Quantifying Resource Management Strategies within WEAP

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Water Evaluation and Planning System

- A generic, object-oriented, programmable, integrated water resources management modeling platform
Examples of Analyses

- Sectoral demand analyses
- Water conservation
- Water rights and allocation priorities
- Financial analyses
- Groundwater and streamflow simulations
- Reservoir operations
- Hydropower generation
- Pollution tracking
- Ecosystem requirements
Planning Model

Critical questions:

- How should water be allocated to various uses in time of shortage?
- How can these operations be constrained to protect the services provided by the river?
- How should infrastructure in the system (e.g. dams, diversion works, etc) be operated to achieve maximum benefit?
- How will allocation, operations and operating constraints change if new management strategies are introduced into the system?
Hydrology Model

Critical questions:
- How does rainfall on a watershed translate into flow in a river?
- What pathways does water follow as it moves through a watershed?
- How does movement along these pathways impact the magnitude, timing, duration and frequency of river flows?
WEAP Structure

- Node-link architecture connects water supplies to demands
- Each demand is assigned a priority and a preferences among available supplies
  - Determines order in which demands are met
  - Determines order in which sources are used
- Constrained by link capacities
## Resource Management Strategies

<table>
<thead>
<tr>
<th>STRATEGIES TO REDUCE WATER DEMAND</th>
<th>Agricultural Water Use Efficiency</th>
<th>YES*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urban Water Use Efficiency</td>
<td>YES*</td>
</tr>
<tr>
<td>STRATEGIES TO IMPROVE OPERATIONAL EFFICIENCY</td>
<td>Conveyance</td>
<td>YES</td>
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<tr>
<td></td>
<td>System Reoperation</td>
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<td></td>
<td>Water Transfers</td>
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<tr>
<td>STRATEGIES TO INCREASE WATER SUPPLY</td>
<td>Conjunctive Management &amp; Groundwater Storage</td>
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<td></td>
<td>Desalination</td>
<td>YES*</td>
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<td></td>
<td>Precipitation Enhancement</td>
<td>YES*</td>
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<td></td>
<td>Recycled Municipal Water</td>
<td>YES*</td>
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<tr>
<td></td>
<td>Surface Storage -- CALFED/State</td>
<td>YES*</td>
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<tr>
<td></td>
<td>Surface Storage -- Regional/Local</td>
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<td>STRATEGIES TO IMPROVE WATER QUALITY</td>
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<td>Groundwater Remediation/Aquifer Remediation</td>
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<td>Matching Water Quality to Use</td>
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<td></td>
<td>Pollution Prevention</td>
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<td>Urban Runoff Management</td>
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<td>STRATEGIES TO PRACTICE RESOURCE STEWARDSHIP</td>
<td>Agricultural Lands Stewardship</td>
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<td>Economics Incentives Policy</td>
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<td>Ecosystem Restoration</td>
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<td>Floodplain Management</td>
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<td>Forest Management</td>
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<td>Recharge Area Protection</td>
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<td>Urban Land Use Management</td>
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<td>Water-Dependent Recreation</td>
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<td>Watershed Management</td>
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<td>STRATEGIES TO IMPROVE FLOOD MANAGEMENT</td>
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<td>Modify Impacts of Flooding</td>
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<td>Modify Susceptibility to Flooding</td>
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<td>Preserve and Restore Natural Floodplain Functions</td>
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</table>

<table>
<thead>
<tr>
<th>Modeled in WEAP</th>
<th>Partially Modeled in WEAP</th>
<th>Not Modeled in WEAP</th>
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</thead>
</table>
Reducing Water Demand
Agricultural Water Use Efficiency

- Improvements in technologies and management of agricultural water
  - Hardware (on-farm irrigation equipment)
  - Crop and farm water management practices, and
  - Improvements to water supplier distribution systems
Managing Irrigation Efficiency in WEAP

- Irrigation efficiency is determined by controlling soil moisture
- Highest when soils are managed in dry range
Managing Irrigation Efficiency in WEAP

Response Packages

Reference
Agricultural Water Use Efficiency
Urban Water Use Efficiency
Conveyance
System Reoperation
Conjunctive Management and Groundwater Storage
Desalination
Precipitation Enhancement
Recycled Municipal Water
Surface Storage
Modify Flooding

Irrigation Thresholds - Row Crops
Lower Soil Water Threshold(%) - 45
Upper Soil Water Threshold(%) - 75

Irrigation Thresholds - Oil Crops

Irrigation Thresholds - Rice

Irrigation Thresholds - Pasture

Irrigation Thresholds - Cereals

Irrigation Thresholds - Orchards

Run Close
Urban Water Use Efficiency

- Technological or behavioral improvements in indoor and outdoor residential, commercial, industrial and institutional water use that lower water demand, lower per capita water use, and result in benefits to water supply, water quality, and the environment.
Urban Demand Management in WEAP
Improving Operational Efficiency
Conveyance

- Design water transmission systems with adequate water capacity to efficiently distribute imported or locally produced water to storage or the end users, so that system bottlenecks do not occur.
Adjusting Conveyance Capacities in WEAP
System Reoperation

- Changing the existing operation and management procedures for such water facilities as dams and canals to meet multiple beneficial uses.
Adjusting Operational Priorities in WEAP

Response Packages

- Reference
- Agricultural Water Use Efficiency
- Urban Water Use Efficiency
- Conveyance
- System Reoperation
- Conjunctive Management and Groundwater Storage
- Desalination
- Precipitation Enhancement
- Recycled Municipal Water
- Surface Storage
- Modify Flooding

Operational Priorities

- Carryover Storage - Reservoir 1 (TAF): 500
- Carryover Storage - Reservoir 2 (TAF): 760
- Storage Priority - Reservoir 1: 95
- Storage Priority - Reservoir 2: 98
Increasing Water Supply
Conjunctive Management and Groundwater Storage

- Coordinated operation of surface water storage and use, groundwater storage and use, and conveyance facilities to meet water management objectives.
Possible Approaches in WEAP

- Adjust supply preferences in wet and dry years
  - For example, Pump groundwater first in dry years, Divert surface water first in wet years
- Operate groundwater object as a bank
  - Track storage accounts, Limit puts/takes to bank
In California, the principal method for desalination is through reverse osmosis technology. There are two primary types of desalination:

- Brackish (low-salinity) surface or groundwater
- Ocean water.
Desalination in WEAP

- Add desalination plant as new water supply model object
- Fixed and variable costs/benefits considered
Precipitation Enhancement

- Precipitation enhancement projects are intended to increase surface water supplies or hydroelectric power. Projects increase the amounts of water produced (~2-15%) by artificially stimulating clouds to produce more rainfall or snowfall than they would naturally.
Adjusting Precipitation in WEAP
Recycled Municipal Water

- Water recycling is the process of treating wastewater from previous uses, and then storing, distributing, and using this recycled water to meet demands. Reclaimed water used for:
  - Golf courses
  - School yards
  - Residential landscape
  - Parks
  - Industrial uses
Wastewater Recycling in WEAP

- Outflows from WWTP are temporarily stored as supplemental water supply
Surface Storage

The CALFED Record of Decision (2000) identified five potential surface storage reservoirs that are being investigated by the California Department of Water Resources, U.S. Bureau of Reclamation, and local water interests.

- Shasta Lake Water Resources Investigation
- North-of-the-Delta Offstream Storage
- In-Delta Storage Project
- Los Vaqueros Reservoir Expansion
- Upper San Joaquin River Basin Storage Investigation
Possible Approaches in WEAP

- Modify existing storage
  - Increase storage capacity
  - Adjust reservoir operating rules (e.g. flood control storage)

- Add new facilities
  - Incorporate proposed operations and engineering specifications
  - Indicate date reservoir comes online
Improving Flood Management
Flood Management

- Projects and programs that detain or divert floodwaters or improve the ability of channels to accommodate floodwaters.
Possible Approaches in WEAP

- Adjust reservoir rule curves
  - Allow additional flood storage in certain months
- Adjust weir diversions
  - Increase amount of spilled water that is diverted to bypasses
Questions
Thank You