

# Draft Findings and Recommendations

San Joaquin River Valley CalSim II Model  
Review

CALFED Science – California Water &  
Environment Modeling Forum

September 30, 2005

# Review Panel Members

- David Ford (David Ford Consulting Engineers)
- Les Grober (Central Valley Regional Water Quality Control Board)
- Thomas Harmon (University of California, Merced)
- Jay R. Lund (Chair) (University of California, Davis)
- Daene McKinney (University of Texas, Austin)

# Panel Charge

- *Part I: Merits of recent work compared to prior representations*
  1. In what ways are these new representations more accurate than prior representations?
  2. In what ways are these new representations less accurate than prior representations?
  3. In what ways would CalSim II results using these new representations consistently differ from the prior model?
  4. Are the new representations expected to lead to any systematic bias in CalSim II results?

# Panel Charge – Cont.

- *Part II. Improvements to the recent work*
  5. How well are the new representations and their underlying data documented? What additional documentation should be prepared?
  6. How well have the new representations and their underlying data been tested? What additional testing should be performed?
  7. What is the accuracy expected and what are major errors remaining (if any) in the representation of the San Joaquin Valley?
  8. How might the new representations be improved?

# So far ...

- Workshop August 4
- Public comments (email, written, oral)
- Panel discussions with modelers, August 5
- Internal drafts by panel members and group
- More discussions and clarifications with modelers

# Thanks so far to ...

- USBR staff and consultants
  - Superior documentation
  - Availability of supplemental data
  - Availability to clarify and discuss
  - Willingness to discuss concerns
  - Patience in clarifying
- Public commentators
  - Important questions and concerns

# After this workshop ...

## ■ Public Draft and Comments

1. To be released soon, reflecting on feedback here; posted on CALFED website
2. Two weeks for written comments

## ■ Final Report Presentation Workshop

1. late November or early December

# Today's Workshop Objectives

- Improve DRAFT and FINAL Panel Reports, findings, and recommendations:
  1. Clarity
  2. Accuracy
  3. Focus
  4. Usefulness

# What should be our review standard?

- Government agency norms for modeling and documentation?
- Scientific and academic norms for modeling and documentation?
- Both?

# Draft Findings: Eastside Hydrology and Operations

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# Eastside Hydrology and Operations: General Comments

- Good efforts at improving representation of hydrology and operations have been made
- We have concerns about several aspects
  - Groundwater
  - Accretions
  - System Losses
  - Historical Comparisons

# Groundwater

- Important component of San Joaquin Valley water management
- Model assumes that unmet water demands are satisfied from groundwater, limited by pumping capacities in some areas
- Pumping and recharge are not linked to aquifer storage
- This approach is problematic when considering multi-year planning horizons
- Sacramento Valley CalSim II model using “response functions” derived from calibrated groundwater models

# Accretions

- Estimate of local runoff, stream-groundwater interaction, and gage errors, adjusted to account for land use development
- Adjustments are based on historic land use changes
- This approach is problematic when considering future land use changes
- Regression Method selected instead of Mass Balance Method in some cases

# System Losses

- Better justification and investigation of system loss rates needed
- Eastside and Westside return flow methodologies should be consistent and include adequate justification and investigation
- Questions/Comments on some systems loss estimates
- General Comment - Model accuracy is very difficult to determine due to numerous undocumented and untested assumptions and approximations

# Historical Comparisons

- Graphically things look OK in many cases, but not in others
- Graphical comparison versus historical releases and reservoir storage need to be interpreted and explained
- Quantitative analyses of these results need to be provided
- Questions/Comments on some facilities
  - New Don Pedro
  - New Melones
  - Vernalis Flows

## Part I: Merits of recent work compared to prior representations

### *1. In what ways is this new representation more accurate than prior representations?*

- More up-to-date than earlier versions
- Inflows, local accretions and depletions, and reservoir operations better established
- Modeled results match well with historical flows and operations with some noted exceptions
- More data are needed
  - Water demands, Eastside operating patterns, Westside drainage and accretions
- Effect of errors and uncertainties in the data?
  - Measurement error
  - Data which are unavailable or impractical to collect

## *2. In what ways is this new representation less accurate than prior representations?*

- Newer model is not less accurate than old one
- Expectations of greater accuracy may lead policy-makers to interpret the model results too finely

*3. In what ways would CalSim II results using this new representation consistently differ from the prior model?*

- No reason for “consistent differences”
  - Except where there have been substantial operating policy changes
- Several elements are more accurately depicted
  - Land-use based demands and accretions
- Level of improved accuracy can't be assessed until the model uncertainty is better known

*4. Is this new representation expected to lead to any systematic bias in CalSim II results?*

- No evidence of systematic “bias” in the results of this new representation.
- Concerns
  - Groundwater
  - Optimization might be “too smart” and allocate exactly the amount of water needed

## Part II. Improvements to the recent work

*5. How well are the new representation and its underlying data documented? What additional documentation should be prepared?*

- Documentation is an improvement over previous efforts
- Concerns
  - Inflows to reservoirs are inaccessible
  - Confusion between measured data and outputs from other models
  - Previous modeling results used to disaggregate CALSIM variables
  - Traditional report form of documentation

## *6. How well has the new representation and its underlying data been tested? What additional testing should be performed?*

- Testing of new model more explicit and public than previous efforts
- Of note
  - Conceptual testing of the model representation versus local knowledge
  - Comparison of modeled flows versus recent historical flows
- Needs
  - Discussion of discrepancies between model and field data
  - Additional testing to estimate the model error

*7. What is the accuracy expected and what are major errors remaining (if any) in the representation of the San Joaquin Valley?*

- All models contain inaccuracies and errors
- Degree to which inaccuracies limit interpretation of results is key
- Needs
  - Compare estimated error in model results with the kinds of accuracy needed for the particular operational, planning, or policy application

## 8. *How might the new representation be improved?*

- Include representation of groundwater storage, processes, and use
- Disaggregate some mainstem SJR reaches (upstream of the Newman gage)
- Expand the number of mainstem SJR gages above Vernalis
- Implement land-use based representation of Westside demands
- Implement model and data
  - development plan
  - documentation framework

# Questions?

# Draft Findings: Eastside Water Demands

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## *Part I: Merits of recent work compared to prior representations*

### *1. In what ways is this new representation more accurate than prior representations?*

- GIS / land-use based demand accounting is big step forward. Has potential to be more accurate, more flexible, more timely, but...
- Accounting of demand components (such as Eastside irrigation districts' operations) potentially yields more accurate demand estimates, but...

## *2. In what ways is this new representation less accurate than prior representations?*

- No reason to expect that conceptual representation is less accurate, presuming that appropriate inputs are used.
- Uncertainty in results may be greater due to increase in number of inputs, each of which is uncertain.

*3. In what ways would CalSim II results using this new representation consistently differ from the prior model?*

- District demands likely lower, due to use of conceptual representation rather than contract amounts.
- Demands may differ due to linkages with hydrometeorology.

#### *4. Is this new representation expected to lead to any systematic bias in CalSim II results?*

- GIS / land-use based accounting + and -. Can be biased in future application if land use not consistent/synchronized in time and place with other inputs.
- Eastside/Westside accounting not consistent, so potential bias to allocating for contract, not use.
- Urban return flows omitted, so some bias in this.

## *Part II. Improvements to the recent work*

*5. How well are the new representation and its underlying data documented? What additional documentation should be prepared?*

- Documentation of demands well done. District-by-district explanation useful.
- Detail missing re: deep percolation, non-recoverable losses.

*6. How well has the new representation and its underlying data been tested? What additional testing should be performed?*

- Difficult to validate overall, due to closure term “taking up slack.”
- Component testing not described.

7. *What is the accuracy expected and what are major errors remaining (if any) in the representation of the San Joaquin Valley?*

- No accuracy requirement cited in documentation--no specification for what is *good enough*.
- Found no errors in the modeling, but identified some omissions.

## 8. *How might the new representation be improved?*

- With new GIS links, analysis can use land use forecasts/ scenarios. Should consider enhancing accounting of loss rates, reuse, etc.
- Aggregating / disaggregating CalSim results and inputs v. temporal resolution of economic models should be resolved.
- Expand to land-use based assessment on West side.

# Questions?

# Draft Findings: San Joaquin River Salinity

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# General Comments

- Much useful information:
  - 1) Excellent model documentation
  - 2) Presentation materials at peer review workshop
  - 3) Model developers responsive to panel requests for clarifying and additional information
  
- Documentation and assistance of model developers made this in-depth review possible

# General Comments

- Water quality module presented and reviewed as interim product
  - Recommendations to model developers on needed model improvements
  - Should there be a caution to model users on the interim nature of the product?

# General Comments

- Goal of new representation:
  - To provide better estimates of salinity at Maze for estimating water quality releases from New Melones
- Not clear from information provided if this goal has been achieved:
  - Physical representation of SJR has been greatly improved but there is insufficient information to take full advantage of this improvement

# General Comments

- The model representation is an improvement but...
- Panel concerns with:
  - Variability and uncertainty of model input
  - Lack of confidence limits on model output
- “Comparative” versus “absolute” model results
- With lack of probabilistic model results can model be used by decision-makers for long-term planning?

# Merits of Recent Work

- Increased Accuracy?
  - Physical representation of SJR system— not just a flow versus EC relationship
  - Can model effects of specific changes, such as reduced tile drainage
- Decreased Accuracy?
  - Generally no
  - Cost is greater data demands
  - Concern when using insufficient data

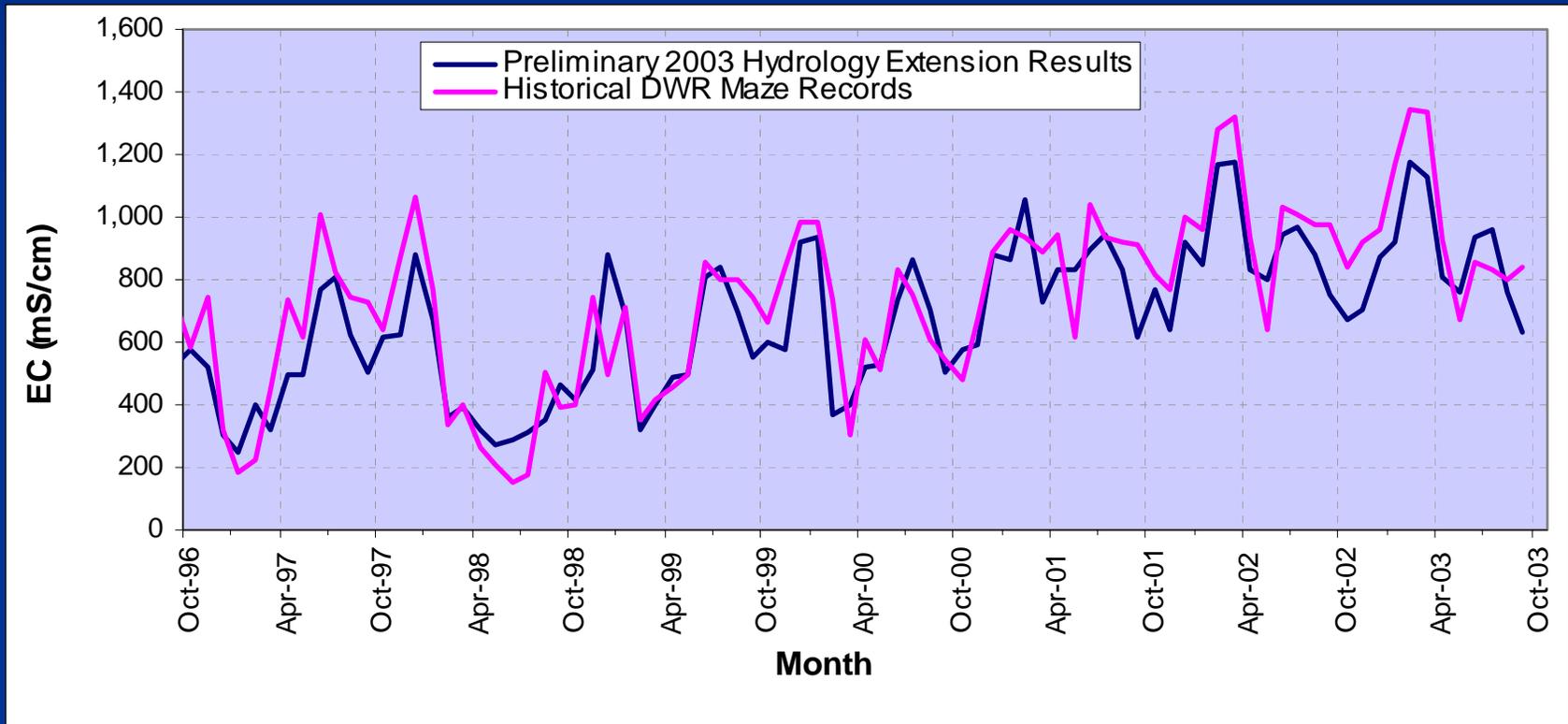
# Merits of Recent Work

- Consistent differences from prior model?
  - More accurate results when modeling disaggregated elements
  - Improved variation resulting from disaggregation
  - Seasonal shifts in modeled EC
  - Consistently lower EC and need for releases from New Melones
- Systematic Bias?
  - Yes...

# Systematic Bias?

- Bias introduced through:
  - Calibration for relatively wet period
  - Underestimated EC during calibration period
  - Large residual flows and loads
  - Lack of variability of model elements
  - Lack of explicit groundwater element

# Maze EC: Historical vs Simulated Operations\*



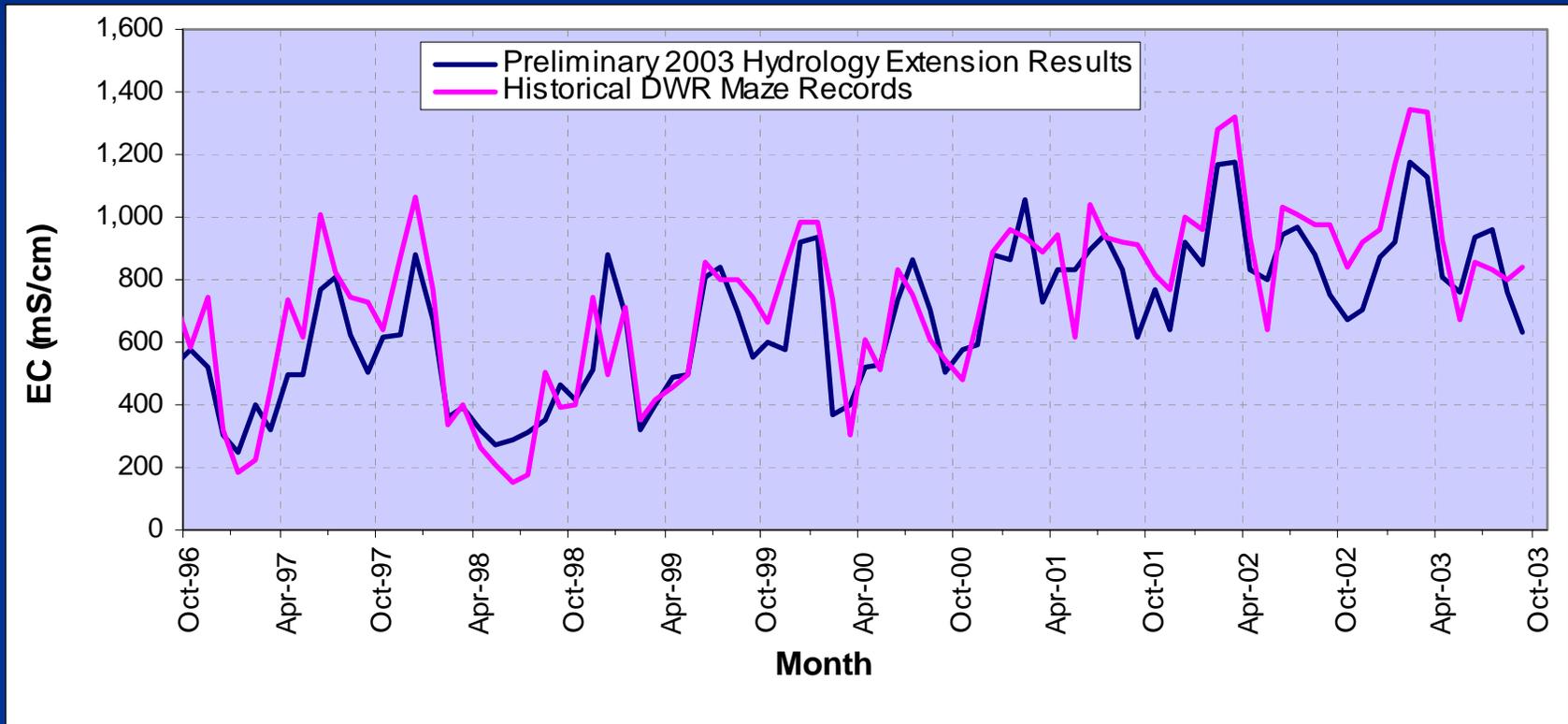
\* Graph presented at 4 August 2005 CalSim Review workshop

# Model Calibration (1997 to 2003)

	1997 to 2003	1901 to 2004
Mean Water Year “Index” (maf)*	3.44	3.34
10 <sup>th</sup> percentile (maf)	2.28	1.89
Critically dry (%)	0	16
Dry (%)	29	14
Below normal (%)	14	116
Above normal (%)	29	20
Wet (%)	29	33

\* WY Index in million acre-feet based on 60-20-20 water year classification system originally specified in 1995 SWRCB Water Quality Control Plan

# Underestimated Maze EC

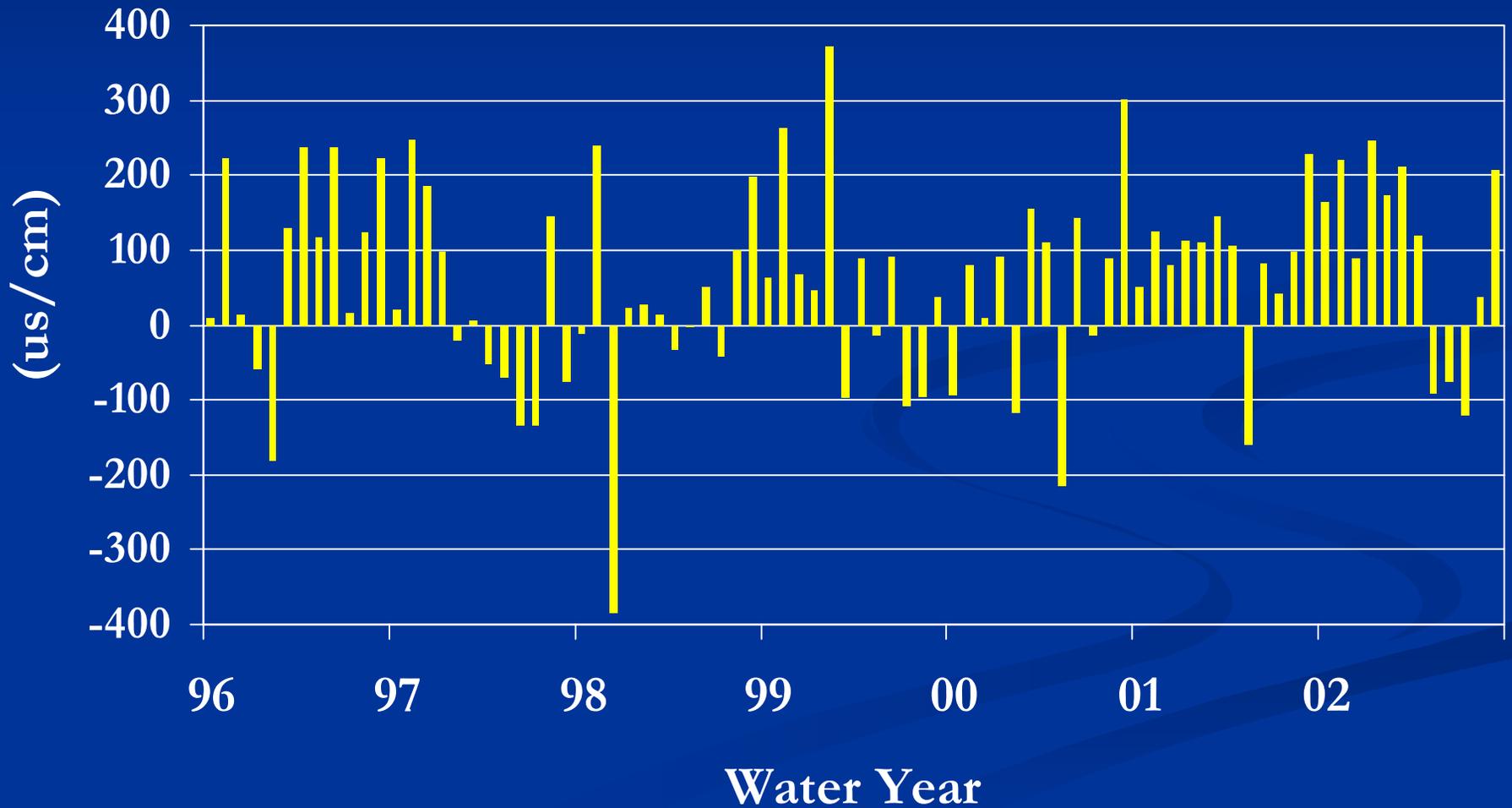




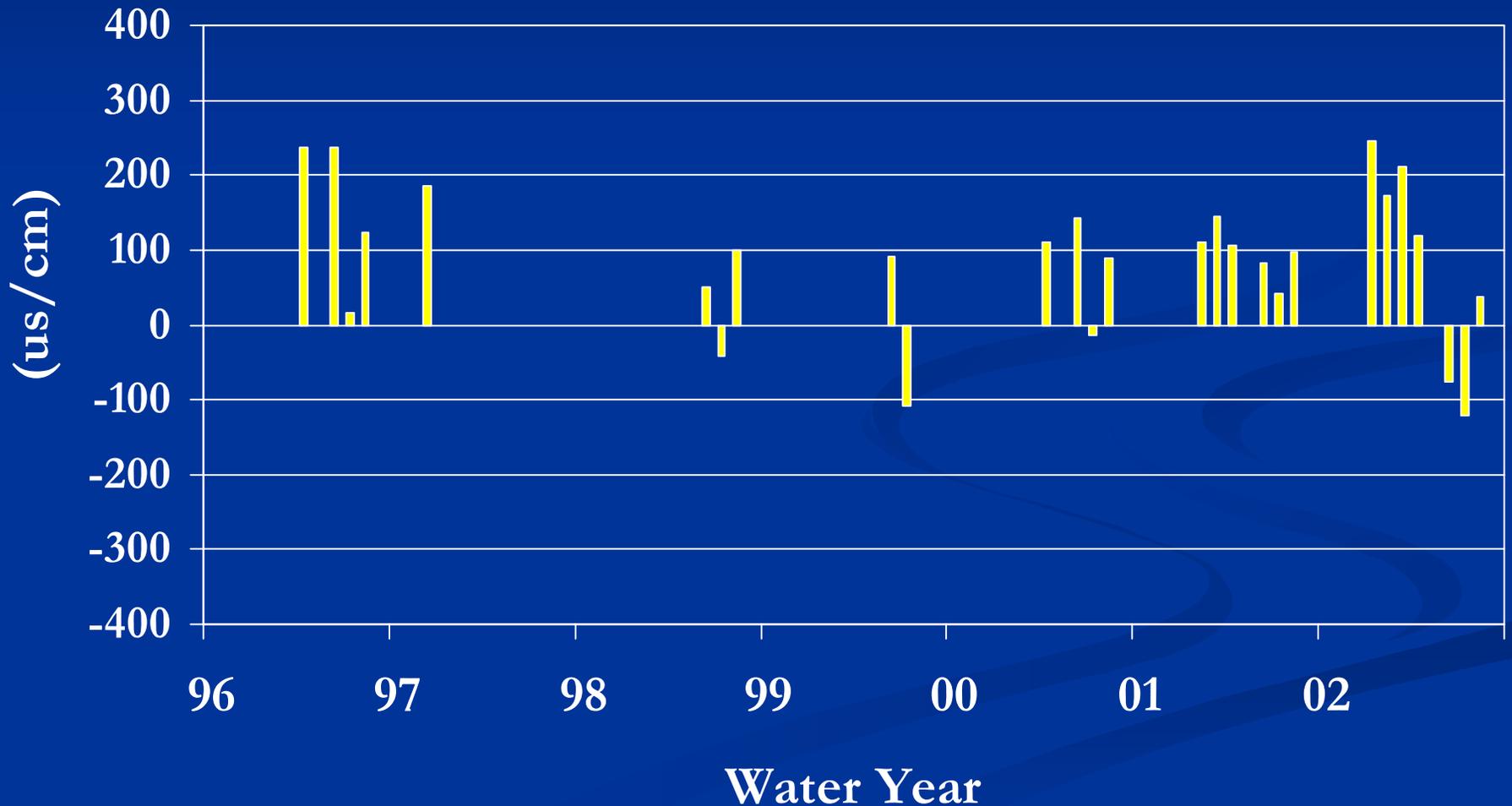
# Underestimated EC

- Underestimated EC in calibration
- Underestimated EC from other causes
- What are the implications?
  - EC is linked to New Melones flow releases
- What is the Sensitivity of New Melones flow releases to Maze EC?

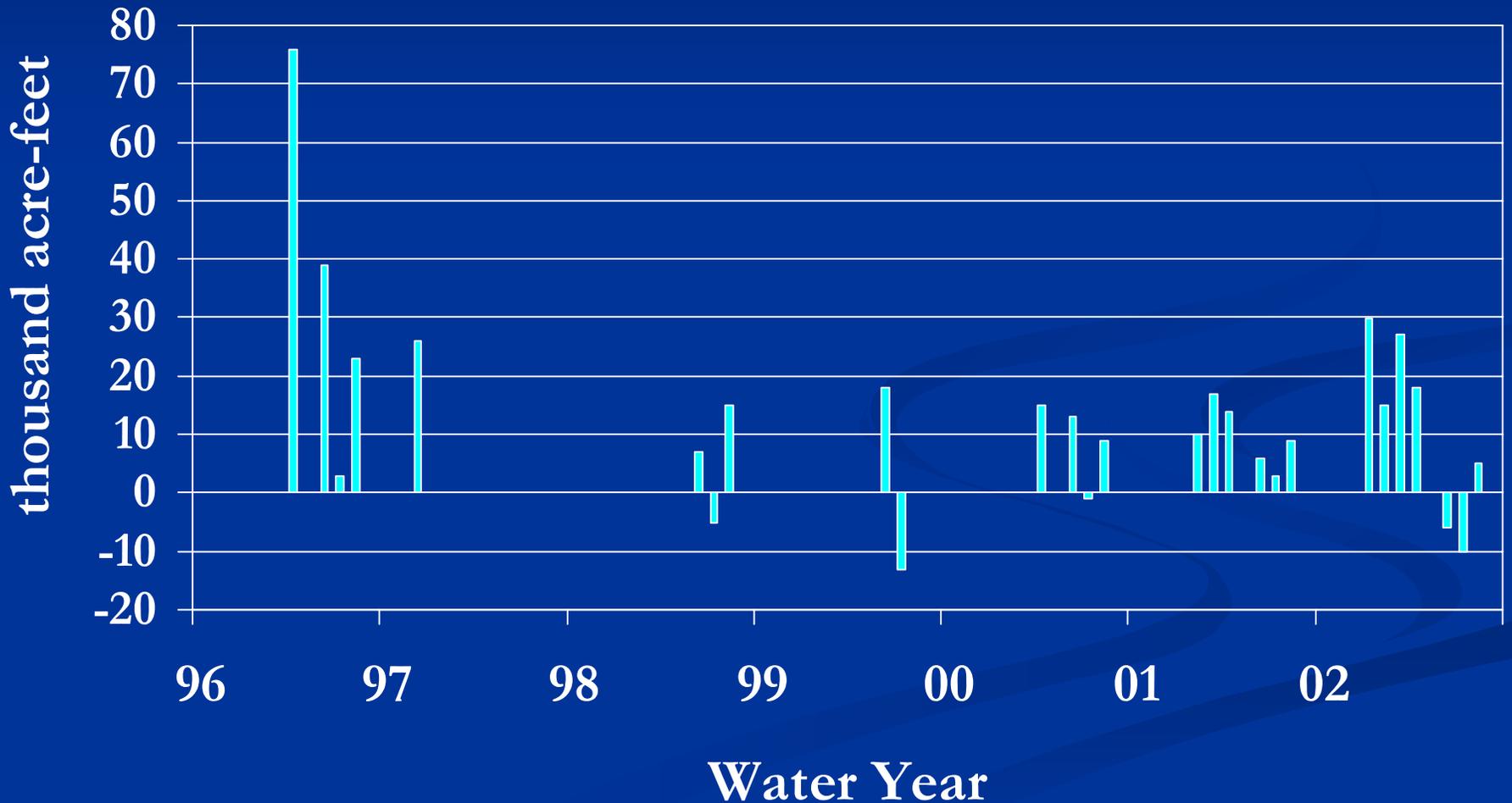
# Historical Minus Calculated Maze EC



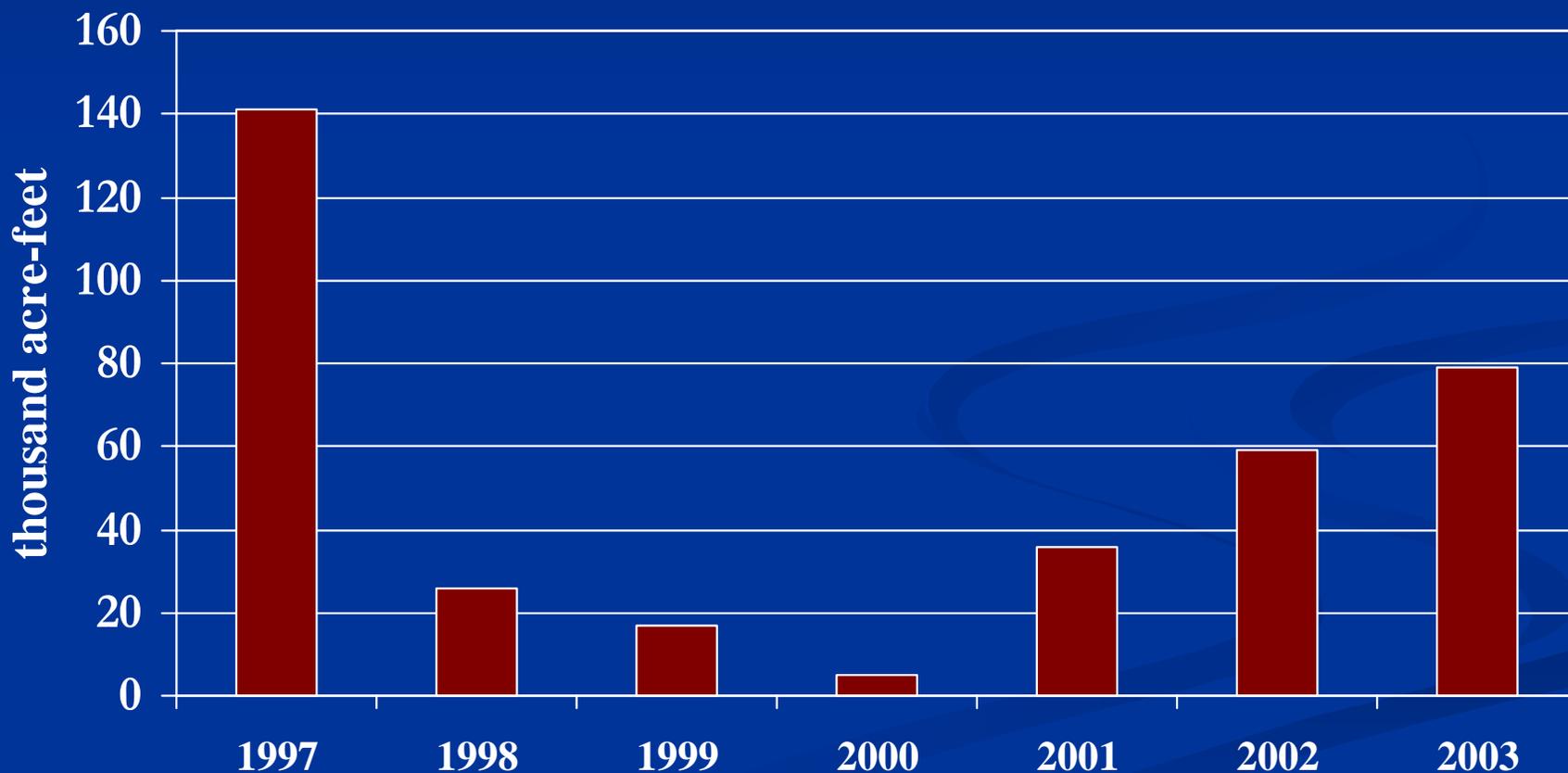
# Historical Minus Calculated Maze EC (Only when Vernalis EC objective is not met)



# Additional New Melones Flow Releases (Monthly)



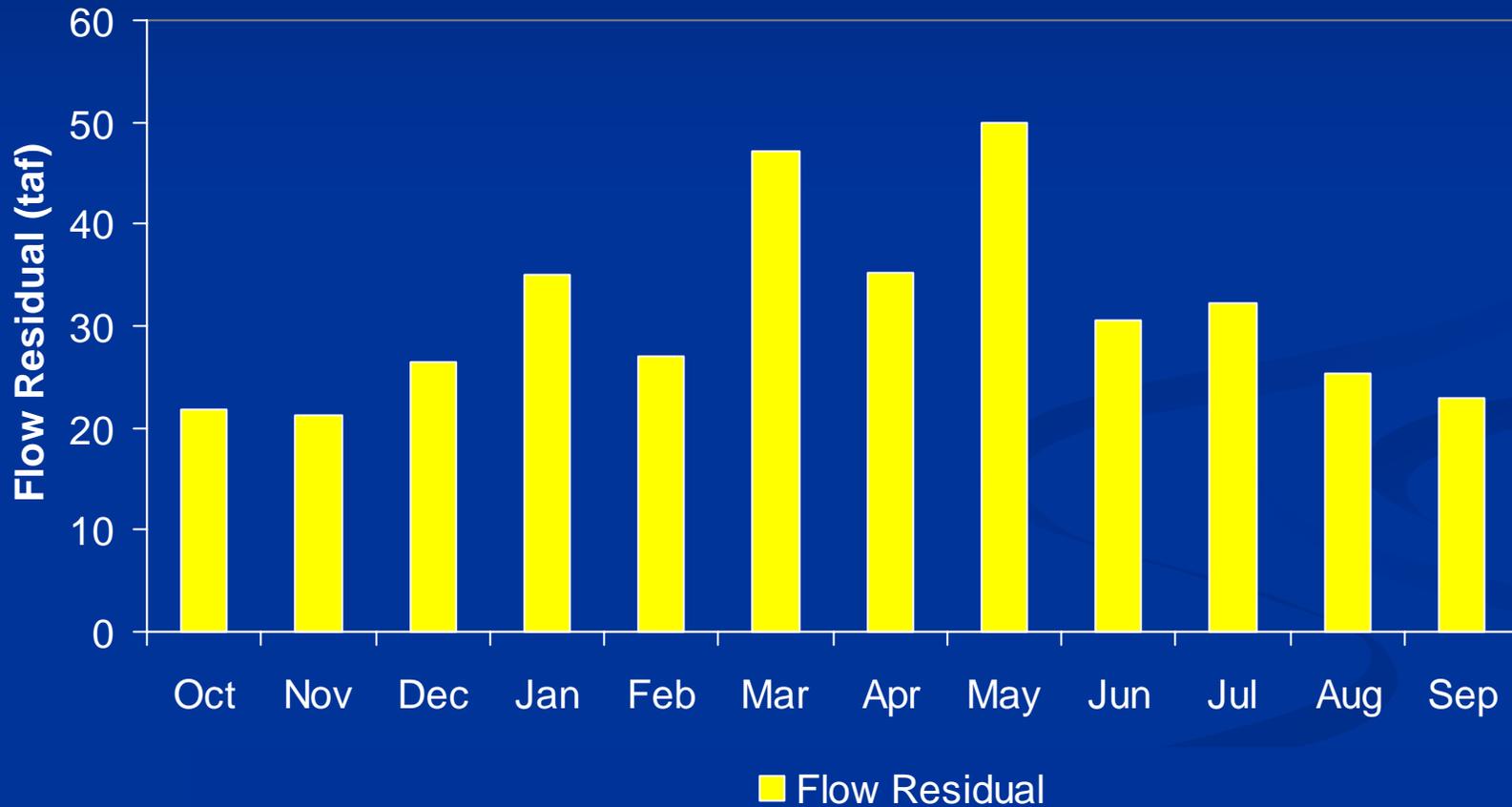
# Additional New Melones Flow Releases (Annual)



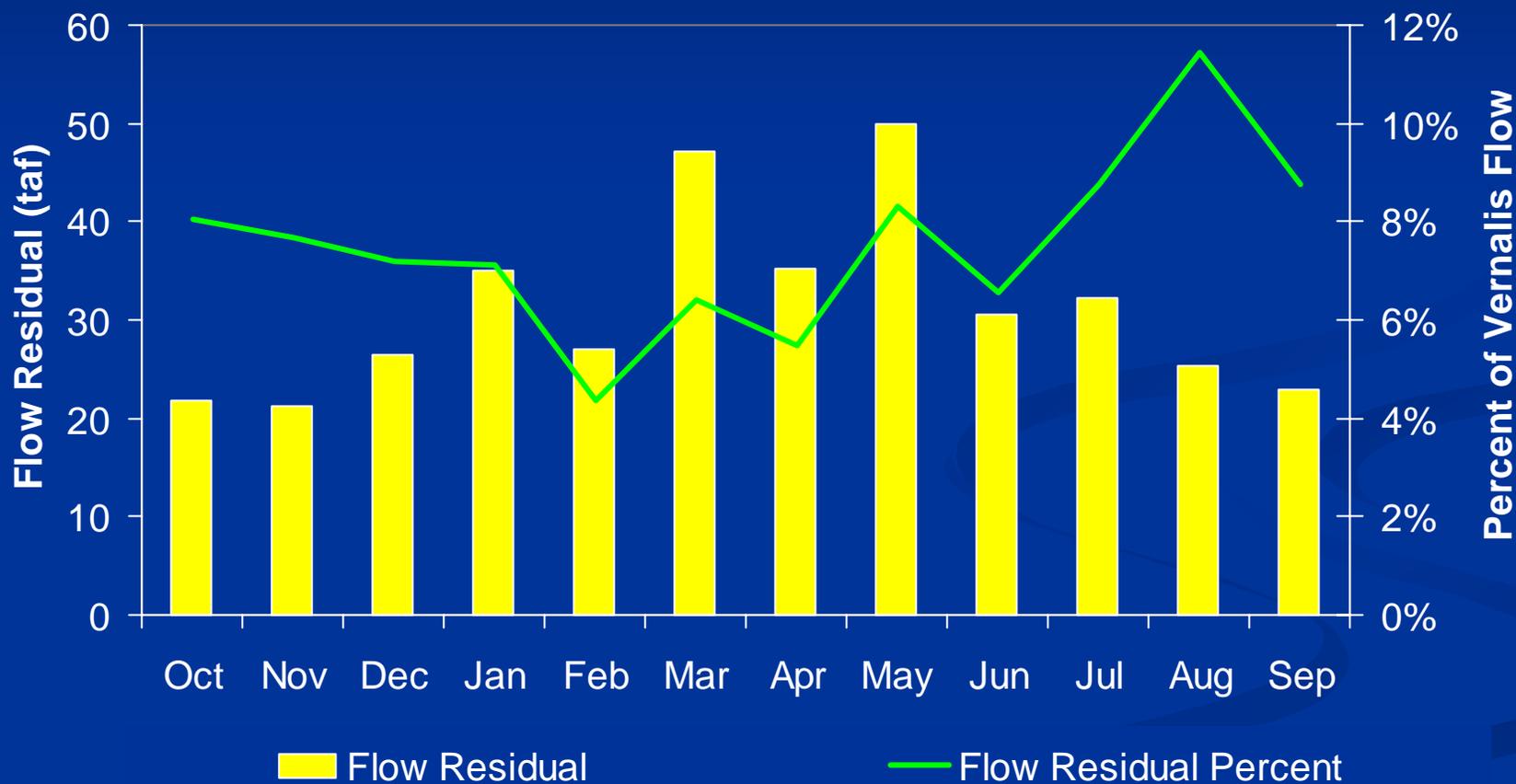
# Large Residual Salt Loads

- Model calibrated to “force” a fit with observed salinity for 1997 to 2003
- Calibration applied to a large “residual” term—lumped unknown and uncertain sources such as:
  - Groundwater
  - Other?
- How big is the residual?

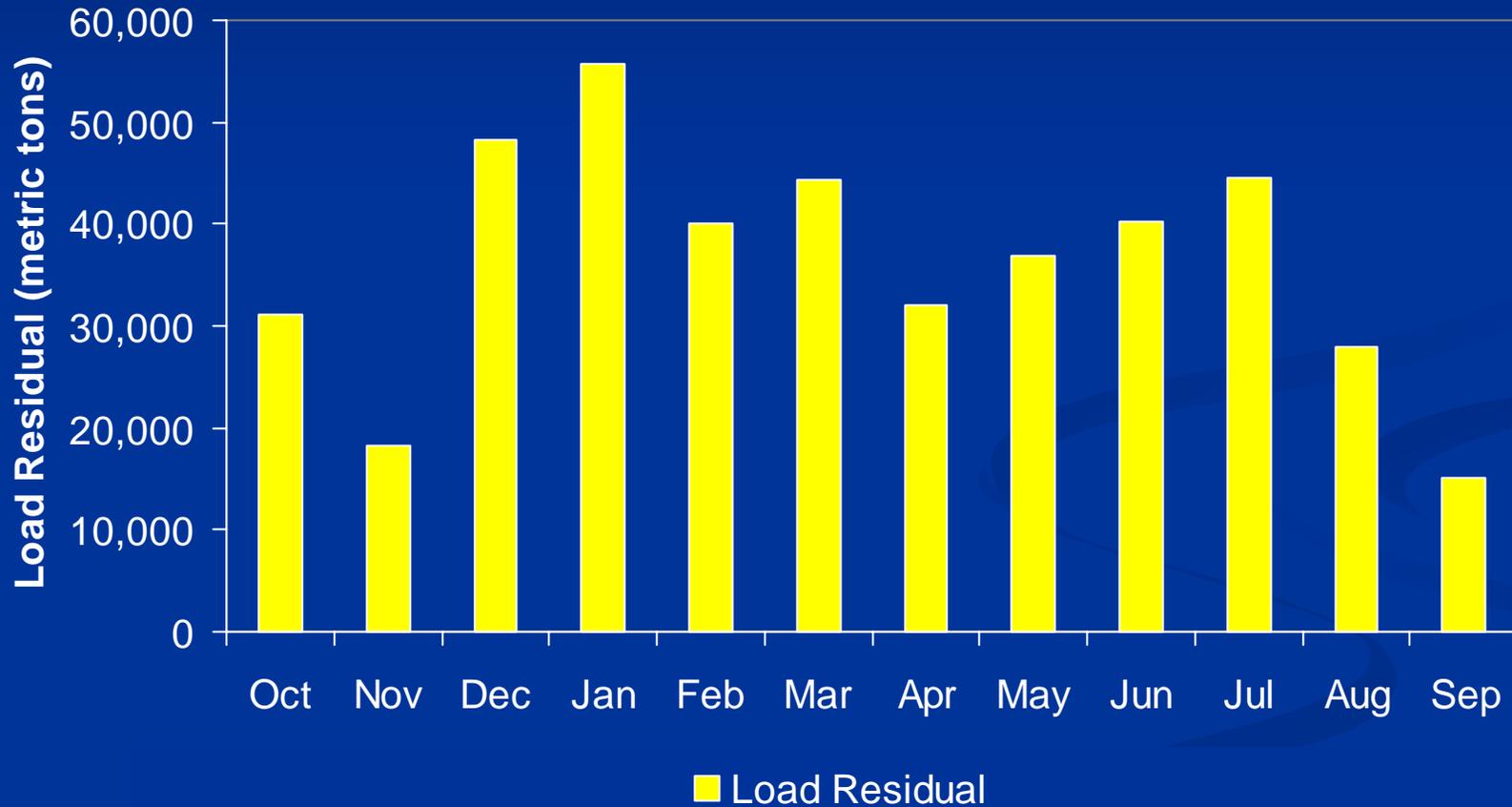
# Flow Residual



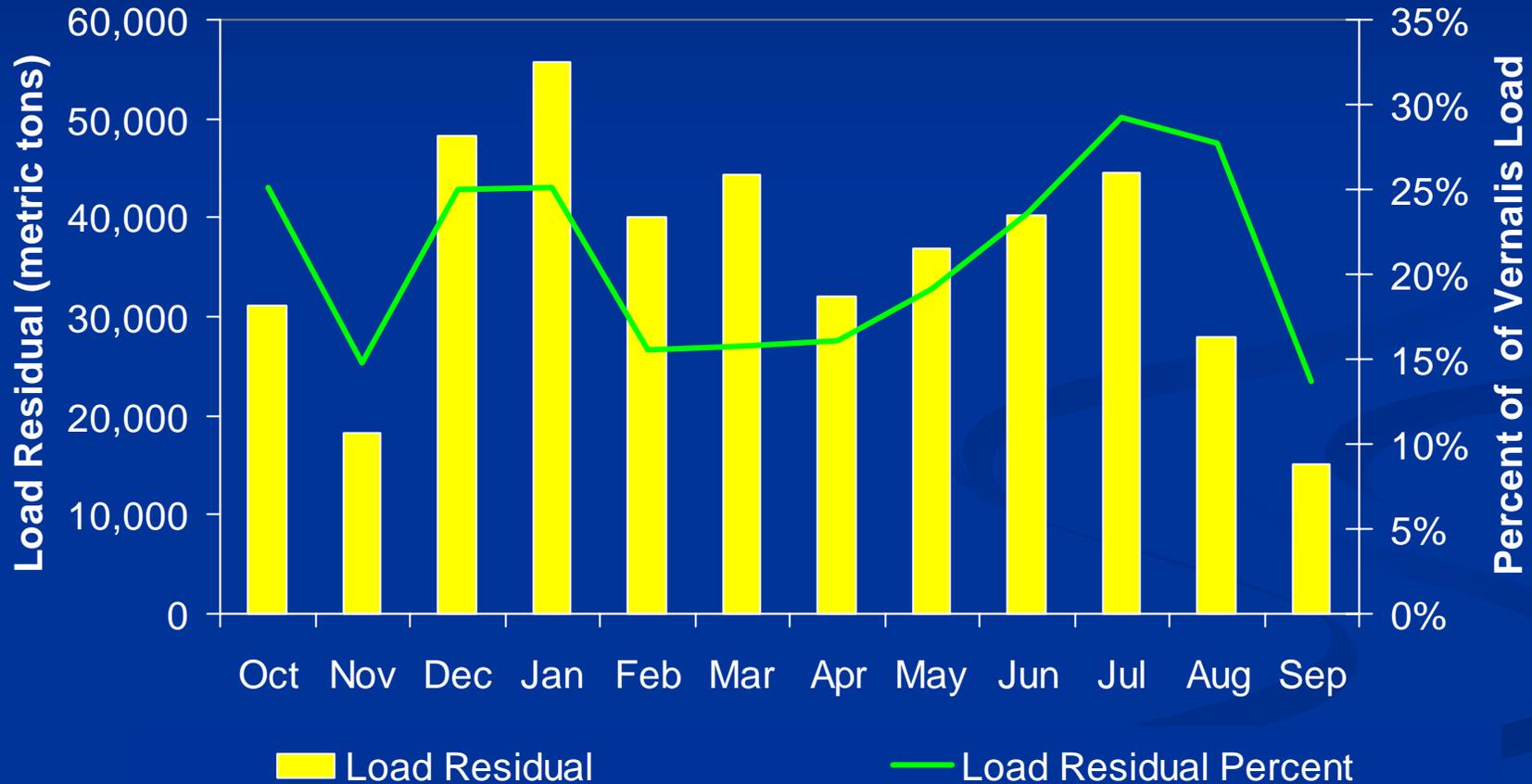
# Flow Residual



# Load Residual



# Load Residual



# Variability and Groundwater

- Lack of Variability
  - Correctly matching means is insufficient
- Lack of Explicit Groundwater
  - Effects of groundwater greatest during low flow periods
- If these are not considered, how do you quantify their potential effect on results?

# Improvements to the Recent Work

- Documentation is excellent— facilitated this review
- Recommend:
  - Better documentation where CALSIM model relies on dataset output obtained from other models

# Improvements to the Recent Work

- Representation and data tested?
  - Insufficient data to quantify uncertainty of model results
- Recommend additional model runs (sensitivity analyses):
  - Model elements that affect Maze EC
  - Likely range of groundwater accretions (quality and quantity)

# Improvements to the Recent Work

- Expected Accuracy?
  - Difficult to determine
- Recommend additional model runs to determine sensitivity of New Melones releases to:
  - Large salt load residual (closure term)
  - Small errors in water quality

# Improvements to the Recent Work

- Overall improvements in representation are not needed
- More and better data is needed
- In absence of additional data:
  - More than one “baseline” is needed
  - What are the limits of the model’s resolution?
- If there are limits to model’s resolution what are the appropriate cautions for model users?

# Questions?

# Draft

# Major Findings

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# Draft Major Findings

- Eastside Hydrology and Operations representation is substantially improved in method and testing, but test results are poorly discussed.
- Eastside Water Demands are substantially improved in method, but level of actual improvement is hard to assess.
- San Joaquin Salinity representation is substantially more flexible and should be superior if proper input data and calibration are available.

# Draft Major Findings (con't)

- Documentation is far superior to previous CalSim studies, but is not complete regarding model assumptions and test results.
- Model testing, QC, and QA is superior to predecessors, but discussion is incomplete.
- Groundwater non-representation is the model's greatest weakness

# Draft Major Findings (con't)

- Westside demands, hydrology, and drainage flows also should be land-use based
- Loss rates are a concern:
  - 10% non-recoverable delivery loss rate
  - Deep percolation rates
- Closure terms should be explicit for water and salt balances
- Fundamental data is often lacking for flow and salt loads

# Draft Major Findings (con't)

- Error/uncertainty analysis is needed to understand the effects of major uncertainties on results
- Future levels of development definition should be addressed
- “Comparative” modeling is inadequate

# Draft

# Major Recommendations

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# Draft Major Recommendations

- *Short Term* (6 months)
  1. Documentation: Revise and further improve
  2. Error analysis: Complete and document
    - Effects on Maze salinity and New Melones releases
    - Effects on Vernalis salinity
    - Especially for critically dry years
    - Implications for interpreting model results
  3. Perhaps re-calibrate Maze EC

# Draft Major Recommendations

- *Longer Term* (> 6 months)
  1. CalSim Development Plan
  2. “Absolute” expectations needed for model results
  3. Model Testing and Documentation Protocols
  4. Groundwater Representation
  5. Westside land-use based demands, hydrology, groundwater, and drainage
  6. Explicit closure terms
  7. Data collection; major effort needed

# Concluding thought

- New Management Problems ...
- Demand new models ...
- Demand new data

# Questions?

1. Clarity
2. Accuracy
3. Focus
4. Usefulness

# Next Steps

## ■ Public Draft and Comments

1. To be released in a few days, reflecting on feedback here; available on CALFED web site
2. Two weeks for written comments

## ■ Final Report Presentation

1. late November or early December

# What should be our review standard?

- Government agency norms for modeling and documentation?
- Scientific and academic norms for modeling and documentation?
- Both?

# Questions?