CALFED Water Quality Program Final Assessment – Status Report

Presentation to
California BDPAC Water Quality Subcommittee

Lisa Holm, PE
Sarahann Dow, Ph.D.
Cindy Paulson, Ph.D.
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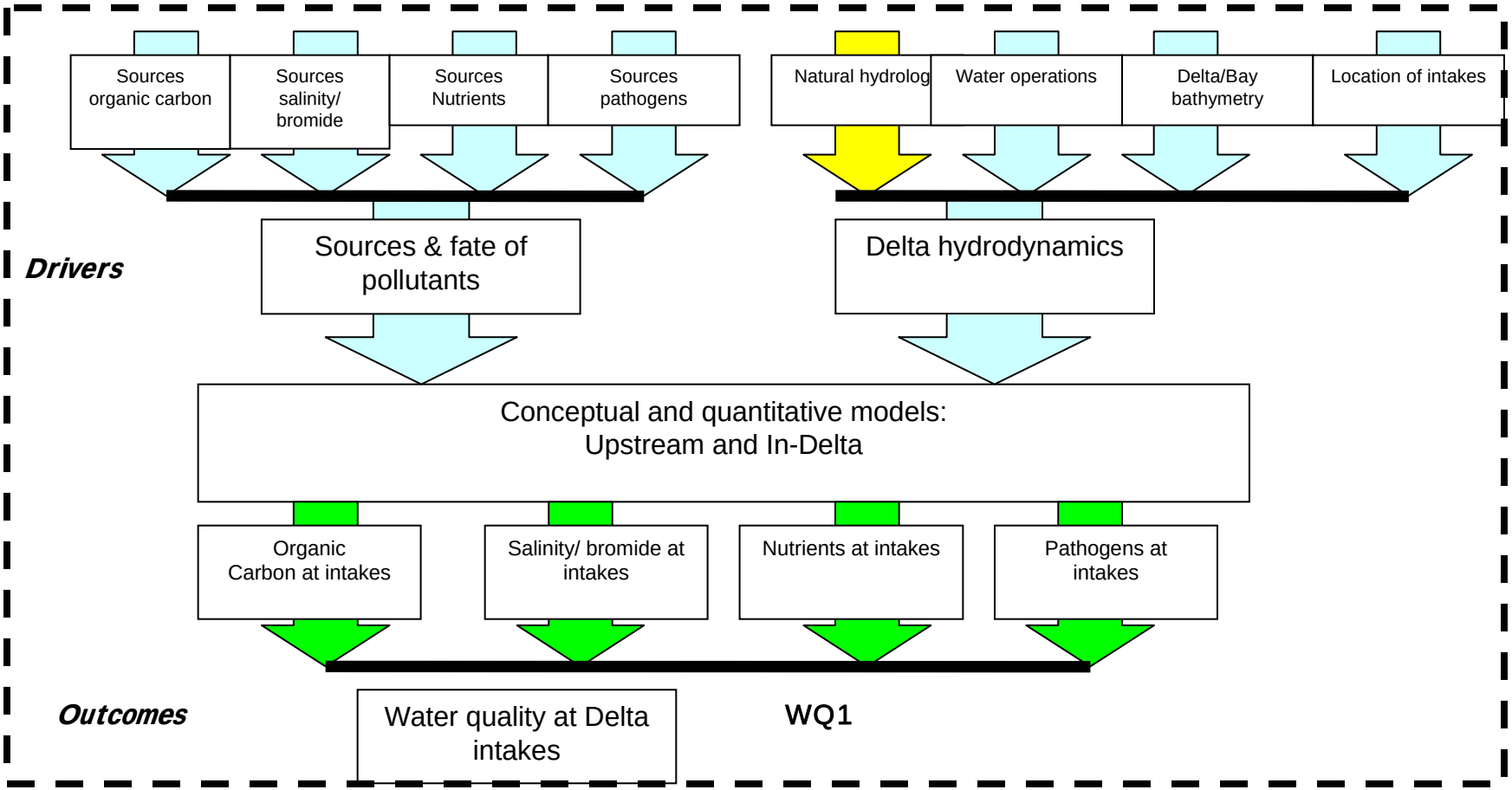
CALFED WQ "Final"

- System-wide look at drinking water quality:
  - Background on goals and interpretation
  - Assessment of watershed sources, transport to intakes and experience with controlling
  - Assessment of treated water quality, development of representative conceptual models of treated water quality
  - Initial economics evaluation
  - Integration with conveyance and storage studies

Final Assessment Goals

- Inform Stage 1 decision on conveyance by providing drinking water quality context
- Identify priorities for Stage 2 implementation of WQ Program, including initial development of performance measures, monitoring and research needs
- Technical work will also support Central Valley Drinking Water Policy (salinity and treatment conceptual models)

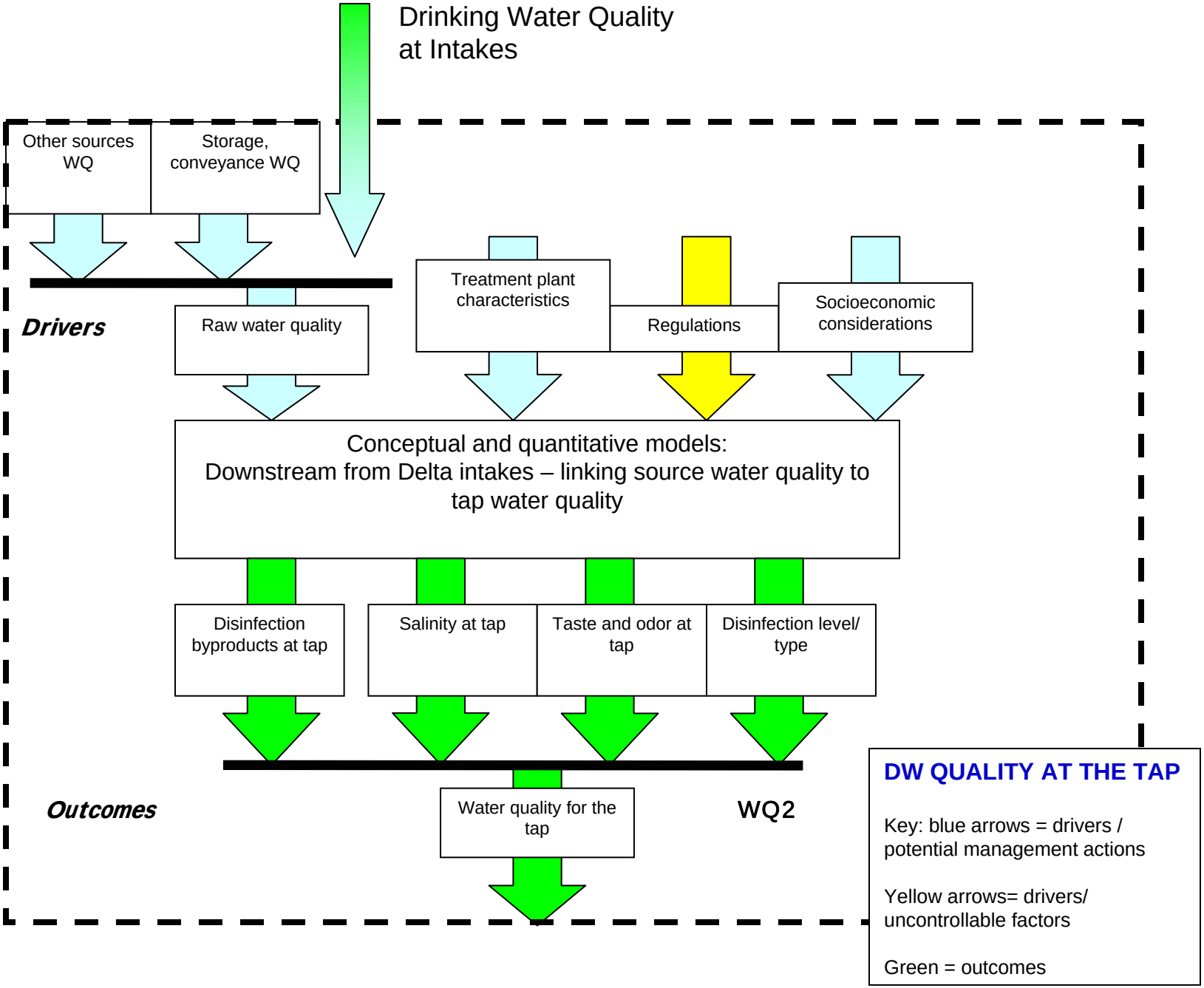


DRINKING WATER QUALITY AT THE INTAKES

Key: Blue arrows = drivers / potential management actions

Yellow arrows = drivers/ uncontrollable factors

Green = outcomes

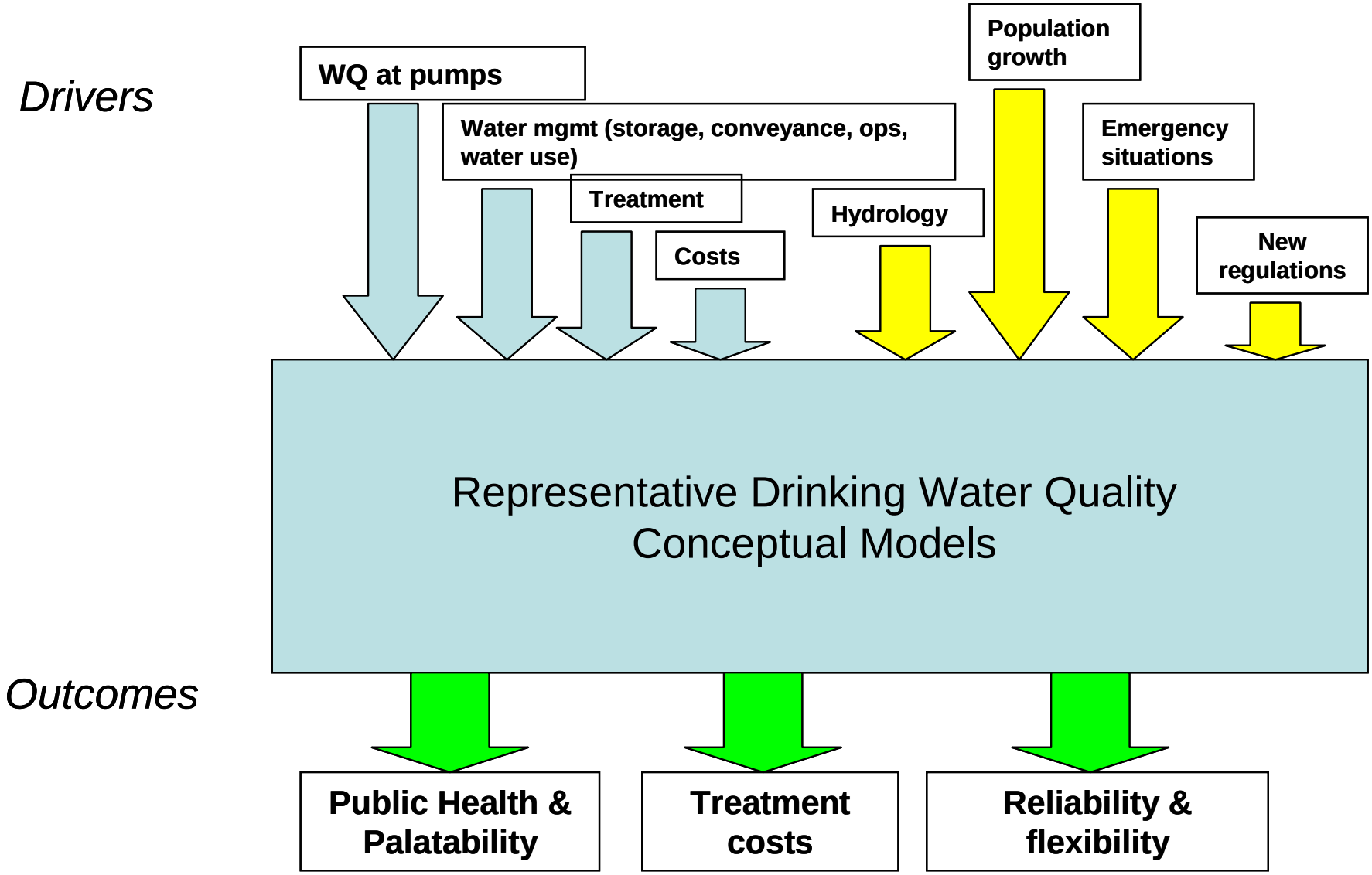

Drinking Water Quality at Intakes
Other sources WQ
Storage, conveyance WQ
Drivers
Raw water quality
Treatment plant characteristics
Regulations
Socioeconomic considerations
Conceptual and quantitative models: Downstream from Delta intakes – linking source water quality to tap water quality
Disinfection byproducts at tap
Salinity at tap
Taste and odor at tap
Disinfection level/ type
Outcomes
Water quality for the tap
WQ2
DW QUALITY AT THE TAP
Key: blue arrows = drivers / potential management actions
Yellow arrows= drivers/ uncontrollable factors
Green = outcomes

Treatment Questions

- How does existing treated water quality compare to CALFED targets?
- How is treated water quality affected by Delta water quality? What are the specific needs for improvement/protection?
- Do the CALFED targets adequately capture this influence and address treatment plant concerns (for a longer time horizon)?
- What are the treated water quality trends?
- Where are the opportunities for improvements? What are the priorities?
- What are the economics of these issues?
- (Can we calculate risk associated with treated water quality?)

Treatment Task Goals

- First look at treated water quality throughout solution area
- Better understand the nature of drinking water quality issues (frequency, magnitude, compounding factors, other drivers)
- Develop quantitative links between Delta intake water quality and treated water quality
- Identify water quality challenges/ opportunities in conveyance, storage, and treatment


Drivers
WQ at pumps
Water mgmt (storage, conveyance, ops, water use)
Treatment
Costs
Hydrology
Population growth
Emergency situations
New regulations
Representative Drinking Water Quality Conceptual Models
Outcomes
Public Health & Palatability
Treatment costs
Reliability & flexibility

Treatment Task 1

- Worked with CVDWPWG and DHS to develop a list of treatment plants in the Central Valley (57 plants)
- Worked with DHS to pull data from the DHS central database for these plants (plant information, treated and raw water quality), surveying utilities for data not in database
- Currently processing this data and analyzing it (will cover this process later) to identify 5 treatment plants for further study
- Use the data to produce some general information about treatment and treated water quality in the CALFED solution area

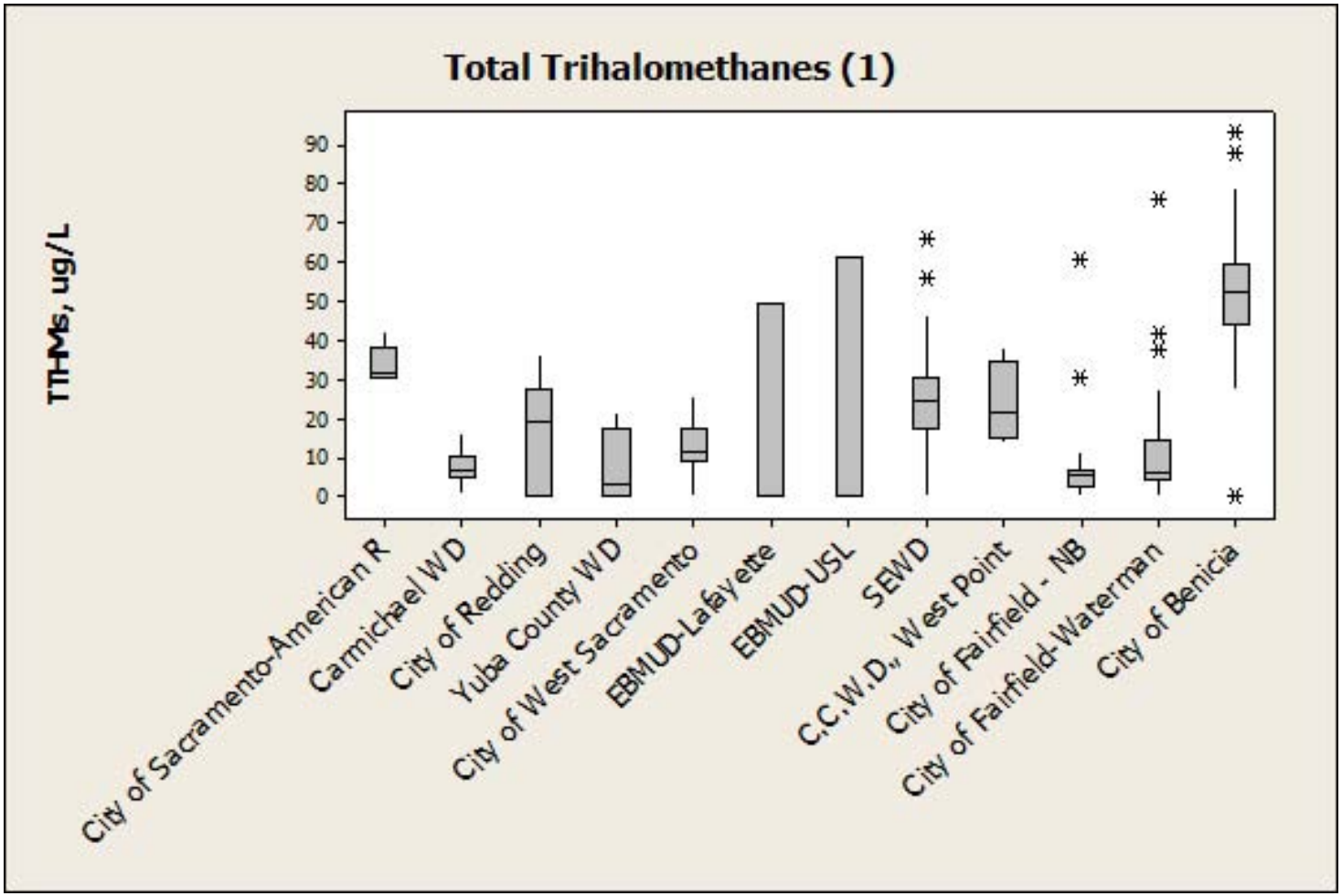
Treatment Task 2

- Review the results of CALFED-funded treatment demonstration studies
- Determine how transferable study findings/information are to existing treatment plants
- Determine priorities for future demonstration studies and products needed to improve transferability

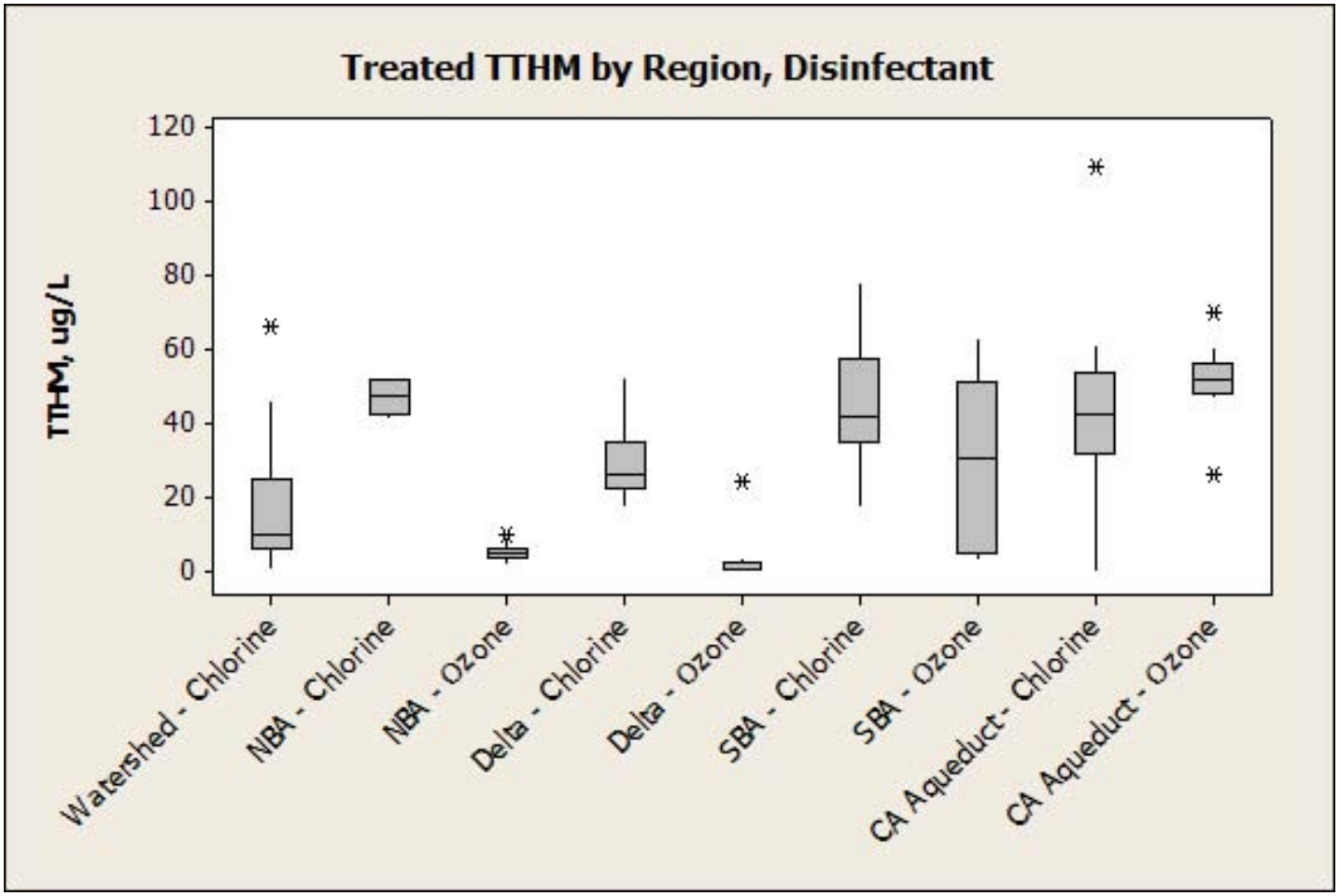
Treatment Task 3

- Work with 5 representative treatment plants
- Develop a better set of data to further explore issues identified in Task 1
- Develop “conceptual models” of treated water quality for the 5 representative plants, addressing the identified questions
- Use conceptual models to prioritize Stage 2 Actions

Example of Treated Water Quality Information



TTHM Concentrations Categorized by Region and Disinfectant



Initial Analysis of Drinking Water Treatment

- Evaluate treatment statewide and regionally using database
  - Developed from DHS central database
  - Refined for assessment
- Categorize treatment plants
  - Raw water source, Delta intake, and conveyance system
  - Treatment technology – filtration and disinfection
- Conduct analysis of raw and finished water quality

Representative Treatment Plant Selection Process

Factor 1 – Raw Water Source and Conveyance System

Factor 2 – Treatment Processes and Community Demographics

Factor 3 – Treated Water Quality

Factor 1 – Raw Water Source and Conveyance System (screen to 22 WTPs)

Delta Intakes

- Upper Watersheds
- North Bay Aqueduct
- Central Delta
- South Bay Aqueduct
- California Aqueduct

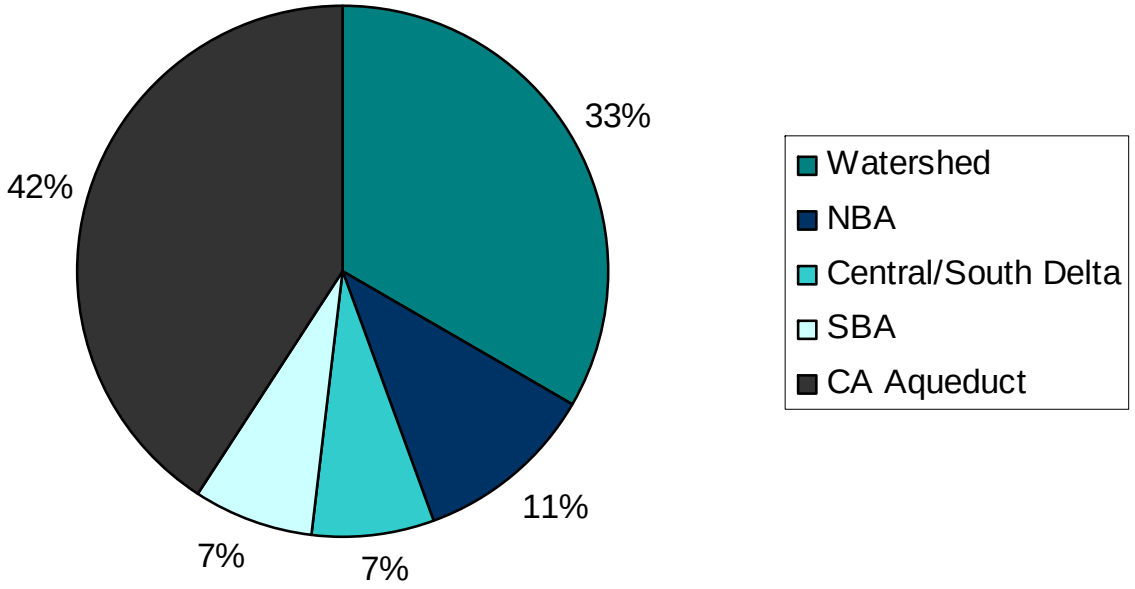
Ability to Blend with Alternative Supplies

- >75 % Delta Water
  or
- > 25% Alternative Supplies

(2 plants for each alternative and Delta region) (About 5 WTPs)

(2 to 3 WTPs)

Regional Distribution of Treatment Plants in Database



Factor 2 – Treatment Processes and Community Demographics (Select 10 to 12 WTPs)

FILTRATION

- Conventional
- Direct Filtration
- Membrane

DISINFECTION

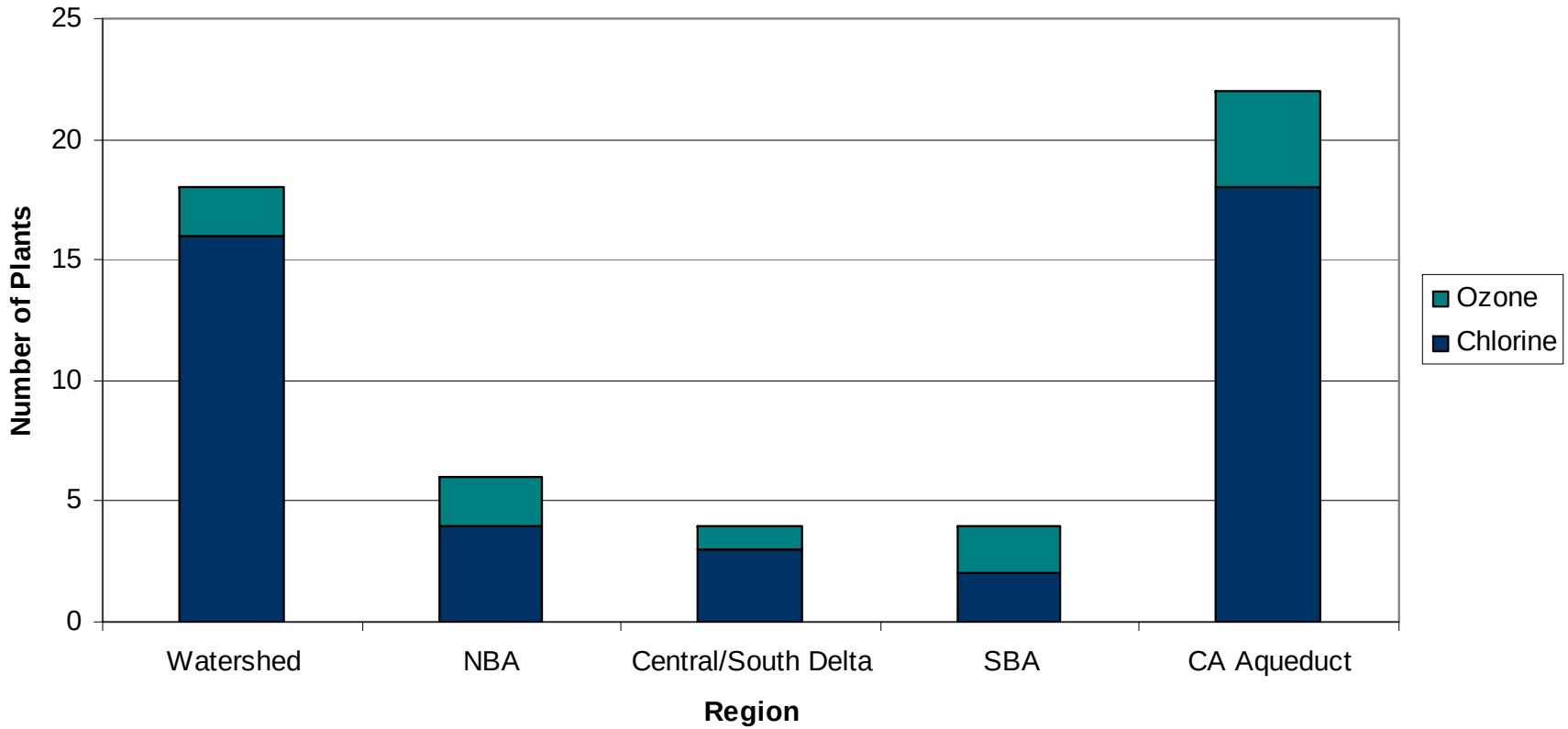
- Ozone
- Chlorine

(Representative of statewide technology use for filtration and disinfection)

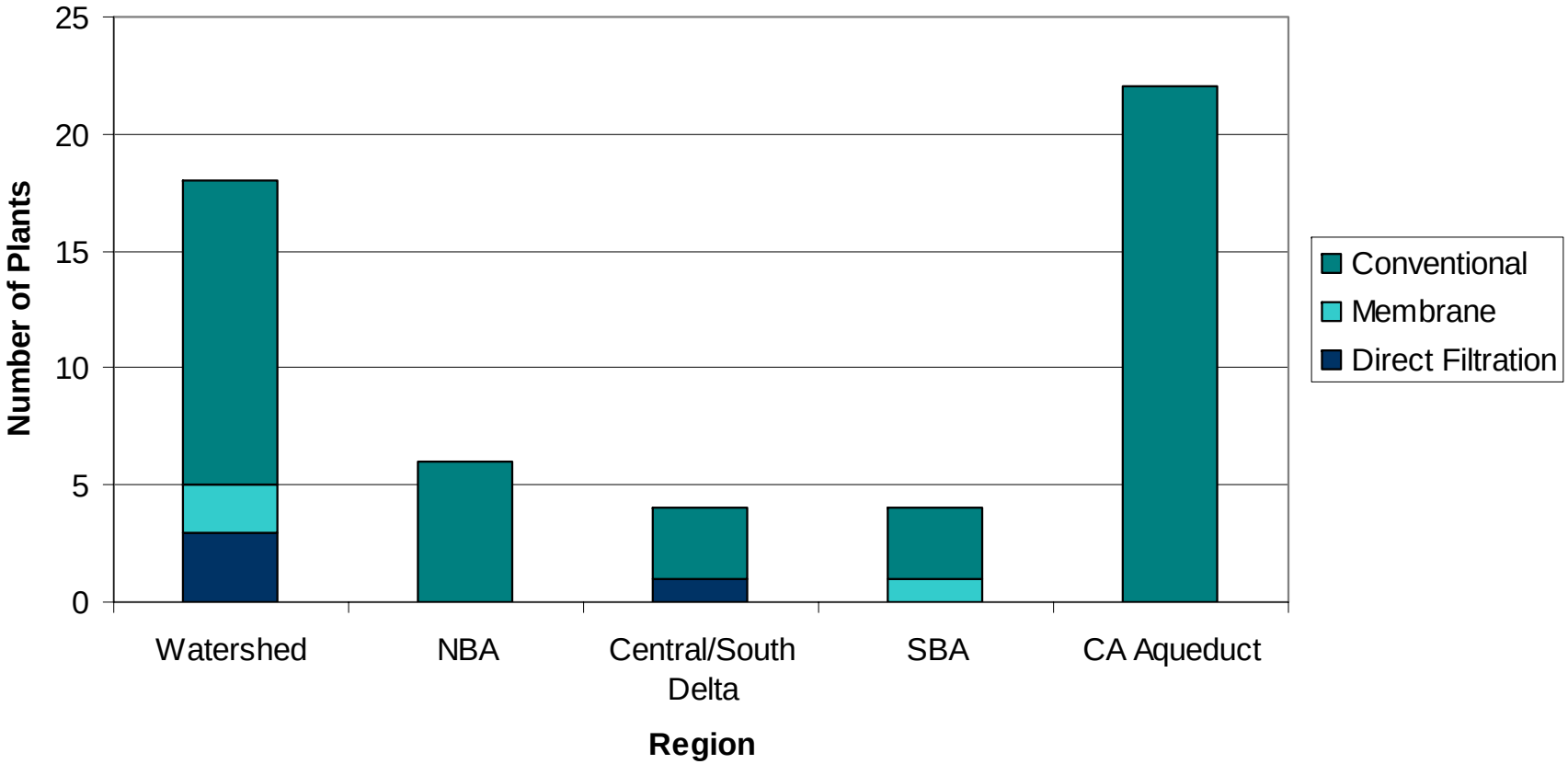
SERVICE COMMUNITY DEMOGRAPHICS

(Representative range of community size/treatment plant size)

Type of Disinfection by Region



Type of Filtration by Region



Factor 3 – Treated Water Quality (Select 5 WTPs)

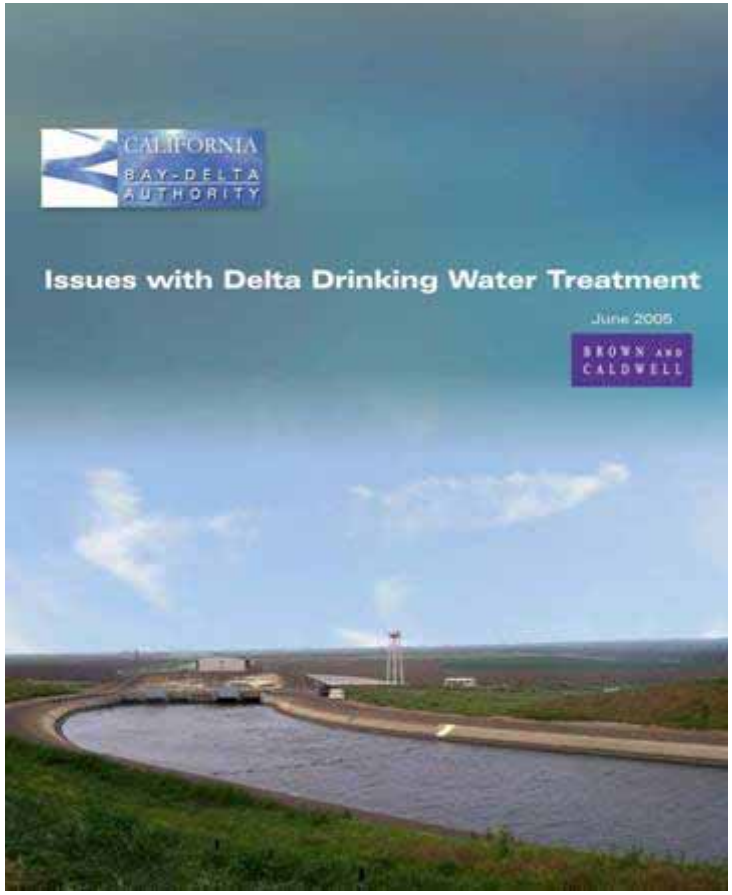
- Disinfection By-Products
- Taste and Odor
- Organic Carbon
- Total Dissolved Solids

- Represent broader issues and water quality
- Include treated water quality issues of concern
- Represent criteria and concerns that surface during database analysis

Drinking Water Quality Conceptual Model Objectives

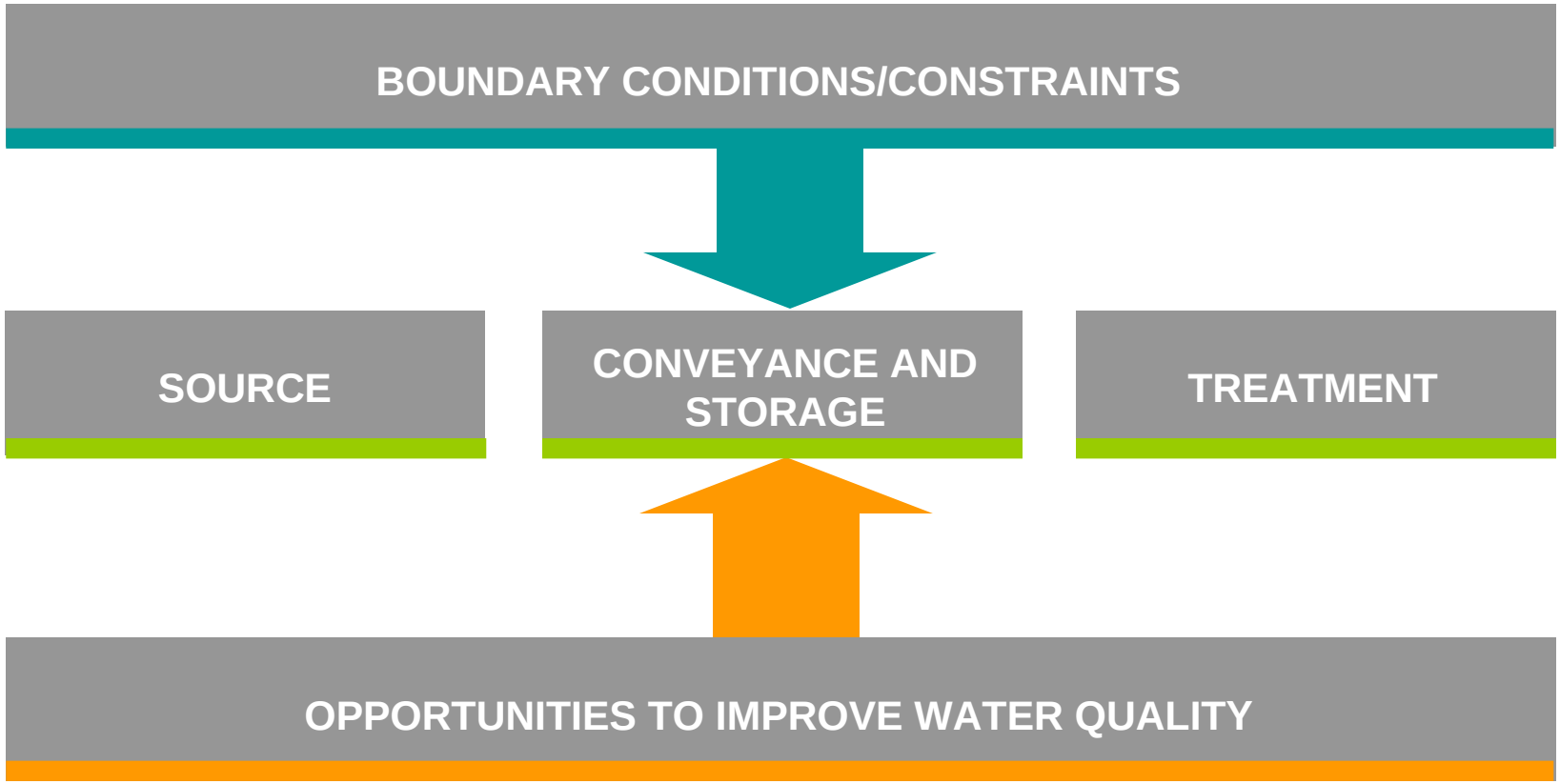
- Capture range of existing conditions
- Generate linkages and relationships from source to tap
- Identify water quality and treatment challenges and the options to address them
- Guide future funding and identification of future resource allocation
- Help refine ELPH and how to achieve it

Development of Drinking Water Conceptual Model

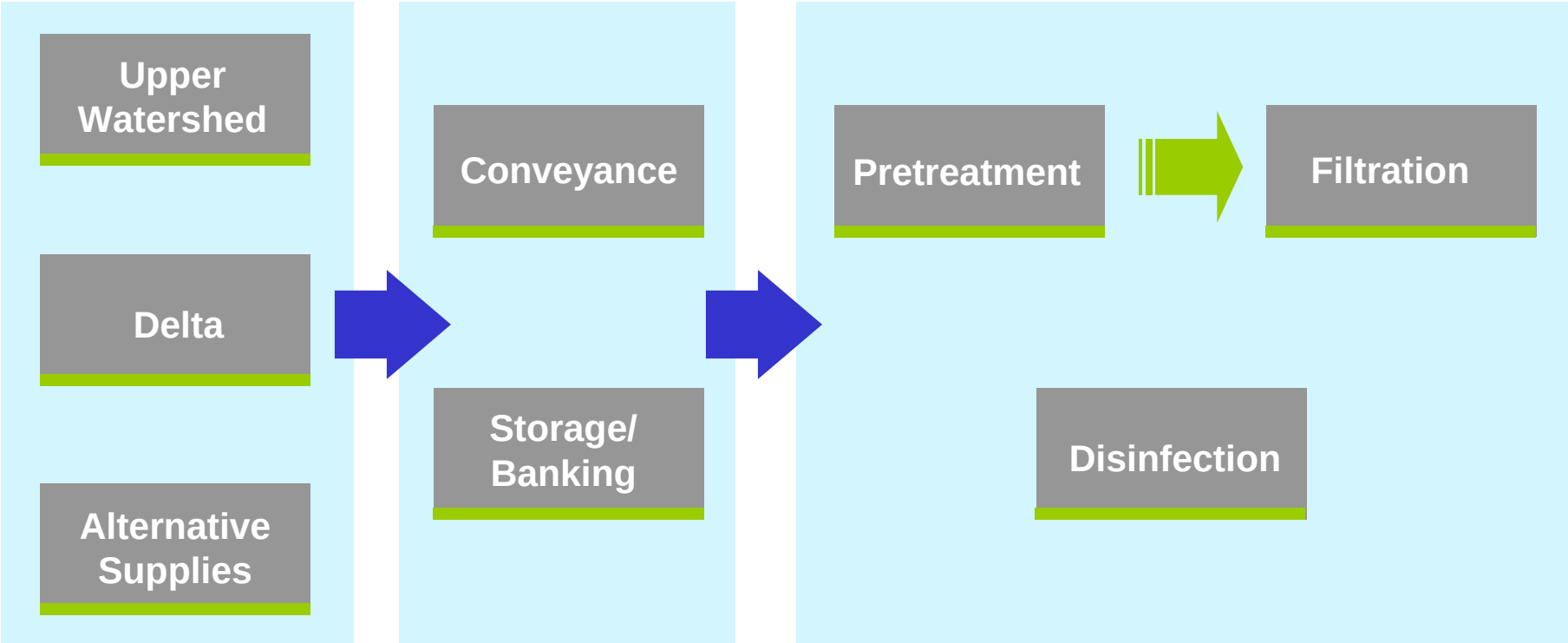


- Presented issues, challenges, and concerns qualitatively in "Issues with Delta Drinking Water Treatment" Report
- Quantify issues and challenges in treating Delta water through detailed analysis
- Communicate challenges and opportunities through conceptual models

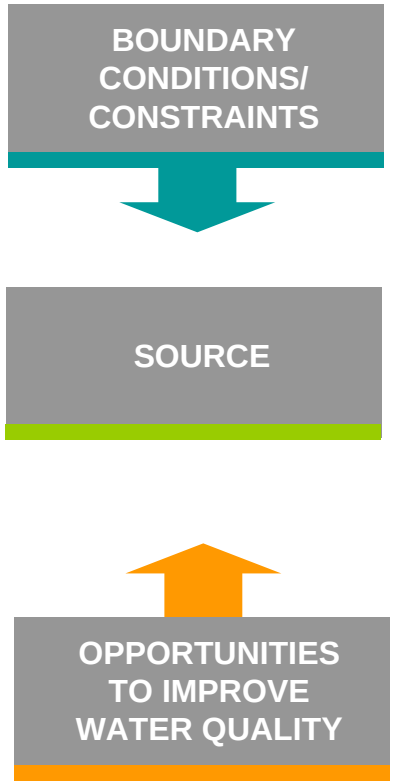
Drinking Water Quality Conceptual Model



Water System Supply and Treatment System



Source



- Water rights and contract constraints
- Daily variable water quality
- High concentrations of DBP precursors
- Other issues with alternative supplies
- Identify and manage blending options
- Manage local supplies

Conveyance and Storage

BOUNDARY CONDITIONS/ CONSTRAINTS

- Management institutions
- Land availability

CONVEYANCE AND STORAGE

- Water quality degradation/attenuation

OPPORTUNITIES TO IMPROVE WATER QUALITY

- Manage conveyance systems
- Manage storage and blending options

Treatment

BOUNDARY CONDITIONS CONSTRAINTS

- Regulatory
- Customer Satisfaction
- Operations

TREATMENT

- Processes designed to treat delivered water

OPPORTUNITIES TO IMPROVE WATER QUALITY

- Balance DBP formation and disinfection
- Apply advanced treatment technologies

Drinking Water Quality Conceptual Models – Detailed Study

- Develop for each of 5 WTPs
- Identify specifics in each category

Source - ACWD WTP No. 2

BOUNDARY CONDITIONS CONSTRAINTS

SOURCE

OPPORTUNITIES TO IMPROVE WATER QUALITY

- South Bay Aqueduct
  - Daily and seasonally variable water quality
- Limited recharge of Lake Del Valle by local watershed
- Manage Lake Del Valle
- Improve Delta water quality
- Manage Clifton Court Forebay

Conveyance and Storage - ACWD WTP No. 2

BOUNDARY CONDITIONS CONSTRAINTS

CONVEYANCE AND STORAGE

OPPORTUNITIES TO IMPROVE WATER QUALITY

- Management determined by others - SBA and Clifton Court Forebay
- Local watershed management
- Lake Del Valle multi-use facility
- T&O and algae increase through conveyance and storage
- Pathogens?
- Manage Lake Del Valle
- Manage SBA conveyance

Treatment - ACWD WTP No. 2

BOUNDARY CONDITIONS CONSTRAINTS

TREATMENT

OPPORTUNITIES TO IMPROVE WATER QUALITY

- Need to balance DBP regulations, T&O, and disinfection
- Pretreatment
- Filtration
- Disinfection
  - Ozone
  - Limit bromate formation with CO2 addition

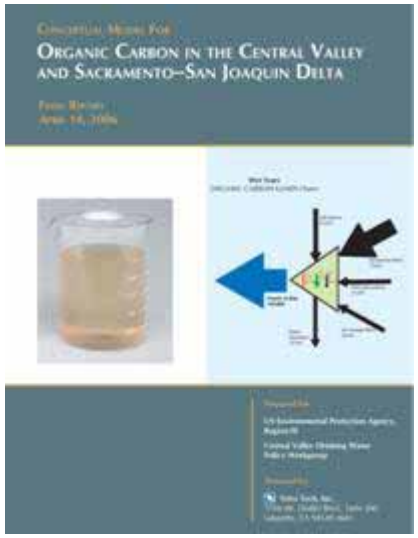
Next Steps – Treatment Tasks

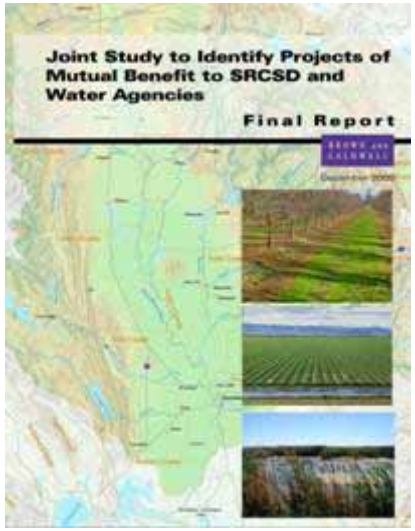
- Today: review selection process and receive comments
- Next 1-2 weeks: Complete Task 1 data analysis
- Week of April 2nd: Convene workshop with volunteers/ stakeholder workgroup to review findings, select 5 plants, and further develop Task 3 focus (after meeting, send summary memo to Subcommittee)
- May meeting: Status on work with selected plants, review of Task 1 memorandum
- July 31: Task 2 draft memorandum complete

Potential Source Water Improvement Actions

Source Water Improvement - Objectives

- Quantify potential reductions of "controllable sources" and relative costs
  - Order of magnitude level of detail
  - Leverage historic and ongoing work by others





- Establish basis for Stage 2 priority setting
  - What's working
  - Critical areas of uncertainty

Source Water Improvement - Watersheds

Sacramento River

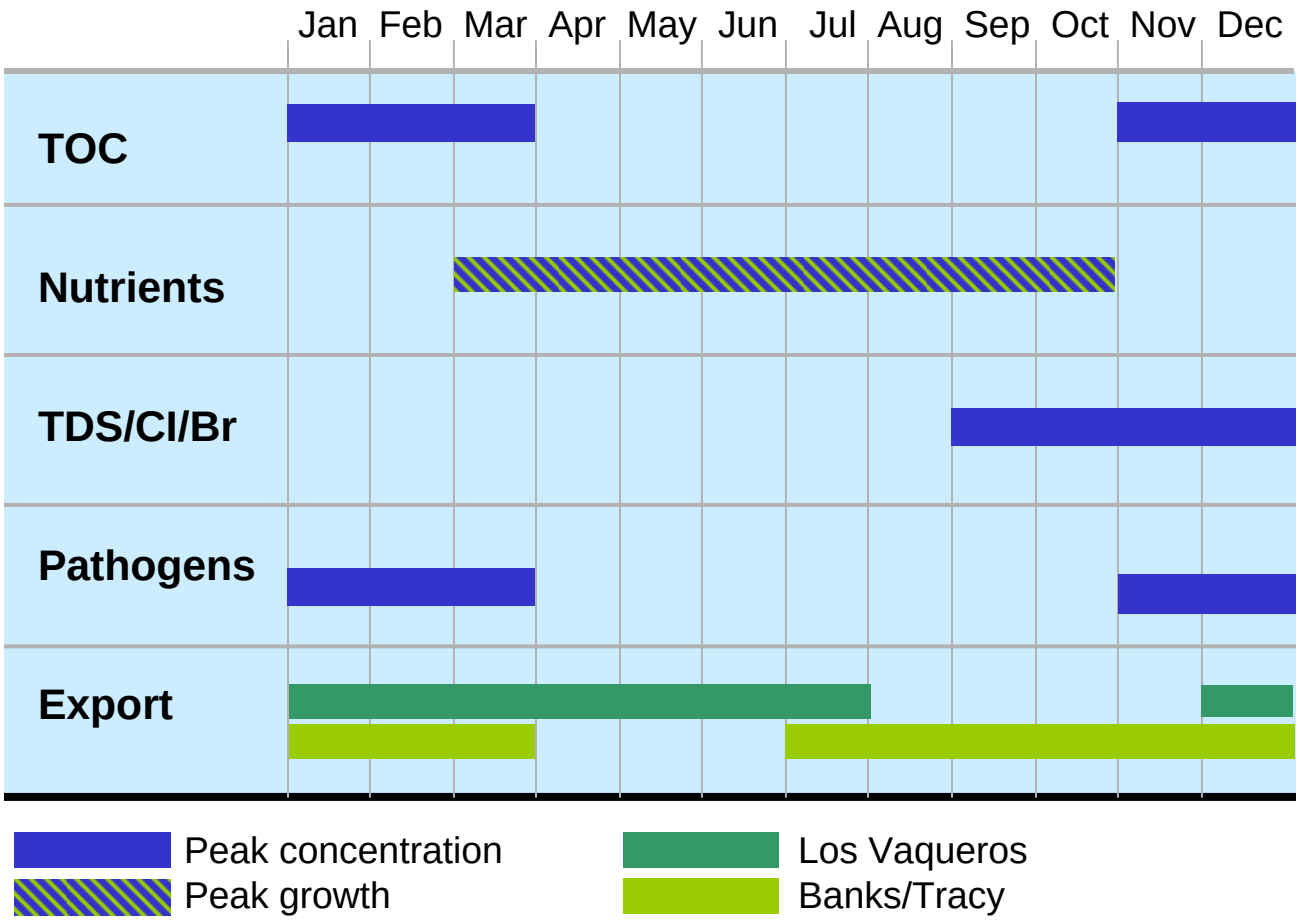
San Joaquin River

Delta

Source Water Improvement – Constituent-Specific Approaches

- Salinity
  - EC, TDS, bromide/chloride
  - San Joaquin River
- Organic Carbon/Nutrients
  - DOC (TOC), P, and N
  - Seasonally variable sources
- Pathogens
  - Indicators, crypto/giardia where available
  - Qualitative approach

Timing to Benefit Drinking Water Supplies



* after Archibald, 2007

Salinity – Ongoing Efforts

- Several programs are currently addressing salinity in the San Joaquin River Valley
  - San Luis Drainage Feature Re-evaluation
  - Westside Regional Drainage Plan
  - Central Valley Salinity Program
  - Lower San Joaquin River Salt and Boron TMDL
- Program objectives focus on agricultural, habitat, and compliance with standards, not so much on drinking water needs

Salinity – Preliminary Recommendations

- Work with ongoing SJR salinity management programs to incorporate drinking water perspective and consider consequences of implementation (e.g., effects on flows)
- Look for opportunities to augment programs to better address drinking water (e.g., bromide) and/or improve salinity in proximity of the intakes
- Consider pilot of real-time management program

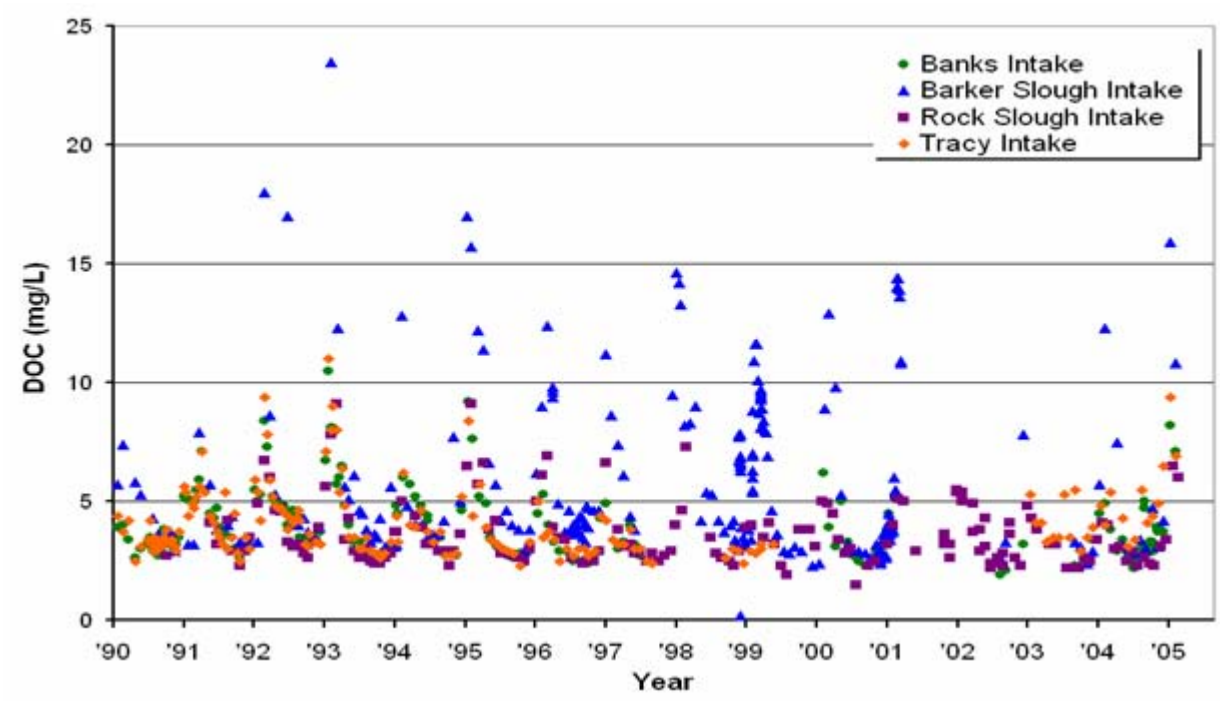
Organic Carbon/Nutrients Workshop

- Objectives
  - Capture ***current*** state of knowledge (over 20 experts)
  - Understand key ***drivers*** and factors that affect organic carbon at Delta intakes
  - Identify high ***priority sources*** and ***actions*** to achieve tangible reductions
  - Answer ***key questions/issues***

Water Utility Concerns, Opportunities to Improve

- Issues Vary by Intake
- WTPs Manage to Meet Regulations on Two Fronts
  - Total concentration (TOC <4 mg/L, running annual avg)
  - Measured THMs (new ones emerging, including N-based)
- Concerns/Opportunities
  - Shave TOC peaks from runoff, and limit effects from anomalies (e.g., Jones Tract +1mg/L)
  - Possibly manage specific forms to limit formation potential
  - Limit nutrients going to reservoirs, manage Delta blooms (developing nutrient target levels)

Seasonal/Episodic Peaks in Organic Carbon



Ecosystem Needs for Organic Carbon, Nutrients

- Information on aquatic ecosystem needs is lacking
- Targets would help frame issues
- Account for timing, quantity, and quality (e.g., bioavailability)
- Balance ecosystem and drinking water needs

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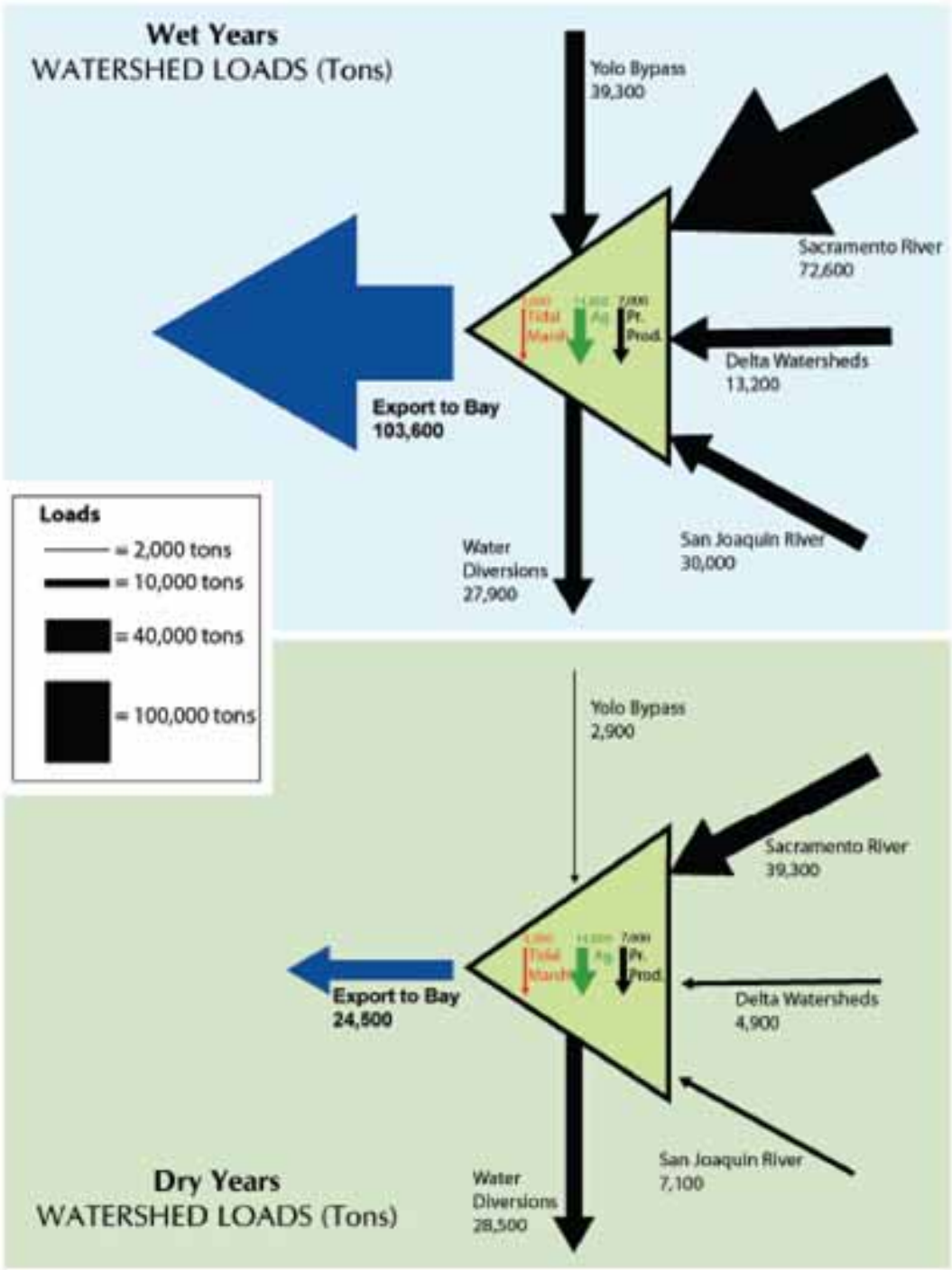
Conceptual Model as Basis - Loads (Tetra Tech)



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Conceptual Model As Basis – Focus on Concentrations (Tetra Tech)

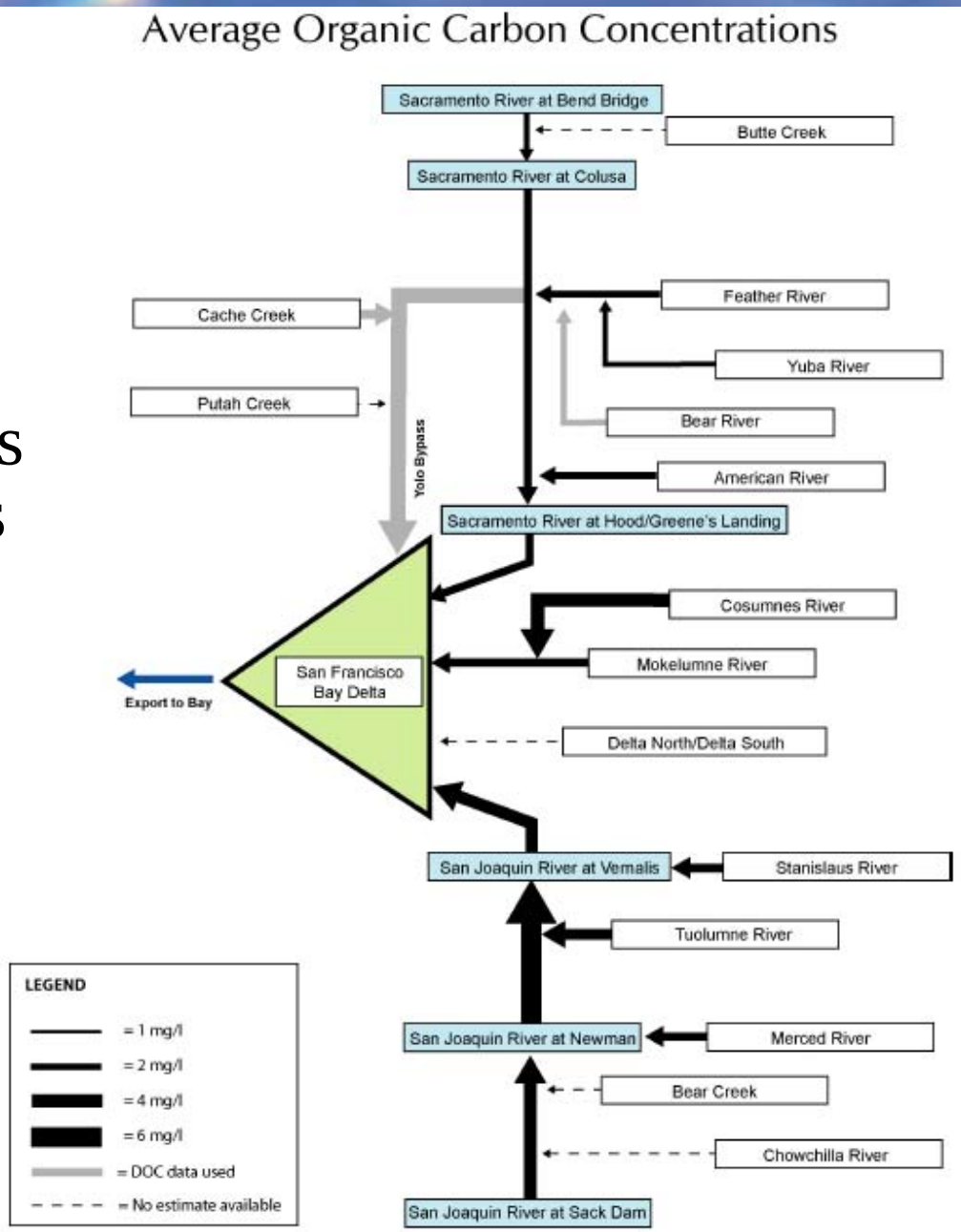
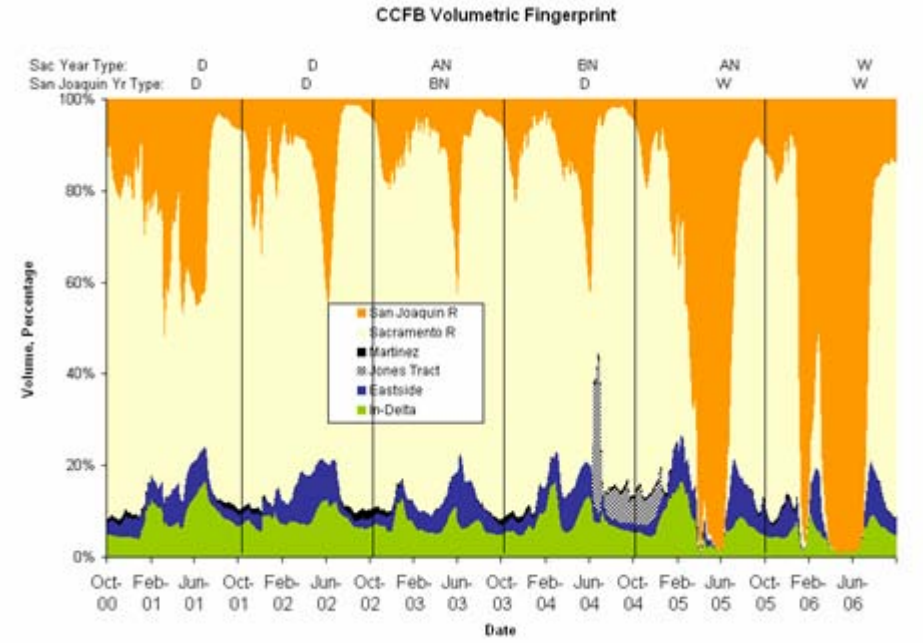
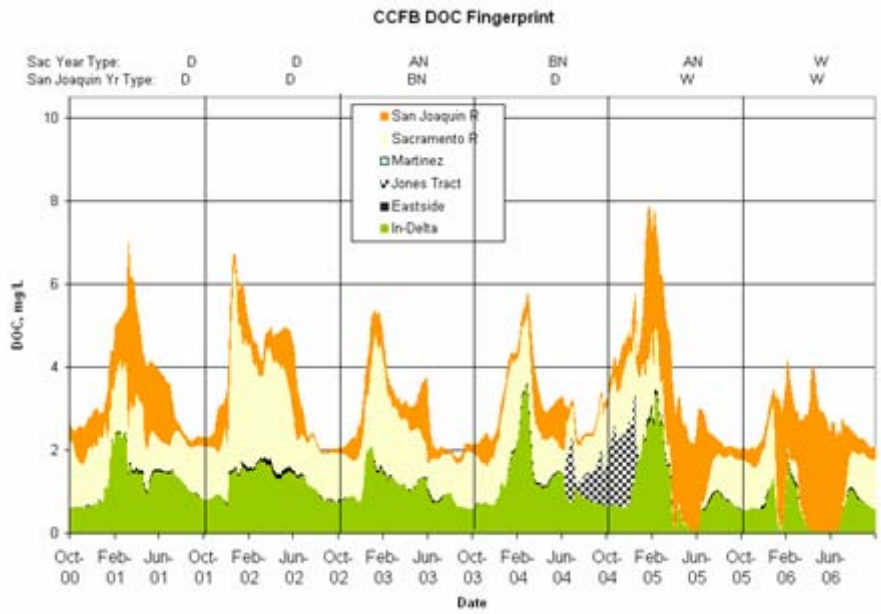


Figure ES-1. Average concentrations of organic carbon (mostly as TOC except where indicated) in the Central Valley and Delta.

Hydrodynamics – Fingerprinting a Useful Tool





Sources – Organic Carbon

- Concentrations
  - San Joaquin River – higher in dry season, “dilution” effect in wet season
  - Sacramento River – “rinsing” effect in wet-season/storm events, episodic rice field drainage
- Loads
  - Delta - 25% annually, 50% winter/spring
  - Rivers- 75% annually
- Trends over last 15 years (USGS, preliminary)
  - 25% drop in river loads
  - 1 to 2 mg/L drop in Delta contributions

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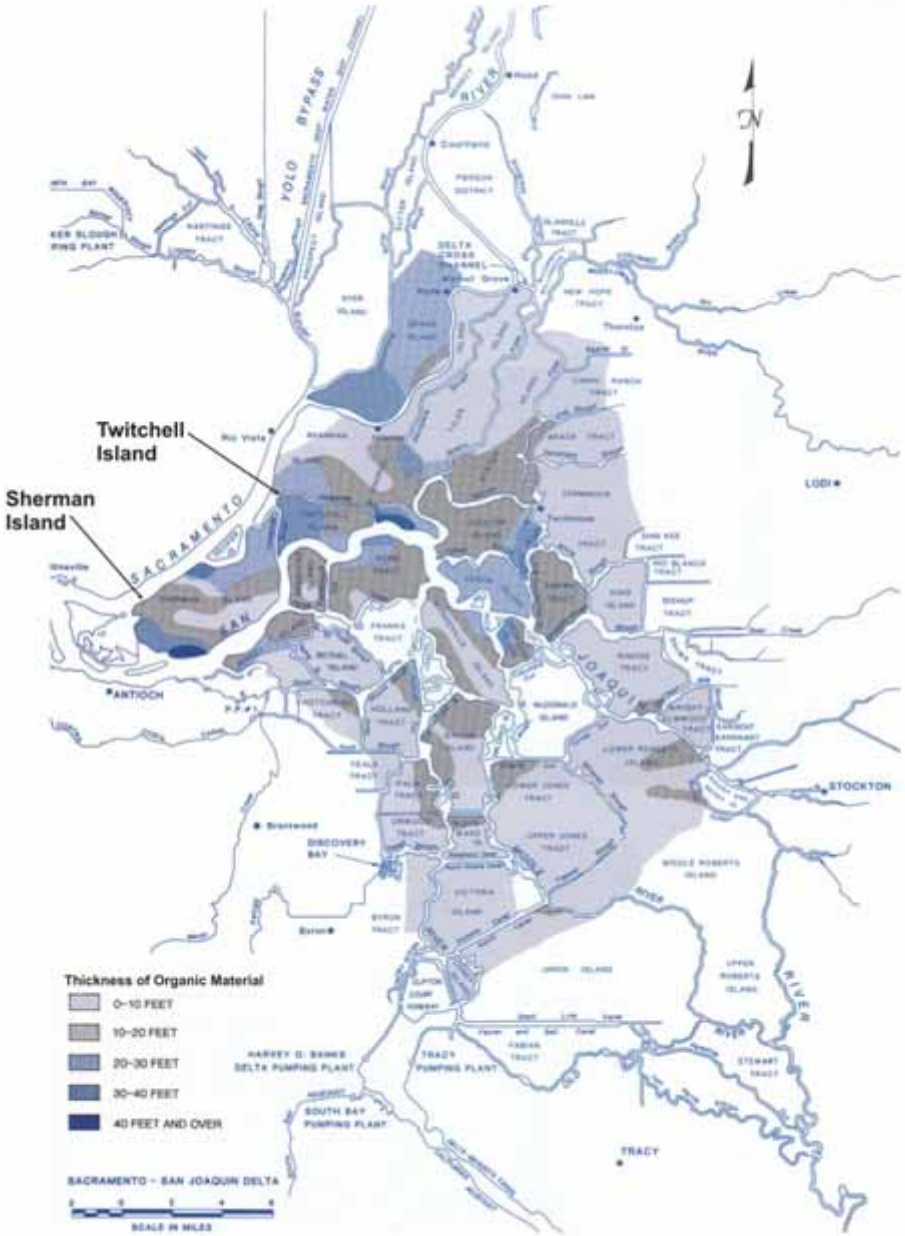
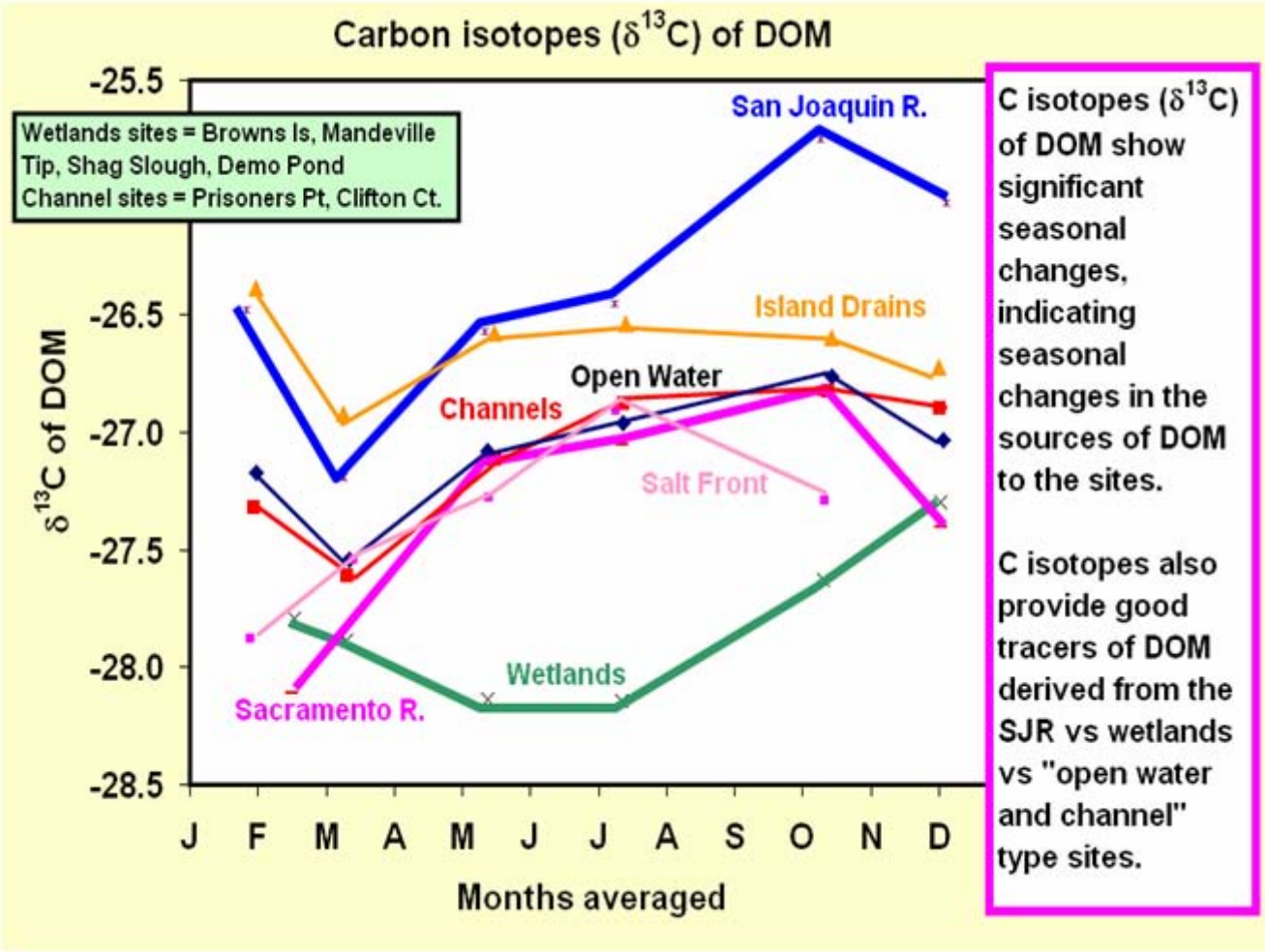
Organic Delta Soils



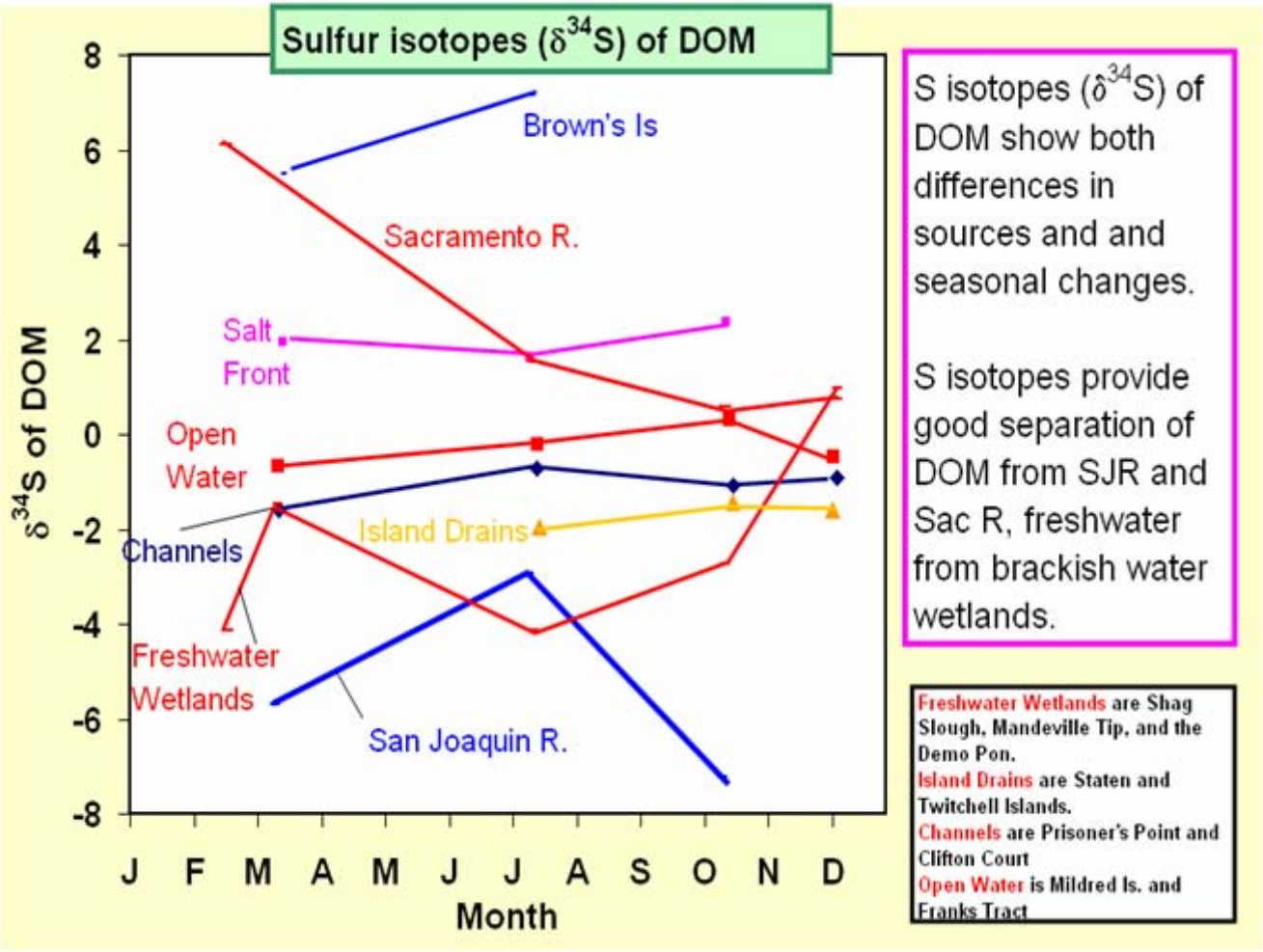
Useful Tools – Isotopes and Fingerprinting



C isotopes ($\delta^{13}C$) of DOM show significant seasonal changes, indicating seasonal changes in the sources of DOM to the sites.

C isotopes also provide good tracers of DOM derived from the SJR vs wetlands vs "open water and channel" type sites.

Useful Tools – Isotopes and Fingerprinting



Types of Organic Carbon

- "Freshness"
  - Age of organic matter and degree to which it has been cycled through the system
  - "Fresh" sources include Delta DOM (e.g., wetlands) relatively "fresher" than upstream waters
  - More fresh, more likely to form THMs
- Bioavailability – River DOM is about twice as bioavailable as Delta DOM
- Quality of DOM (SUVA and THMFP) varies significantly over the seasons (e.g., irrigation season DOM has lower propensity to form THMs)

Proximity Issue – Where to Focus Efforts?

- Historically, models have treated organic carbon as conservative, but…
  - Production and degradation occur
  - Sources, sinks, transformations are important
- Hydrodynamics are so variable that upstream improvements can have more or less downstream effects at Delta intakes
- So, intuitively makes more sense to target sources closest to the Delta

Reduction and Control Measures

- Research and demonstration projects are testing a range of measures, particularly agricultural

- Results on effectiveness and costs are still largely unavailable, but in process

Agricultural Management Practices

- Focus on reducing runoff volume, associated pollutants
- No “one size fits all” solution, need individual assessments of on-site strategies
- Simple to complex options – drainage modifications, cover crop/filter strips, detention basins, tailwater capture and recycle, crop and/or irrigation changes
- Incentives would “make a difference”, funding institutional requirements currently a barrier

Rice Management Practices – Work in Progress

- Manage drainage
  - Drain fields for harvest (Aug/Sept), prep/planting (Feb/Mar), herbicide application (May/June)
  - Maintenance flows during season
- Manage sources – straw, algae
- Options limited by competing regulations
  - Air quality
  - Pesticides/herbicide application
  - Vectors

Form of Organic Carbon - Management Possibilities

- Provide greater residence time (less "fresh")
- Target particular sources

Preliminary Workshop Highlights

- Still a lot of work in progress to answer questions, with promising results, but not yet published
- No existing comprehensive database that captures BMP effectiveness in improving drinking water quality constituents, and particularly at intakes
- Funding mechanisms are an issue for many stakeholders
- "Adopt a region" approaches may be more effective and easier to measure results

Workshop Synthesis – A Few Take Home Messages

- Practices are available to make some improvements in source water quality
- Best to focus on targets of greatest opportunity
  - Highest concentration sources
  - Most cost-effective, reliable measures
  - sources closest to the Delta
- Don't "whac-a-mole" – consider the whole system comprehensively

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Questions??