

PNWS AWWA Water Resources Committee
Pre-Conference Workshop
Salem, May 6, 2009
Climate Variability and Water Resource Planning

Seattle
 Public
Utilities

Planning for Climate Change

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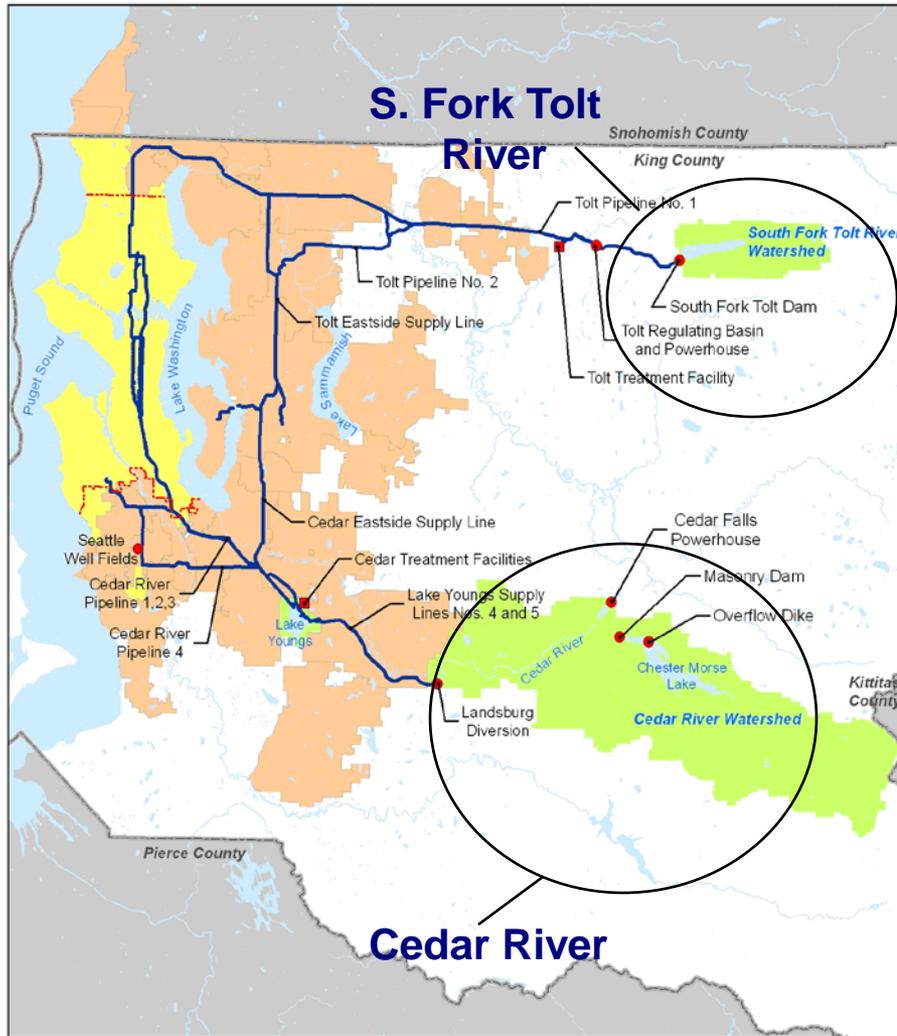
Purpose of Presentation

- Provide background on Seattle Public Utilities
- Examine what constitutes climate vulnerability
- Highlight projected impacts on water supply in the Seattle area
- Describe approaches to enhance adaptation and coping capacities

Will not cover:

- Impacts on water quality, ecosystems
- GHG mitigation

Location: Seattle's Water System

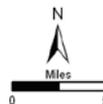


- Responsibilities:
 - Retail and wholesale water to 1.3 million people
 - Instream flows for salmon habitat
 - Flood management
 - Hydropower generation
- Mountain-based surface water supplies, nominal groundwater
- Largest supply is unfiltered
- Rely on snowpack and rain, may be more dependent on rain than snow
- Storage to inflow ratio low
 - 19% on Cedar
 - 48% on Tolt

Seattle Regional Water Supply System

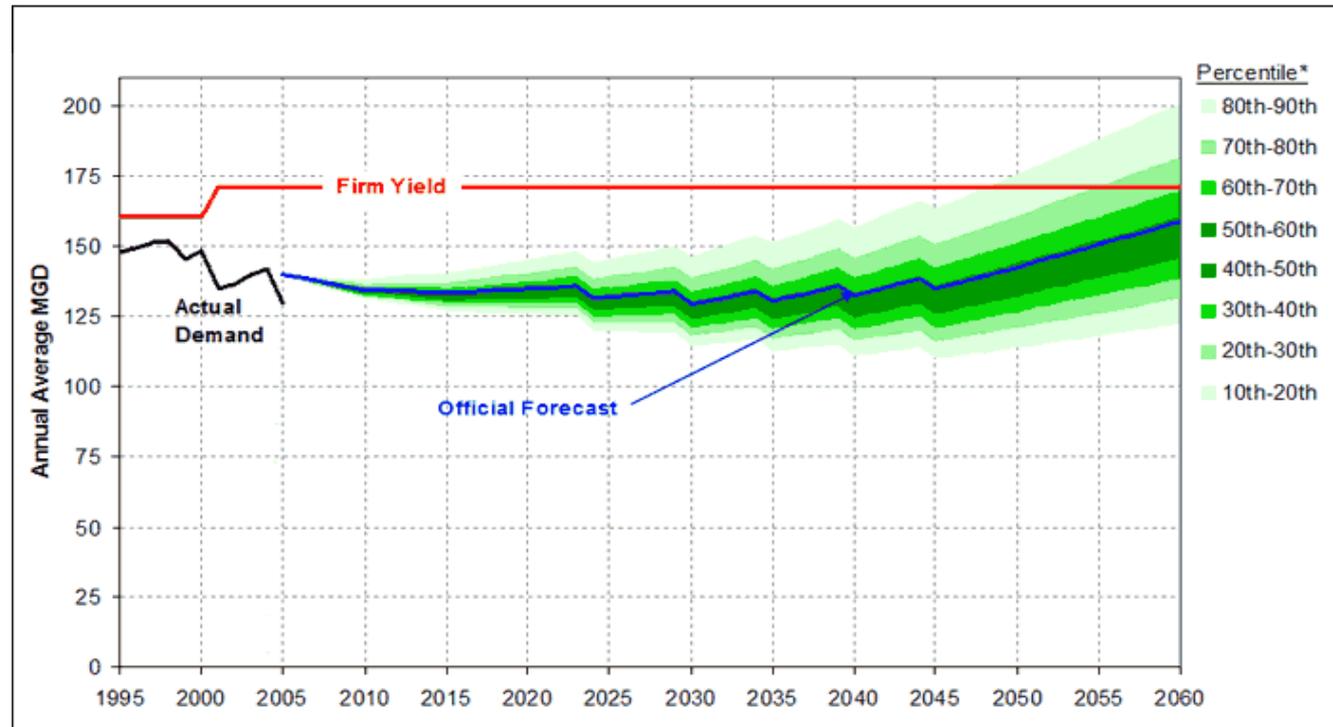


- Seattle City Limits
- Transmission Pipeline
- Water Bodies
- Municipal Watersheds
- Current Area Served (2006)
- Seattle Retail Service Area
- Seattle Wholesale Customer



Seattle's Water Supply Outlook

- **Total Demand:**
 - 2008: 123 mgd
 - 2060: 159 mgd
- **Firm yield 171 mgd**
 - Based on past 76 years
 - 98% reliability
 - Meet instream flows
- **New supply needed after 2060**
- **Potential impacts due to climate change not included**



Note: Percentiles represent the probability that actual demand will be less than the value shown. Ranges reflect uncertainty in projected household, employment, price and income growth, price elasticity, income elasticity, and conservation. Note that the Official Forecast is at about the 57th percentile.

Mitigation and Adaptation

- Complementary approaches to a comprehensive climate strategy
- *Mitigation* limits the magnitude of climate change
 - Greenhouse gas (GHG) *mitigation* can avoid, reduce or delay the impacts of climate change
- *Adaptation* limits the impacts of climate change
 - Some impacts are unavoidable due to past emissions, hence the need for *adaptation*

“A portfolio of adaptation and mitigation measures can diminish the risks associated with climate change”
- Intergovernmental Panel on Climate Change, 2007

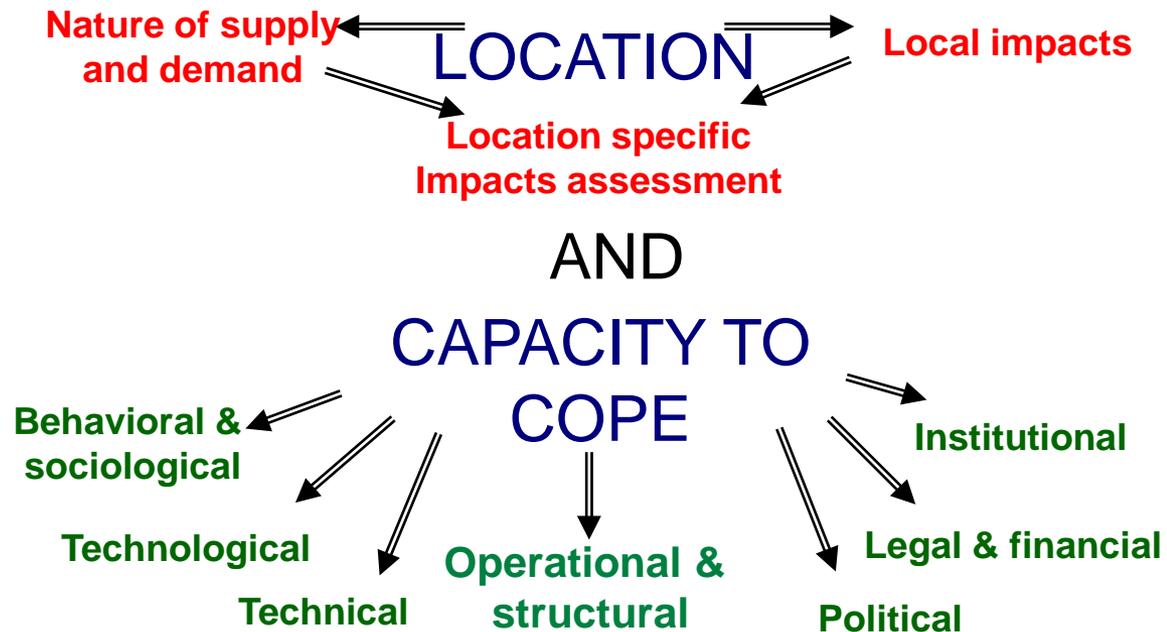


Climate Vulnerability and Adaptation

- Vulnerability is a function of location and capacity to cope*

- Adaptation pursued to reduce vulnerability and increase resiliency

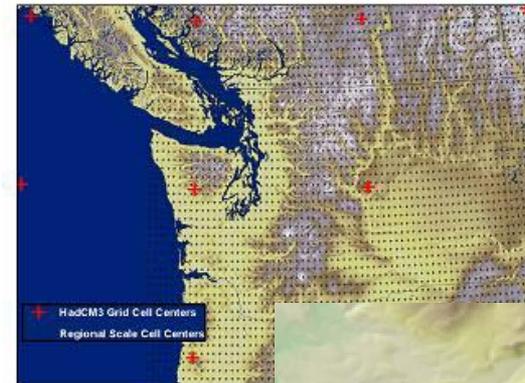
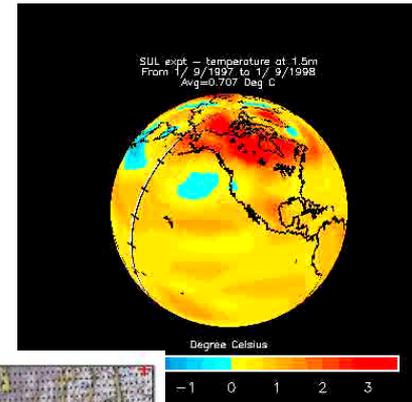
- Identify potential impacts
- Incorporate information into planning and decision-making
- Enhance capacities in multiple realms



Regional Climate Impacts

Downscaled GCM outputs to regional scale

- 3 Climate Change Scenarios for 2000, 2025, 2050, 2075:
 - Warm: GISS_ER-B1
 - Warmer: Echem5-A2
 - Warmest: IPSL_CM4-A2
- Temperature
 - Warming trend, primarily in winter and summer
 - Average warming is generally 1°C per 25-year period
- Precipitation
 - Less agreement between models than there is with temperature
 - In general, more precipitation in winter, less in summer
- Hydrology
 - Shift towards higher winter flows and lower spring/early summer flows
 - Substituted *future* hydrology for *historic* in SPU's systems models



Climate-Altered Hydrology:

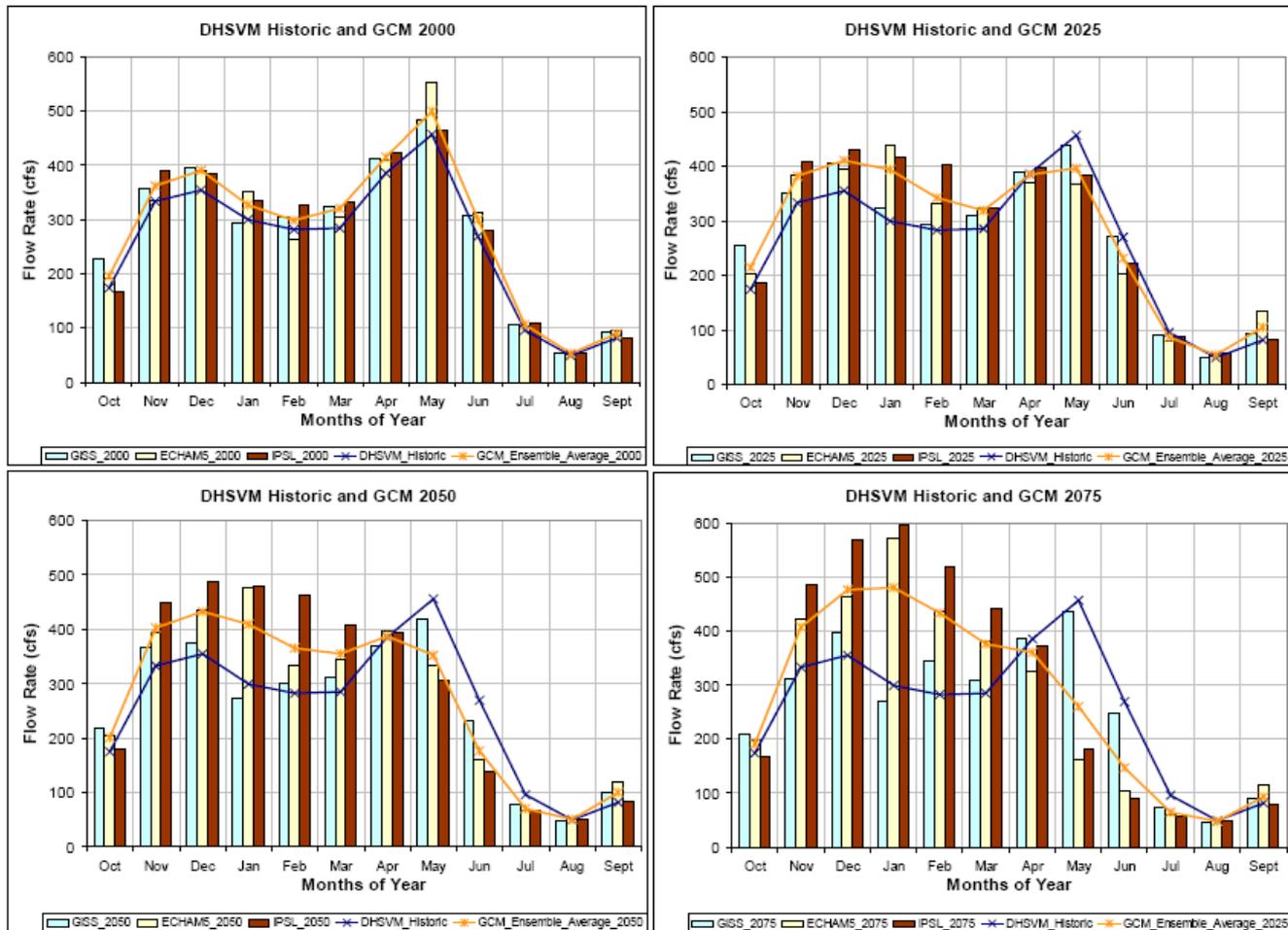
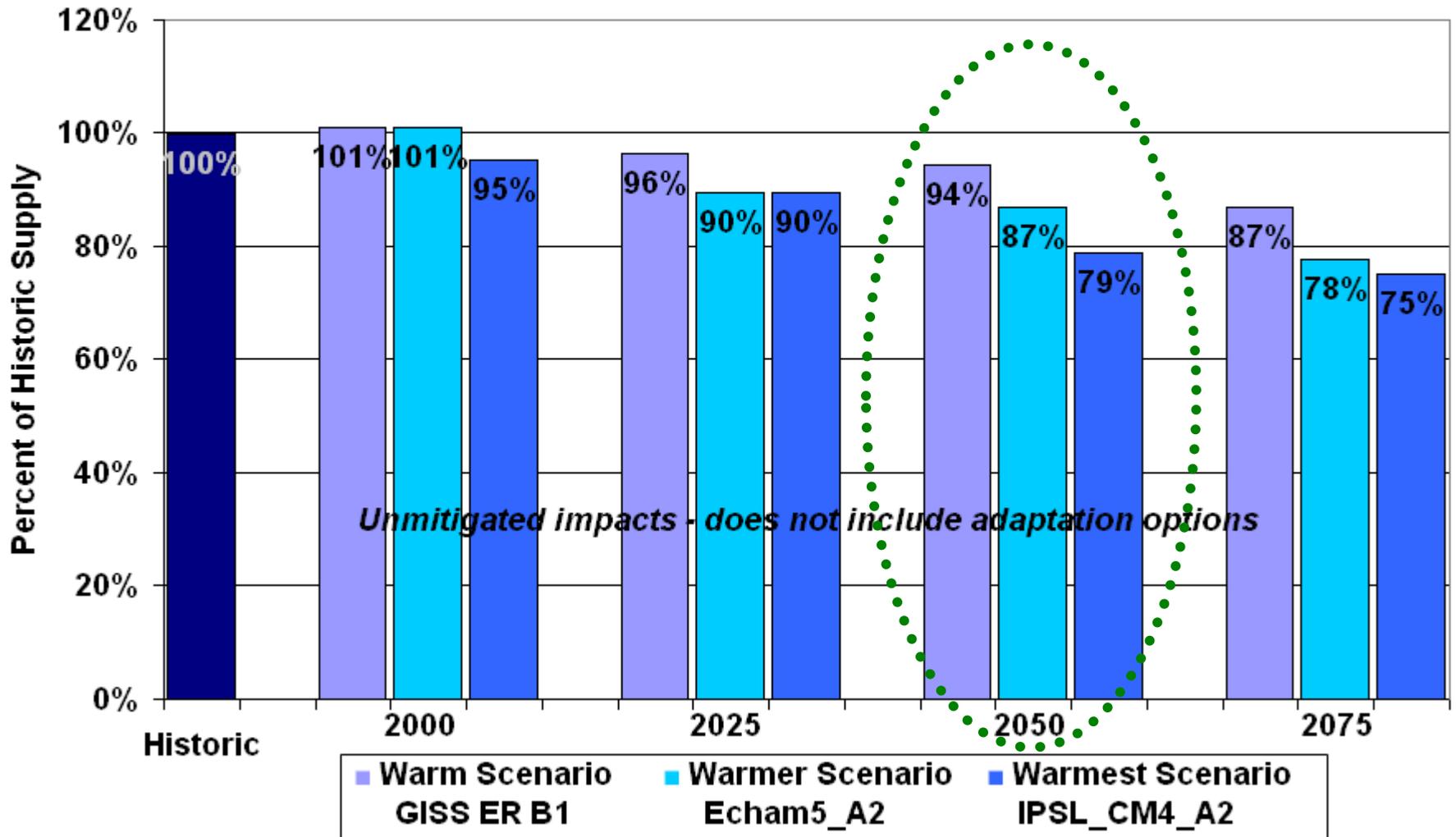


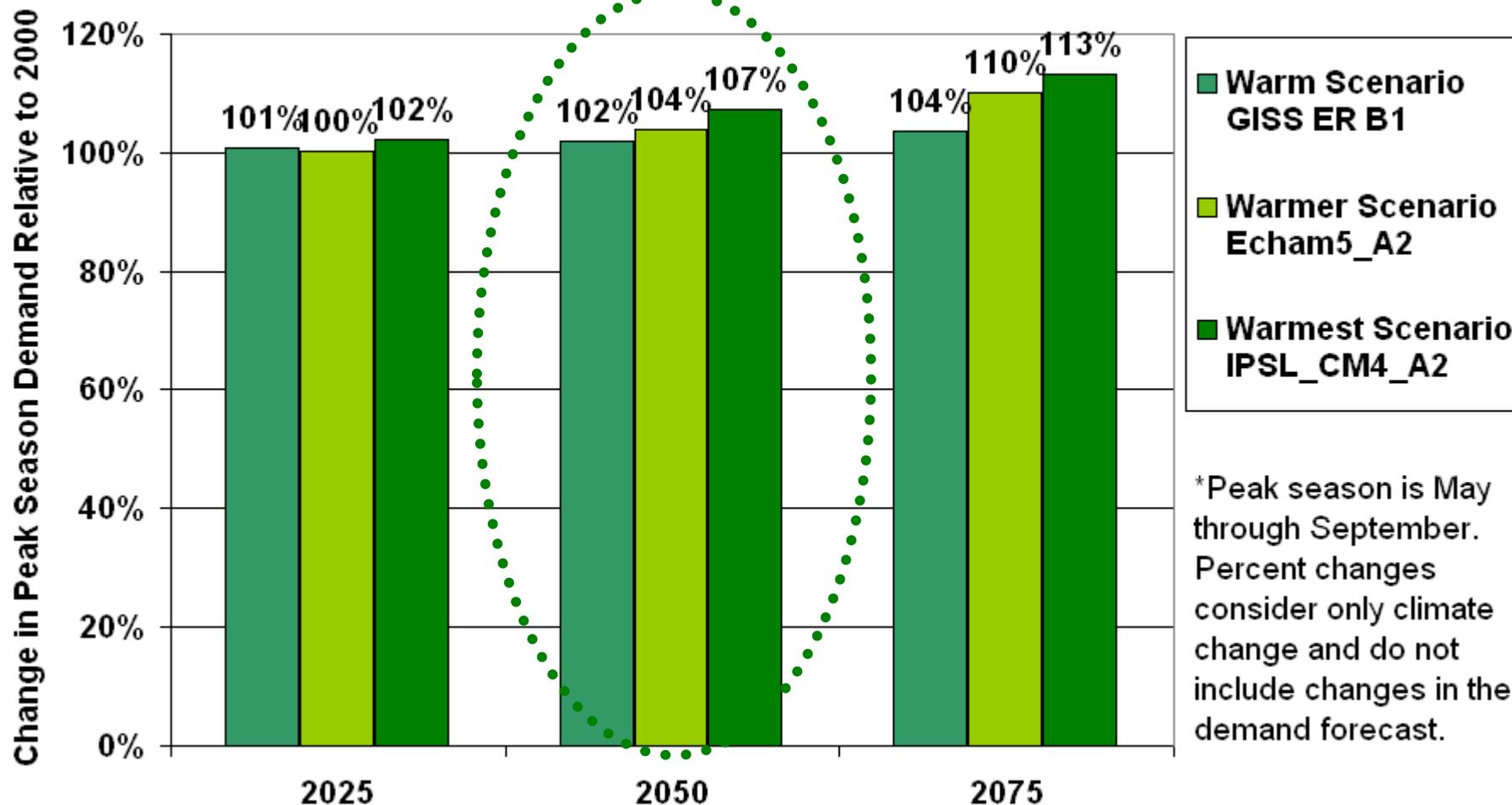
Figure 51 – Simulated 2000, 2025, 2050, and 2075 Projected Annual Average Streamflow at Cedar 1

Source: Polebitski, A., L. Traynham, and R.N. Palmer. 2007. "Technical Memorandum #5: Approach for Developing Climate Impacted Streamflow Data and its Quality Assurance/Quality Control" A report prepared by the Climate Change Technical Subcommittee of the Regional Water Supply Planning Process, Seattle, WA.

Change in Water Supply with Climate Change Scenarios *Baseline Operations*



Change in Peak Season Consumption* with Climate Change Scenarios

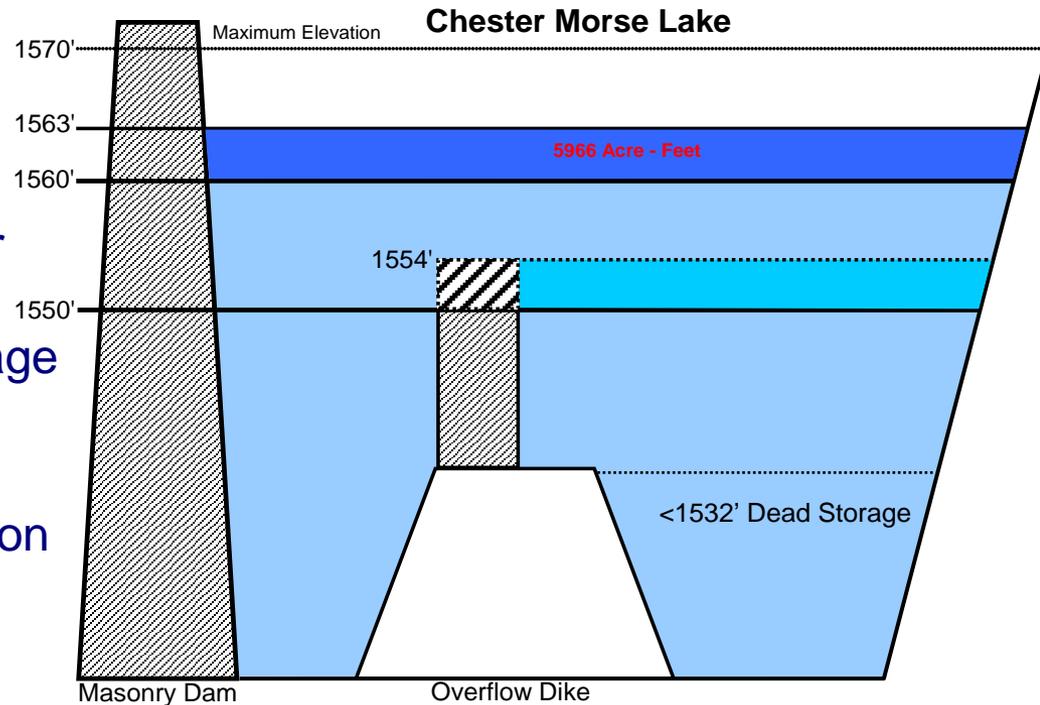


Portfolio of Operational / Structural Adaptation Options

- SPU identified a series of intra-system modifications and new supply options – and grouped them into Tiers.
- Applied the effects on supply using Tier 1 intra-system modifications.
 - Restore available supply to current levels, or better.
 - Generally add more storage to system.
 - No or low cost, or already in place but not in models.
- Where Tier 1 modifications did not restore supply fully, identified the need for subsequent Tiers.
 - Options become more costly and complex.

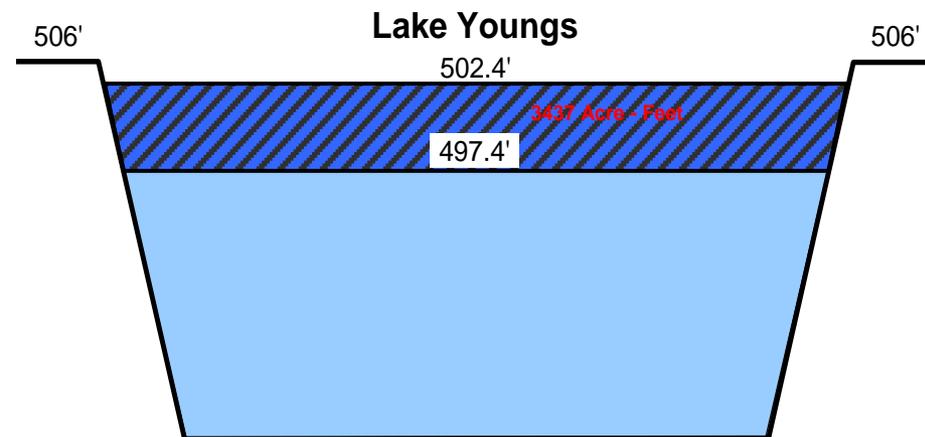
Tier 1 Modifications – Operational

- Builds on current practice of dynamic reservoir operations
 - Based on current conditions.
- Refill Chester Morse Reservoir 3 feet higher
 - Adds **12%** more useable storage
- Raise Overflow Dike by 4 feet
 - Reduces seepage losses
 - New project under consideration



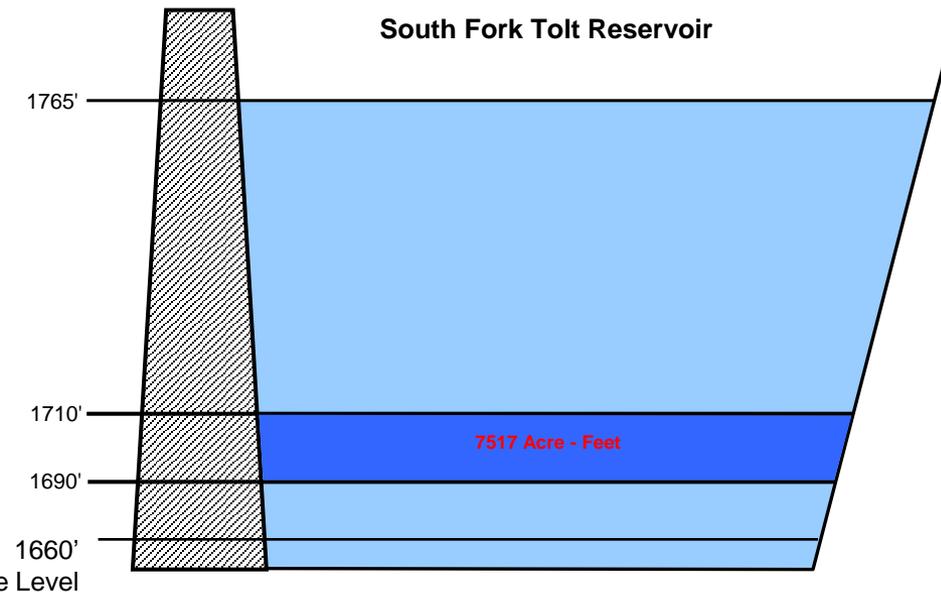
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- Lake Youngs – model use of 5 feet storage for supply
 - Current practice but not modeled
 - Adds **7%** more useable storage



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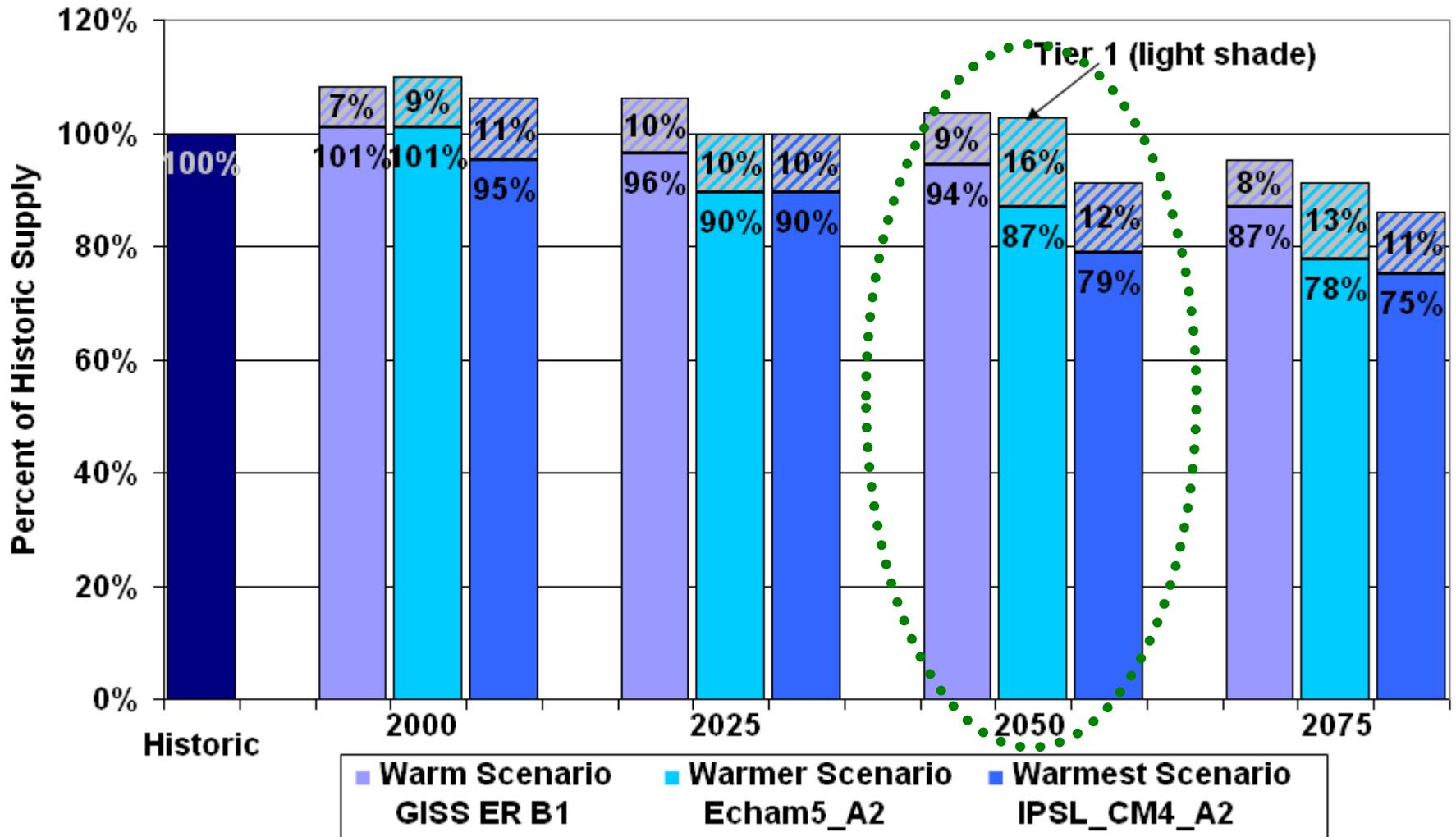


Low cost, first step actions

Enhance flexibility, operational capacity of current assets and infrastructure to reflect dynamic conditions

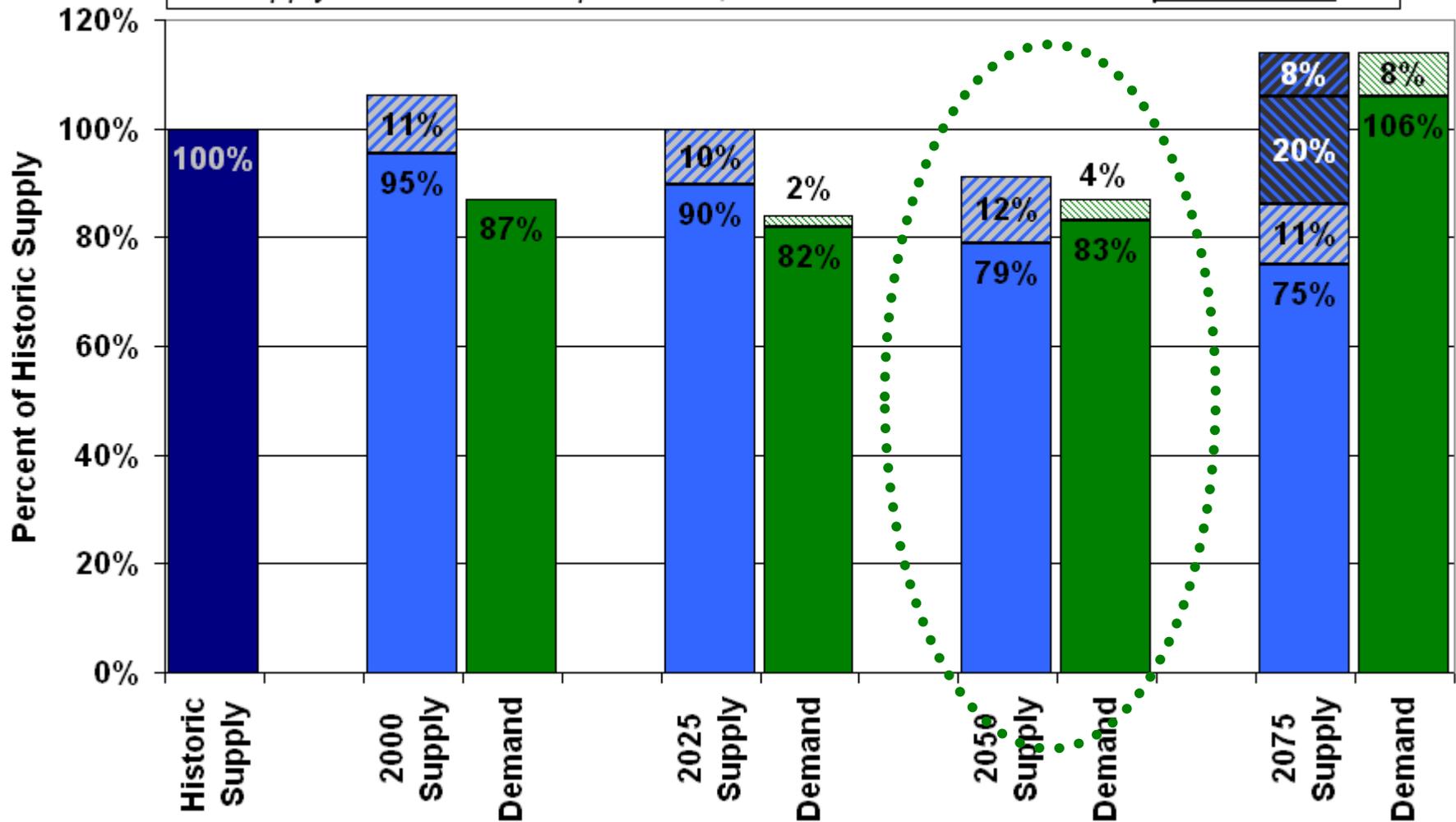
Offset loss of storage from *reduced snowpack* by accessing more *reservoir* storage

Change in Water Supply with Climate Change Scenarios *Baseline Operations plus Tier 1*



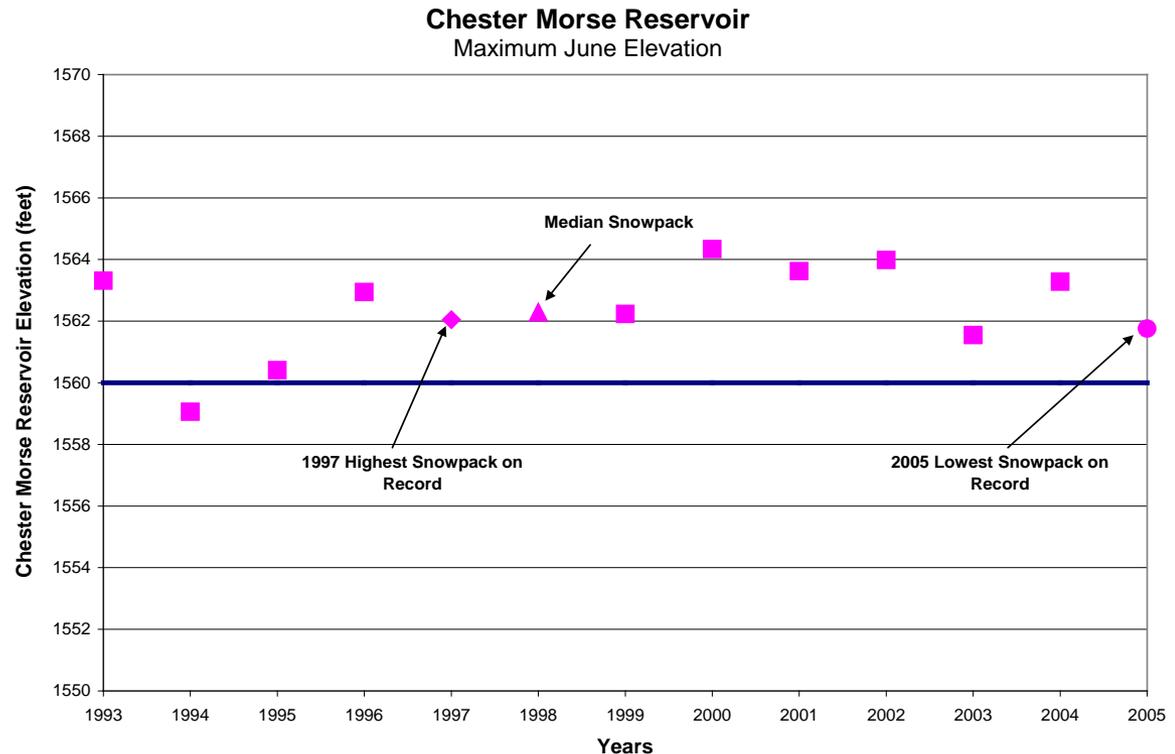
Warmest Scenario Results from Monthly CUE and Demand Forecast Model - IPSL_CM4_A2

Supply bars show Base plus Tiers; Demand bars show forecast plus climate



Testing Operational Flexibility: 2005

- Snowpack:
 - Lowest snow water equivalent on record (61 yrs)
- Precipitation
 - MAMJ - 26th driest (75 yrs)
- Temperature
 - MAMJ - 23rd warmest (75 yrs)
- Reservoir levels in June same as year with largest snowpack on record, 1997
- Refill level higher than assumed in water supply models





Multiple Adaptation Realms

■ Operational and Structural

- Traditional domain, focus of utilities
- Optimize system operations to enhance flexibility
- Modify infrastructure to reflect changing conditions
 - Identify intra-system modifications before new supply, suite of options instead of single, large projects
 - Used future hydrology to assess how the modifications would perform and ability to restore supply to current yield



Multiple Adaptation Realms

- Behavioral/sociological
- Technological
- Legal/Financial
- Institutional
- Technical
- Political

Behavioral/Sociological: Conservation

- Since mid 80's:

- Population up,
consumption down

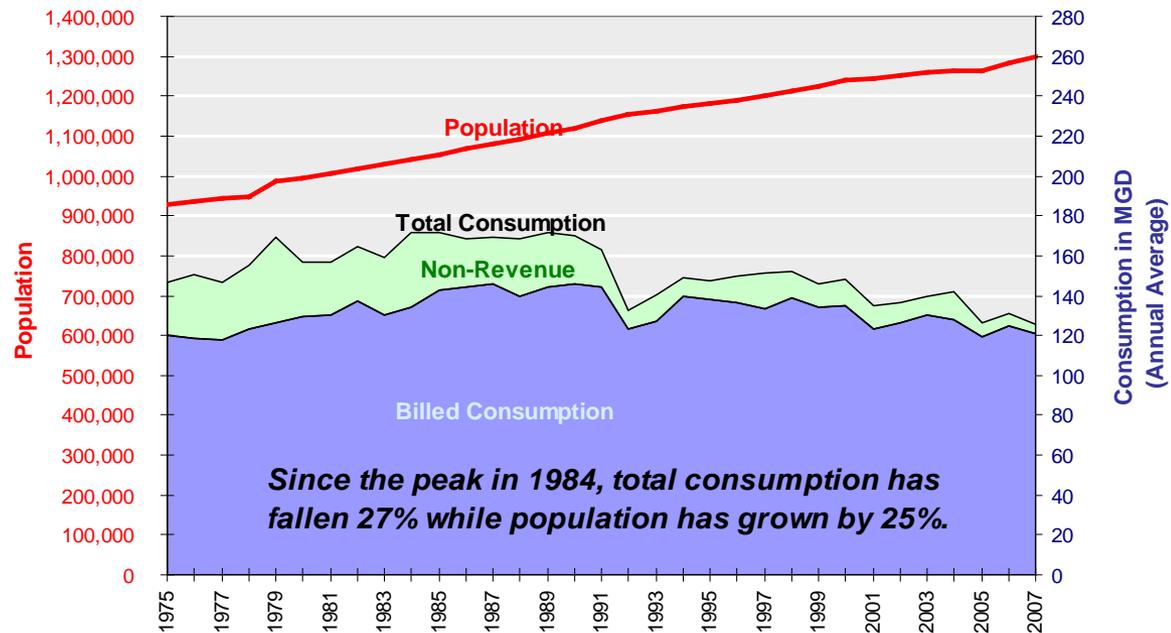
- Significant reductions
in water use

- 44 mgd of savings
since 1980

- Another 15 mgd of
savings 2010-2030

- Future conservation
seen as hedge
against climate
change impacts

**Growth in Population and Water Consumption
Seattle Regional Water System: 1975-2007**



Technological:

Urban water as supply

- Use of rain, storm, grey and waste water is emergent (blue, grey, black)
- Opportunities for integrated water management
 - Too much water in urban environment during winter, flooding problems
 - High quality drinking water used for non-potable purposes ~ 50% +
- City of Seattle rainwater right
- Interest amongst early adopters in design and developer community
 - Gates Foundation - 3.7 liter cistern, use rainwater to flush 100+ toilets



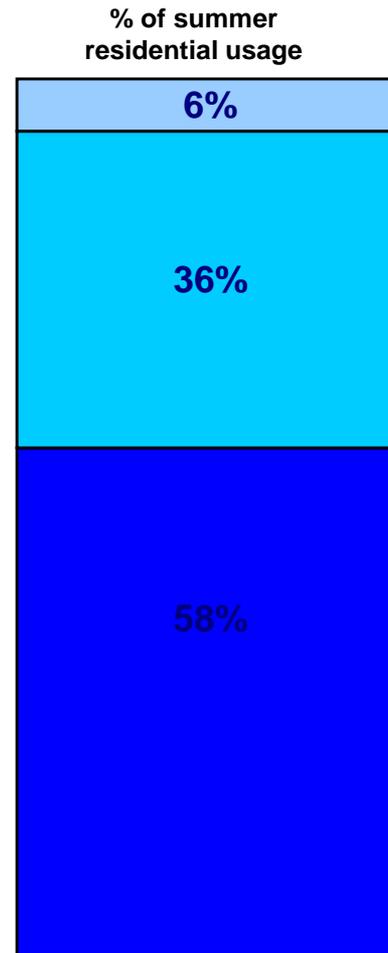
Legal & Financial: Buying Efficiency and Certainty

■ Pricing strategies

- SPU has tiered rate structure, the more one consumes the more one pays
- Also seasonal rates, water is more expensive in the dry summer than wet winter
- Sewer rates tied to water consumption, much more expensive, reduce water use also reduce sewer bill

■ Certainty

- Seattle settled historic and future claims with Muckleshoot Indian Tribe



Significantly stronger price incentive to very high volume users to reduce water use

3rd block – over 18 ccf
\$8.55 per ccf

Higher price incentive to reduce discretionary water use

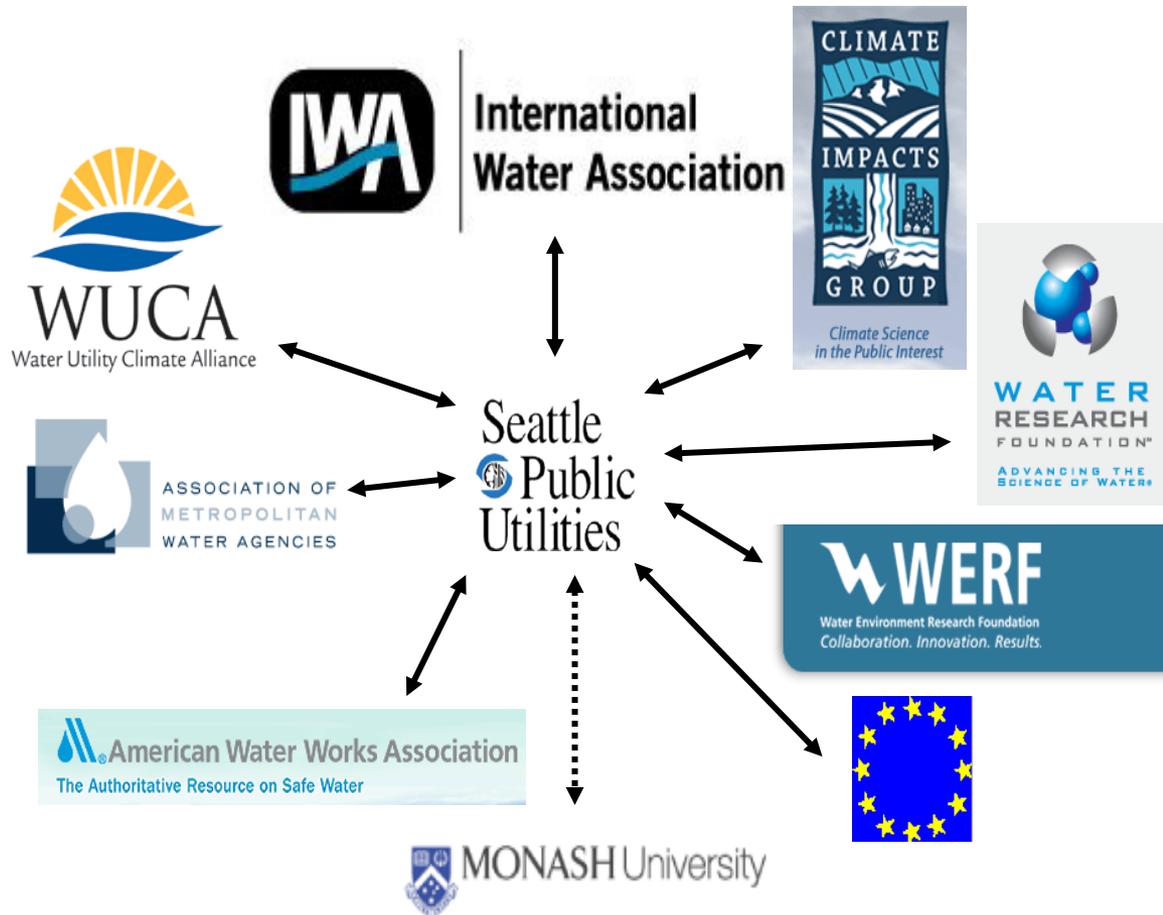
2nd block – next 13 ccf
\$3.35 per ccf

Lower rate “lifeline” amount of water

1st block – up to 5 ccf
\$2.88 per ccf

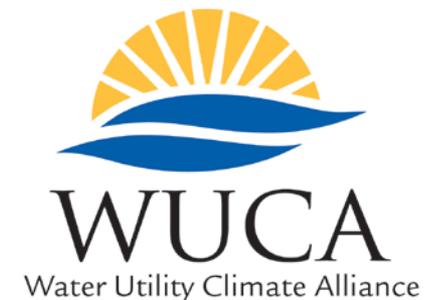
Institutional: Enhancing Our Knowledge Base

- Building internal capacity to understand technical/policy implications of climate change
- Tapping into network to incorporate information into internal decision-making and planning



Technical: Research

- Water Research Foundation
 - Developing multi-year climate research program for water sector
 - Initial focus: vulnerability assessments, information clearinghouse, impacts on demand
- Water Environment Research Foundation
 - Focus on stormwater & wastewater
- Potential collaboration with two EU research proposals
 - Water supply and sanitation
 - Urban flood management
- WUCA funding research in two areas:
 - Decision Support Systems
 - Climate Modeling
- Need for collaborative partnerships between utilities and researchers



Political:

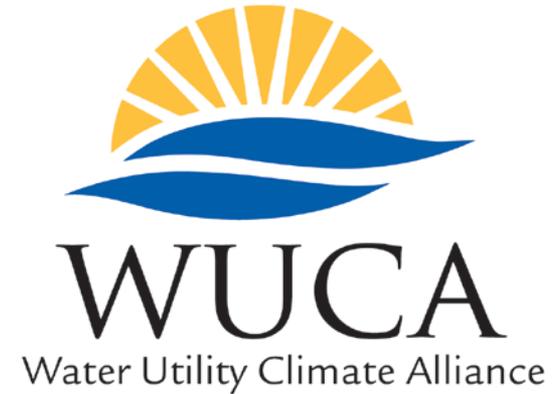
Leverage industry groups

■ WUCA

- Eight urban water suppliers
- Focused on influencing federal legislation
- Funding research

■ IWA

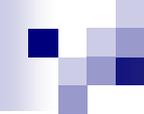
- Active in international arena and developing world issues
- Created Climate Change Specialist Group
- Publishing a book with AWWA



Denver Water
Metropolitan of Southern CA
NYC Dept. of Env. Protection
Portland Water Bureau
San Diego County Water Authority
San Francisco PUC
Seattle Public Utilities
Southern Nevada Water Authority



**International
Water Association**



Conclusions

- Climate impacts are significant, if not imminent
- Vulnerability is a function of location and capacity to cope
- Opportunities to expand concept of what constitutes adaptation
 - Adjust operations before large new structural investments
 - Pursue non-structural possibly before new structural, dependent upon risk appetite, and timing/magnitude in locale
- Collaboration as a way to leverage knowledge
- Need to stay engaged and incorporate new research

Thank You

