Basin Plan Amendment to Establish New Salinity and Boron Objectives and a TMDL in the Lower San Joaquin River

Public Workshop
Stanislaus County Ag Center
8 February 2006
Why are we here today?

• Status of Salt and Boron TMDLs
  – First Phase – Vernalis
  – Second Phase – Upstream Objectives
• Solicit feedback
Agenda

- Background
- First Phase TMDL
- Second Phase: Objectives
  - Technical basis
  - Policy considerations
- Second Phase: Load Allocations
  - Technical basis
  - Policy considerations
Lower San Joaquin River Basin

- San Joaquin River
- Stanislaus River
- Tuolumne River
- Merced River
- Stockton
- Modesto
- Vernalis
- Delta Mendota Canal
- Crows Landing
- Friant Dam
- Mendota Dam
Project Area for the Lower San Joaquin River

Project area = 2.9 Million Acres
Average Electrical Conductivity SJR Near Vernalis

Electrical Conductivity (µs/cm)

Year

Average Electrical Conductivity SJR Near Vernalis
15-year Running Average Electrical Conductivity SJR Near Vernalis

Friant completed, SJR diverted south

Delta water delivered to west side SJV
San Joaquin River near Vernalis
30-Day Running Average Electrical Conductivity

Electrical Conductivity (µs/cm)

April to August
September to March
San Joaquin River at Crows Landing
Monthly Average Electrical Conductivity

Electrical Conductivity (µs/cm)

April to August
September to March
San Joaquin River Electrical Conductivity
Impetus for Second Phase TMDL

• Federal Clean Water Act- TMDL Required for impaired waters
• State Board Direction- Water Rights Decision 1641
• Timeline in First Phase TMDL- Basin Plan Amendment adopted in November 2005
• State Board Direction- adopt upstream objectives by September 2006
First Phase SJR Salt TMDL

- Adopted by State Board November 2005
- Based on attaining Vernalis water quality objectives
- Established salt load limits:
  - fixed base load and real time
- Established load allocation ‘framework’
First Phase SJR Salt TMDL

Regulatory Tools

• Non-point Sources:
  – Waste Discharge Requirements
  – Waivers of Waste Discharge Requirements

• Point Sources
  – NPDES Permits
Waste Discharge Requirements

- Conservative and static effluent limits
- Provides assurances
- Regulatory backstop
Waiver of WDRs

- Modify Irrigated Lands Waiver or create new (salt specific) waiver
- Relies on stakeholder driven solutions and tools to:
  - Meet water quality objectives
  - Meet real-time load allocations
Preferred Implementation

- Waiver of WDRs (Real-time Management):
  - Achieves standards
  - Allows for export of salts
  - Provides flexibility
U.S. Bureau of Reclamation

- Responsible for salt in supply water
- Management Agency Agreement
- Report of Waste Discharge
Waste Load Allocations

- Relatively small contribution
- Implemented through NPDES permits: concentration based effluent limits for salt set equal to existing water quality objectives
First Phase SJR Salt TMDL

Recommendations to State Water Board

- Prohibit water transfers that contribute to salinity impairment
- Condition water rights permits on meeting water quality objectives
Second Phase TMDL

- Objectives
  - Technical basis
  - Policy considerations
Water Quality Objectives

• Technical Basis:
  – Beneficial uses
  – Existing objectives
    • Drinking water
    • Agricultural (Vernalis standard)
  – New information
    • Bay Delta Periodic Review
# Beneficial Uses

<table>
<thead>
<tr>
<th>Lower San Joaquin River Reach</th>
<th>MUN</th>
<th>AGR</th>
<th>PROC</th>
<th>REC-1</th>
<th>REC-2</th>
<th>WARM</th>
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<th>MIGR</th>
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<td>Sack Dam to Merced River</td>
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P = potential  E = existing
## Beneficial Uses

<table>
<thead>
<tr>
<th>Reach</th>
<th>Drinking Water</th>
<th>Irrigation Supply</th>
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<td>Mendota Dam to Sack Dam</td>
<td>potential</td>
<td>existing</td>
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<tr>
<td>Sack Dam to Merced River</td>
<td>potential</td>
<td>existing</td>
</tr>
<tr>
<td>Merced River to Vernalis</td>
<td>potential</td>
<td>existing</td>
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Basin Plan Drinking Water Requirements

“At a minimum, water designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the following provisions of Title 22 of the California Code of Regulations…”
### Secondary Maximum Contaminant Level  
**Electrical Conductivity (us/cm)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Value</th>
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<tr>
<td>Recommended b</td>
<td>900</td>
</tr>
<tr>
<td>Upper c</td>
<td>1,600</td>
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<tr>
<td>Short Term d</td>
<td>2,200</td>
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</table>

**a.** For the constituents shown, no fixed consumer acceptance contaminant level has been established.

**b.** Constituent concentrations lower than the Recommended contaminant level are desirable for a higher degree of consumer acceptance.

**c.** Constituent concentrations ranging to the Upper contaminant level are acceptable if it is neither reasonable nor feasible to provide more suitable waters.

**d.** Constituent concentrations ranging to the Short Term contaminant level are acceptable only for existing systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources.

*Section 64449, table 64449-B*
Irrigation Supply

- Protect Salt Sensitive Crops
- Review of peer-reviewed literature
  - Ayers and Westcot: foundational citation
  - Maas and Grattan: University of California Publication 8066, Irrigation Water Salinity and Crop Production
Irrigation Supply

- Assumptions:
  - 15 to 20 percent leaching fraction
  - All other factors (fertility, irrigation scheduling, pest control) are *optimized*
- 700 µs/cm for beans, carrots
- 1,000 µs/cm for numerous tree, vine, vegetable, and row crops…
  ...notably almonds and grapes
### Project Area Crop Acreage

<table>
<thead>
<tr>
<th>Crop</th>
<th>County Acreage*</th>
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<tr>
<td></td>
<td>San Joaquin</td>
</tr>
<tr>
<td>Beans</td>
<td>7,800</td>
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<tr>
<td>Almonds</td>
<td>34,157</td>
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<td>Grapes</td>
<td>68,651</td>
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<tr>
<td>Total</td>
<td>110,608</td>
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* Source: USDA Crop Acreage Reports for 2004 and 2005
New Information

• Bay Delta Periodic Review:
  • Dr. Charles Burt
  • Dr. John Letey
• Provide “reasonable protection”
• Evaluations assume higher salinity can be mitigated through application of additional water
Salinity Option 1
“Existing” Narrative Drinking Water

- Year-round objective of 1,600 µS/cm
- 1,600 µS/cm is upper level MCL* for domestic drinking water supplies per Title 22 of the California Environmental Health Code of Regulations

* Maximum Contaminant Level
Salinity Option 2
“Full Protection”

- 700 μS/cm from 1 April to 31 August when agriculture is most sensitive beneficial use
- 900 μS/cm from 1 September to 31 March when municipal water supply is most sensitive beneficial use
Salinity Option 3
“Export Limit”

• Year-round objective of 1,000 µS/cm
• 1,000 µS/cm is numeric standard for Delta waters at intakes to California Aqueduct and Delta-Mendota Canal
Factors to Consider

• Beneficial uses
• Characteristics of the hydrographic unit
• What can reasonably be achieved
• Economics
• Need to develop housing
• Need to develop & use recycled water
## SJR Reach Characteristics

<table>
<thead>
<tr>
<th>Reach</th>
<th>Length (miles)</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Mendota Pool to Sack Dam</td>
<td>23</td>
<td>DMC deliveries and upper SJR</td>
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<tr>
<td>Sack Dam to Bear Creek</td>
<td>46</td>
<td>Flood flows and groundwater</td>
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<tr>
<td>Bear Creek to Salt Slough</td>
<td>6</td>
<td>Wetland, ag returns, and Bear Ck</td>
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<tr>
<td>Salt Slough to Mud Slough</td>
<td>9</td>
<td>Wetland and ag returns</td>
</tr>
<tr>
<td>Mud Slough to Merced</td>
<td>3</td>
<td>Grassland tile drainage</td>
</tr>
<tr>
<td>Merced to Stanislaus</td>
<td>43</td>
<td>East side tributary</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>130</strong></td>
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</table>
Salinity Alternatives

- Various combinations of options
- Are they reasonable?
  - Do they protect the use?
  - Are they consistent with established policies?
  - Are they achievable?
- Performance goal versus objective
Salinity Alternative 1

Merced River

Sack Dam

April to August

September to March

Mendota Dam → 132 miles → Vernalis
Salinity Alternative 3

- Merced River
- Sack Dam

- April to August
- September to March

Mendota Dam → 132 miles → Vernalis
Loading Capacity

Developing Design Loads:

• Determine design flows for each water year type (DWRSIM & CALSIM)

• TMML (Loading Capacity) = WQ objective * design flow
Loading Capacity

The TMML must consider ambient loading and a Margin of Safety

\[ \text{TMML} = \sum \text{LA} + \sum \text{WLA} + \text{BG loads} + \text{GW Loads} + \text{MOS} \]

Load Allocations are dependant on background loads and groundwater loads

\[ \sum \text{LA} + \sum \text{WLA} = \text{TMML} - (\text{BG loads} + \text{GW Loads} + \text{MOS}) \]
<table>
<thead>
<tr>
<th>Year Type</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>VAMP</th>
<th>May</th>
<th>Jun</th>
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# SJR Compliance Stations

<table>
<thead>
<tr>
<th>Reach</th>
<th>Compliance Station</th>
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<tbody>
<tr>
<td>Mendota Pool to Sack Dam</td>
<td>Sack Dam</td>
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<tr>
<td>Sack Dam to Bear Creek</td>
<td>SJR at Lander Avenue</td>
</tr>
<tr>
<td>Bear Creek to Salt Slough</td>
<td>SJR at Lander Avenue</td>
</tr>
<tr>
<td>Salt Slough to Mud Slough</td>
<td>SJR at Fremont Ford</td>
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<tr>
<td>Mud Slough to Merced</td>
<td>SJR at Hills Ferry</td>
</tr>
<tr>
<td>Merced to Stanislaus</td>
<td>SJR near Patterson /Crows Landing</td>
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<tr>
<td></td>
<td>SJR at Maze Road</td>
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<tr>
<td>Stanislaus to Vernalis</td>
<td>SJR near Vernalis</td>
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## Loading Capacity - Phase I TMDL
**SJR at Vernalis (thousand tons)**

<table>
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<tr>
<th>Year Type</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>VAMP</th>
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<tr>
<td><strong>Wet</strong></td>
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</table>
## Load Allocations - Phase I TMDL

**SJR at Vernalis (thousand tons)**

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Lower San Joaquin River Subareas
## Loading Capacity

**SJR Subareas (pounds / acre)**

<table>
<thead>
<tr>
<th>Year Type</th>
<th>Jan</th>
<th>Feb</th>
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## Loading Capacity - Phase I TMDL

### SJR Subareas (pounds / acre)

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<td>31</td>
<td>49</td>
<td>42</td>
<td>39</td>
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Loading Capacity

- Loading capacity for each subarea is the lowest loading capacity applicable
  - For example loading capacity per acre for Grasslands subarea could be controlled by loading capacity at Vernalis or Crows Landing
SJR EC Objectives

• Are they reasonable given high poor quality groundwater base flow?
• Three options:
  – Groundwater control program
  – Flow augmentation
  – Use attainability analysis (UAA)
Groundwater Loads

• Three methods used to calculate groundwater accretions:
  – USGS studies
  – Mass balance
  – Low flow at Lander Avenue

• Water quality based on
  – USGS estimate
  – Mass balance
Groundwater Accretions
Upstream of Merced River

Mean monthly flow = 118 cfs
(84,000 acre-feet per year)
How to Account for Groundwater Salt Load?

- Assumptions:
  - WQO: 1,600 µs/cm
  - Groundwater salinity: 2,800 µs/cm
  - Dilution flow salinity: 200 µs/cm
Dilution Flows
Upstream of Merced River

Mean monthly flow = 99 cfs (72,000 acre-feet per year)
Dilution Flow Versus Increased Leaching Requirement?

- Dilution flow of 99 cfs (72,000 acre-feet per year)
- What is impact of higher salinity water?
  - Additional leaching requirement…
    … how much?
Effect of Increased Salinity Irrigation Water

• Assume for beans* :
  – $EC_e = 1,000 \mu S/cm$ (no yield decline)
  – Increase leaching ratio from 0.25 to 0.57
  – Crop evapotranspiration (ET) for beans of 1.8 feet

• Applied water increases from 2.4 to 5.4 feet to satisfy leaching requirement and no yield decline

• Example provided by Dr Burt in exhibit SJEC-EXH–01 prepared for Bay-Delta periodic review
Effect of Increased Salinity Irrigation Water

• Assume:
  – Increased need for water: 3.0 acre-feet/acre
  – 60,000 acres irrigated by SJR water from Sack Dam to Vernalis
  – One-third acres planted with salt-sensitive crops
• Requires 60,000 acre-feet of additional water to assure no loss in productivity
• Equivalent to 200 cfs in each month, April to August
Dilution Flows
Upstream of Merced River

Mean monthly flow = 99 cfs
(72,000 acre-feet per year)
Tradeoff

- Improved water quality (lower salinity) results (in general) in lower water use due to decreased leaching requirement
Other Considerations

- Central Valley Project Impacts
- Need for salt balance
Central Valley Project Impacts

• Decreased SJR flows: diversion of SJR flows to outside SJR Basin
• Increased CVP salt load imports with replacement water supply
• Consistent with Phase I TMDL and Water Right Decision 1641: USBR is principle cause of the salinity impairment
Central Valley Project Impacts
SWRCB D-1641

• The SWRCB Order in Decision 1641, adopted 29 December 1999, amended the CVP permits under which the USBR delivers water to the San Joaquin Basin to require that the USBR meet the 1995 Bay Delta Plan Salinity objectives at Vernalis.

• The USBR has wide latitude in developing a program to achieve this result.
Need for Salt Balance

- Salt and boron are naturally occurring elements that are mobilized whenever water is applied to soils (precipitation and applied irrigation water)
- Concentrations of salt and boron also increase as a result of evapotranspiration
- Historically more salt has been imported to basin that has been exported
Need for Salt Balance
TMDL Implementation

• Typically, fixed TMDL load limits are established to meet water quality objectives during low flow conditions.
• Recognizing need to maintain a salt balance in the basin, there is a need in the salt and boron TMDL to maximize salt exports while still meeting water quality objectives.
Challenge:

How can these considerations be incorporated in the TMDL?
Load Allocation Methodology

- Base Load Allocation Method
- Import Water Relaxation
- CVP Load Allocation
- Real-time Relaxation
Base Load Allocation

- Low flow conditions
- Background loads are subtracted from total loading capacity
- Consumptive use allowance loads subtracted from total loading capacity
- Waste load allocation: current limits
- Remaining assimilative capacity evenly distributed to non-point sources
Import Water Relaxation
(For SJR & Central Valley Project Imports)

• Subareas with high salt supply receive additional allocation
• “Supply water relaxation” is 50 percent of mean salt load imported to the subarea during low flow conditions
• Problem: additional load allocation results in violation of water quality objectives
Import Water Relaxation
(For SJR & Central Valley Project Imports)

- Problem: additional load allocation results in violation of water quality objectives
- Solution: impose load limits on supply water
CVP Load Allocation

• USBR responsible for salt load in Central Valley Project (CVP) water delivered to the TMDL project area that is in excess of a base load for equivalent volume of Sierra Nevada quality water

• This load responsibility offsets additional allocation provided to subareas that receive CVP water supply credit
CVP Load Allocation

- Consistent with Phase I TMDL, USBR will have wide latitude to address salt imports:
  - Reduce salt in supply
  - Drainage treatment / disposal
  - Dilution flows
Real-time Load allocations

- Base loads plus import water relaxation may still be too restrictive
- TMDL includes opportunities to utilize real-time load allocations in lieu of the base load allocations
Real-time Load allocations

• Real time relaxation may only be employed if physical and organizational infrastructure is put in place to manage discharges
Other Basin Plan Amendment Elements
Other Basin Plan Amendment Elements

- Surveillance and Monitoring
- Time Schedule
- Economic Analysis
Surveillance and Monitoring

• Determine Success of Amendment
• Discharger Ultimately Responsible
• Program Goals
  – Compliance with Objectives
  – Compliance with Load Allocations
  – Effective Management
Time Schedule for Compliance

- Schedule will be determined based on factors including relative contribution to the problem and achievability
- Performance goals versus full compliance with water quality objectives
Economic Analysis

- Nonpoint source discharger costs
- Point source (NPDES Permittee) costs
- Program costs
- Potential sources of financing
### Salt and Boron Project Timeline

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
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<tbody>
<tr>
<td>Public Workshop on Draft BPA and TMDL</td>
<td>February 2006</td>
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<tr>
<td>Draft BPA and TMDL released</td>
<td>April 2006</td>
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<tr>
<td>Regional Board Workshop</td>
<td>June 2006</td>
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<tr>
<td>Regional Board Hearing</td>
<td>September 2006</td>
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<tr>
<td>State Board review</td>
<td>December 2006</td>
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<tr>
<td>OAL &amp; U.S. EPA</td>
<td>February 2007</td>
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Next steps

Submit Comments:
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Website:
http://www.waterboards.ca.gov/centralvalley/programs/tmdl/upstream-salt-boron/

Listserve:
http://www.waterboards.ca.gov/lyrisforms/reg5_subscribe.html