Approach Used for Planning Area Scale Analysis

- Critical Methodological Issues that Arose During Water Plan Update 2009 on the Planning Area Scale Analysis, and How They Were Addressed
Approach Used for Planning Area Scale Analysis

- Brian Joyce (SEI)
- David Yates (NCAR)
- Andy Draper (MWH)
Qu. 1: Snowmelt and Rainfall Runoff Processes

- Two bucket soil moisture model

\[ P_{\text{obs}} = f(P_{\text{obs}}, \text{Snow Accum}, \text{Melt rate, Ti, Ts}) \]

\[ P_e = f(P_{\text{obs}}, \text{Snow Accum}, \text{Melt rate, Ti, Ts}) \]

\[ \text{surface runoff} = f(z_{fa}, RRF_{\text{fa}}, P_e) \]

\[ \text{interflow} = f(z_{fa}, Hc_{fa}, 1-f) \]

\[ \text{Percolation} = f(z_{fa}, Hc_{fa}, 1-f) \]

\[ \text{Baseflow} = f(Z, HC) \]

\[ \text{ET} = f(z_{fa}, kC_{fa}, \text{PET}) \]

\[ Z_{fa} \]

\[ W_{fa} \]

\[ U_{fa} \]

\[ L_{fa} \]

\[ W_{fa} \]

\[ Z \]
Qu. 1: Snowmelt and Rainfall Runoff Processes

- **Shasta Inflows**
  - RMSE = 138
  - R = 0.95

- **Oroville Inflows**
  - RMSE = 168
  - R = 0.86
Qu. 1: Snowmelt and Rainfall Runoff Processes – Additional Calibration

New Bullards Bar Reservoir

Monthly Flow (TAF/month)

Simulated  Observed

50 100 150
Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep

50 100 150

3,500

New Bullards Bar Reservoir

Annual Flow (TAF/year)

Simulated  Observed

1,500 2,000 2,500 3,000

Yuba River Watershed

Projection: CA State Plane II MAF3
Cartography: DML
Map Prepared: August 2010

© Yuba_WQ_MAP Định, General FF225A, Overview, 20180728, cc0-d
Qu. 1: Snowmelt and Rainfall Runoff Processes – Additional Calibration

<table>
<thead>
<tr>
<th>Land Use Type</th>
<th>PA Model Phase I</th>
<th>PA Model Phase II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hydraulic Conductivity (mm/month)</td>
<td>Soil Water Capacity (mm)</td>
</tr>
<tr>
<td>Forest</td>
<td>128</td>
<td>473</td>
</tr>
<tr>
<td>Non Forest</td>
<td>255</td>
<td>810</td>
</tr>
<tr>
<td>Barren</td>
<td>170</td>
<td>257</td>
</tr>
<tr>
<td>Impervious</td>
<td>255</td>
<td>101</td>
</tr>
<tr>
<td>Pervious</td>
<td>115</td>
<td>506</td>
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<table>
<thead>
<tr>
<th>Watershed Parameter</th>
<th>PA Model Phase I</th>
<th>PA Model Phase II</th>
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</thead>
<tbody>
<tr>
<td>Freezing Temperature (2,000-2,500 meters)</td>
<td>-4.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Freezing Temperature (0-2,000 meters)</td>
<td>-8.00</td>
<td>-7.71</td>
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<tr>
<td>Melting Temperature (2,000-2,500 meters)</td>
<td>4.00</td>
<td>7.99</td>
</tr>
<tr>
<td>Melting Temperature (0-2,000 meters)</td>
<td>3.00</td>
<td>5.13</td>
</tr>
</tbody>
</table>
Qu. 1: Snowmelt and Rainfall Runoff Processes – Additional Calibration

Simulated and Observed Annual Unimpaired Inflows to New Bullards Bar Reservoir

Simulated and Observed Monthly Unimpaired Inflows to New Bullards Bar Reservoir
Qu. 2: Water Use

- Crop Water Demand
  - Based on crop and soil characteristics and climate

\[
\text{ET} = f(z_{fa}, k_{cfa}, PET) \\
\text{P}_{e} = f(P_{obs}, \text{Snow Accum}, \text{Melt rate}, T_l, T_s) \\
\text{surface runoff} = f(z_{fa}, RRF_{fa}, P_{e}) \\
\text{Percolation} = f(z_{fa}, H_{cfa}, 1-f) \\
\text{Baseflow} = f(Z, HC)
\]
Qu. 2: Water Use
Agricultural Applied Water

- Calibrated to DWR Water Portfolio Data

- Sacramento Valley

- San Joaquin Valley
Qu. 2: Water Use
Urban Outdoor Applied Water

- Calibrated to DWR Water Portfolio Data

Sacramento Valley

San Joaquin Valley
Qu. 2: Water Use
Qu. 3: Groundwater

- 15 Groundwater Basins based on B-118

- Basin Parameters Include:
  - Hydraulic Conductivity
  - Specific Yield
  - Geometric Factors: Distance to river, Length of hydraulic connection
Qu. 3: Groundwater

- Calibrated to DWR Water Data Library

**Sacramento-American Normalized WSE**

**Eastern San Joaquin Normalized WSE**
Qu. 4: Reservoir Operations

- Release to meet all downstream demands
  - Dependent upon:
    - Storage priorities (relative to other reservoirs)
    - Unrestricted releases from Conservation Zone
    - Limited releases from Buffer Zone
Qu 4: Reservoir Operations

- Combined Monthly and Carryover Storage
Qu. 4: Reservoir Operations
PA Model and CalLite Comparison
Qu 4: Reservoir Operations
PA Model and CalLite Comparison

Shasta Monthly Storage

Trinity Monthly Storage
Qu. 4: Reservoir Operations
PA Model and CalLite Comparison

![Graph](image-url)
Qu. 4: Reservoir Operations
PA Model and CalLite Comparison

San Luis Monthly Storage

Total Monthly Exports (Banks & Jones)
Qu. 5: Delta Operations

- Regulatory Considerations within PA Model
  - X2
  - Salinity (G-Model)
  - MRDO
  - VAMP Export Limits
  - Export/Inflow Limits

- Does not Consider
  - COA
  - DXC
Qu. 5: Delta Operations
Delta Inflows

Sacramento River at Freeport

San Joaquin River at Vernalis

Average Monthly Flows

Total Annual Flows
Qu. 5: Delta Operations
Delta Outflows

Average Monthly Flows

Total Annual Flows

Net Delta Outflow

Average Monthly Flows

Total Annual Flows

Net Delta Outflow
Qu. 5: Delta Operations

Comparison of PA model and CalLite no limits on surface water diversion

<table>
<thead>
<tr>
<th>Description</th>
<th>Average Annual Flow/Storage (TAF) Water Years 1971-2005</th>
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<tbody>
<tr>
<td></td>
<td>Callite</td>
</tr>
<tr>
<td>Sacramento River at Hood + Yolo Bypass at Lisbon Weir</td>
<td>20,356</td>
</tr>
<tr>
<td>Trinity River at Lewiston</td>
<td>796</td>
</tr>
<tr>
<td>Sacramento River diversions Shasta Dam to Wilkins Slough</td>
<td>2,334</td>
</tr>
<tr>
<td>Diversion Yuba/Feather</td>
<td>1,181</td>
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<tr>
<td>Diversion Sac/American</td>
<td>387</td>
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<tr>
<td><strong>Total Diversions</strong></td>
<td>3,903</td>
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<tr>
<td>Change in North of Delta Reservoir Storage</td>
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<tr>
<td>North of Delta Reservoirs Evaporation</td>
<td>296</td>
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<tr>
<td>Delta Diversions and Exports&lt;sup&gt;7&lt;/sup&gt;</td>
<td>6,382</td>
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<tr>
<td>Net Delta Outflow</td>
<td>18,534</td>
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<tr>
<td>Exports + Outflow (Includes CCWD)</td>
<td>24,916</td>
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</tbody>
</table>

Comparison of PA model and CalLite with limits on surface water diversion

<table>
<thead>
<tr>
<th>Units in TAF</th>
<th>Callite</th>
<th>PA model</th>
<th>Difference</th>
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</thead>
<tbody>
<tr>
<td>Sacramento River at Hood + Yolo Bypass at Lisbon Weir</td>
<td>19,315</td>
<td>20,241</td>
<td>-926</td>
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<tr>
<td>Trinity River at Lewiston</td>
<td>792</td>
<td>627</td>
<td>165</td>
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<tr>
<td>Sacramento River diversions Shasta Dam to Wilkins Slough</td>
<td>2,138</td>
<td>1,766</td>
<td>372</td>
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<tr>
<td>Diversion Yuba/Feather</td>
<td>1,178</td>
<td>1,239</td>
<td>-61</td>
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<tr>
<td>Diversion Sac/American</td>
<td>387</td>
<td>462</td>
<td>-75</td>
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<tr>
<td><strong>Total Diversions</strong></td>
<td>3,703</td>
<td>3,466</td>
<td>237</td>
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<tr>
<td>Change in North of Delta Reservoir Storage</td>
<td>-23</td>
<td>9</td>
<td>-32</td>
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<tr>
<td>North of Delta Reservoirs Evaporation</td>
<td>298</td>
<td>-173</td>
<td>471</td>
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<tr>
<td>Delta Diversions and Exports&lt;sup&gt;7&lt;/sup&gt;</td>
<td>6,191</td>
<td>4,540</td>
<td>1651</td>
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<tr>
<td>Net Delta Outflow</td>
<td>17,558</td>
<td>20,168</td>
<td>-2610</td>
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<tr>
<td>Exports + Outflow (Includes CCWD)</td>
<td>23,749</td>
<td>24,708</td>
<td>-959</td>
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