Quantifying Resource Management Strategy Benefits and Robustness

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California Department of Water Resources
Presentation Overview

- Application of scenarios from Update 2009
- Enhancements for Update 2013
- Water Plan climate data requirements

Acknowledgements

- Dr. Mohammad Rayej, DWR
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- Dr. David Yates, National Center for Atmospheric Research
- Dr. Hal Cardwell, USACE, Institute for Water Resources
Managing an Uncertain Future
Risk, Uncertainty, and Sustainability
Update 2009 Scenarios

Factors of Uncertainty

<table>
<thead>
<tr>
<th>Population</th>
<th>Current Trends</th>
<th>Slow &amp; Strategic Growth</th>
<th>Expansive Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Recent trends are assumed to continue into the future. Regulations are not coordinated or comprehensive, creating uncertainty for planners and managers. The state continues to face lawsuits, from flood damages to water quality and endangered species protections.</td>
<td>Private, public, and governmental institutions form alliances to provide for efficient planning and development that is less resources intensive than current conditions. State government implements comprehensive and coordinated regulatory programs to improve water quality, protect fish and wildlife, and protect communities from flooding.</td>
<td>Future conditions are more resource intensive than existing conditions. Protection of water quality and endangered species is driven mostly by lawsuits. State government has responded on a case-by-case basis, creating a patchwork of regulations and uncertainty for planners and water managers.</td>
</tr>
<tr>
<td></td>
<td>59.5 million* (22.8 million increase)</td>
<td>44.2 million (7.5 million increase)</td>
<td>69.8 million (33.1 million increase)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Continued development</th>
<th>Compact development</th>
<th>Sprawling development</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8.6 million acres (0.7 mil. acre decrease)</td>
<td>9.0 million acres (0.2 mil. acre decrease)</td>
<td>8.2 million acres (1.0 mil. acre decrease)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Irrigated Crop Area</th>
<th>1.0 additional MAF</th>
<th>1.5 additional MAF</th>
<th>0.6 additional MAF</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Environmental Water</th>
<th>10% more efficient</th>
<th>15% more efficient</th>
<th>5% more efficient</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Background Water Conservation</th>
<th></th>
<th></th>
<th></th>
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</thead>
</table>
Analysis Considers Possible Climate Change Impacts

- Global circulation models produce numerous projections of future temperature and precipitation patterns.
- Statistical downscaling methods produce local weather sequences.
- Weather sequences drive hydrologic models to calculate:
  - irrigation demand
  - hydrologic flows

Global circulation models:
- produce numerous projections of future temperature and precipitation patterns.
- Statistical downscaling methods:
  - produce local weather sequences.
- Weather sequences drive hydrologic models to calculate:
  - irrigation demand (HR and PA)
  - hydrologic flows (PA analysis, only)

Summary

This archive contains fine spatial-resolution translations of:
- climate projections over the contiguous United States (U.S.) developed using two downscaling techniques (monthly BCSD, Figure 1, and daily BCDA Figure 2), and
- hydrologic projections over the western U.S. (roughly the western U.S. Figure 3) corresponding to the monthly BCSD climate projections.

Purpose

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

Hydrologic Model
Update 2009
Regional Water Demand Changes By Scenario

Legend:
- Water demand change:
  - range with climate change
  - without climate change

Sacramento River
North Coast
22.2 MAF

North Lahontan
21.7 MAF

San Francisco

San Joaquin River

Central Coast

Tulare

South Lahontan

South Coast

Colorado River

LEGEND

Water demand change:
- Current Trend
- Strategic Growth
- Expansive Growth

0 baseline = Average historical demand (1998-2005)
### Resource Management Strategies (Update 2009)  
**A Range of Choices**

#### Reduce Water Demand
- Agricultural Water Use Efficiency
- Urban Water Use Efficiency

#### Improve Operational Efficiency & Transfers
- Conveyance – Delta
- Conveyance – Regional / Local
- System Reoperation
- Water Transfers

#### Increase Water Supply
- Conjunctive Management & Groundwater Storage
- Desalination – Brackish & Seawater
- Precipitation Enhancement
- Recycled Municipal Water
- Surface Storage – CALFED
- Surface Storage – Regional / Local

#### Improve Flood Management
- Flood Risk Management

#### Improve Water Quality
- Drinking Water Treatment & Distribution
- Groundwater / Aquifer Remediation
- Matching Quality to Use
- Pollution Prevention
- Salt & Salinity Management
- Urban Runoff Management

#### Practice Resource Stewardship
- Agricultural Lands Stewardship
- Economic Incentives (Loans, Grants & Water Pricing)
- Ecosystem Restoration
- Forest Management
- Land Use Planning & Management
- Recharge Areas Protection
- Water-Dependent Recreation
- Watershed Management

#### Other
- Crop idling, dew vaporization, fog collection, irrigated land retirement, rainfed agriculture, waterbag transport
Improvements to analytical tools allow for more comprehensive evaluation.
## Summary of Water Plan Scenario Analysis

<table>
<thead>
<tr>
<th>Scenario Factors</th>
<th>Resource Management Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Demographics</td>
<td>• Urban water use efficiency</td>
</tr>
<tr>
<td>• Urban and agricultural footprint</td>
<td>• Agricultural water use efficiency</td>
</tr>
<tr>
<td>• Climate conditions</td>
<td>• Recycled municipal water</td>
</tr>
<tr>
<td>• Costs of resource management strategies</td>
<td>• Conjunctive management and groundwater storage</td>
</tr>
<tr>
<td></td>
<td>• Surface storage</td>
</tr>
<tr>
<td></td>
<td>• System reoperation</td>
</tr>
<tr>
<td></td>
<td>• Meet new instream flow objectives</td>
</tr>
<tr>
<td></td>
<td>• Groundwater overdraft recovery</td>
</tr>
<tr>
<td><strong>Analytical Tools</strong></td>
<td><strong>Performance Metrics</strong></td>
</tr>
<tr>
<td>Water Evaluation And Planning system (WEAP) Central Valley Model</td>
<td>• Urban supply reliability</td>
</tr>
<tr>
<td>UPlan urban growth model</td>
<td>• Agricultural supply reliability</td>
</tr>
<tr>
<td>Statewide Agricultural Production model (SWAP)</td>
<td>• Instream flow reliability</td>
</tr>
<tr>
<td>Demographic analysis</td>
<td>• Groundwater levels</td>
</tr>
<tr>
<td>Costs and economic impact tools</td>
<td>• Combined SWP/CVP Delta exports</td>
</tr>
<tr>
<td></td>
<td>• Cost of implementing response packages</td>
</tr>
<tr>
<td></td>
<td>• Economic impacts of unmet water demand</td>
</tr>
</tbody>
</table>
Water Evaluation And Planning System

Generic, object-oriented, programmable, integrated water resources management modeling platform
Central Valley WEAP Model
Water Evaluation And Planning (WEAP) Model*
Integrates Hydrology and Water Management

- Monthly temperature and precip. drive rainfall/runoff model
- Indoor demands:
  - Households / employees
- Irrigation demands:
  - monthly climate
  - land use patterns
- Network of rivers, reservoirs, conveyance, groundwater basins
- Linear program routes supplies to demand nodes according to supply preferences and priorities

*http://www.weap21.org/
Gridded Climate Data

- 2,905 California grid points for climate data
- Central Valley WEAP PA model uses 233 representative points from 1,045 points covering source watershed and demand areas
Elevation Banding of Source Watersheds

Ex. American River:
- Six 500-meter elevation bands
- 6 points selected from 33 grid points
Valley Floor Demand Areas

Ex. Southern San Joaquin Valley (PA’s 609, 702, 703, 704, 705, 706):
- 8 points selected from 104 grid points
Areas Outside of Sacramento River, San Joaquin River and Tulare Lake Regions

- Apply simpler Hydrologic Region model developed for Update 2009
- Quantify regional water demand
  - Update 3 growth scenarios
  - Update 12 climate scenarios
- Ability to include some demand management strategies
Water Plan Climate Data Requirements

- 2005-2050 monthly time series of future projections of precipitation, average temperature, average relative humidity, and average wind speed
- 12km gridded climate data for California
  - spatially averaged at the Water Plan Planning Areas for the Central Valley floor areas
  - spatially averaged across 500 meter elevation bands in the foothills and Sierra Nevada Mountains
  - spatially averaged across the hydrologic regions for areas outside of the Central Valley
Schedule for Water Plan Scenarios

- JAN-JUN 2012 – Data development
- JUL-SEP 2012 – Initial scenario runs
- OCT-DEC 2012 – Initial public vetting of scenarios
- JAN-MAR 2013 – Refinement of scenario runs and documentation
What the Water Plan needs from the CCTAG

- By May 2012, provide a high level assessment of the strengths and weaknesses of the 12 CAT climate scenarios and the 5 ensemble informed scenarios used by BDCP, and other existing and available projections or ensembles of projections for sampling the distribution of future climate projections.

- By May 2012, provide recommendations for climate scenarios (selecting from existing and available projections or ensembles of projections) that are appropriate for representing a reasonable variation of future climate conditions for use in Update 2013 of the Water Plan.
Water Plan Update 2013
Timeline and Major Deliverables

- **Oct. 2009**
  - Plenary Meeting

- **Fall 2010**
  - Project Management Plan

- **March 2010**
  - Project Team Meeting

- **January 2010**
  - Update 2009 AC Meeting

- **July 2010**
  - Public Meeting

- **Jan. 2009**
  - Update 2009 AC Meeting

- **Jan. 2010**
  - 5 Steering Committee Meetings

- **Jan. 2011**
  - 12 Work Team Lead Meetings

- **Jan. 2011**
  - Project Management Plan

- **Jan. 2012**
  - Update 2012 Draft Assumptions and Estimates Report

- **April 2012**
  - Draft Assumptions and Estimates Report

- **Apr. 2013**
  - Release Public Review Draft

- **Dec. 2013**
  - Post Final Update 2013

- **Mar. 2014**
  - Distribute Printed Copies

End of Scoping

End of Water Plan Update 2013
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SWAN
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