California Water Plan Update 2009

Future Scenarios Overview and Statewide Summary

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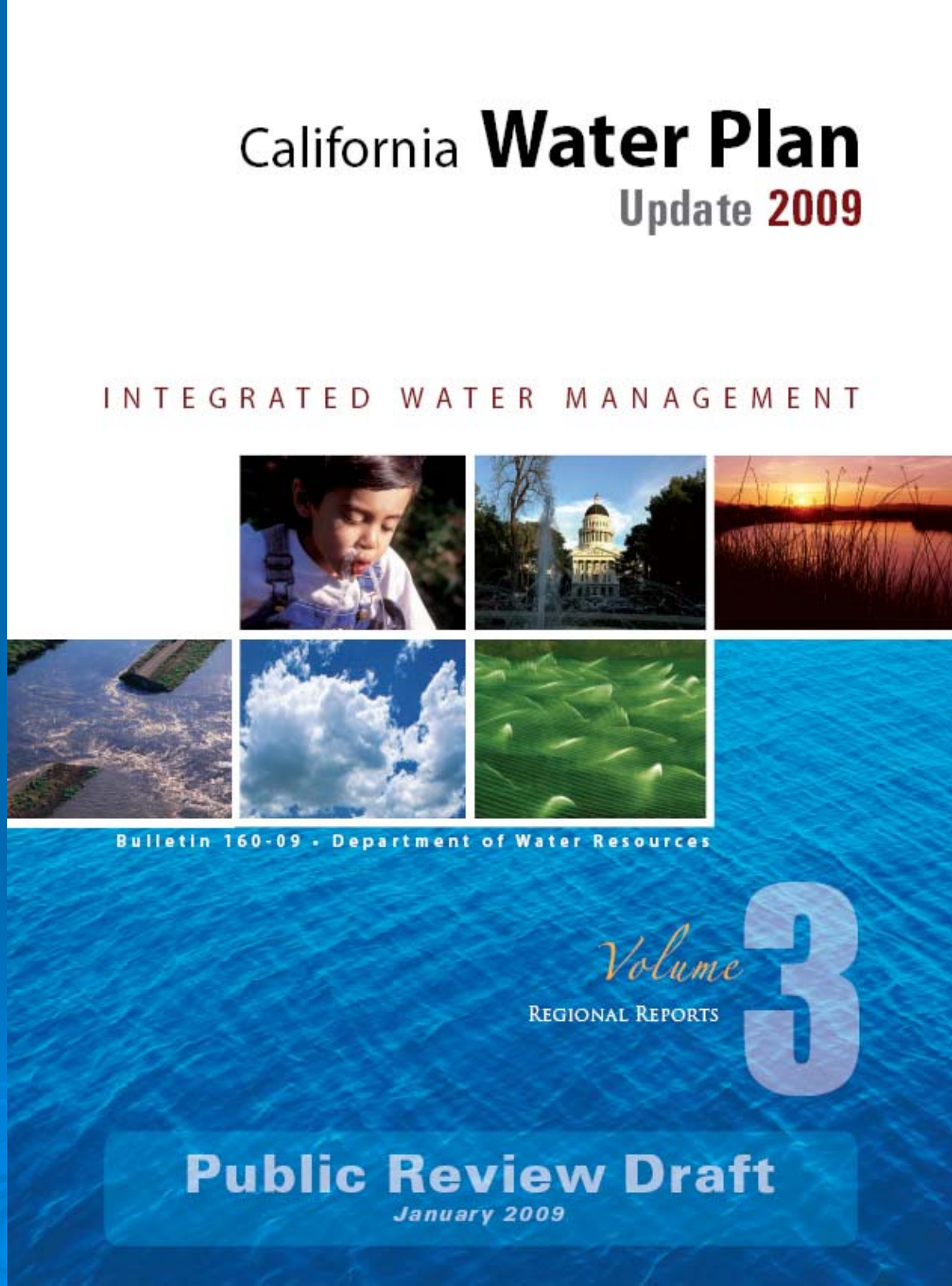


Water Plan Scenarios Used To Consider Future Uncertainty

- Three plausible yet very different conditions during 2050 planning horizon
- Explore key uncertainties facing water community
- Factors water community has little control over
- Not predictions ---- used to evaluate water management responses

3 Baseline Scenarios for 2050
Plausible Yet Different Futures

- **Current Trends**
  - ✓ Recent trends continue into the future for population, agricultural production, environmental water, and background water conservation
- **Strategic Growth**
  - ✓ More coordinated planning & infill
  - ✓ Lower population growth
  - ✓ Lower reduction in agricultural production
  - ✓ New environment water -- High
  - ✓ More background water conservation
- **Expansive Growth**
  - ✓ Less coordinated planning, sprawl
  - ✓ Higher population growth
  - ✓ Higher reduction in agricultural production
  - ✓ New environment water -- Low
  - ✓ Less background water conservation

Technical Outreach for Scenario Work

- December 2007 – Scenario proposal
- April 2008 – Shared Vision Planning
- June 2008 – Refinement of scenario proposal
  - Climate change
  - Environmental water
  - Flood management
  - Water quality
- February 2009 – Review of preliminary demands
- June 2009 – Review of revised results & graphics

Quantifying Future Scenarios for Update 2009

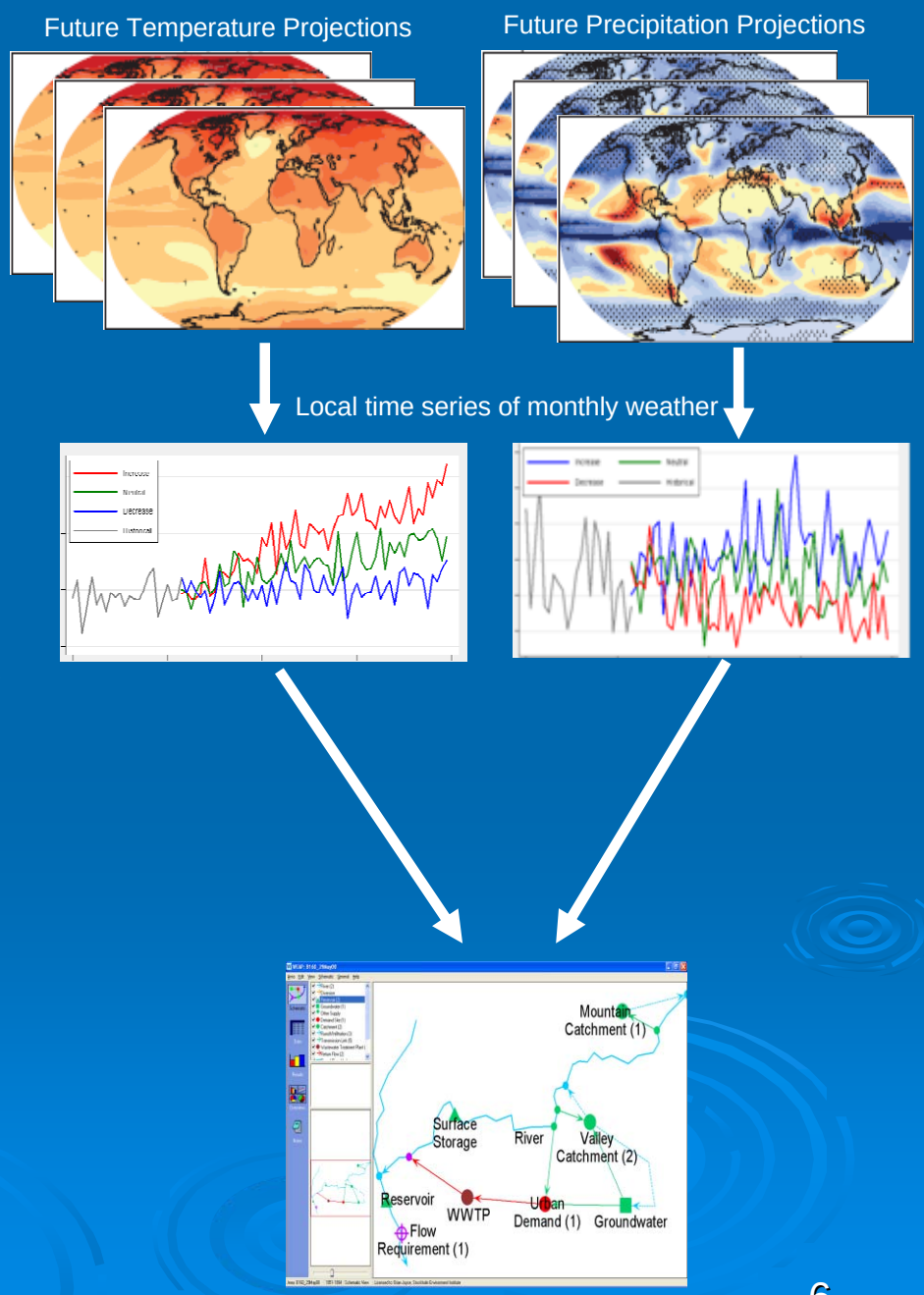
- Using WEAP analytical tool to quantify water demand and supplies for future scenarios and water management responses
- WEAP Hydrologic Region analysis being done for all regions --- high level, coarse representation
- WEAP Planning Area analysis for Sacramento and San Joaquin regions --- more physically based
- Each scenario evaluated with 12 climate sequences (climate change, multiple year droughts, wet years)

Analysis Considers Possible Climate Change Impacts

- **Global circulation models produce numerous projections of future temperature and precipitation patterns**
  - **Six GCMs**
  - **Two global emissions scenarios**

- **Statistical downscaling methods produce local weather sequences***

- **Weather sequences drive hydrologic models to calculate:**
  - **irrigation demand (HR and PA)**
  - **hydrologic flows (PA analysis, only)**



Hydrologic Model

* Using the World Climate Research Programme's (WCRP's) Coupled Model Intercomparison Project phase 3 (CMIP3) multi-model dataset

Scenario Assumptions for Key Factors

Statewide Summary

Scenario Factors Affecting Water Demand	Year 2005 Observed	2050 Current Trends	2050 Strategic Growth	2050 Expansive Growth
Population (millions)	36.7	59.5	44.2	69.8
Irrigated Crop Area (thousand acre)	9245	8566	8999	8254
Environmental Water Instream flows & refuges (maf)	2005 Level	+1.0	+1.5	+0.6
Background Water Conservation (% Incr.)	----	10%	15%	5%

Hydrologic Region Scale Analysis

Hydrologic Region Analysis

- Monthly, climate-driven demands to 2050
  - reflect global climate change projections
  - Agriculture, Urban, and Environmental sectors
- Simple representation of supplies possible

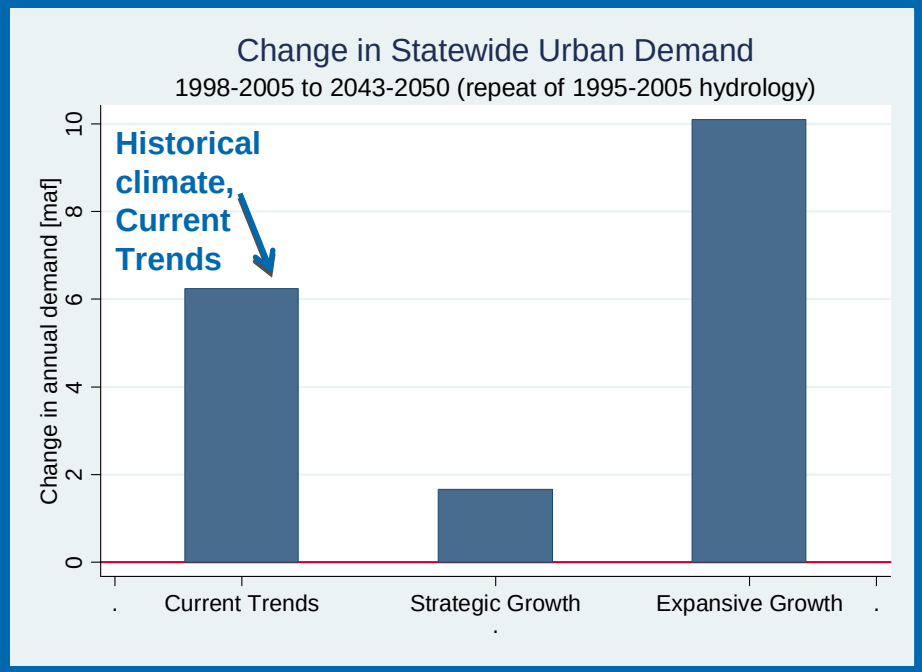
All 10 Hydrologic Regions

Statewide Scenario Demand Analysis is Only the Beginning

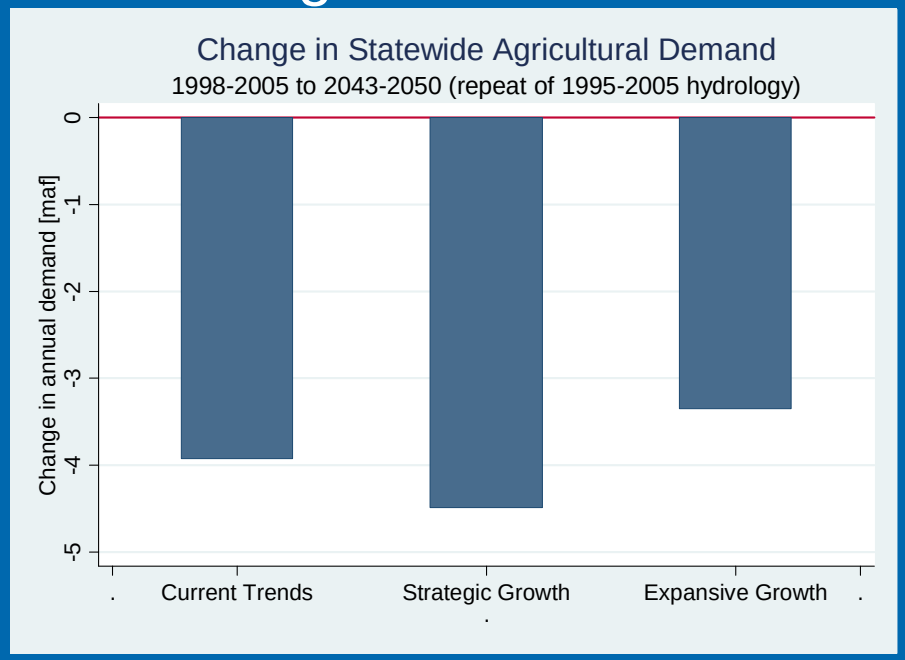
Uncertain Factors (X) and Scenarios	Management Actions (L) & Response Packages
Population Household factors Employment factors Irrigated Crop Area } 3 land use/ demographic scenarios Temperature Precipitation } 12 climate sequences ★ New! + historical	Current management (no response) Response packages evaluated using Planning Area model for select Hydrologic Regions
Model (R)	**Performance Measures (M)**
WEAP model by Hydrologic Region ★ New!	Demand (historical climate) Demand (projected climate) Supply and environmental flows addressed using Planning Area model

Change in statewide water demand (assuming historic climate) vary widely across narrative scenarios and sector

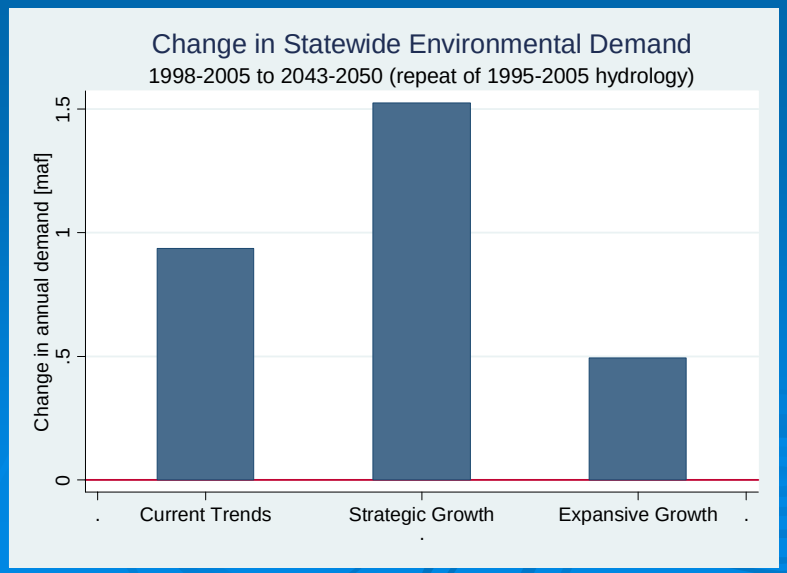
Urban Sector



Agricultural Sector



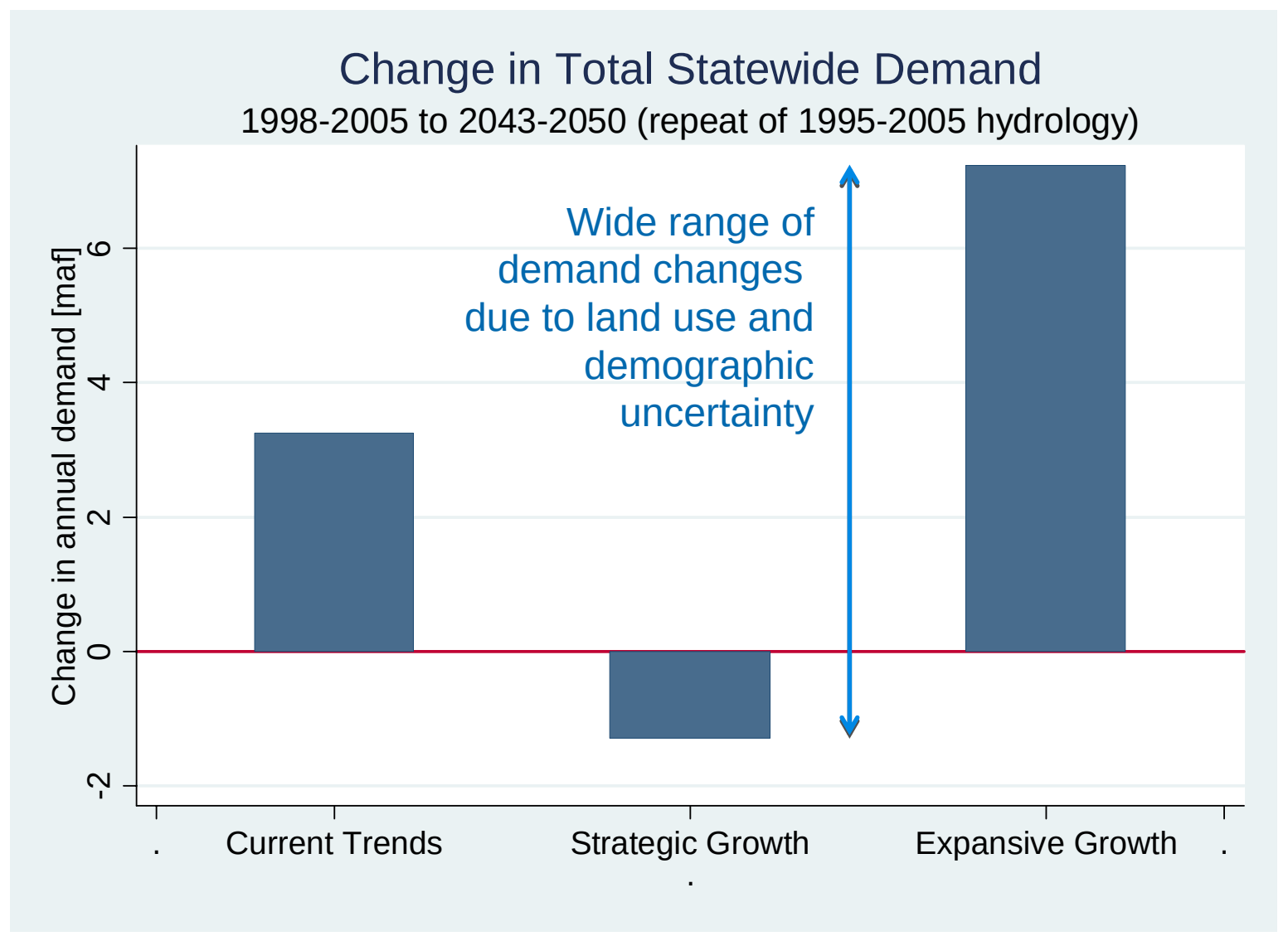
Environmental Sector



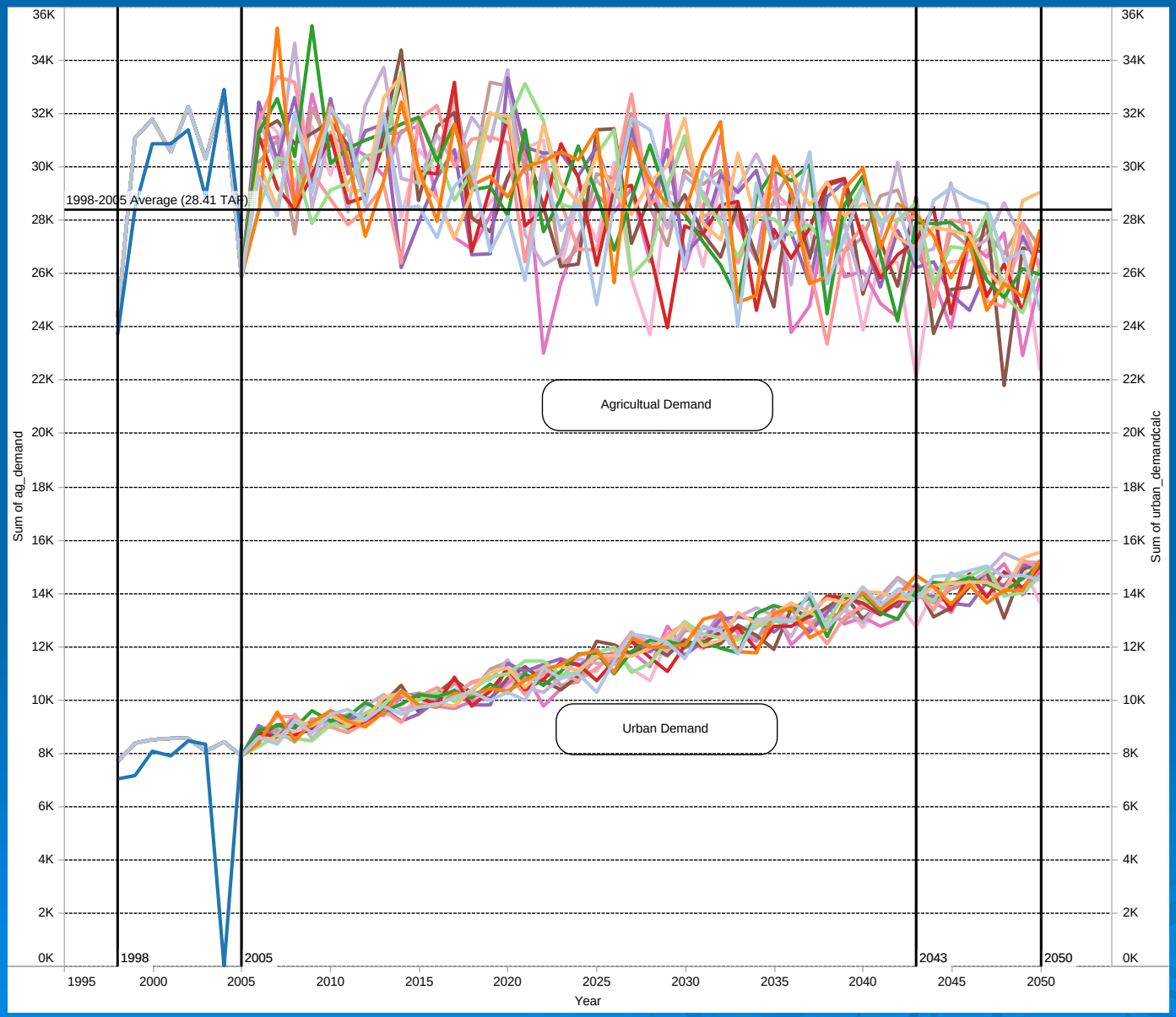
Results assume a *repeat of 1998-2005 hydrology* in 2043-2050

Total statewide water demand may increase or decrease depending on land use and demographic changes (assuming historic climate)

Total Demand

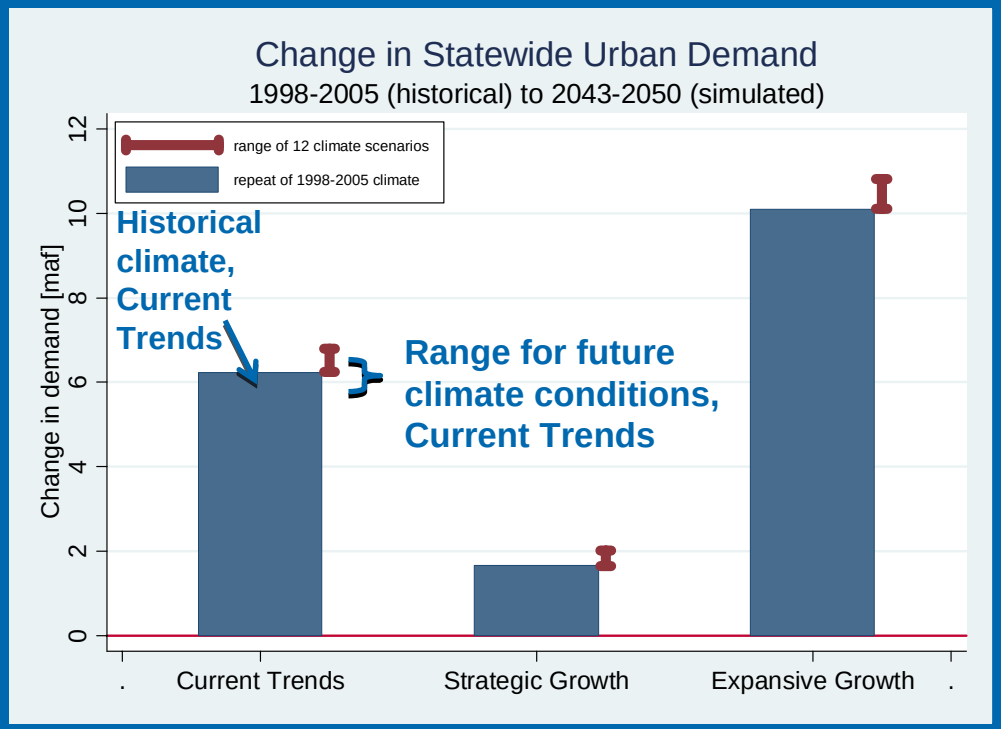


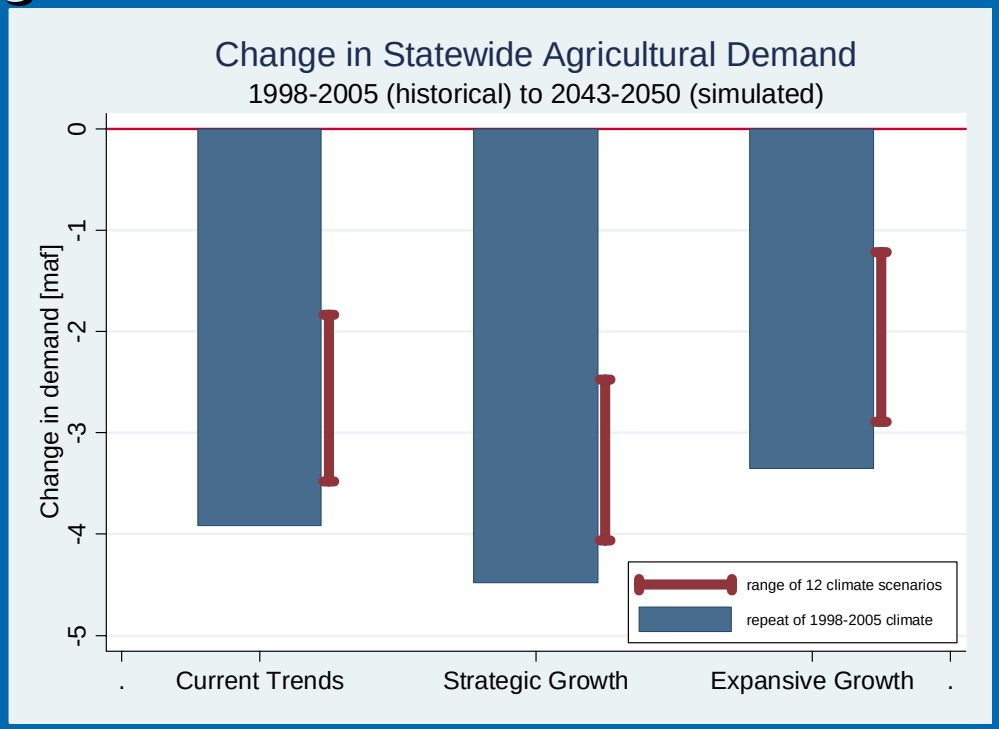
Climate change increases variability and range of future statewide water demands

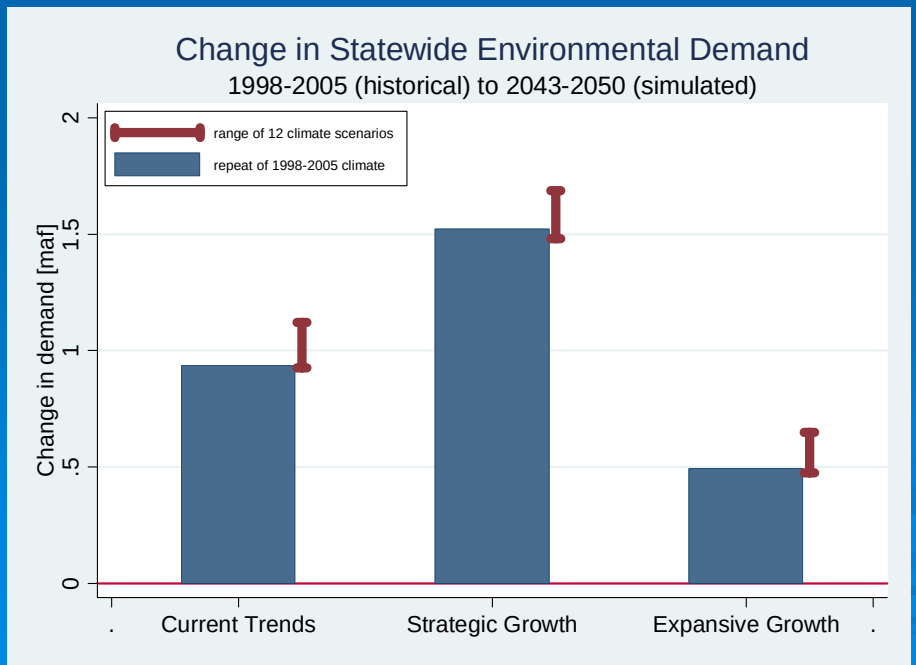


- Current Trends narrative scenario only
- Each colored line represents 1 of 12 climate scenarios
- Historical period shows actual demand (blue) and model calculated demand (gray line)
- Climate impacts outdoor urban demand only
- Ag demand changes do not imply declines in production

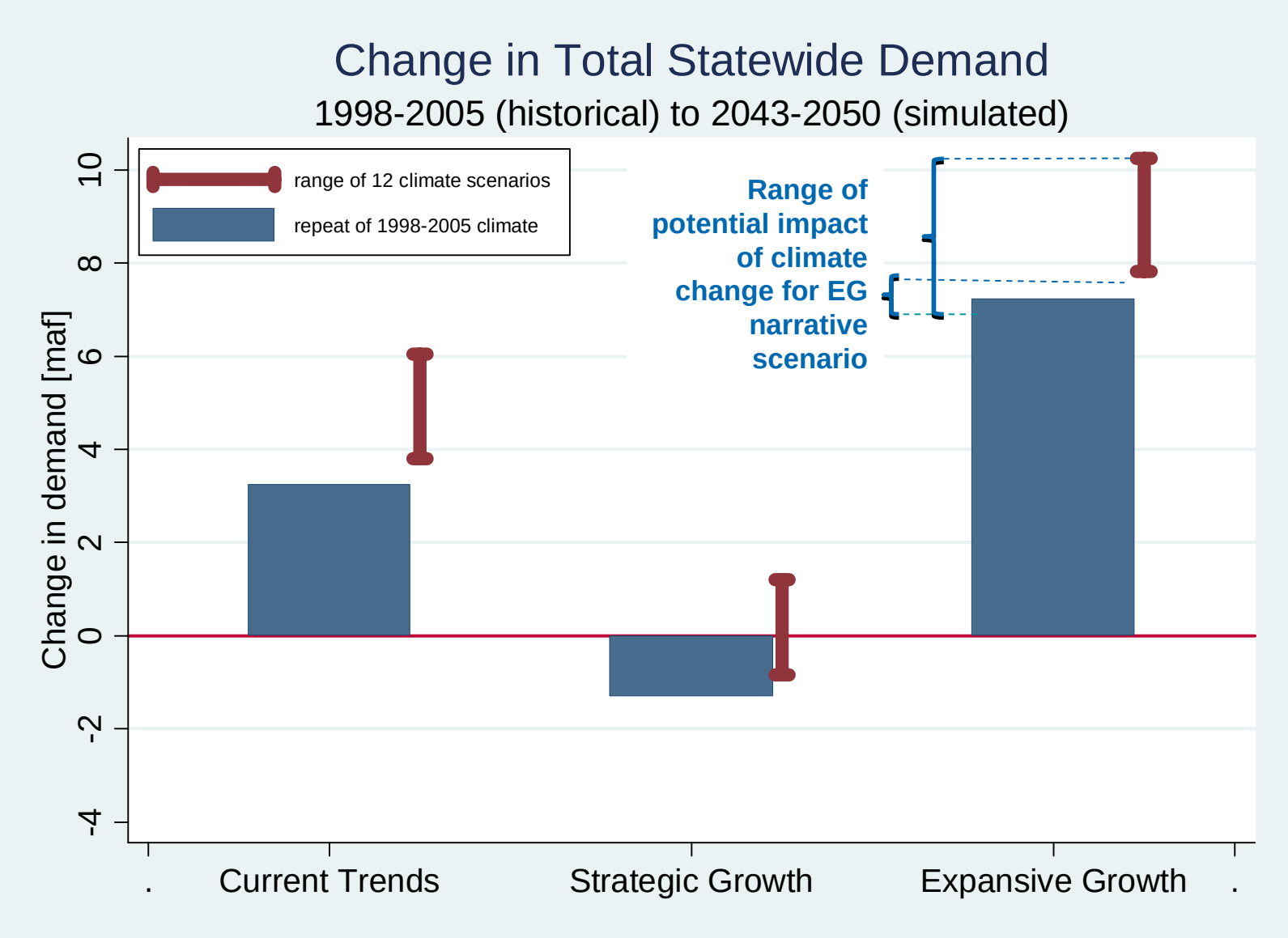
Inclusion of potential climate impacts increases change in demand



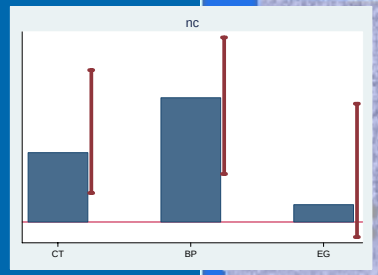


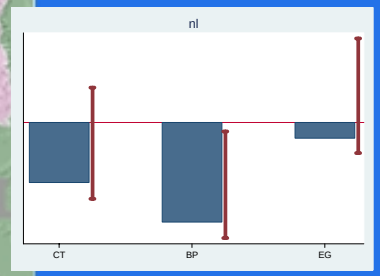


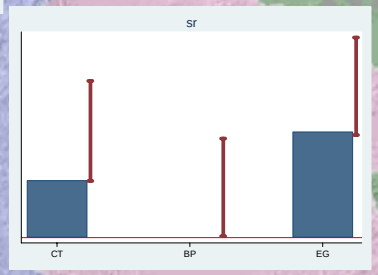
Potentially-significant climate impact on total statewide demands possible

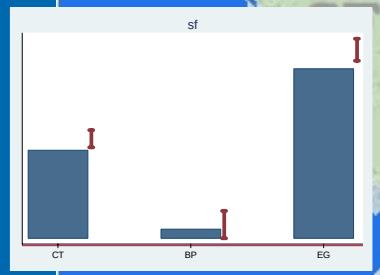


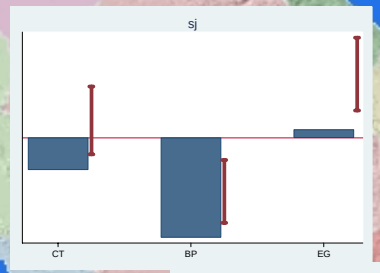
Significant regional differences in scenario water demand changes

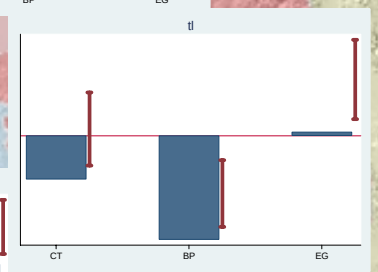


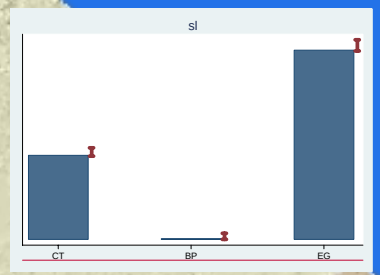


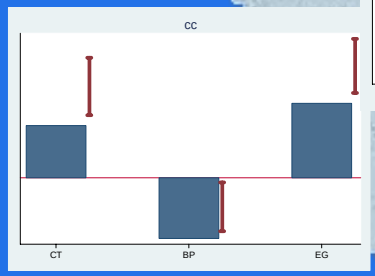


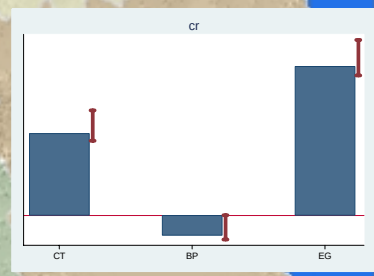


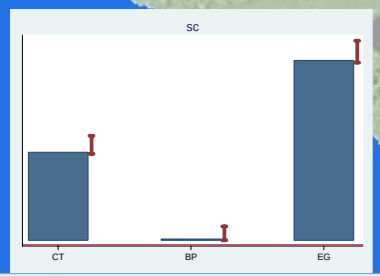


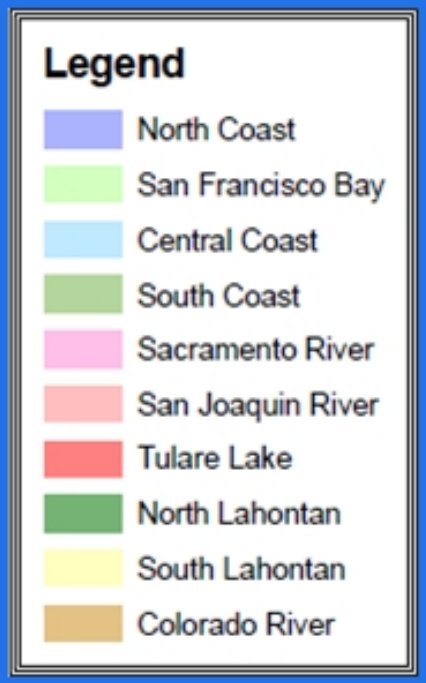






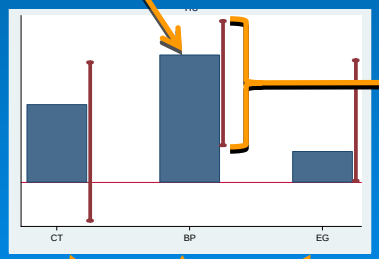






KEY:

Demand change, Historical climate



Demand change range, Future climate

Narrative Scenarios

Planning Area Scale Analysis

Preliminary Results

Planning Area Analysis
Sacramento and San Joaquin River Regions

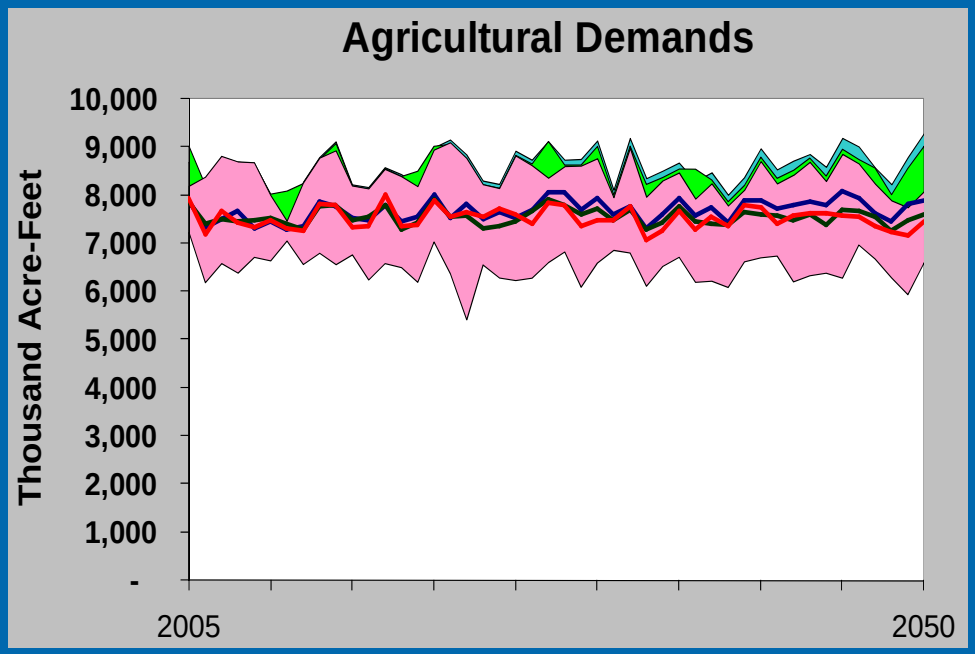
- Hydrologically-based water system simulation by month to 2050
  - reflect global climate change projections
- Estimate environmental flows, system operations, deliveries, and reliability
- More direct representation of response packages

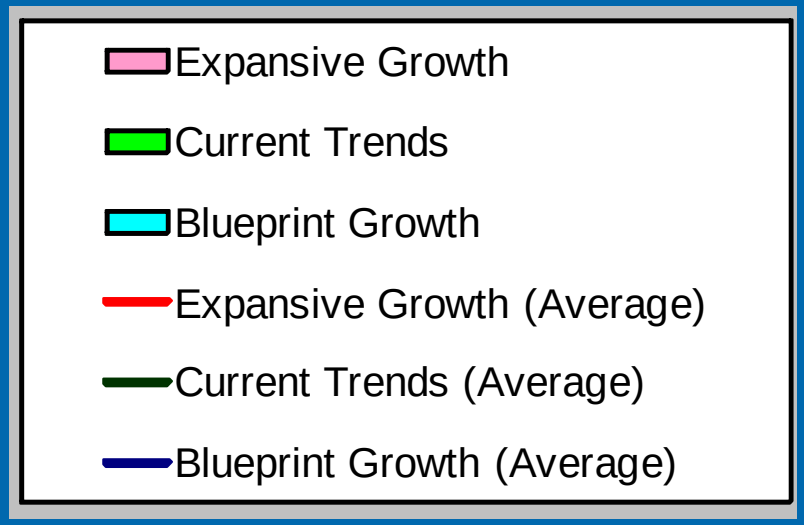
Sacramento River & San Joaquin River Hydrologic Regions

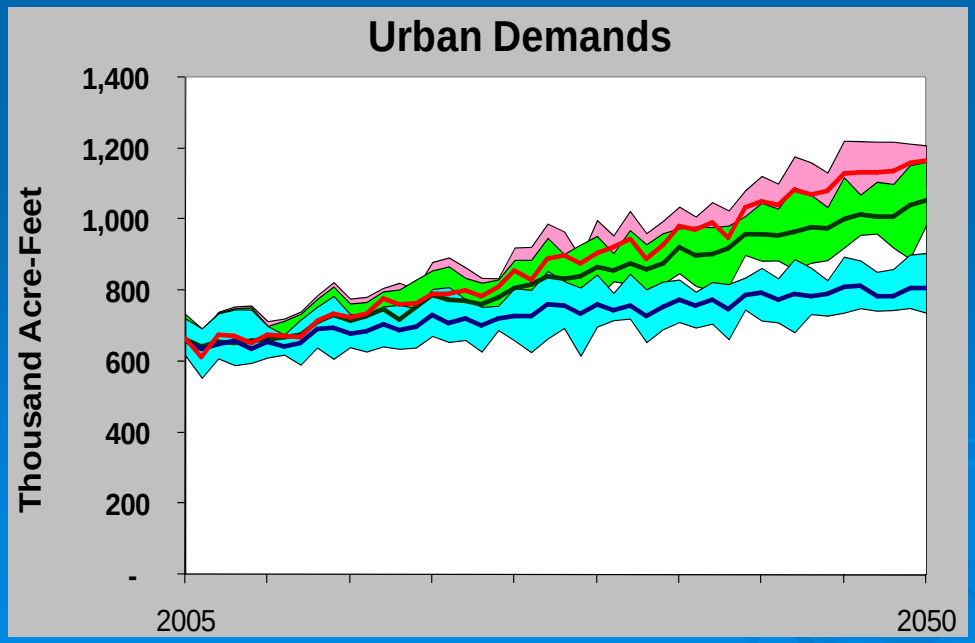
Planning Area Scale Model
Sacramento River and San Joaquin River HR's

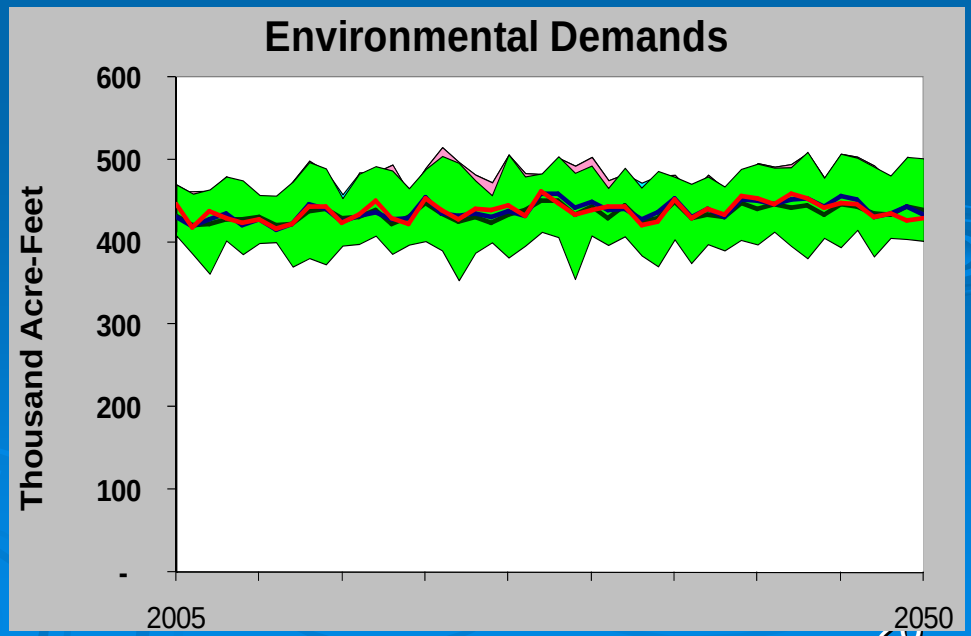
Uncertain Factors (X) and Scenarios*	Management Strategies (L) & Response Packages
Population Household factors Employment factors Irrigated crop area } 3 Scenarios Temp/Precip } 12 Climate sequences + Historical	Current management (no response) Expected management Themed response packages - High water use efficiency - Local resource development - Storage and conveyance
Model (R)	**Performance Measures (M)**
Planning Area WEAP model for SR and SJ Hydrologic Regions * PA Scenarios same as for HR (for now)	Demand by node Delivered supply by node Reliability - % of years with unmet demand by sector - unmet demand by node Environmental objectives - Fish flows (AFRP) (4) - Delta outflow - X2 position Operations - Storage volume for major dams (5) - Delta exports (Cal Aqueduct and Delta Mendota canals) Groundwater volumes "Cost" of response package implementation

Demands – Sacramento River HR

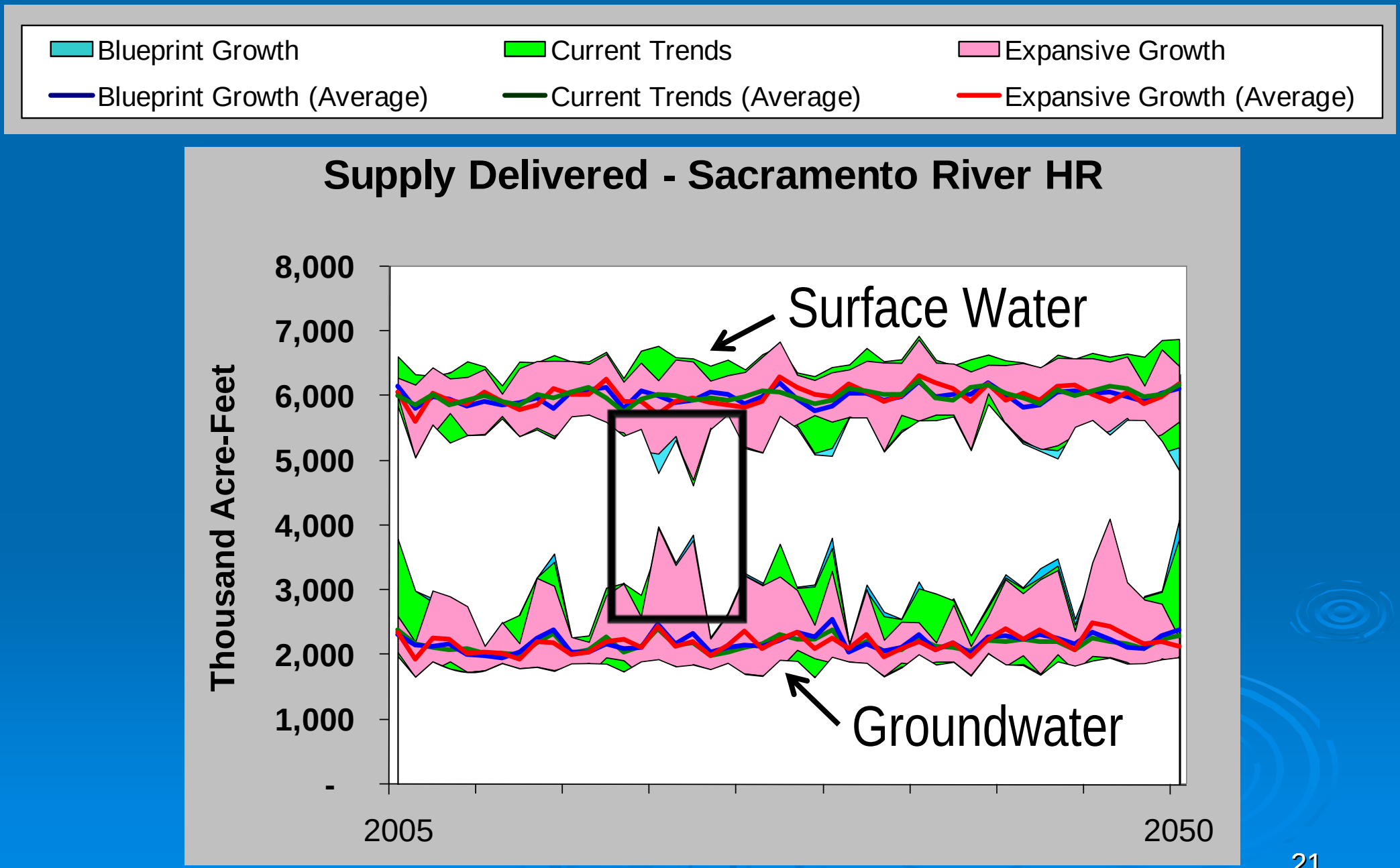




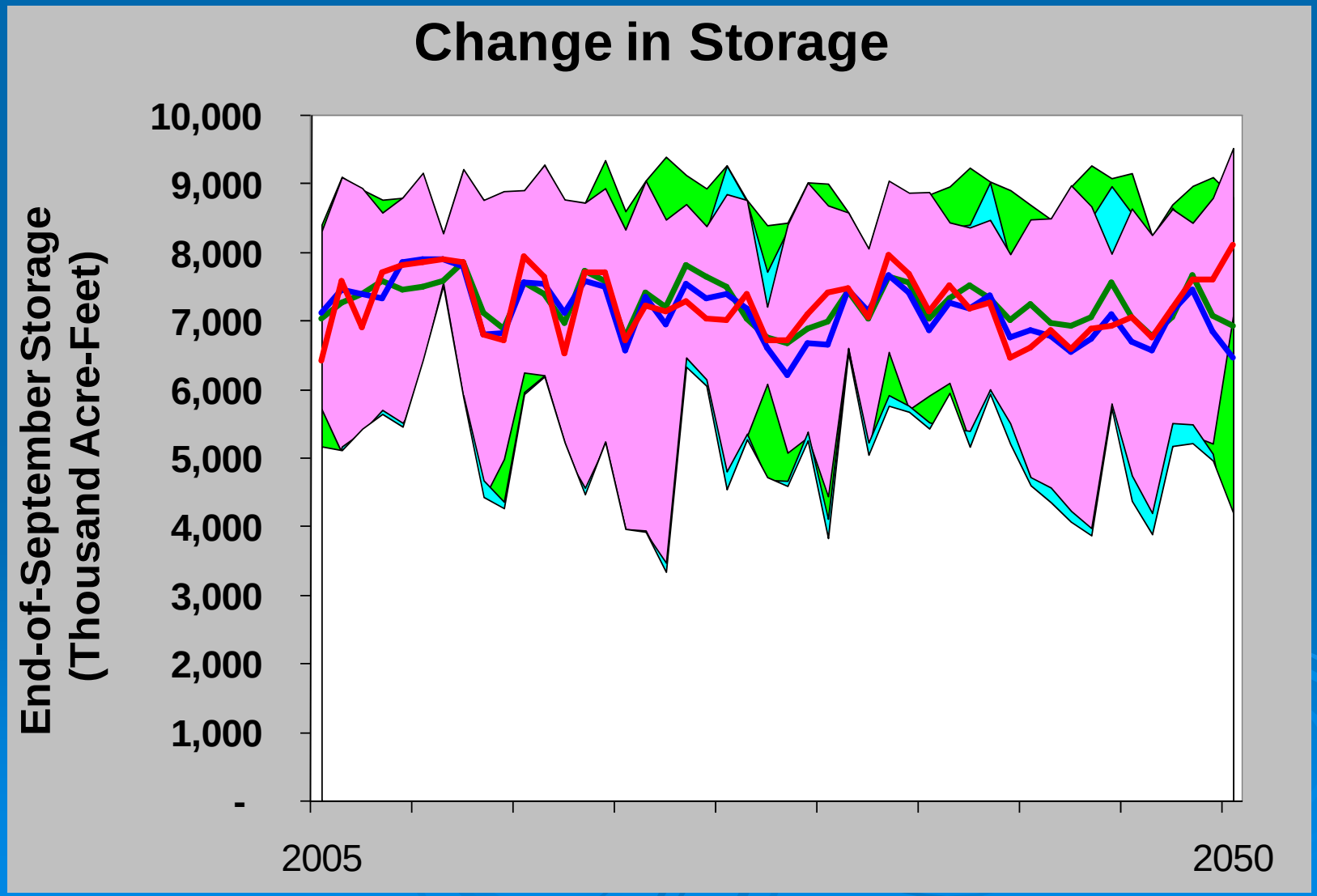




Supply Delivered – Sacramento River HR



Carryover Storage - Sacramento River HR



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