Revising Reservoir Planning Based On Vulnerability To Sustained Drought In The Past And Future

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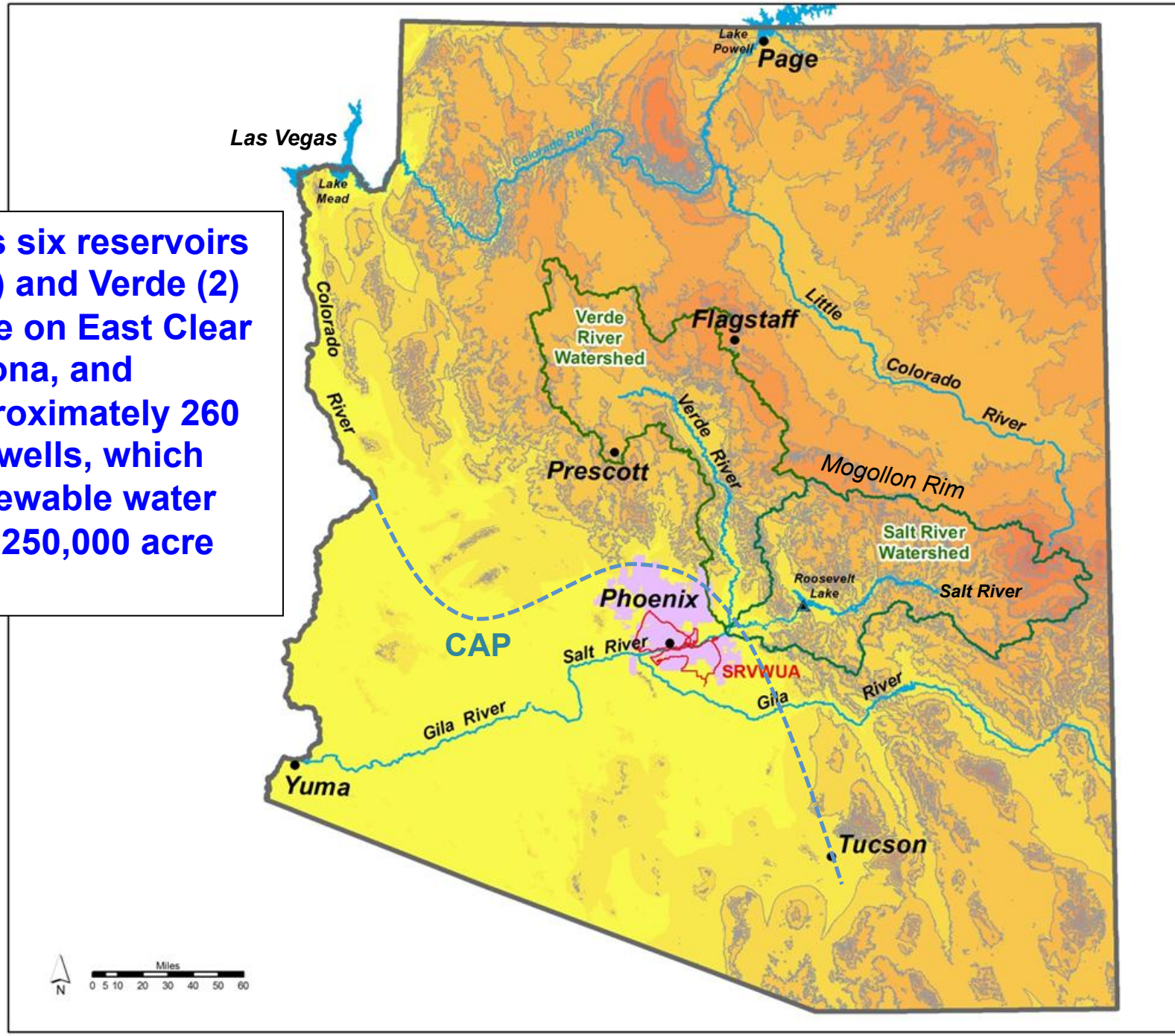
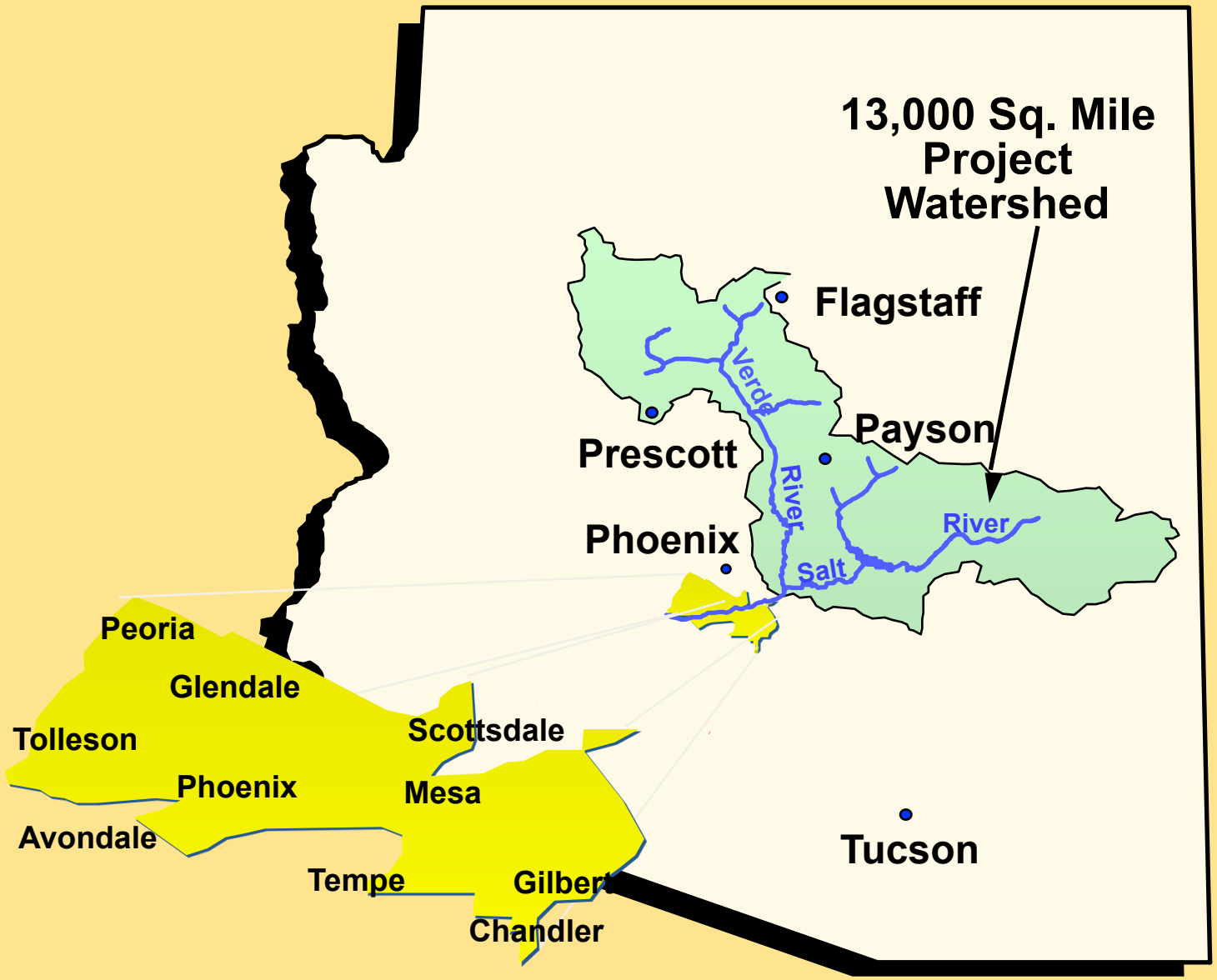
October 2, 2013

SRP manages six reservoirs on the Salt (4) and Verde (2) rivers and one on East Clear Creek in Arizona, and operates approximately 260 groundwater wells, which provide a renewable water supply to the 250,000 acre service area.

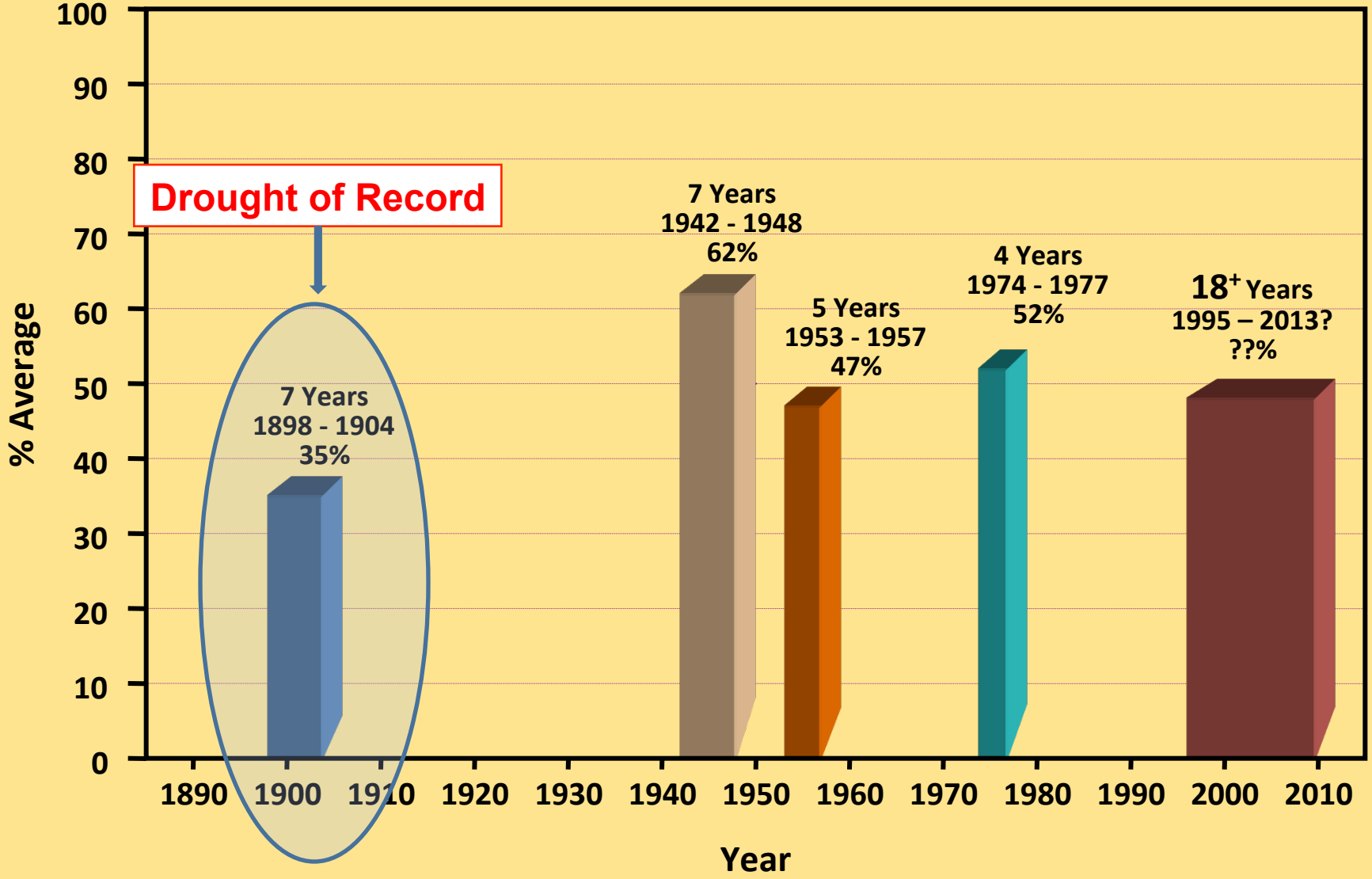


SRP Water Service Area



Salt River Project Historic Drought Periods

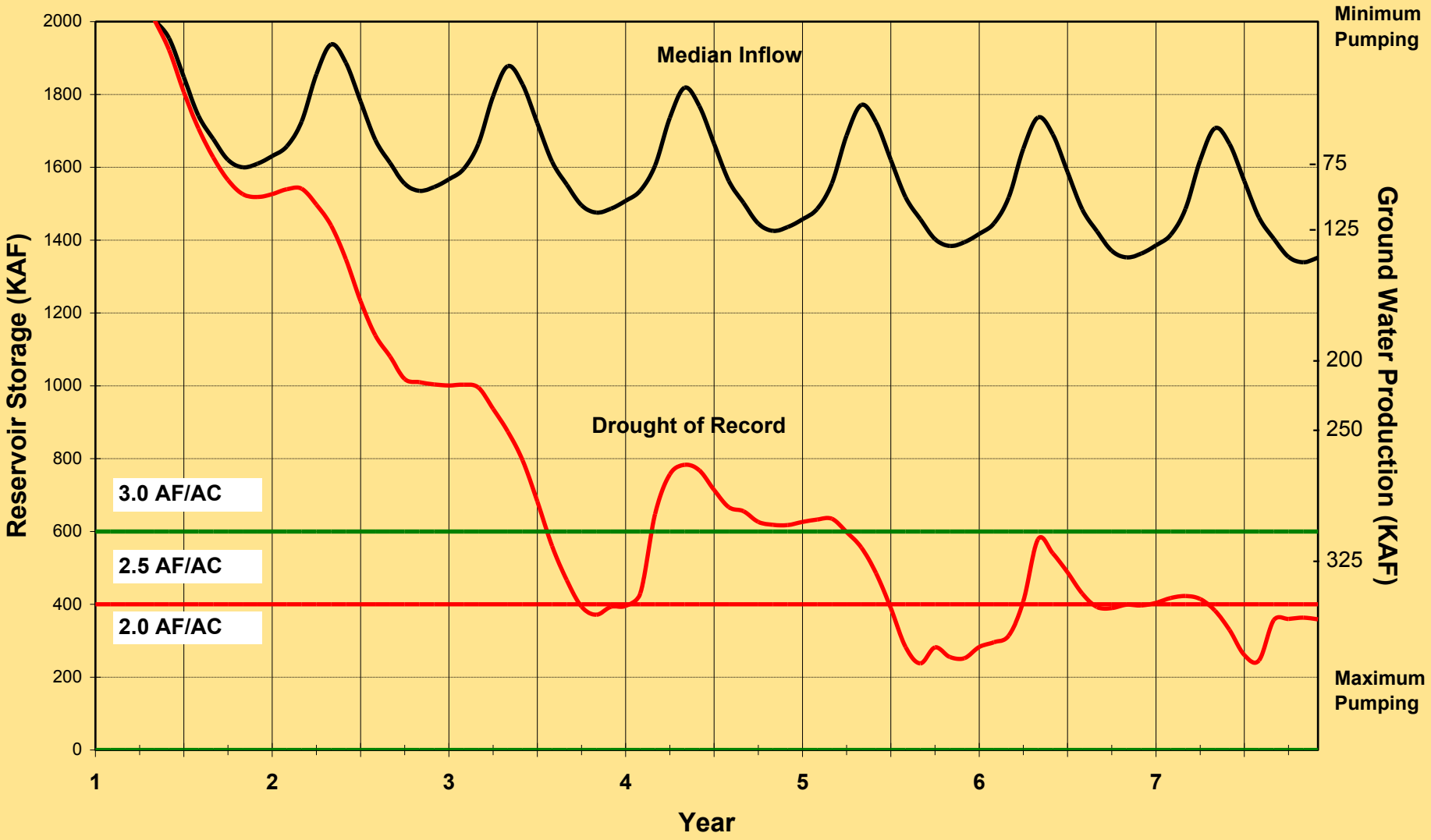
(Average Runoff 1913–2010 = 1,172,215 AF)



Planning Assumptions Version 1.0 (1980s and 1990s)

- 950,000 AF -- full demand
- 325,000 AF -- maximum pumping
- Historical “drought of record”: 1898-1904
- Use of allocation and pumping to manage for “drought of record”
- Demand mainly agricultural

SRP Storage, Pumping & Water Allotment Planning



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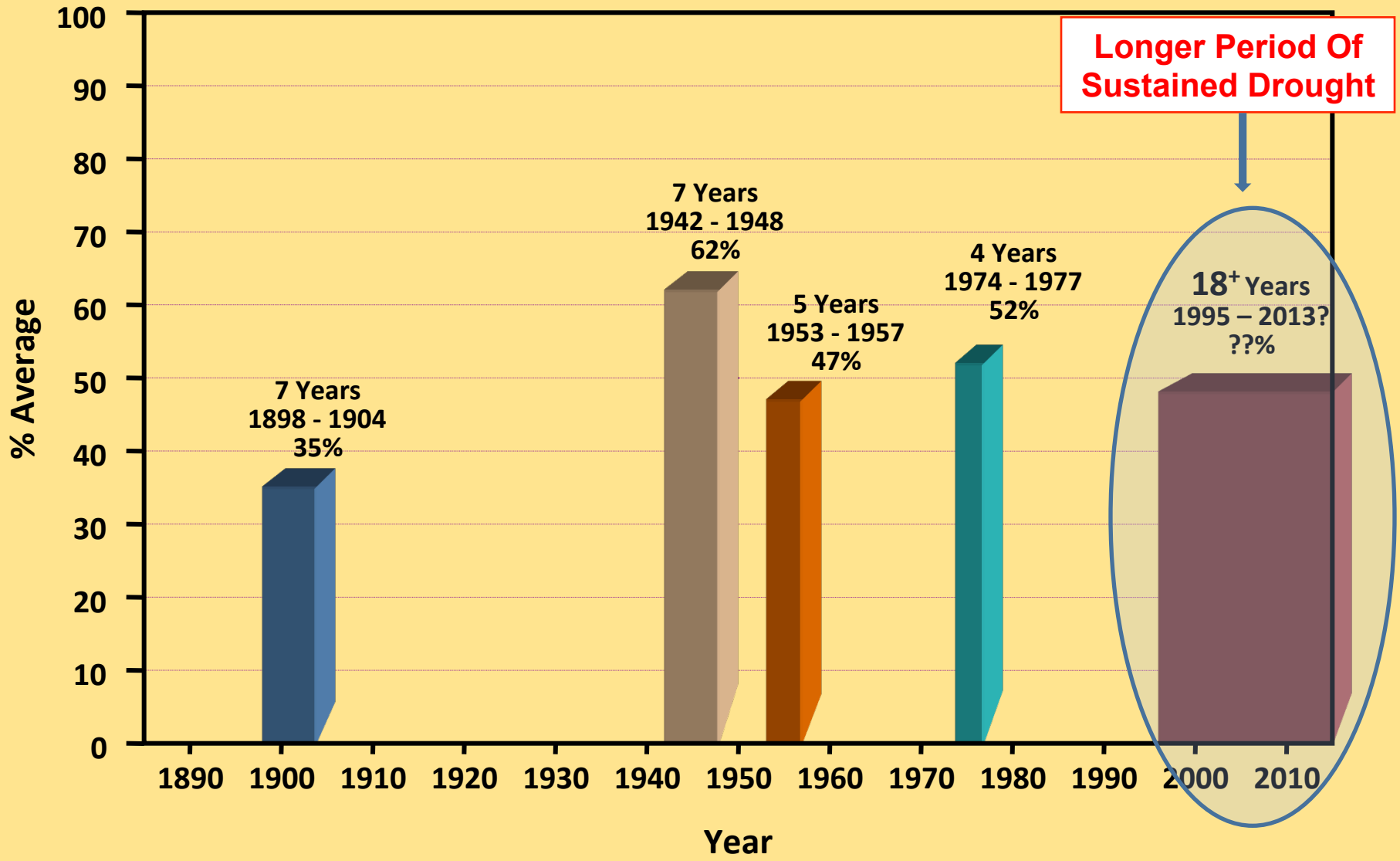
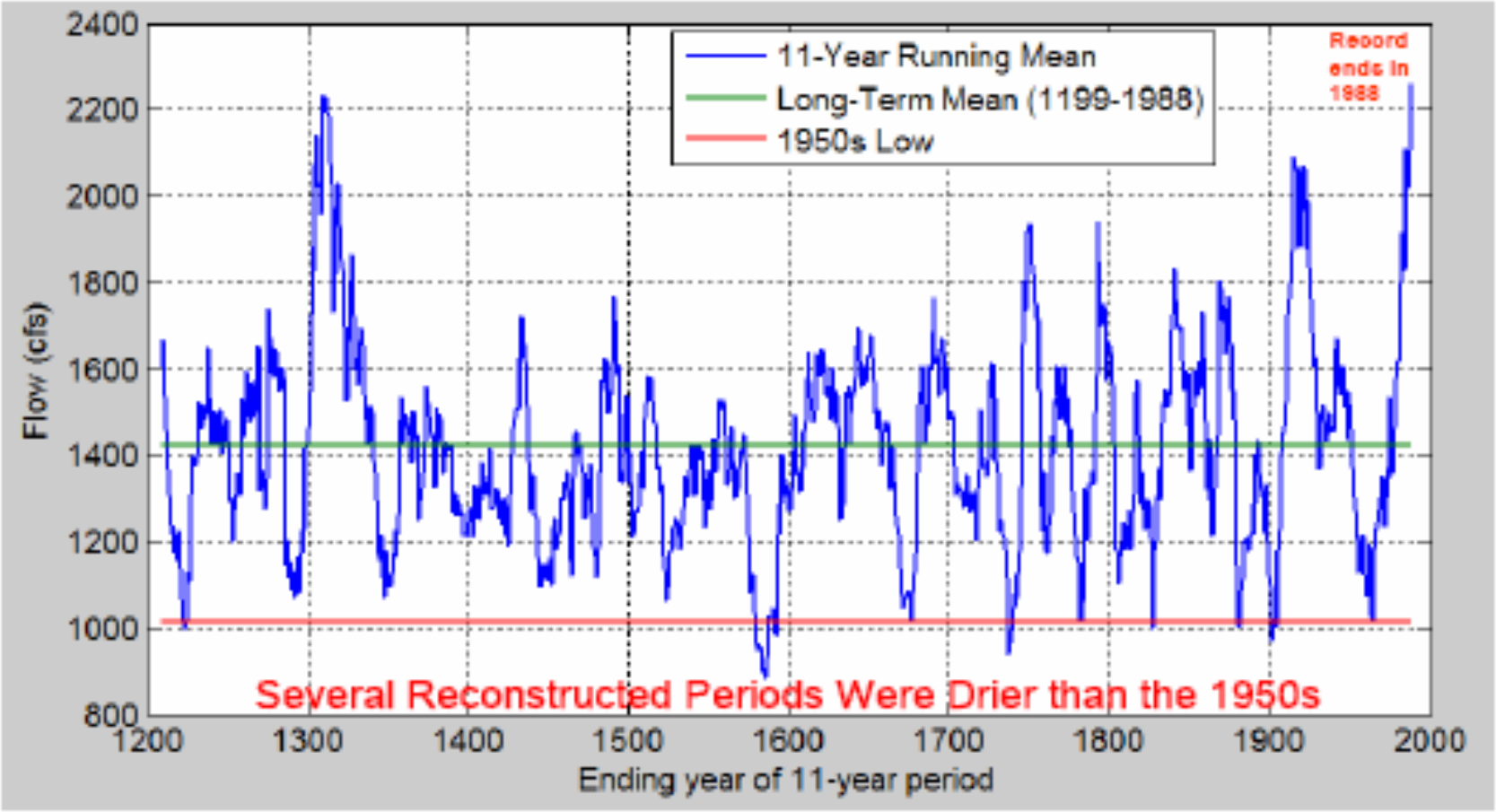


Severity of Current Drought in Context of Reconstructed Record: Salt + Verde + Tonto Reconstruction

Figure 23b

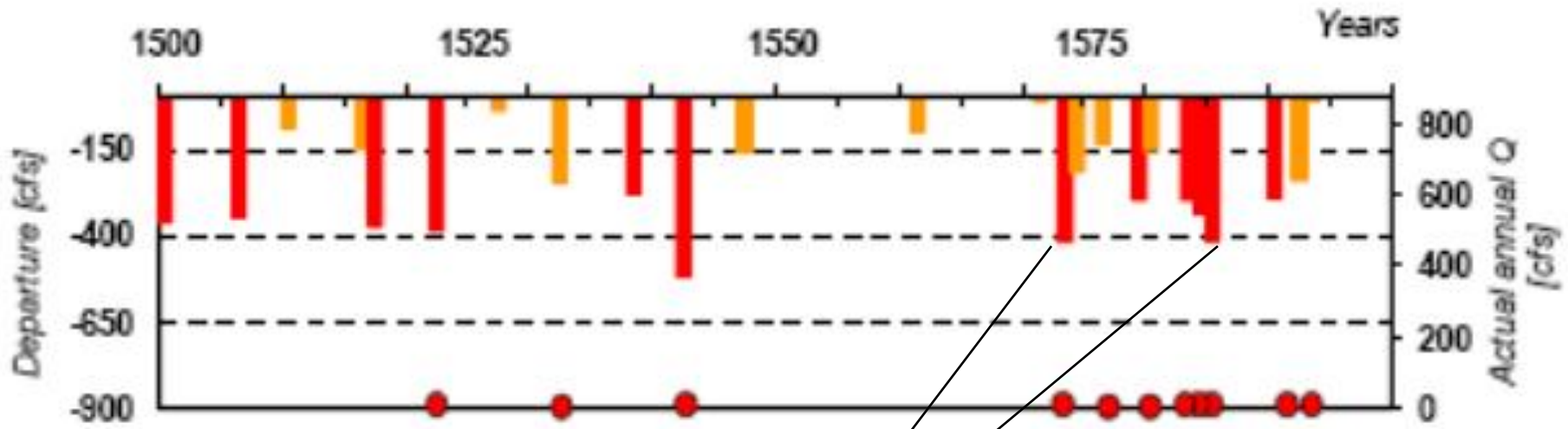


-- Current drought was about as severe as 1950s in terms of flows averaged over 11 years

-- 8 other droughts were as severe, according the tree-ring record

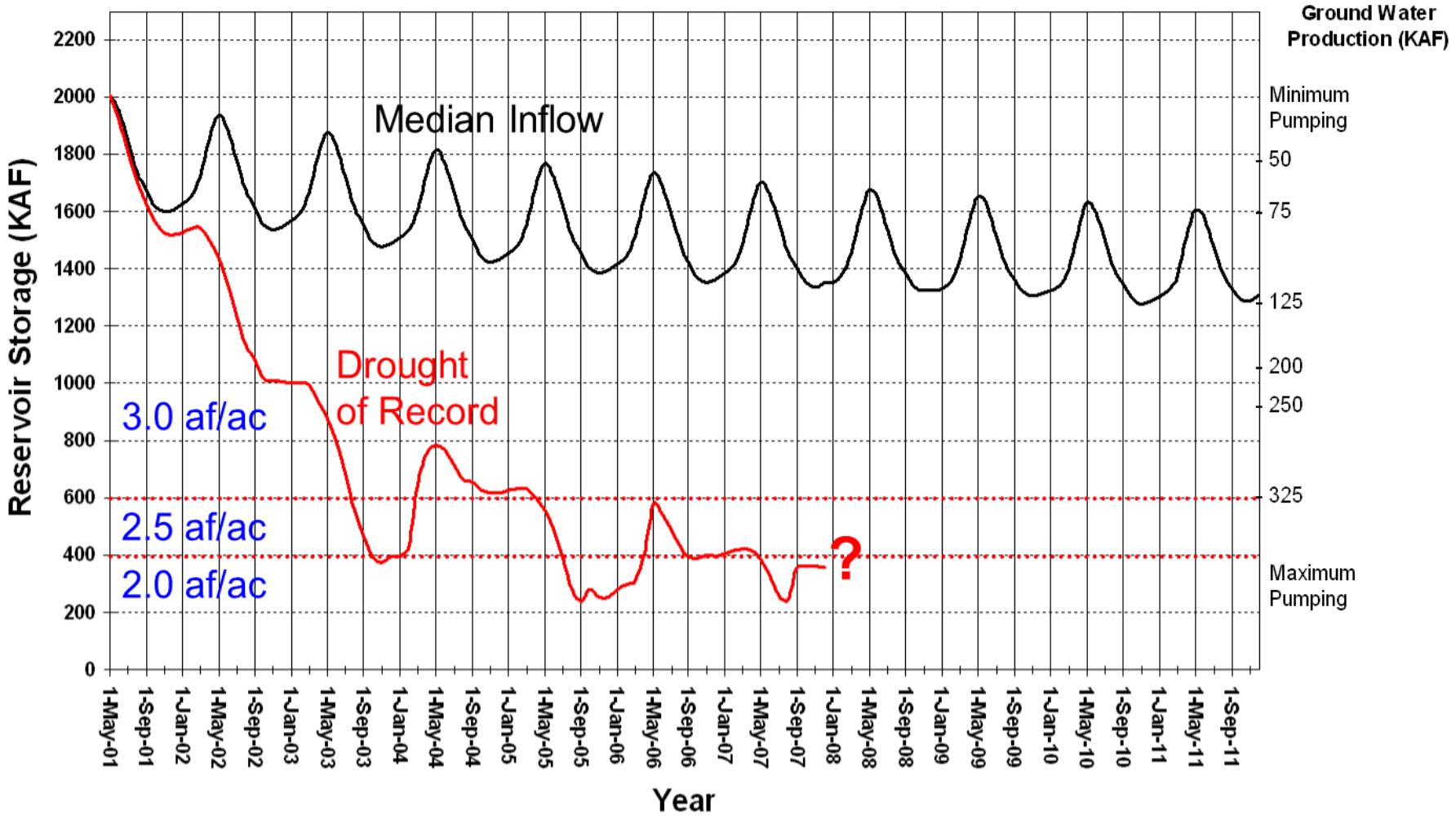
-- Late 1500s megadrought was much more severe

The 11-year period was 1575 - 1585.



11-Year Drought With 70% Of Historical Gaged Median Inflow

SRP Storage, Pumping & Water Allotment Planning



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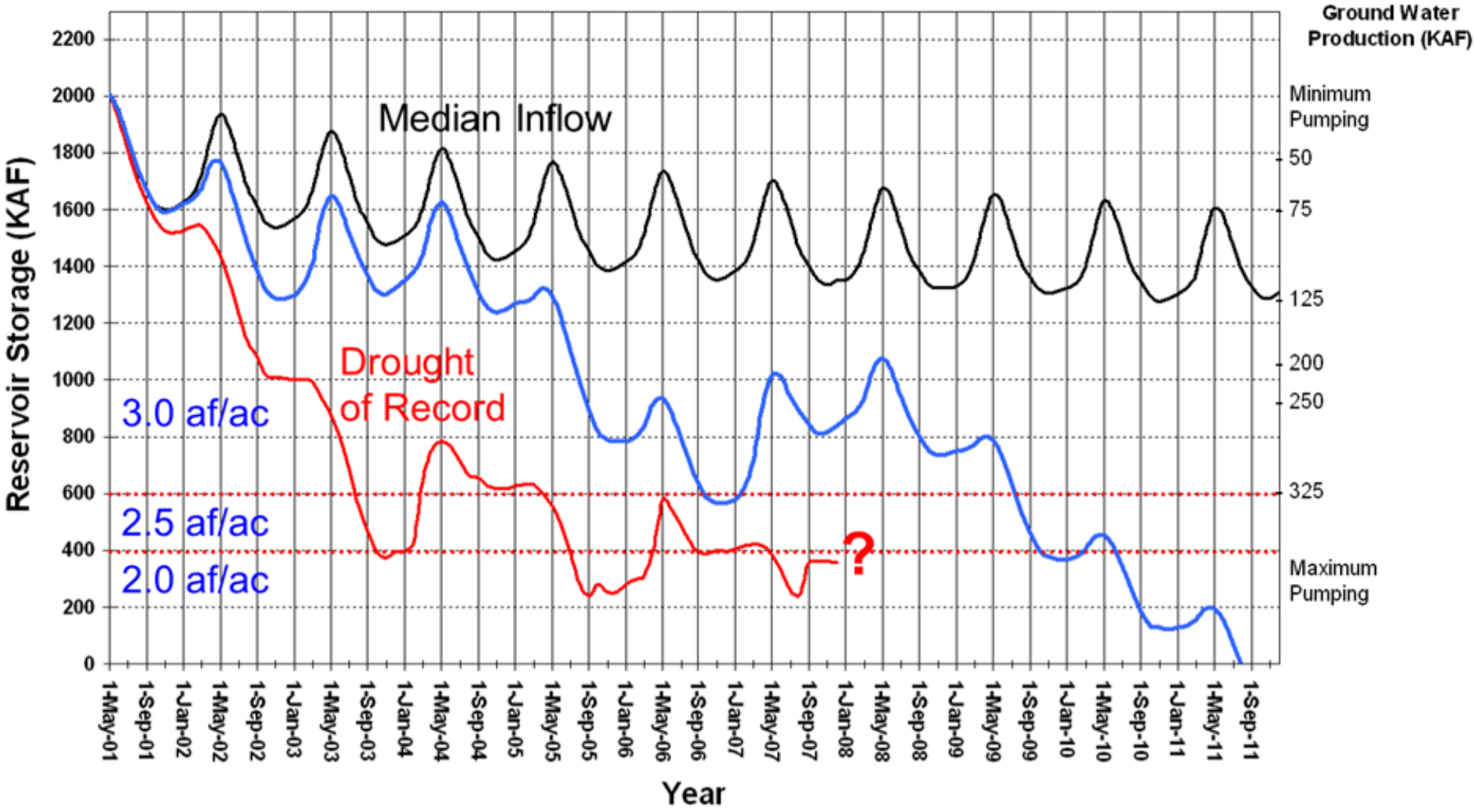
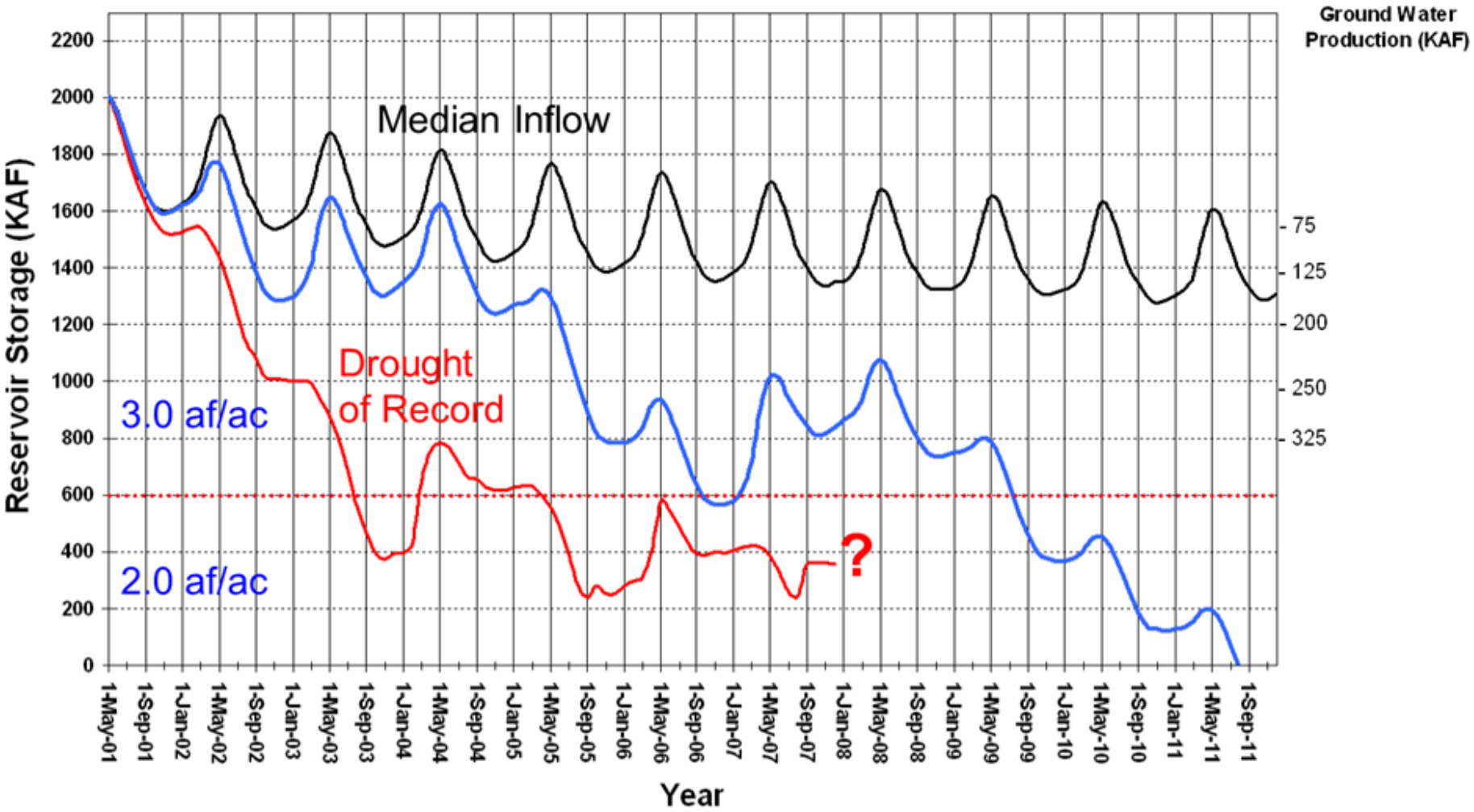
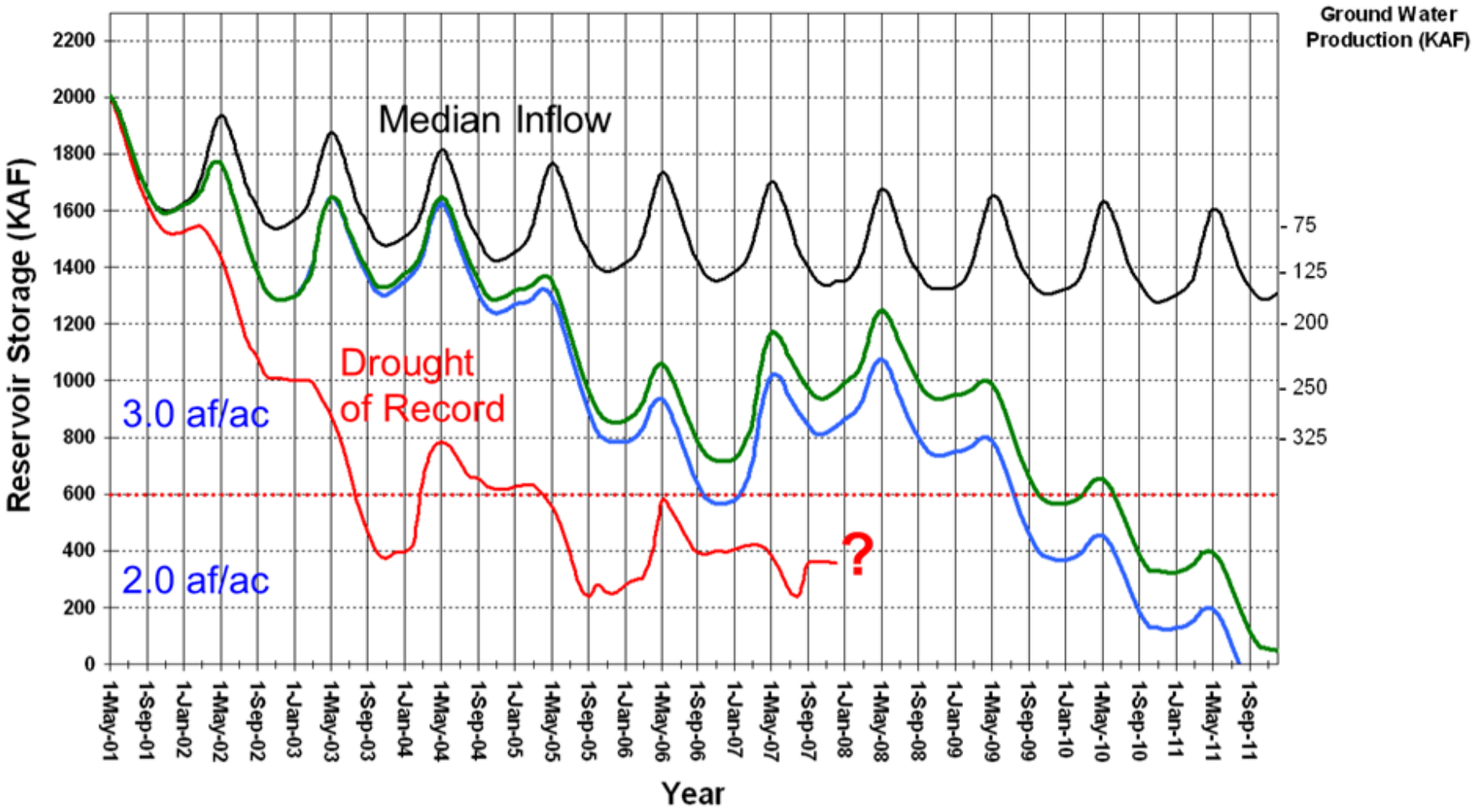


11-yr Tree-ring Drought with previous planning scenario

SRP Storage, Pumping & Water Allotment Planning



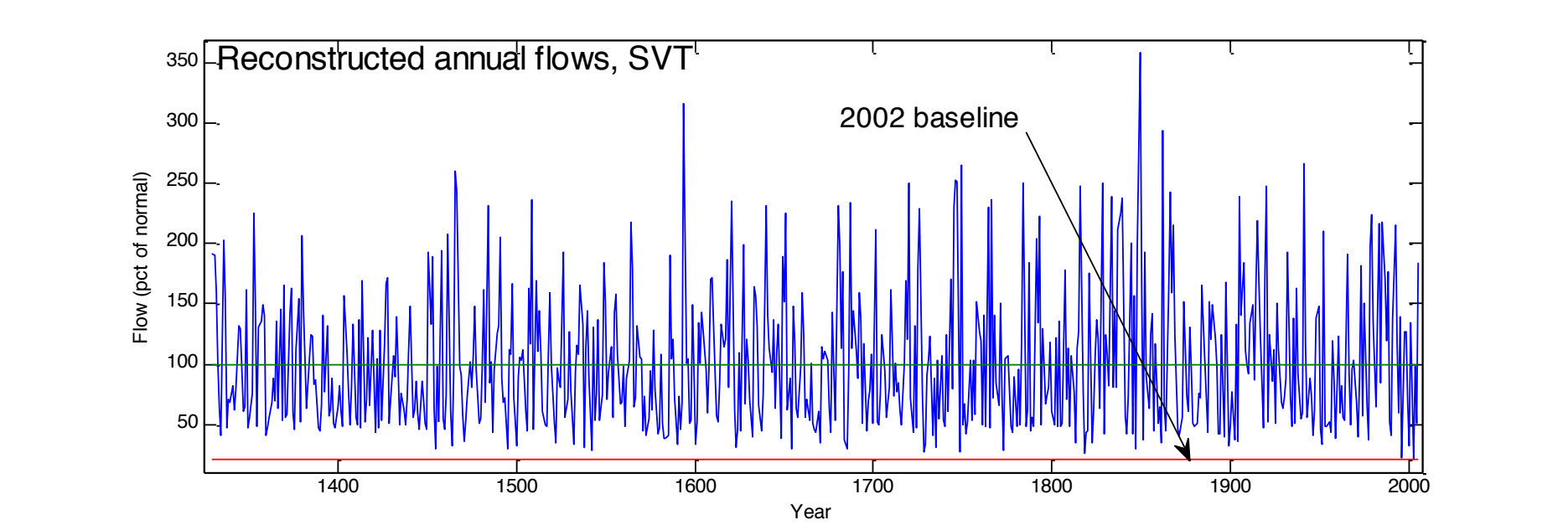
SRP Storage, Pumping & Water Allotment Planning



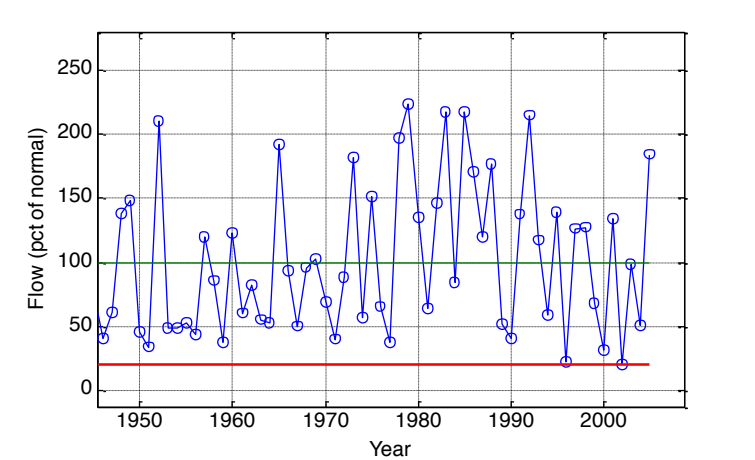
11-year Tree-ring Drought with new planning scenario

Time To Rethink Old Assumptions

2002 and 1996: long-term extreme lows



- Reconstructed flow was 21% of normal* in 2002, 22% of normal in 1996
- No other reconstructed flow from 1330 to 2005 was lower than 25% of normal.
- Tree growth recovered with wetter conditions in 2005



*normal is 1914-2007 mean, water year, Salt+Verde+Tonto

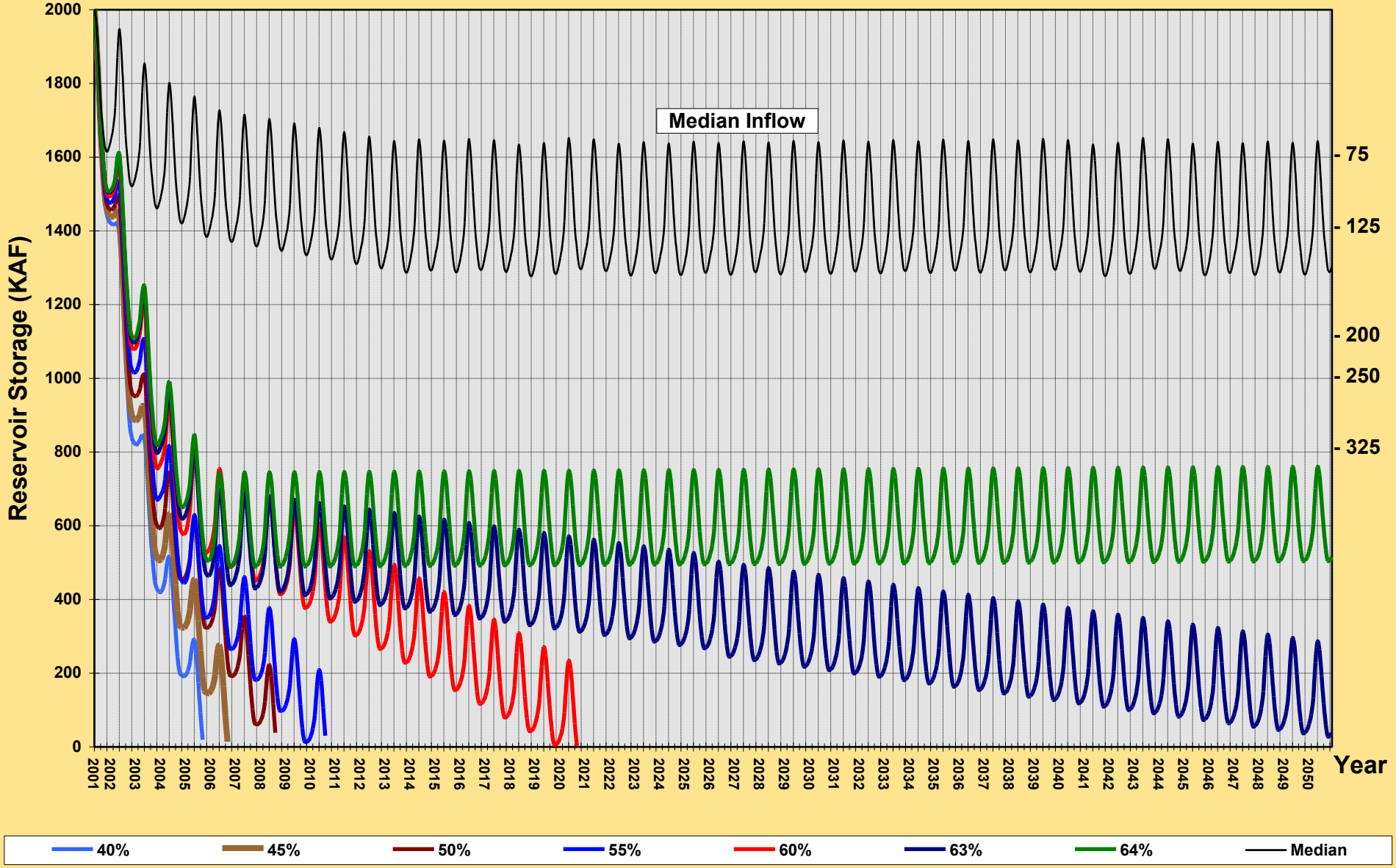
How Vulnerable Are We?

- Historical Record
- Tree Ring Record
- Climate Change Scenarios

Key Question:

What is minimum flow that allows SRP to maintain carryover storage in perpetuity?

SRP Storage, Pumping & Water Allotment Planning

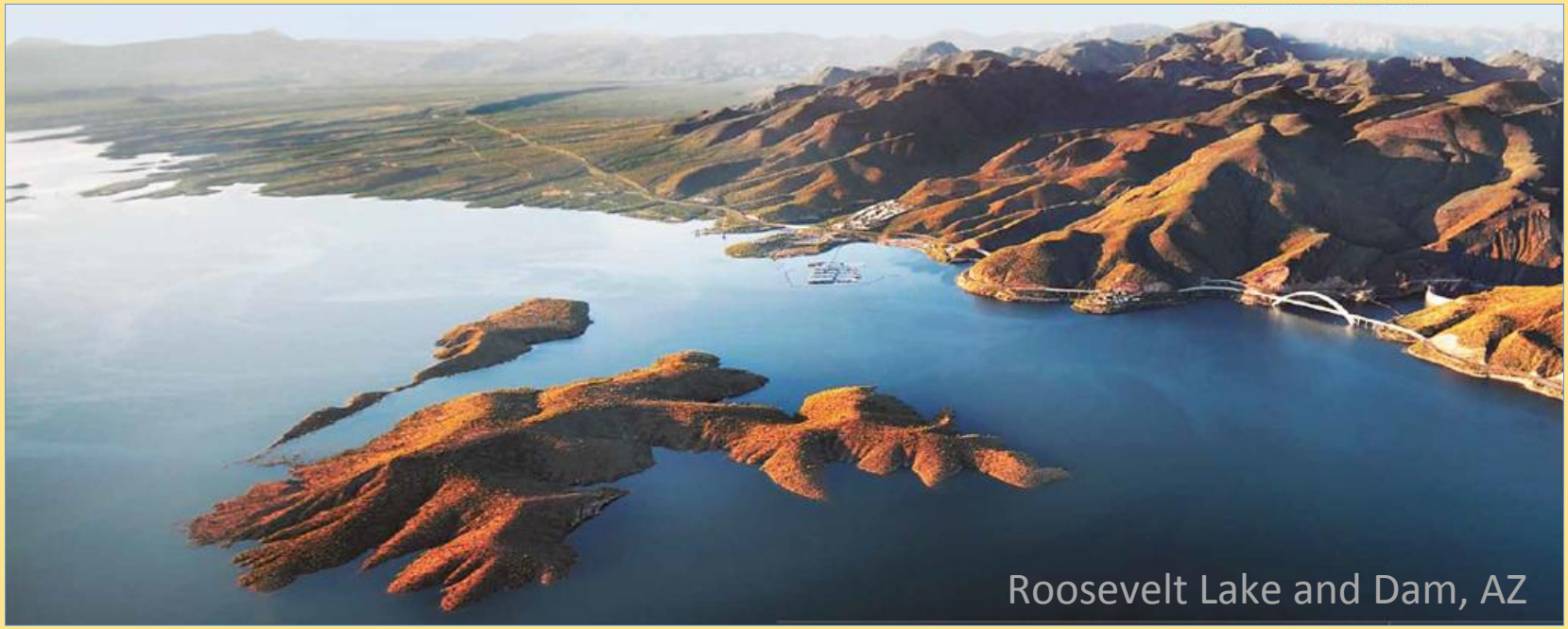


Simulated Reservoir Storage for a Range of Perpetually Reduced Inflows (as a percent of historical median)

How Vulnerable Are We?

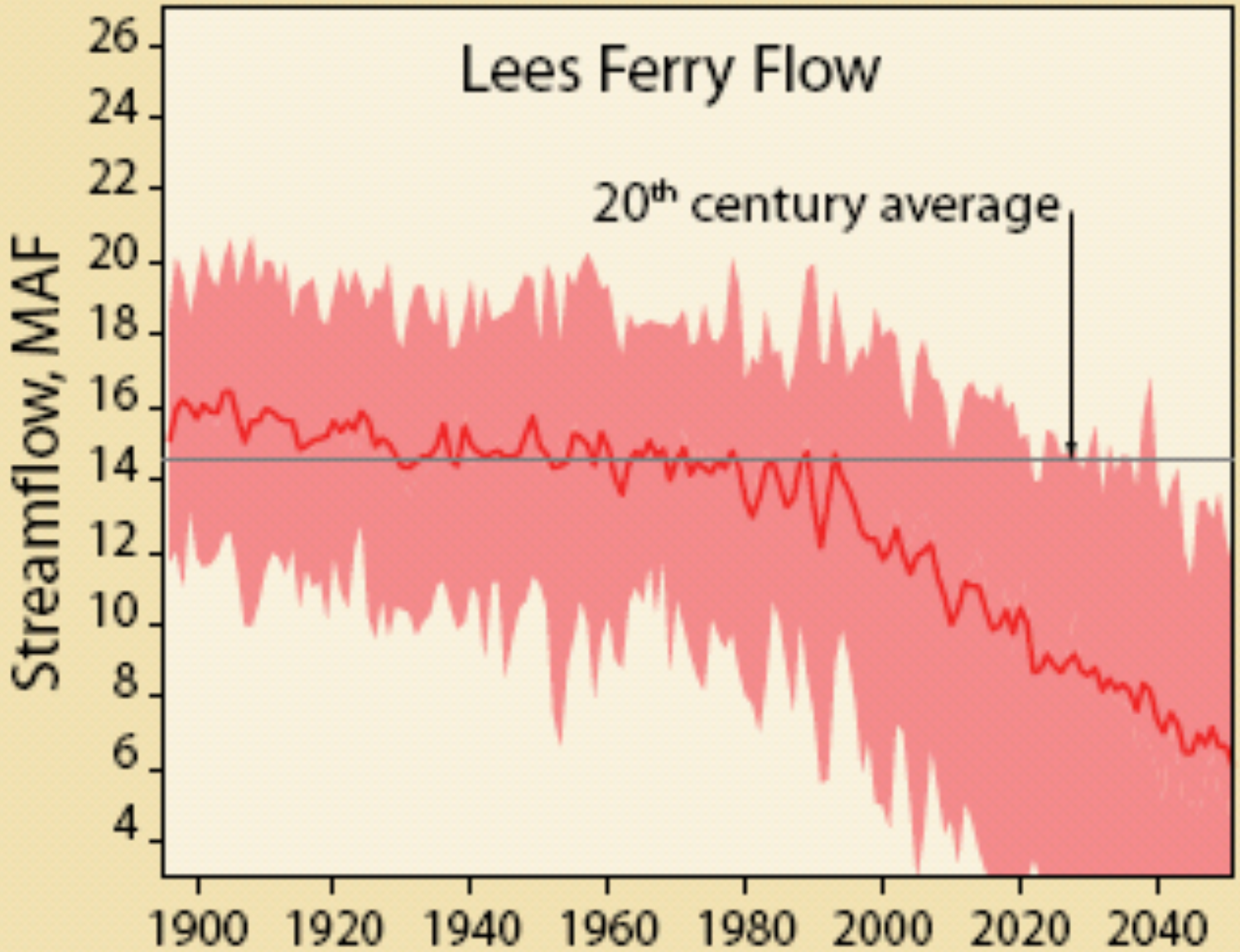
PERCENT OF MEDIAN INFLOW	YEARS TO RESERVOIR DRYUP
64	INDEFINITE
63	50+
60	19.5
55	9.3
50	7.3
48	6.4
45	5.4
40	4.4

Climate Change



The Story in the Southwest

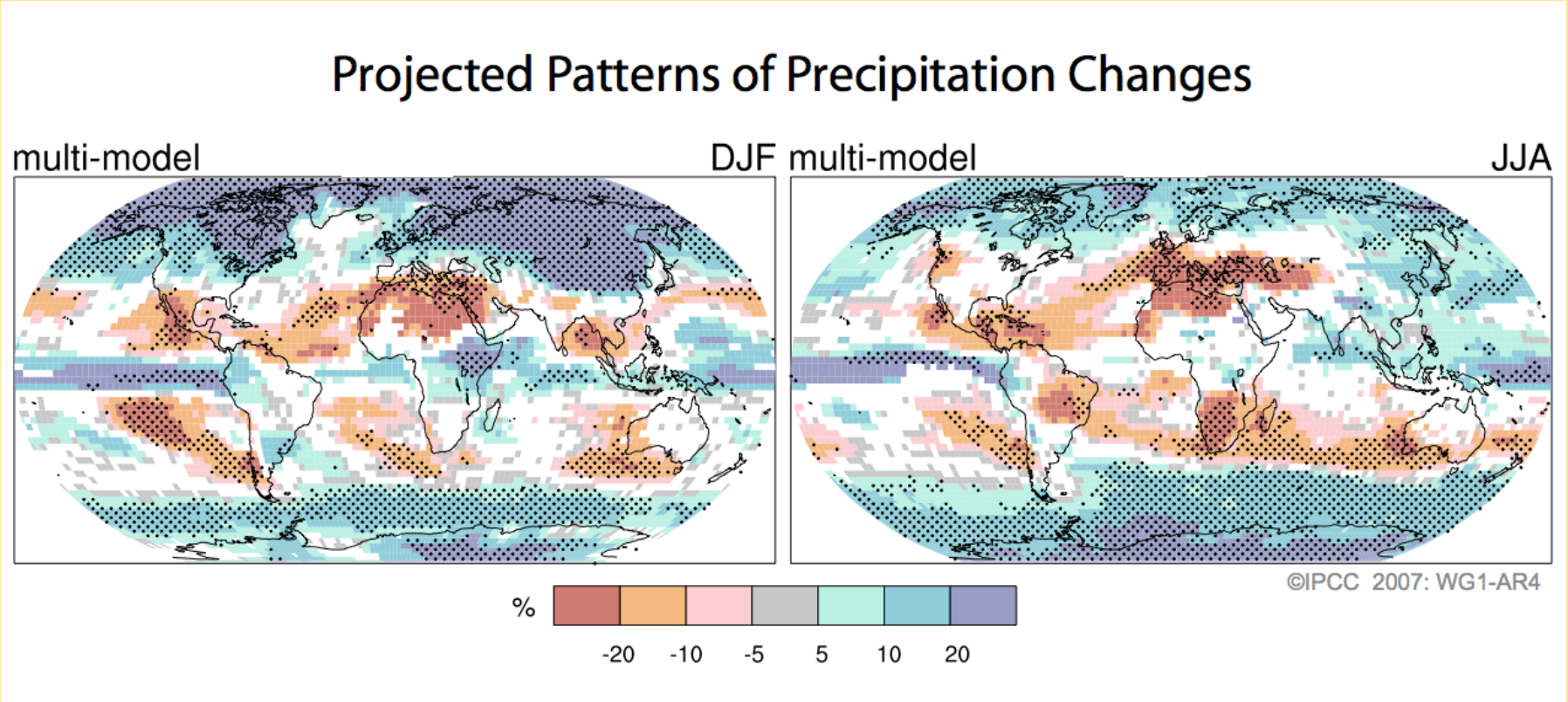
Climate Model Results …



42-Model Run Average and 10% and 90% Range of Individual Simulations

From Martin Hoerling, NOAA, and Jon Eischeid, U of CO, Past Peak Water in the Southwest, Southwest Hydrology, Jan/Feb 2007. Results of Intergovernmental Panel on Climate Change Fourth Assessment Report, 2007.

Projections of Future Changes in Climate



Precipitation increases *very likely* in high latitudes

Decreases *likely* in most subtropical land regions

What We Do Know: Climate Change? Bottom Line for The Southwest

Continued warming could result in:

Twenty (20) to fifty (50) percent decrease in runoff over the next several decades

Which would require:

Search for additional water supplies for same level of service; and,

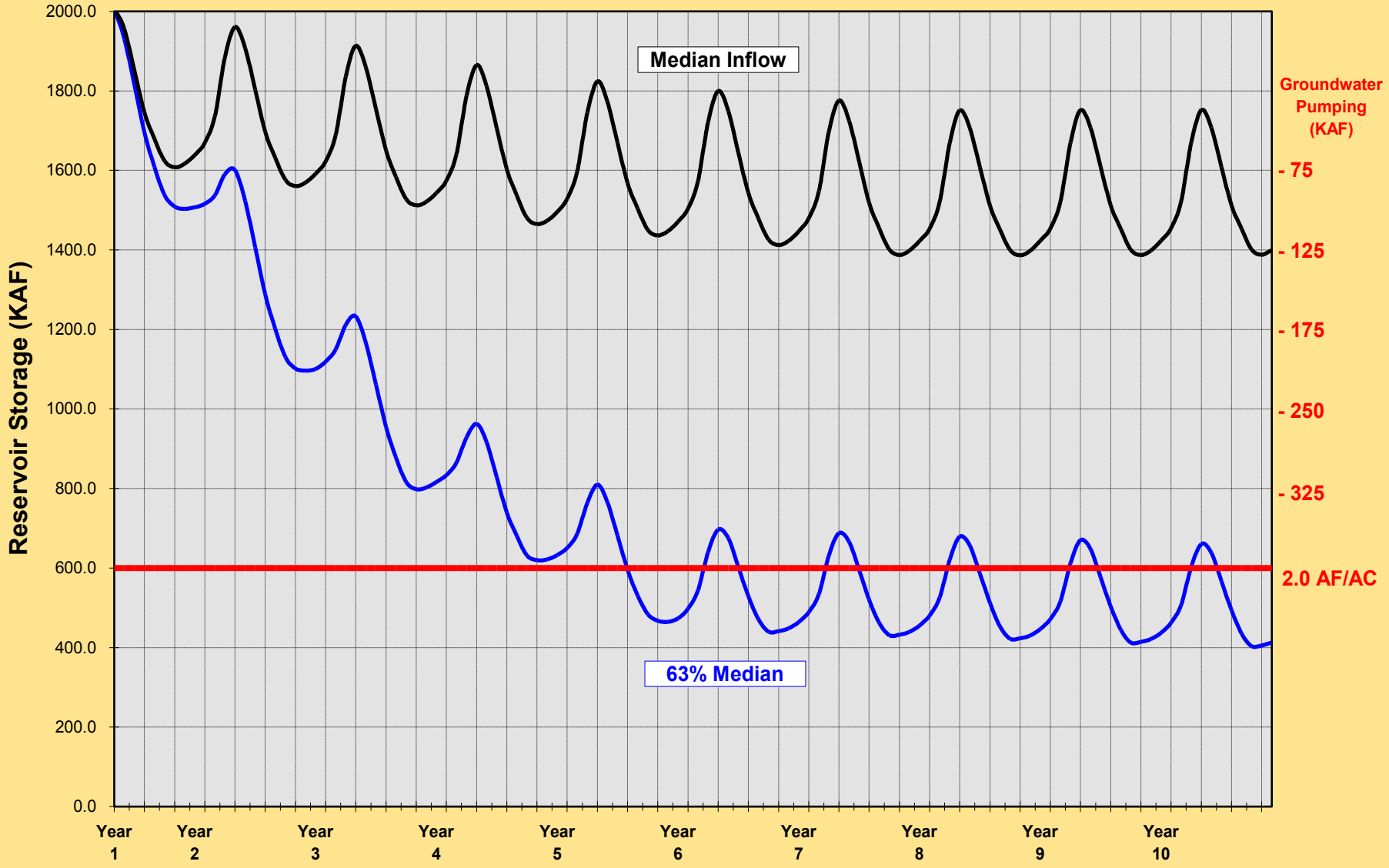
Some idea of the how much time we have to plan for those resources to be available (lead time)

In a climate changing world the question becomes: How much worse (drying) before previous droughts become a problem?

Severe Droughts Capable of Depleting Surface Water Supply With The Noted Reduction In Flow

Period	Source	Duration (yrs)	Flow Reduction	Average Annual % of Median
1214-1217	Tree-ring	4	20%	40%
1579-1585	Tree-ring	7	15%	50%
1666-1670	Tree-ring	5	20%	45%
1817-1823	Tree-ring	6	20%	48%
1898-1904	Historical	7	20%	48%
1999-2002	Historical	4	20%	40%

SRP Storage, Pumping & Water Allotment Planning



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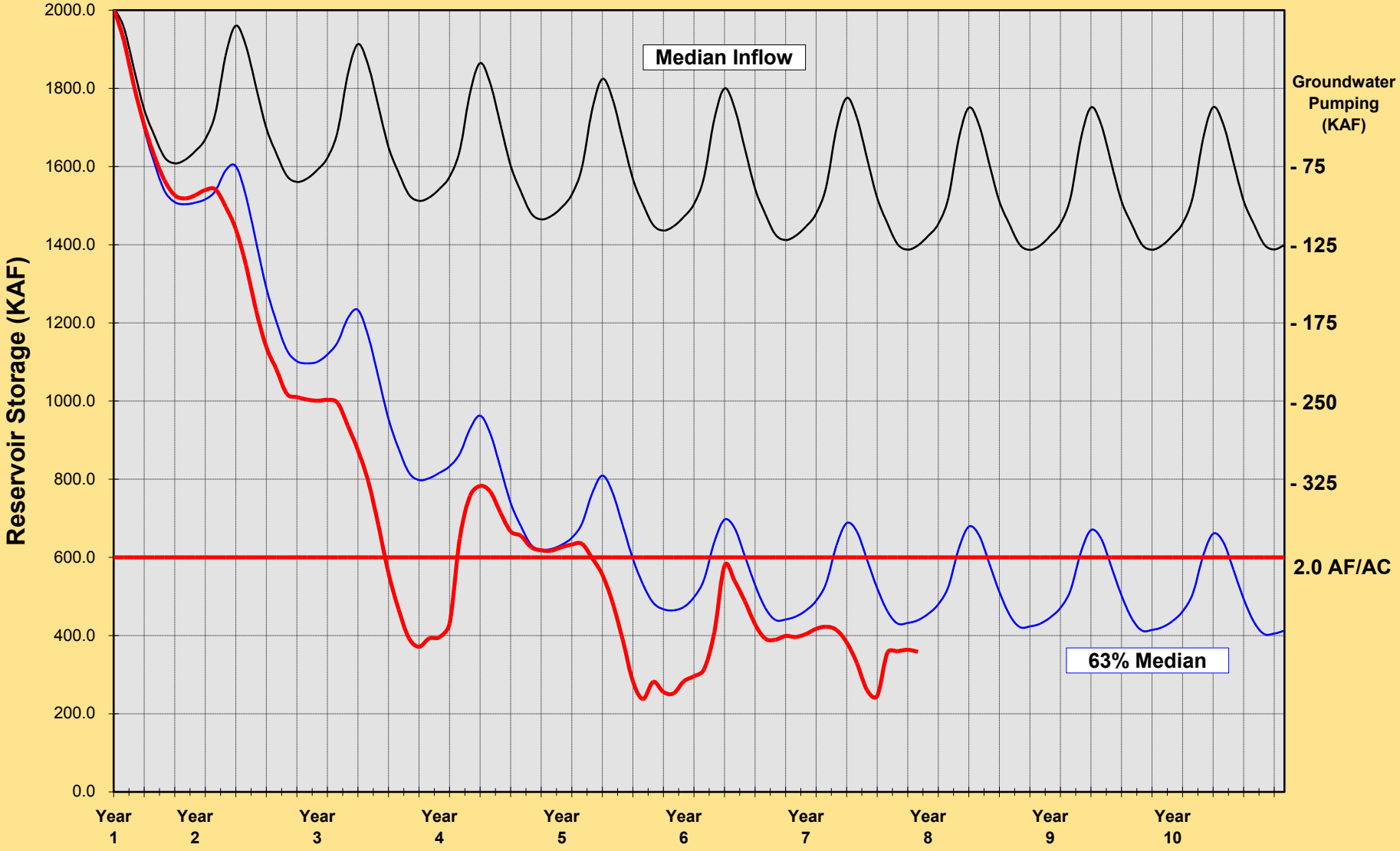

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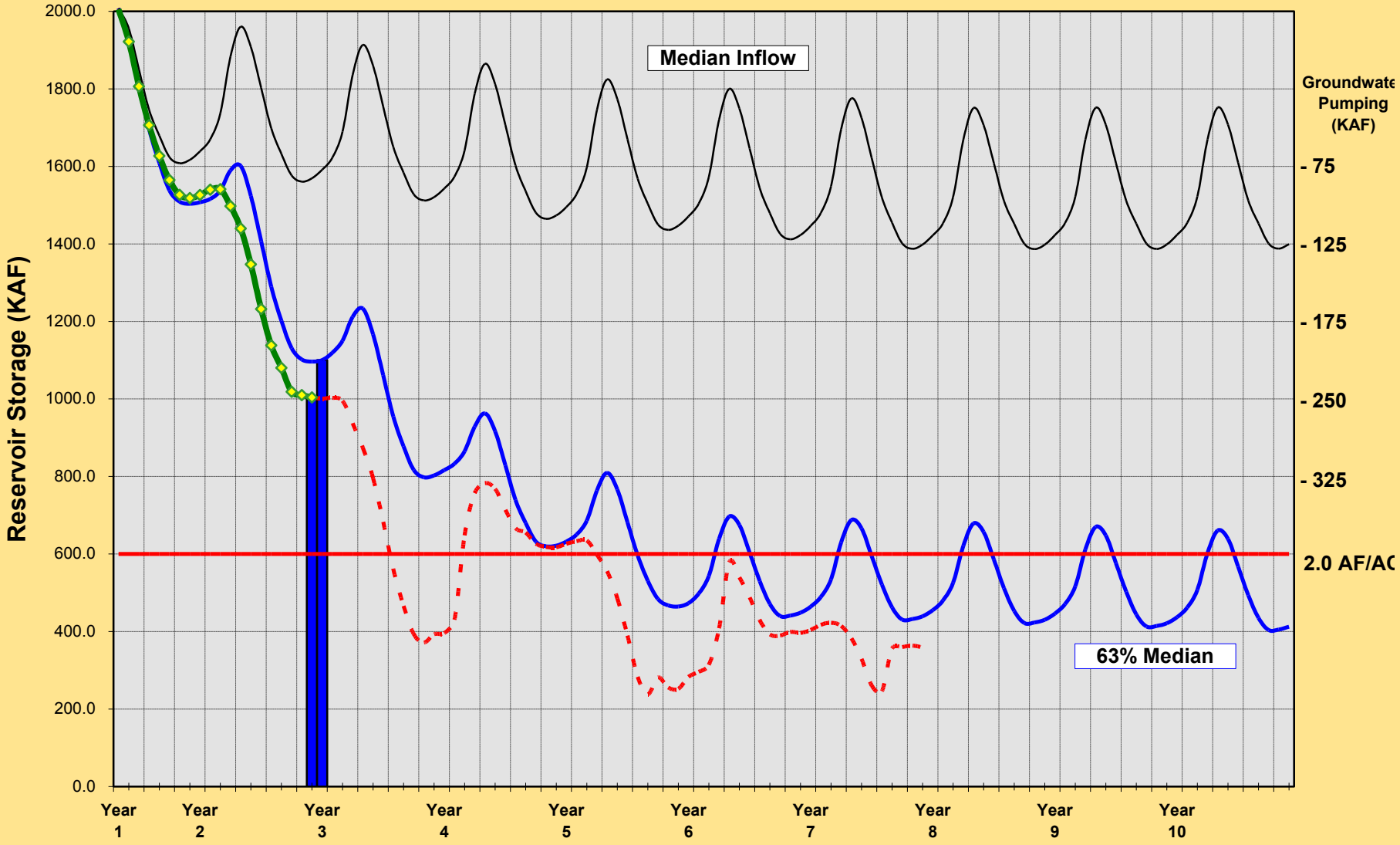

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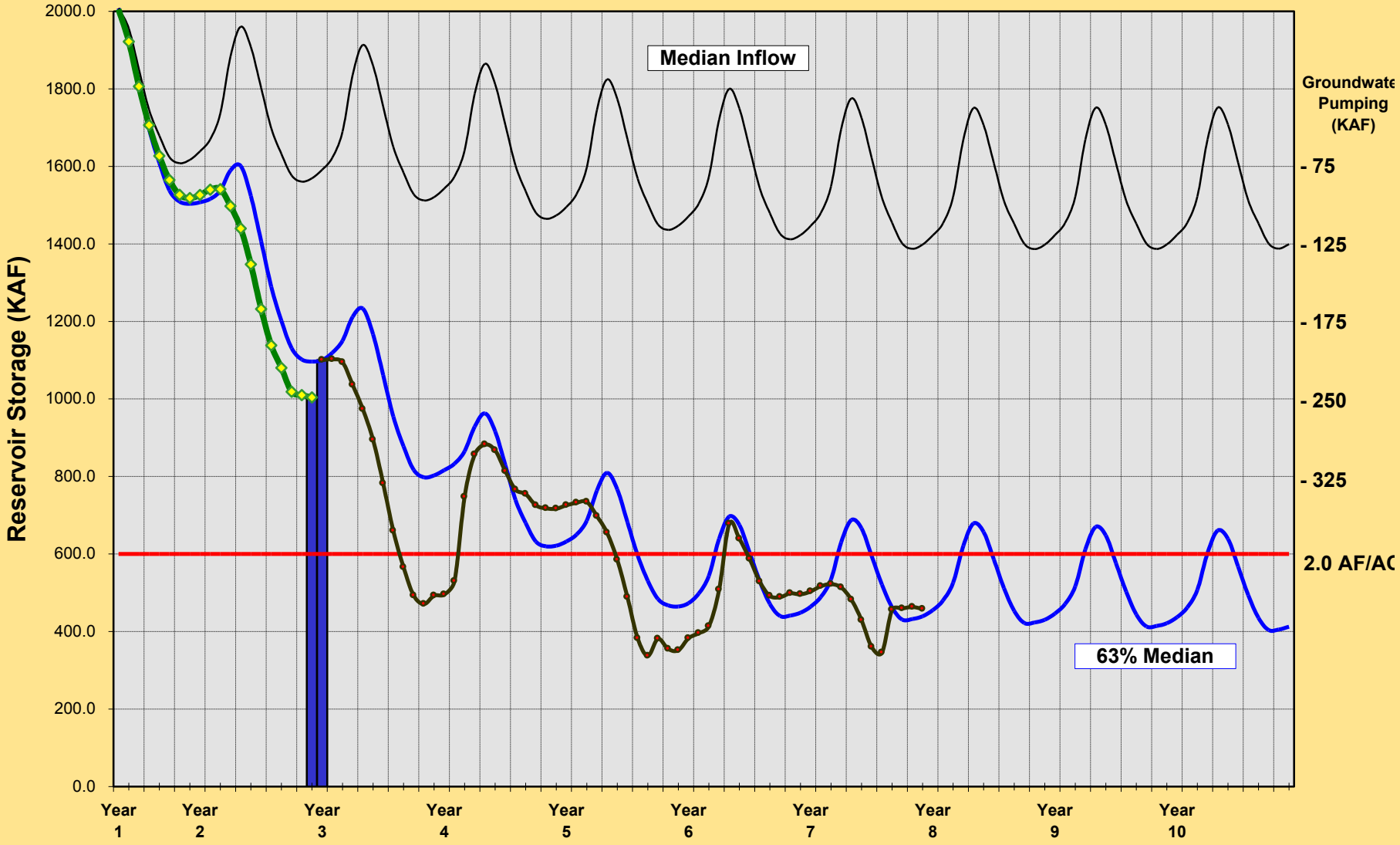

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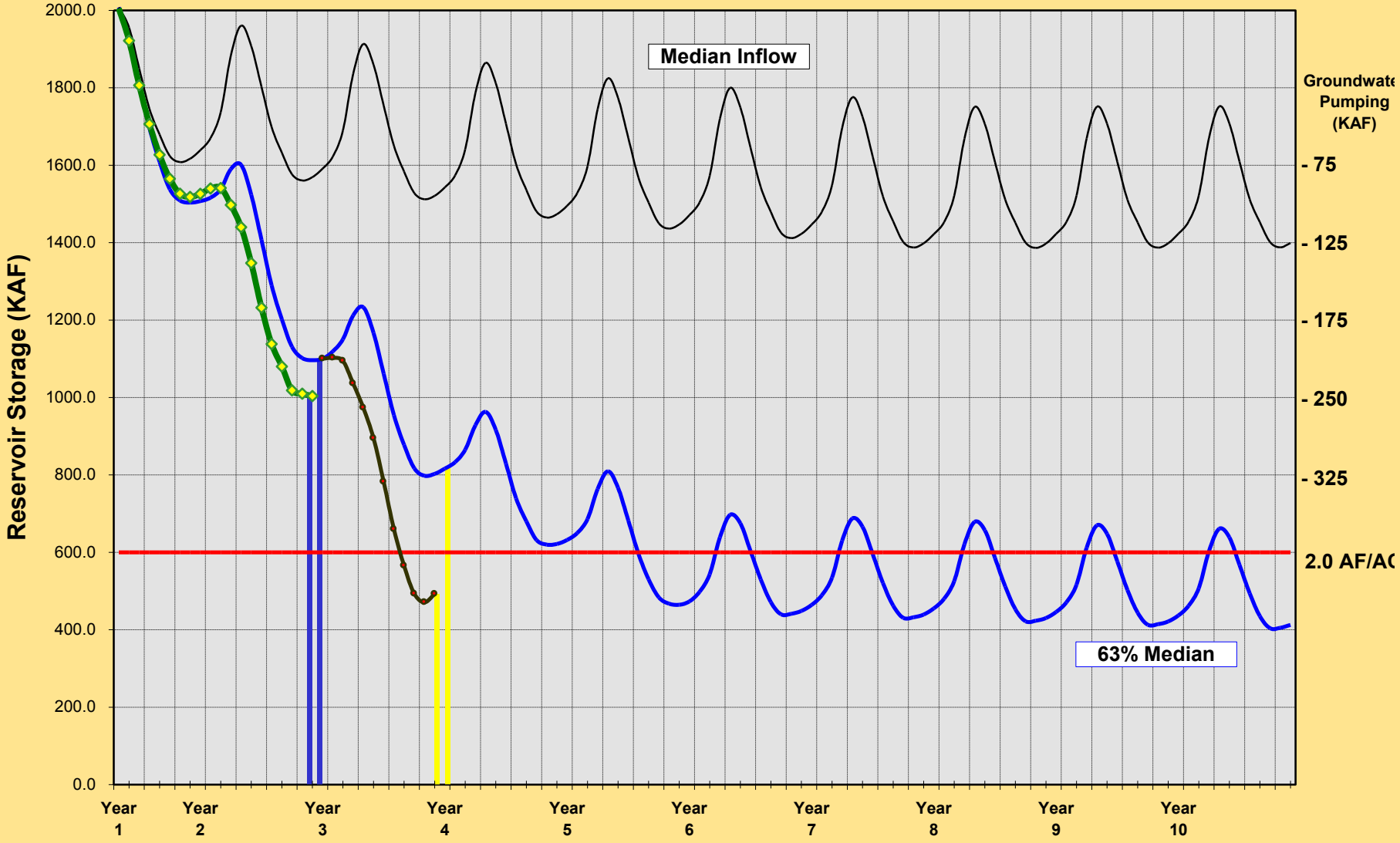

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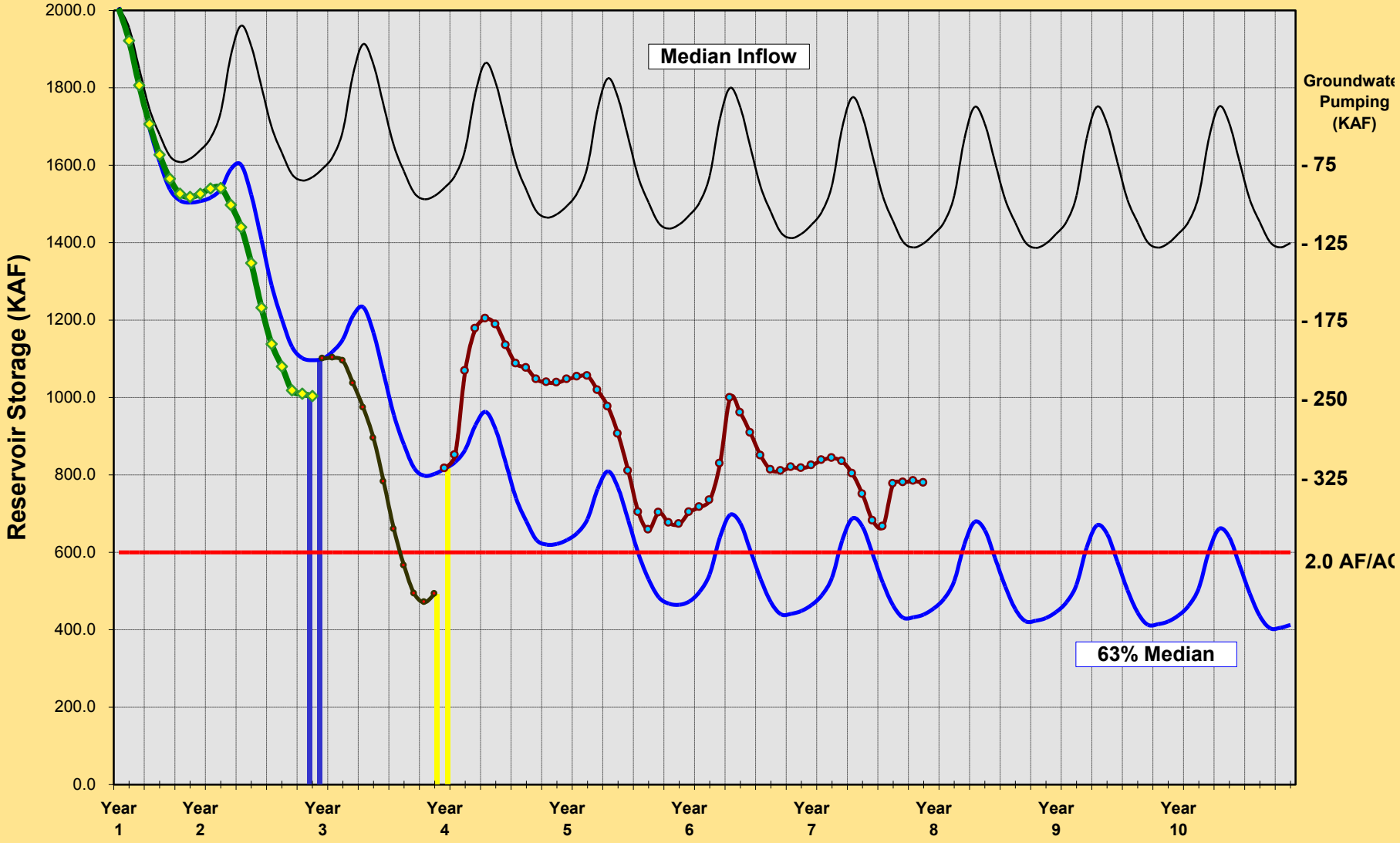


When Storage Drops Below The Target 63% Line:

Activate Augmentation Efforts to Raise Storage Back to the 63% Line…

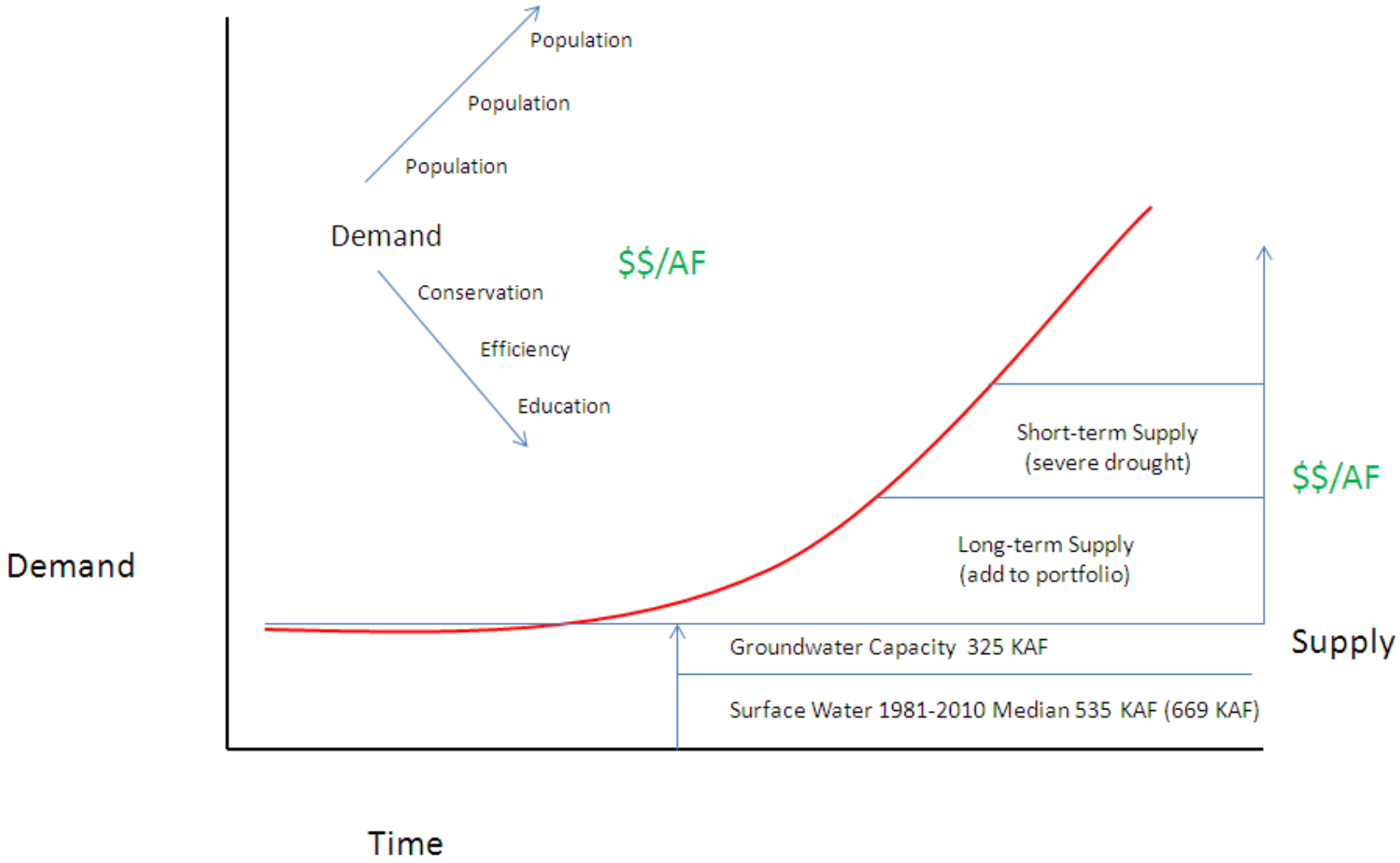
Menu Of Options:

- *Increase Groundwater Pumping (Restoration Program)*
- *Reduce Allocation Of Water*
- *Purchase Central Arizona Project Water*
- *Exercise Lease Options—Indian And Non-Indian Agriculture*
- *Recover Long Term Underground Storage Credits*
- *Conservation Efforts*
- *Watershed Management/Weather Modification Activities*

Water Necessary to Recover to the Target 63% Line

Historical Drought		Recovery Water (KAF)											
	Reduction	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Total
1212-1218	20%					132	114	298					544
1576-1586	15%			169				143	285	316			913
1665-1671	20%			29	190	40		256					515
1817-1824	20%			337	140	261		19	112				869
1895-2005	20%							298	180	38			516
1998-2004	20%			19	242		283						544

Water Resources Planning Will Change



Proposed Methodology: Process To Determine Timing and Volume of Additional Supplies

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