

RECLAMATION

Managing Water in the West

An Approach for Reducing Demand Uncertainty in the Central Valley Project Allocations

S&T Risk and Uncertainty Workshop

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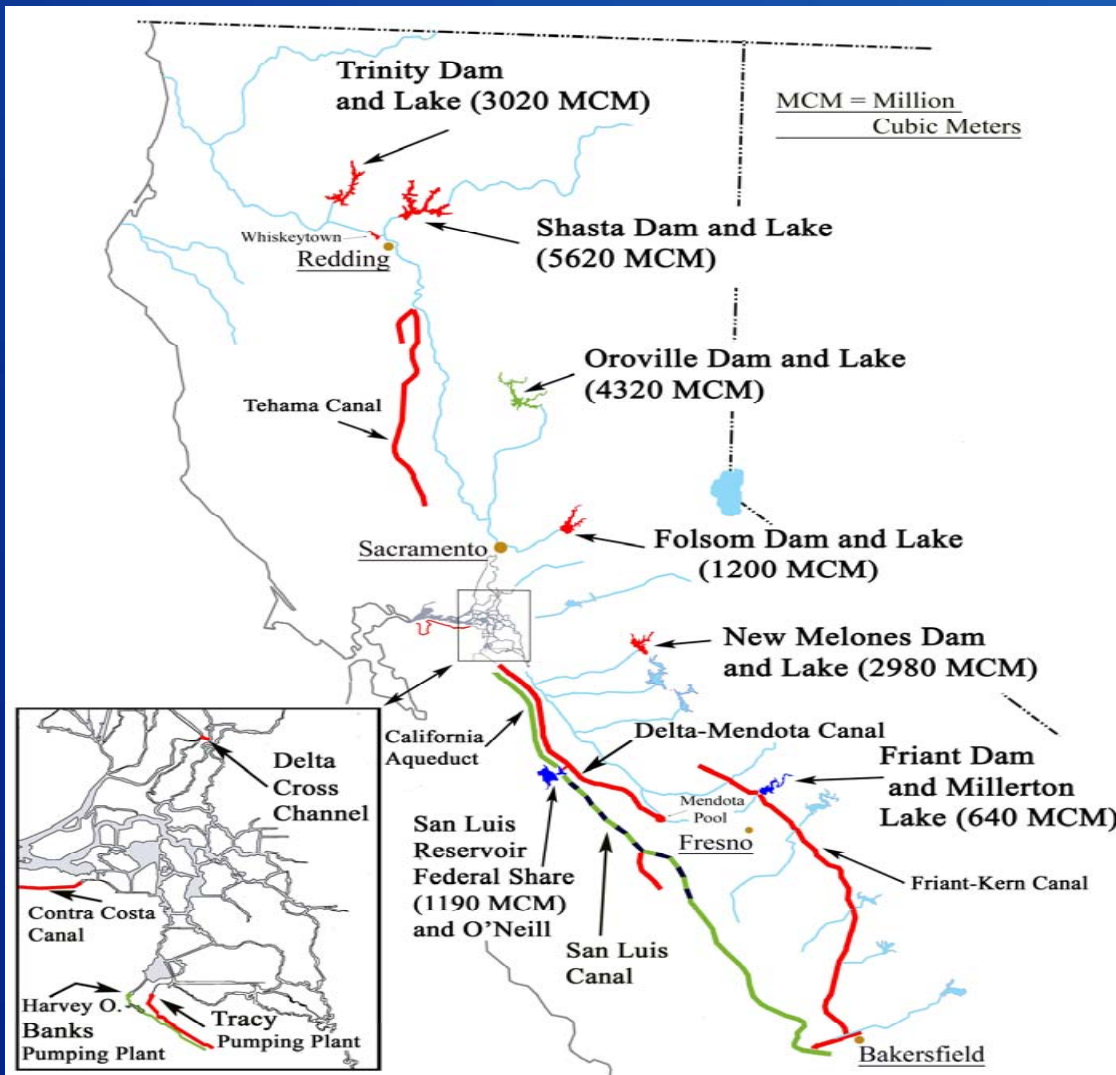
Brian Joyce, Stockholm Environment Institute, Boston, MA



**U.S. Department of the Interior
Bureau of Reclamation**

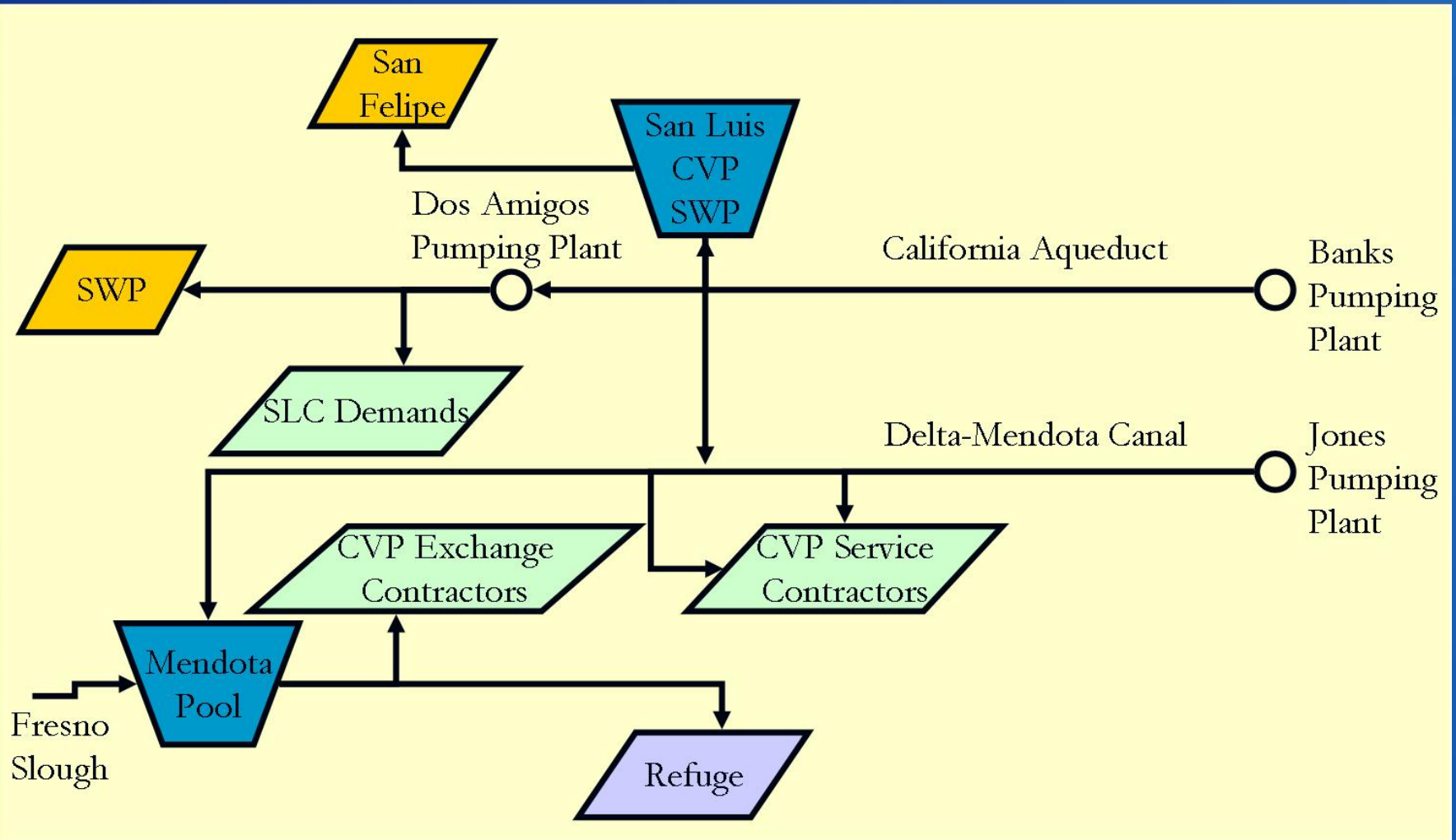
June 17, 2009

Central Valley Project



- Annual Delivery of 7 MAF
 - 1 million acres of irrigated lands
 - 2 million urban users
 - 19 national wildlife refuges

CVP South of Delta Schematic



CVP Allocation Process

- Initial allocation in February based on measured snowpack, current reservoir storage, historical 90% exceedence inflows, historical demands & system modeling.

Mid-Pacific Region Initial Water Year 2009 Supply Forecast February 20, 2009									
Probability of Exceedence Forecasts	Percent of Historical Average Sacramento Valley Index & Year Type	North of Delta Allocation				South of Delta Allocation			
		Ag	M&I	R	WR	Ag	M&I	R	WR
Dry Forecast (90%)	41% Critical	0%	50%	75%	75%	0%	50%	75%	77%
Median Forecast (50%)	55% Critical	10%	60%	100%	100%	10%	60%	100%	100%

Ag = Agriculture M&I = Municipal and Industrial R = Refuges WR = Water Rights M&I supply is based on historical deliveries

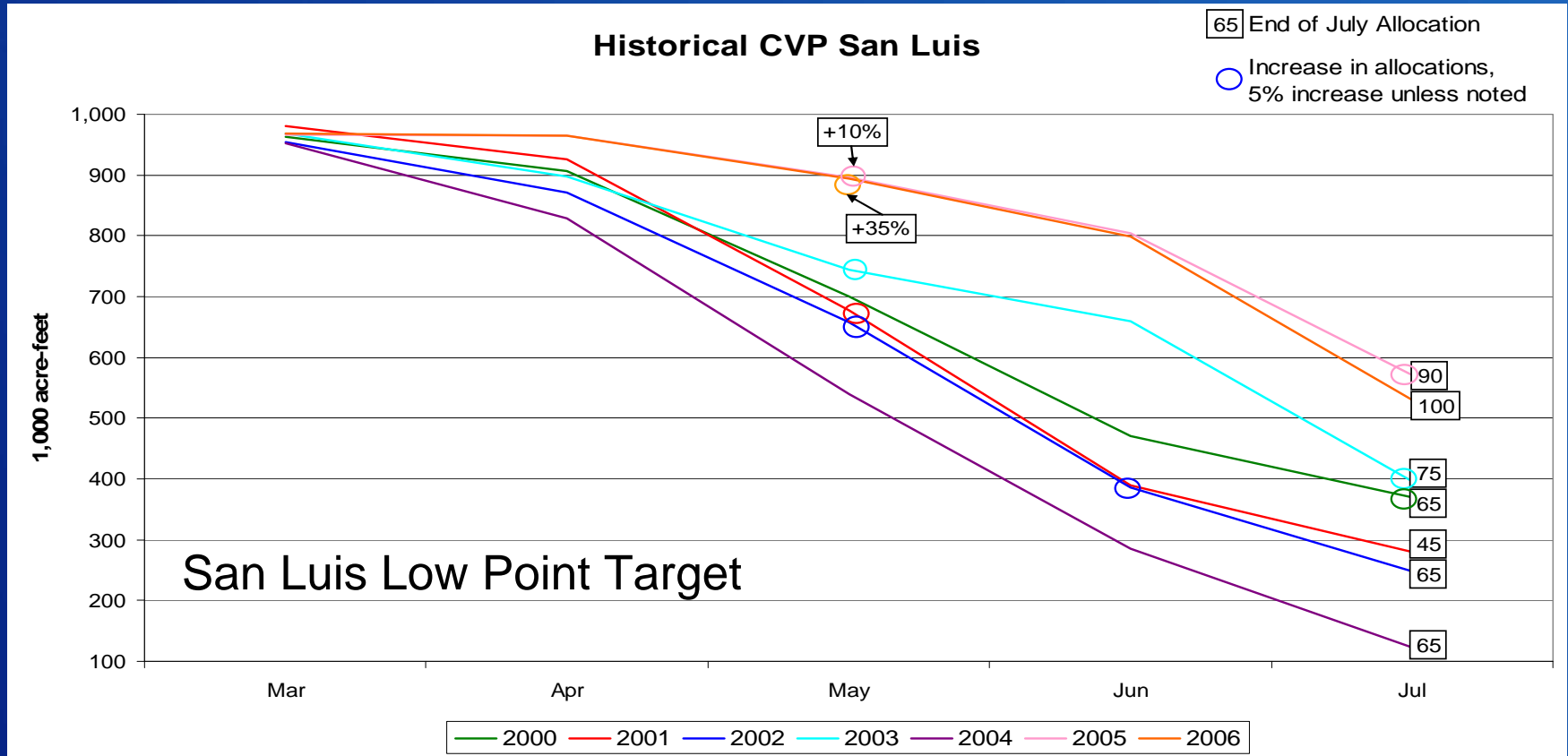
CVP Allocation Process

- Subsequent allocations include updated hydrologic data, contractor's estimate of monthly demands & additional system modeling

Probability of Exceedence Forecasts	Sacramento Valley Index* (Percent of Average/Water Year Classification)	North of Delta Allocation				South of Delta Allocation			
		Ag	M&I	R	WR	Ag	M&I	R	WR
Dry Forecast (90%)	61% / Critical	15%	65%	100%	100%	10%	60%	100%	100%
Median Forecast (50%)	69% / Dry	15%	65%	100%	100%	15%	65%	100%	100%

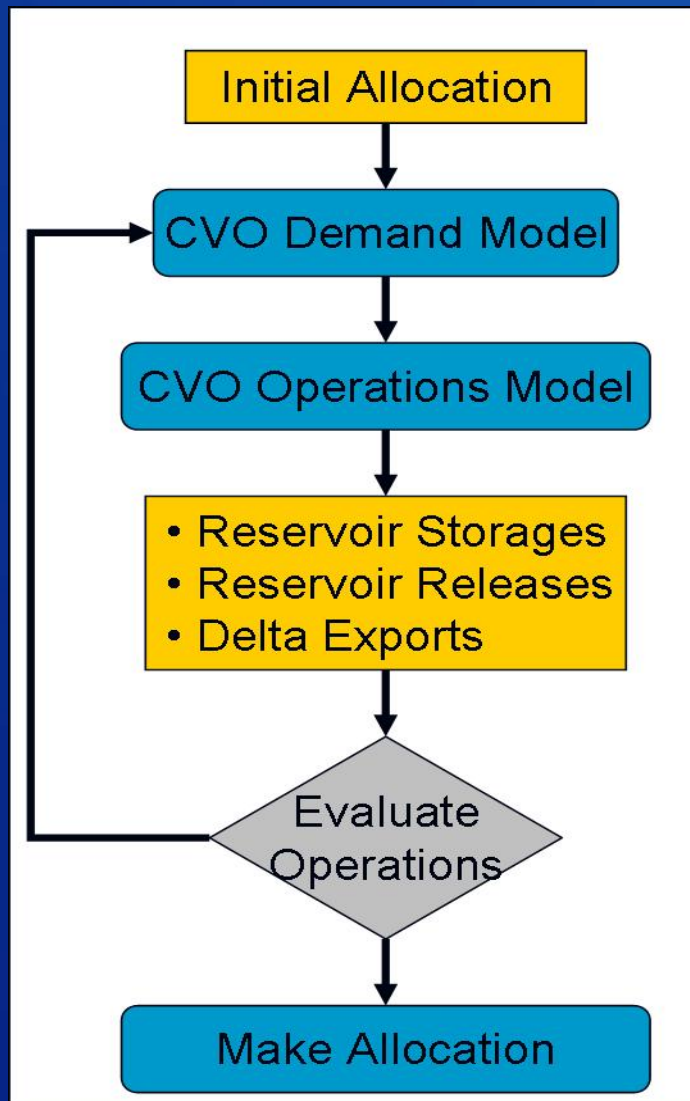
CVP Allocation Process

- South of Delta (SOD) demands are met by Delta exports, San Luis Reservoir storage, groundwater pumping, purchases & local supplies



- Late season increases in allocations are not as useful to agricultural users

CVP Allocation Modeling



- Apply Forecast Hydrology
- **Estimate Demands**
- Estimate Regulatory Standard Requirements
- Apply Reservoir Storage Targets
- Determine Export Capability
- **Make Allocation:**
 - Ag
 - M&I
 - Refuges

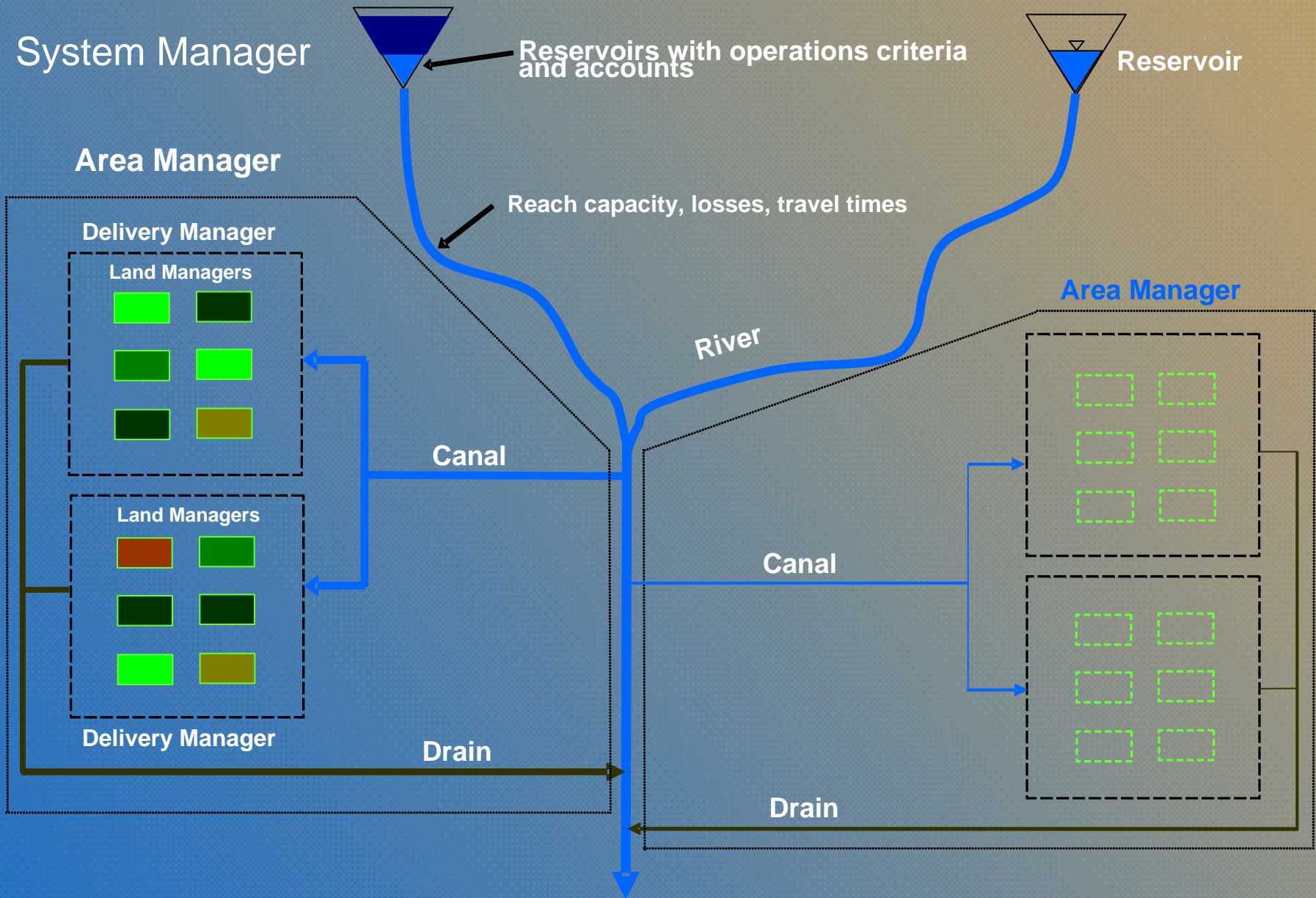
Key Factors in CVP SOD Demands

- SOD demands are primarily driven by irrigated agriculture.
- Potential Evapotranspiration (PET) is the physical driver of agricultural water requirements.
- On-farm water requirements are affected crop types, soil properties, irrigation systems and management practices.
- Farmers may have access to multiple sources of supply.

Improving CVP SOD Demand Estimates

- Forecast PET
 - 14 & 90 day forecasts based on NOMADS and IRI products
- Use forecasted PET in a model that simulates irrigation management
 - Land Atmosphere Water Simulator (LAWS)
 - Surface & groundwater sources
 - Reservoirs & Conveyance
 - Daily crop consumptive use based on FAO 56 dual crop coefficient method

LAWS Spatial Organization



California PET Website

Potential Evapotranspiration - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http: Go Links >>

California Central Valley Potential Evapotranspiration

Disclaimer: This is a research product being developed to forecast evapotranspiration in California's Central Valley, and is not intended for applied use

Latitude: Longitude: 38 -121 Auto Center

8 Day Forecast | 90 Day Outlook | Data Retrieval Tools | Climate Change Scenarios | About

Select a model run

- 2009.06.14 - 12:00 (Newest Complete Dataset)
- 2009.06.14 - 06:00
- 2009.06.14 - 00:00

Text File : <http://www.CaliforniaPET.org/8-Day-Txt.aspx?Lat=38&Lon=-121>
DSS File : <http://www.CaliforniaPET.org/8-Day-Dss.aspx?Lat=38&Lon=-121>

Grid Cell Center: Set Decimal Precision:

<input checked="" type="radio"/> Daily	PET	Precipitation	Air Temperature	Relative Humidity	Wind Speed	Net Radiation
<input type="radio"/> Hourly <input type="button" value="PST"/>	mm/day	mm/day	°C	%	m/s	MJ/m ² /day
06/13/2009	3.42	0	15.06	66.8	2.64	13.69
06/14/2009	4.27	0	16.88	54.53	2.85	16.93
06/15/2009	3.98	0	17.65	56.29	2.44	16.72
06/16/2009	4.74	0	21.43	49.73	2.49	16.08
06/17/2009	5.28	0	23.2	48.89	2.2	17.5
06/18/2009	5.49	0	24.85	42.79	2.16	17.27
06/19/2009	5	0	24.48	35.48	3.03	16.37
06/20/2009	2.83	1.38	17.99	66.9	3.59	10.89

Show model grid 38 848264 -119.366455

Internet 2:06 PM

California PET Website

Potential Evapotranspiration - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://

California Central Valley
Potential Evapotranspiration

Latitude: Longitude:
38.54011 -121.780229 Auto Center

2D 3D Road Aerial Bird's eye Labels

Station Code: Da [38.54, -121.78]

8 Day Forecast 90 Day Outlook Data Retrieval Tools Climate Change Scenarios About

Temperature Above Average Below Precipitation Above Average Below Ensembles: 1

HTML Text DSS Generate Outlook

Date	PET	Avg Temp	Precip
Jun 14	3.63222024752274	27.82	0
Jun 15	3.71169554955482	27.18	0
Jun 16	3.38368136303794	28.75	0
Jun 17	3.5851417577233	29.1	0
Jun 18	3.60073133267516	33.76	0
Jun 19	3.38865949464283	28.87	0
Jun 20	3.93138620859783	32.35	0
Jun 21	3.92875830523163	31.35	0
Jun 22	2.95721075680607	24.94	7.9
Jun 23	3.32664679153424	32.15	0
Jun 24	3.73864447119964	29.87	0
Jun 25	3.74191836052887	36.6	0
Jun 26	3.65192011076755	31.83	0
Jun 27	3.89390811228507	32.63	0
Jun 28	3.66043367144939	34.27	0
Jun 29	2.9862139383555	28.79	0

IRI Multi-Model Probability Forecast for Temperature for April-May-June 2009, Issued March 2009

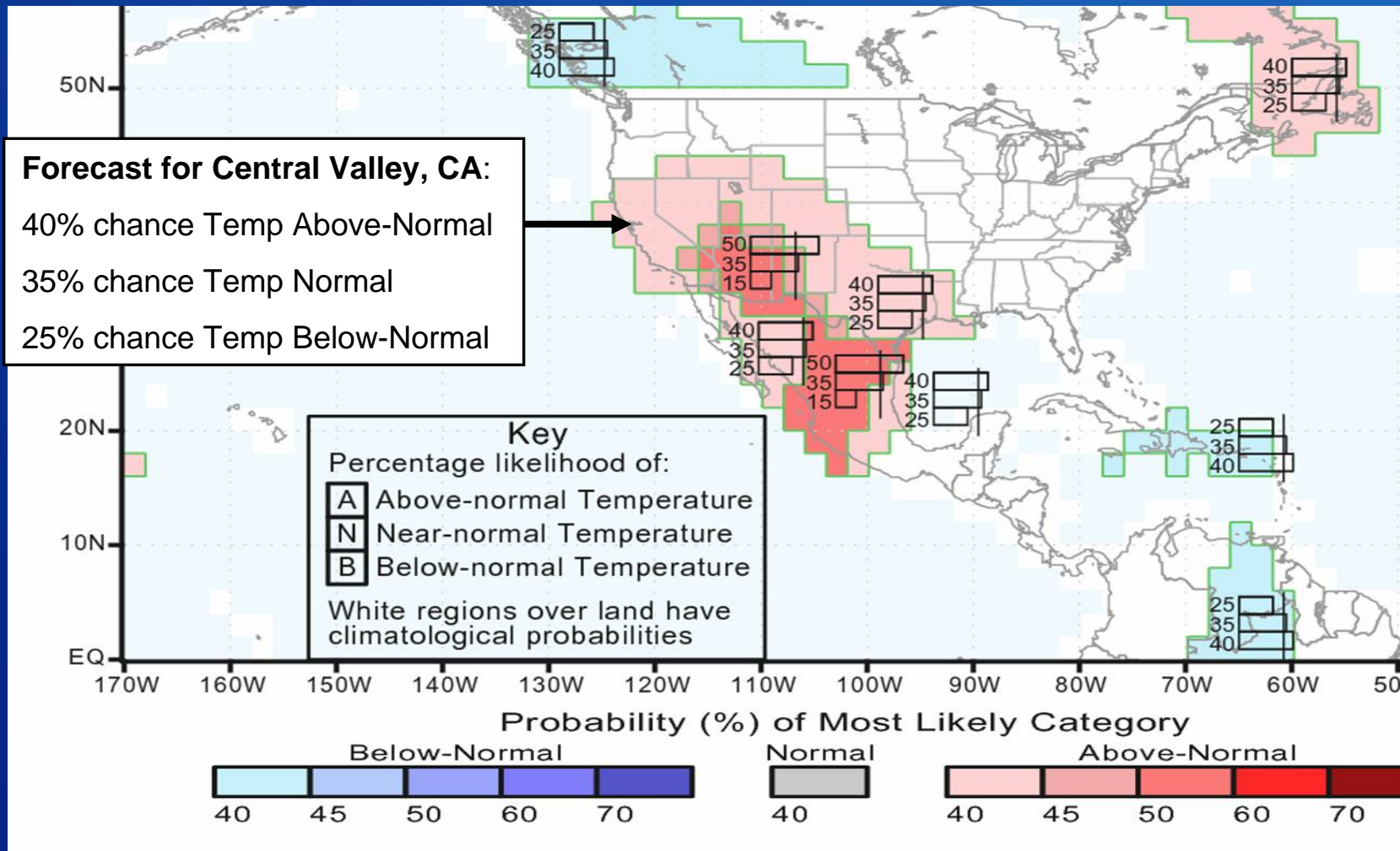
Key: Percentage likelihood of Above-normal Temperature, Near-normal Temperature, Below-normal Temperature. White regions over land have climatological probabilities.

Probability (%) of Most Likely Category: Below-Normal, Normal, Above-Normal.

Internet

start C:\S&T Risk & Unc... S&T Risk & Uncert... Yates Monterey_1... Joyce - Session 15... Intel(R) PROSet/... Potential Evapotra... Microsoft Word 2:20 PM

IRI Temperature Forecast for February – April Issued January 2009



Knn Forecasting Methodology

Forecast for Central Valley, CA:

40% chance Temp Above-Normal

35% chance Temp Normal

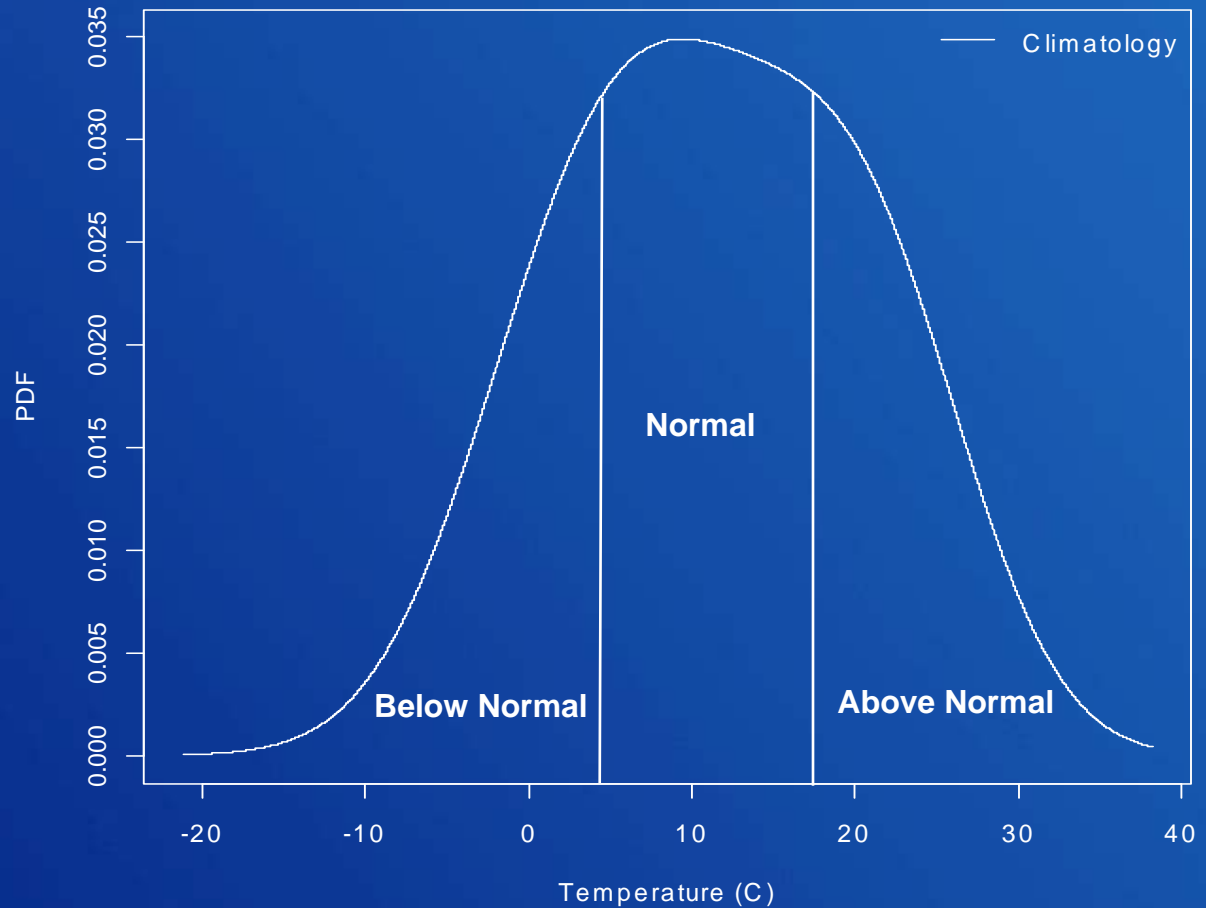
25% chance Temp Below-Normal

If sample size = 100 Then

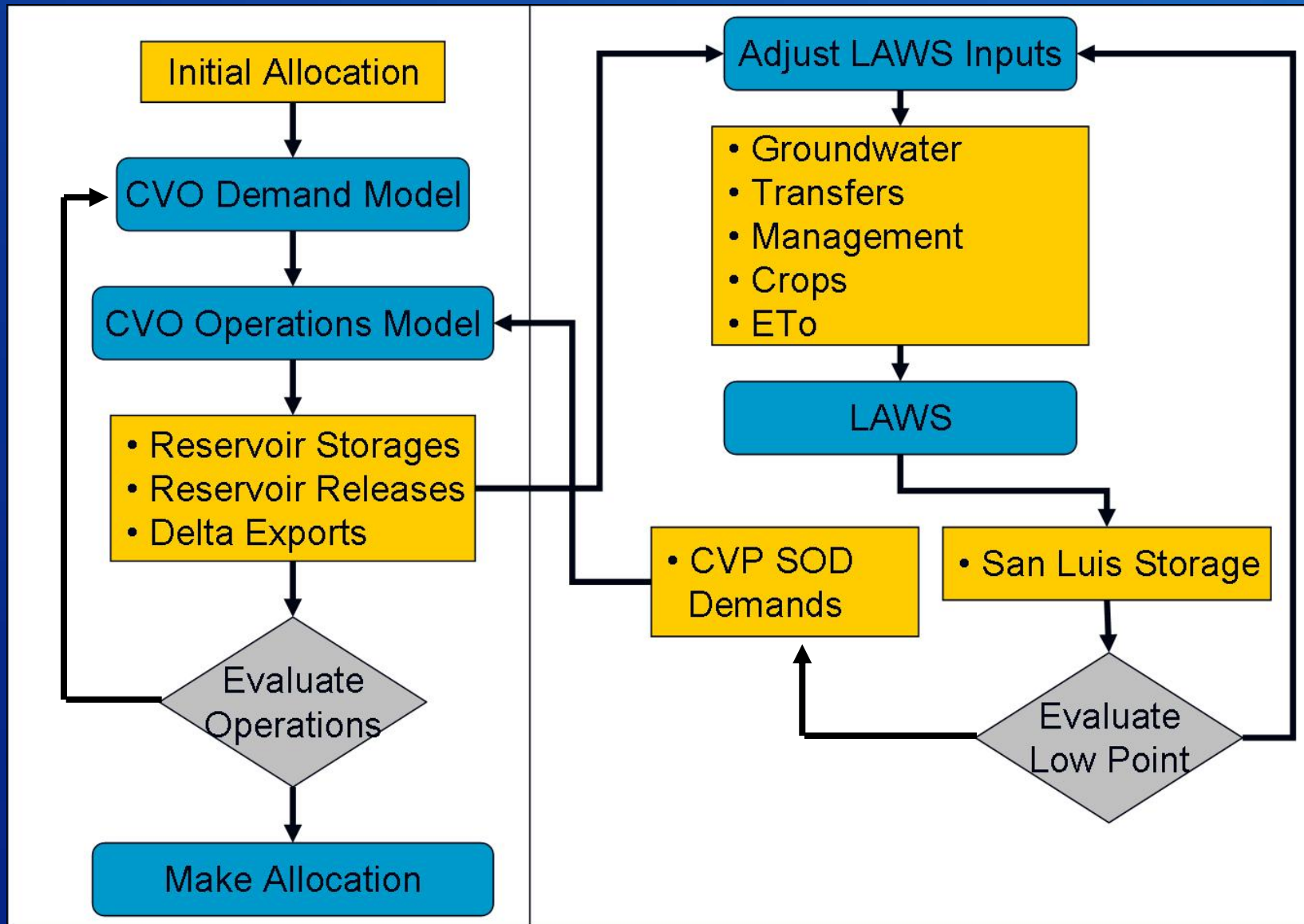
Take **40** samples from upper tercile

Take **35** samples from middle tercile

Take **25** samples from lower tercile



Modified CVP Allocation Process



That's All Folks!!!
???

CVP Allocation Modeling

