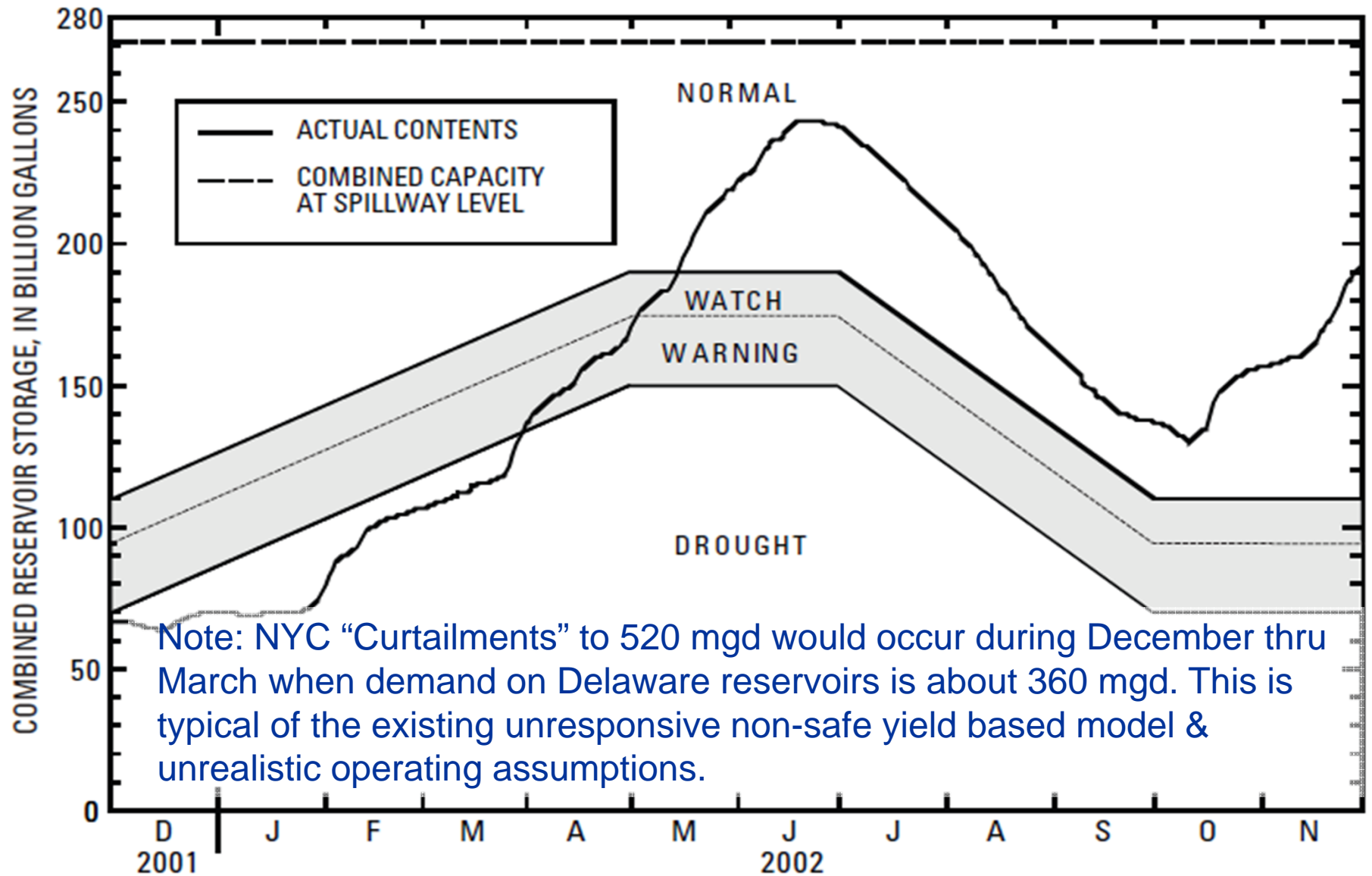
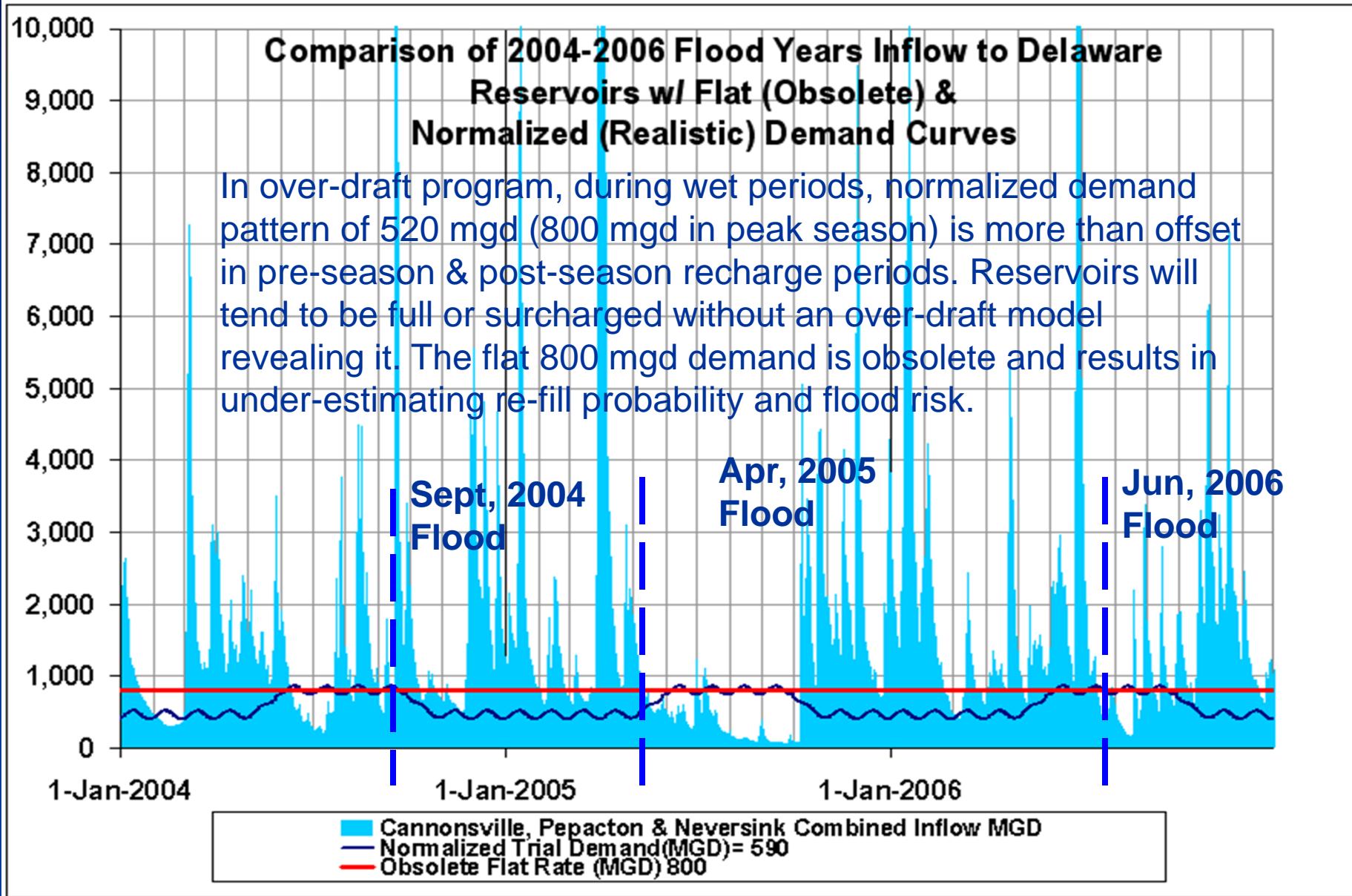


Figure 2. Operation curves and actual contents for New York City reservoirs in the Delaware River Basin, December 1, 2001, to November 30, 2002.

2004-2005 Inflow Compared to Draft Patterns



Recommendations

- New Jersey Recommends that a comprehensive safe yield analysis be conducted that includes realistic demand, hydraulic & hydrologic limitations, considers conjunctive effects of all NYC reservoirs, and applies consistent standards between the systems (e.g. reserve storage) to equitably optimize alternative operations for optimal uses by all Parties so as to safeguard economic, environmental and public safety interests by:
 - Establishing a realistic safe yield based plan & modify reservoir operations to sustain uses through the design drought
 - Creating meaningful flood mitigation within constraints of the systems.
 - Designing more consistent, sustainable fisheries flow goals
 - Protecting NYC & lower basin water supply quantity & quality
 - Repelling saltwater migration to protect Phila. & NJ American intakes
 - Restoring an equitable New Jersey diversion at D&R Canal
 - Applying an Early Warning System or OST to enhance flood mitigation in a realistic, safe yield based model so that responsive, practical advance releases can enhance mitigation of flood risk.



QUESTIONS / DISCUSSION