Performance Measures Phase 1 Water Quality Indicators

November 2006

Independent Science Board

Water Quality Indicators

- Phase 1 Indicators
  - Ecosystem and human health
  - Drinking water
- Status of Work
- Next Steps
  - Integrating across program objectives
  - Monitoring plan development
- Issues and Questions

Water Quality Objectives

Provide good water quality for all beneficial uses.

Program Mission Statement

Ecosystem and Human Health

• Eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife and people.

• Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed. *Ecosystem Restoration Program, Goal 6.*

Drinking water

• Maintain water quality at the Delta intakes for safe, reliable drinking supplies.

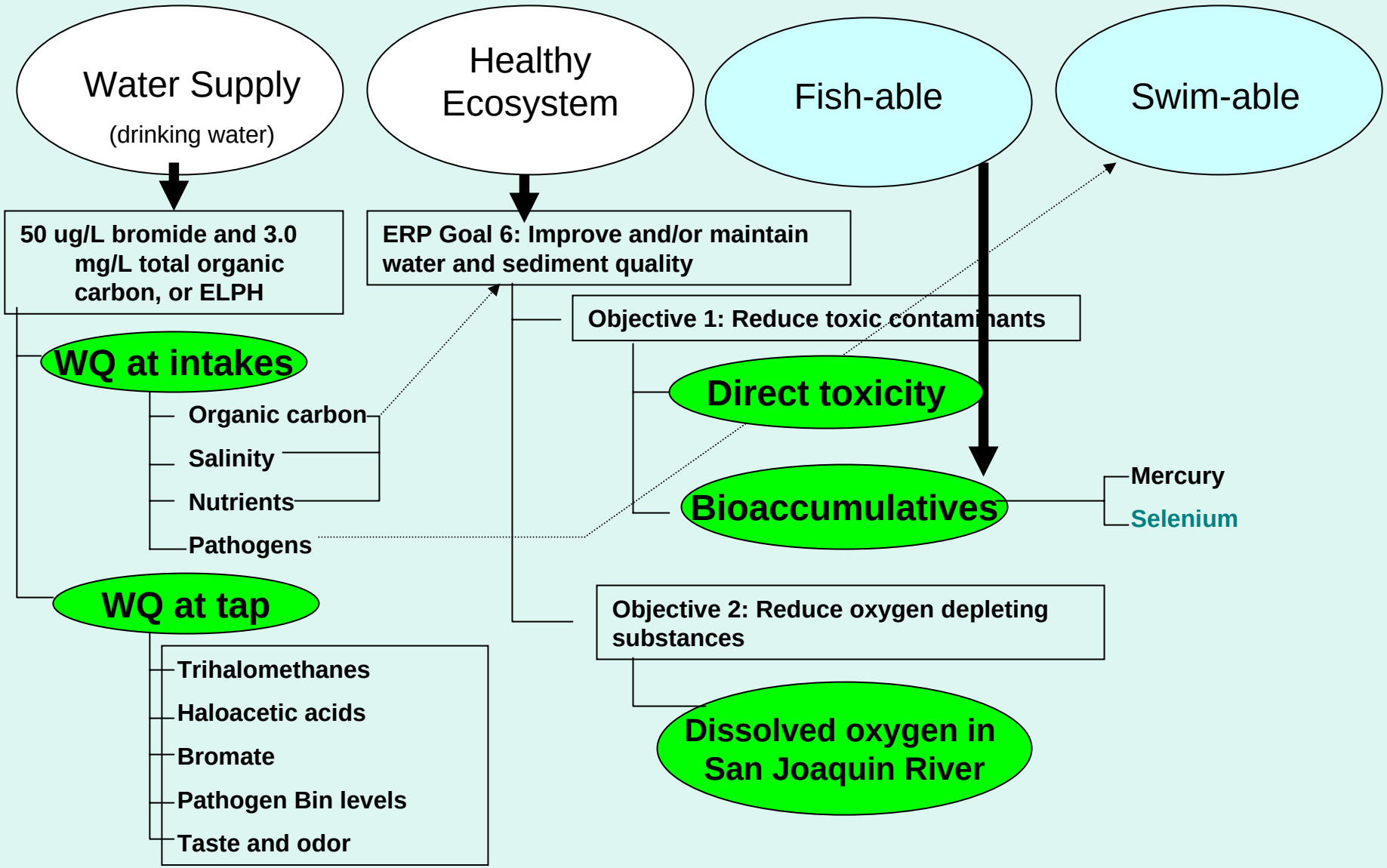
• Drinking water quality at the tap meets drinking water standards.

CALFED Program Plan Record of Decision.

Criteria for Proposed Outcome Indicators

- Significance for priority beneficial uses
  (ecosystem and/or human health)
- Importance to the Delta
- CALFED Program investment and other agency priorities
  - Plans and projects
  - Research and monitoring
  - *Available information*

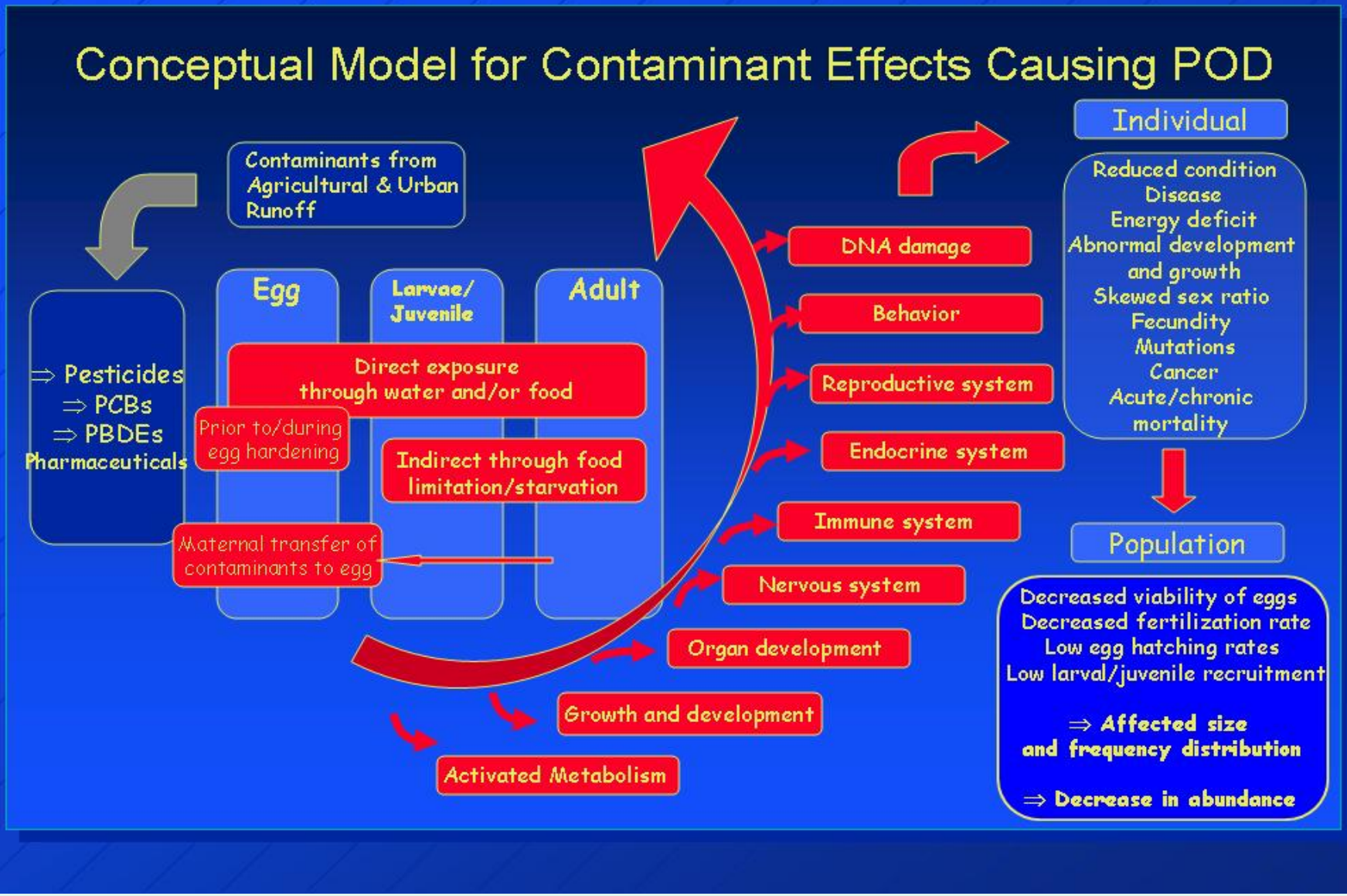
Provide good water quality for all beneficial uses.



Toxicity objectives: • Identify toxic constituents and reduce toxicity to aquatic organisms • Reduce loadings of toxic contaminants • Conduct studies to identify causes of unknown toxicity	**Toxicity outcome indicators**: • Indications that toxicity can be attributed to known sources • No likely significant aquatic toxicity • Establish if toxicity is a significant factor in POD; if so, identify contaminants and sources	
Mercury and dissolved oxygen objective: • Improve and/or maintain water and sediment quality to levels that do not adversely affect aquatic organisms, humans, and wildlife	**Mercury outcome indicators**: • Mercury concentrations in tissue of representative “sport fish” • Public health benefits • Mercury concentrations in tissue of representative biosentinels ***Dissolved oxygen pending***	
Drinking water objectives: • Maintain water quality at the Delta intakes for safe, reliable drinking supplies • Drinking water quality at the tap that meets drinking water targets	**DW outcome indicators**: • Intake water quality: organic carbon, salinity/bromide, nutrients, pathogens • Water quality “at the tap” for Delta providers: salinity, taste/odor, disinfection byproducts, treatment levels	

Toxicity Status

- Strategy to Address Toxicity of Unknown Cause *(CALFED Program, 2001)*
- Being evaluated as a potential factor in Delta Pelagic Organism Decline
- Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) is developing conceptual models for toxicity of unknown cause.



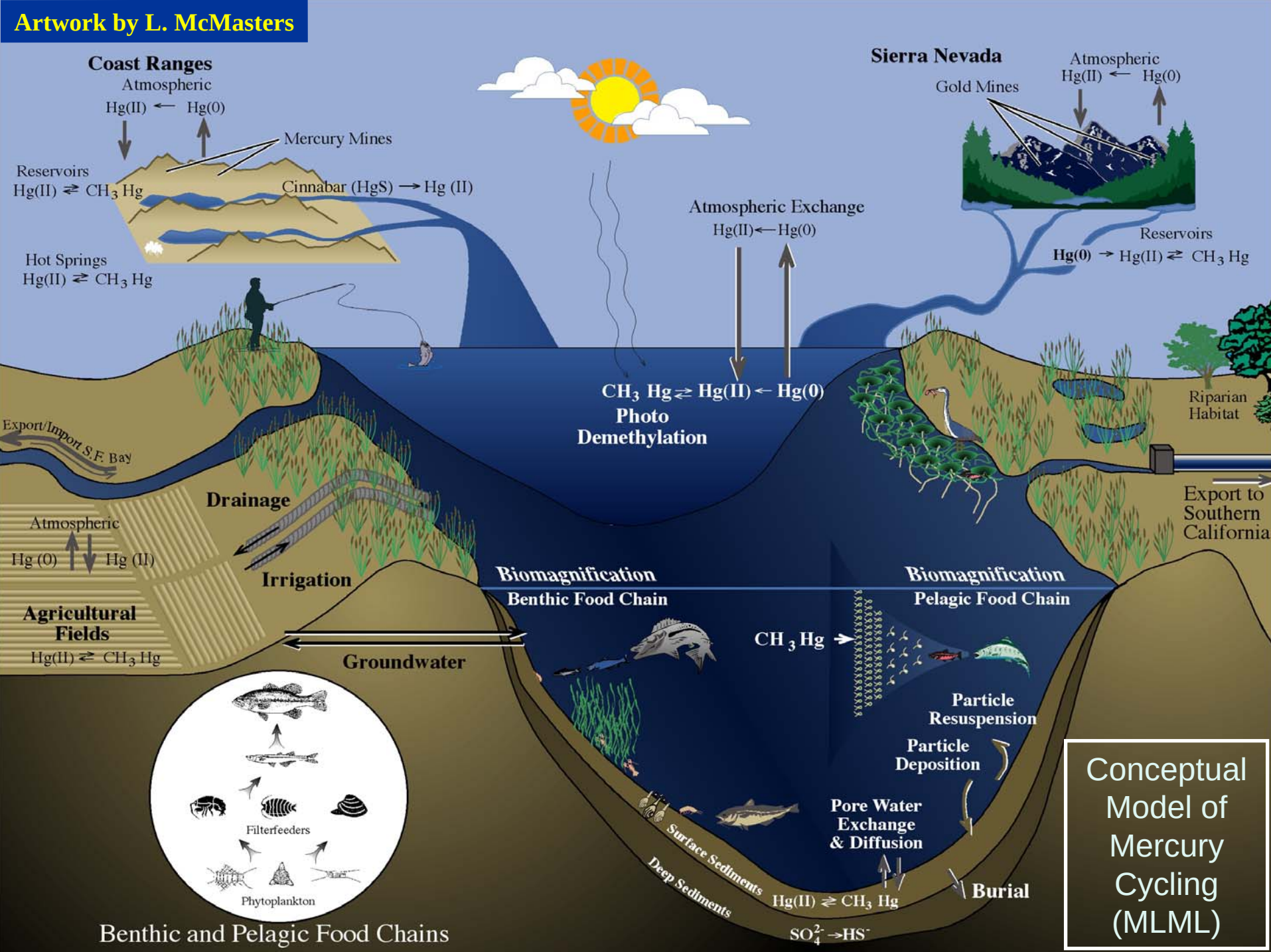
Example: Conceptual Model for Contaminant Effects on Delta Smelt

Toxicity Next Steps

- **Update Toxicity Strategy**: plan to fill data gaps, conduct comprehensive data assessment, expand monitoring.
- **Integrate indicator information needs** with the "Comprehensive Monitoring, Assessment and Research Program" (CMARP).
- **Refine conceptual models** on ecosystem-level effects through POD and DRERIP.
- **Fund research on biomarkers**.
- **Additional resources** in water quality and natural resource agencies are needed for indicators/ performance measures.

Mercury (total and methylmercury) Status

- **Mercury Strategy for the Bay-Delta Ecosystem** ***(CALFED, 2003)***
- **CALFED-funded mercury projects.** ***For example:***
  - Assessment of ecological and human health impacts of mercury in the Bay-Delta watershed
  - Biogeochemical mercury transformations and trophic transfer
  - Mass balance: transport, cycling and fate of mercury in the Delta and tributaries
  - Mercury cycling and release from wetlands
  - Mercury in birds and fish
  - Fish contamination monitoring, stakeholder involvement and risk communication
- **Regional Water Board Basin Plan Amendments/ TMDLs to control total and methylmercury**


Artwork by L. McMasters
Coast Ranges
Atmospheric
Hg(II) ← Hg(0)
Mercury Mines
Reservoirs
Hg(II) ⇄ CH3 Hg
Cinnabar (HgS) → Hg (II)
Hot Springs
Hg(II) ⇄ CH3 Hg
Sierra Nevada
Gold Mines
Atmospheric
Hg(II) ← Hg(0)
Reservoirs
Hg(0) → Hg(II) ⇄ CH3 Hg
Atmospheric Exchange
Hg(II)←Hg(0)
CH3 Hg ⇄ Hg(II) ← Hg(0)
Photo
Demethylation
Export/Import S.F. Bay
Drainage
Irrigation
Atmospheric
Hg (0) Hg (II)
Agricultural
Fields
Hg(II) ⇄ CH3 Hg
Groundwater
Riparian
Habitat
Export to
Southern
California
Biomagnification
Benthic Food Chain
Biomagnification
Pelagic Food Chain
CH3 Hg
Particle
Resuspension
Particle
Deposition
Pore Water
Exchange
& Diffusion
Surface Sediments
Deep Sediments
Hg(II) ⇄ CH3 Hg
SO4 2- →HS-
Burial
Filterfeeders
Phytoplankton
Benthic and Pelagic Food Chains
Conceptual
Model of
Mercury
Cycling
(MLML)

Mercury next steps

- **Refine conceptual models** of mercury sources, cycling, and fate.
  - DRERIP conceptual model. End of 2006.
- **Conduct comprehensive review and assessment** based on CALFED mercury projects and related work. Begins spring 2007.
- **Refine Mercury Strategy**.
- **Develop monitoring plans**: regional baseline/trends and targeted.
  - Comprehensive Monitoring, Assessment and Research Program
- **Provide guidance for wetland monitoring** and development of mercury management practices through experimental design.
- **Mercury coordinator** needed.
- **Resources needed** for performance measures development.

Drinking Water Quality

- Performance measures tier off other efforts:
  - Central Valley Drinking Water Policy
  - Final Program Assessment
  - Delta Conveyance Studies
  - Funded Projects
- Because of this, progress on conceptual models, data collection, and assessment

Performance Measure Development

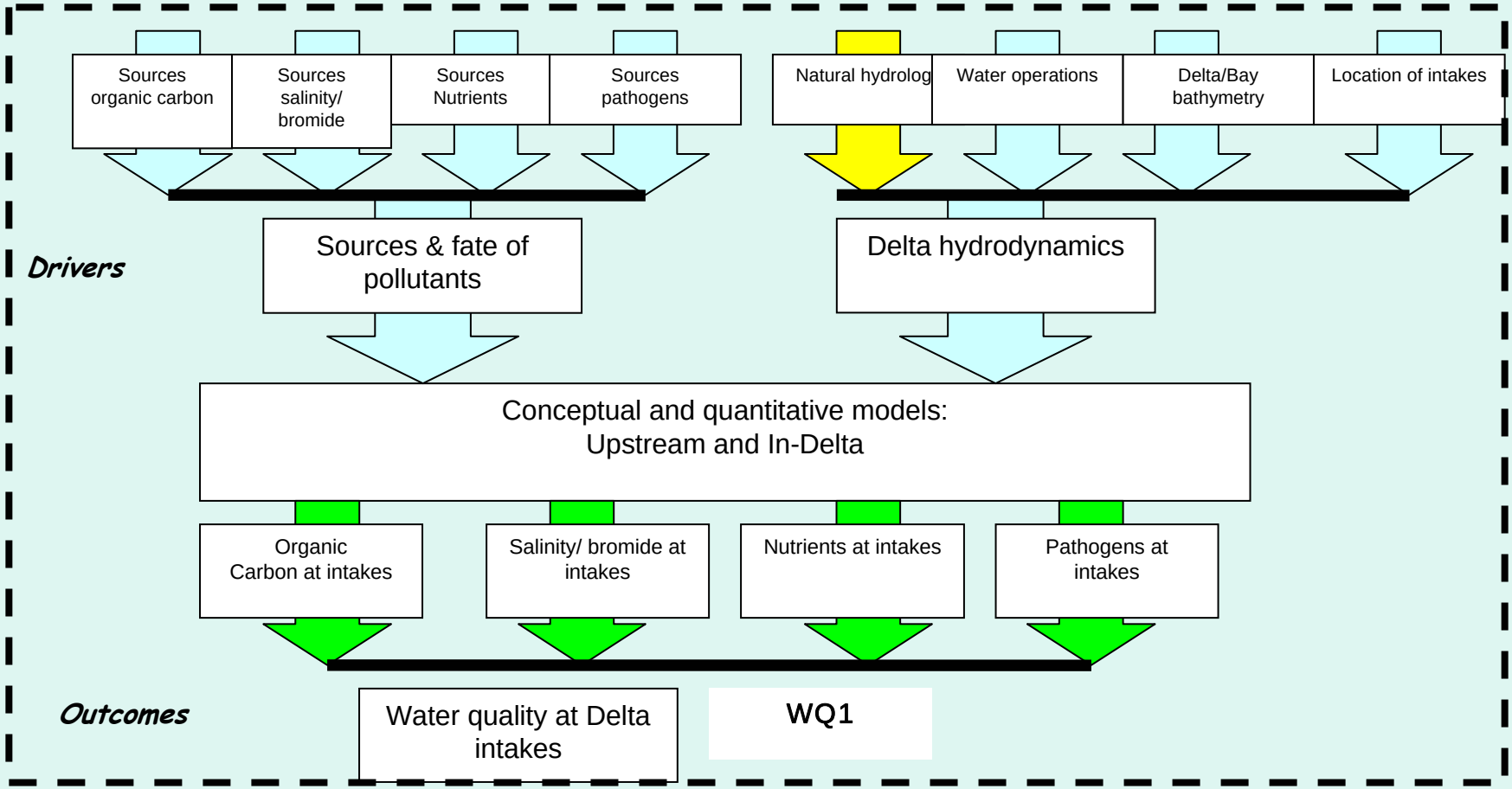
- System-level conceptual models
- Tiered basin, watershed-level conceptual models
- Information/Data Assembly and Analysis
- Identification of Critical Performance Indicators
- Gap and Uncertainty Analysis

Multiple Barrier Principle

Source Protection

Treatment Effectiveness

Distribution Integrity

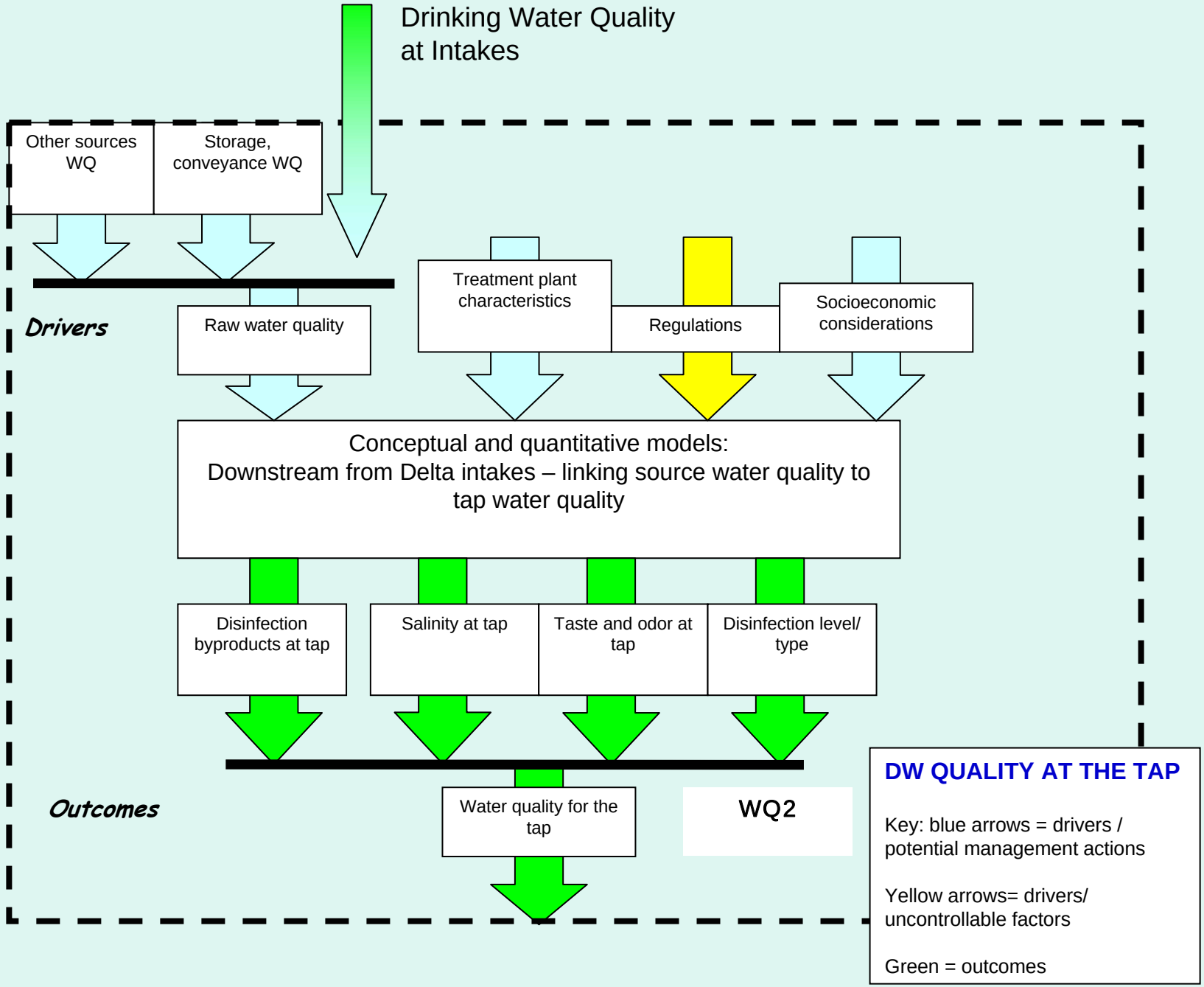


DRINKING WATER QUALITY AT THE INTAKES

Key: Blue arrows = drivers / potential management actions

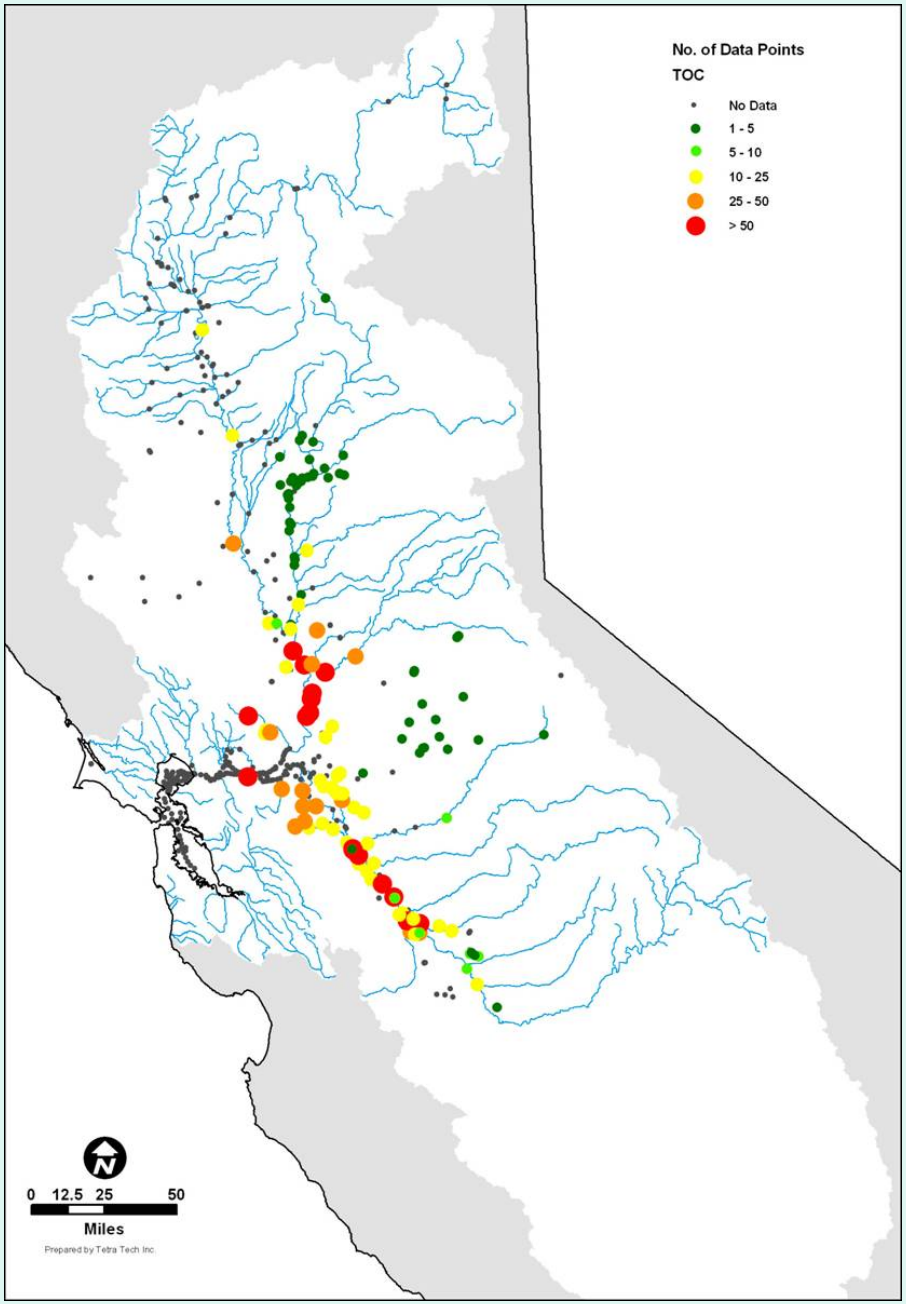
Yellow arrows = drivers/ uncontrollable factors

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

Data Analysis

- Presentation of available data
- Variety of ways to look at data (time series, averaging schemes, geographical, ambient v. sources)
- Using statistical methods and numerical models to analyze and as filter
- Started with San Joaquin organic carbon in 2005, still working on it (major resource issues)



TOC Data

Number of Data Points

Stations in Alpahabetical Order

American River at Discovery Park--41
American River at Sacramento Water Plant--70
American River below Nimbus Dam--41
Barker Slough--24
Bear Creek at Thornton Road--15
Bear Creek near Bert Crane Road--20
Calhoun Cut at Hwy 113--9
Colusa Basin Drain--14
Contra Costa PP Number 01--23
Cosumnes River at Twin Cities Road--15
Deep Slough at Green House Road--19
Del Puerto Creek at Vineyard Ave--15
Delta Mendona Canal at Lindeman Road--27
Delta Isand Drainage--316
Delta Pumping Plant Headworks--26
Feather River near Nicolaus--13
French Camp Slough at Airport Way--25
Grayson Road Drain at Grayson--15
Hospital Creek at River Road--11
Ingram Creek at River Road--14
Lindsay Slough at Hastings Cut--28
Lone Tree Creek at Austin Road--22
Merced River at River Road--24
Middle River at Union Pt_--27
Mokelumne River at New Hope Road--23
Mt House Creek at Mt House Parkway--14
Mud Slough at Gun Club Road--7
Mud Slough at San Luis Drain--28
Mud Slough Upstream of SLD Terminus--27
Natomas EMDC at El Camino Road--29
New Jerusalem Tile Drain--16
Old River at Rancho Del Rio--27
Old River at Tracy Blvd--23
Old River Near Byron--34
Orestimba Creek at River Road--24
Pixley Slough at Davis Road--17
Sacramento River above Bend Bridge--13
Sacramento River above Colusa Basin Drain--6
Sacramento River at Colusa--25
Sacramento River at Freeport--74
Sacramento River at Hamilton City--13
Sacramento River at Hood-Greene's Landing--181
Sacramento River at Mallard Island--51
Sacramento River at Veterans Bridge--56
Sacramento River at W_ Sac Intake Structure--44
Sacramento Slough--14
Salt Slough at Hwy 165--33
Salt Slough at Wolfsen Road--6
San Joaquin River at Crows Landing--127
San Joaquin River at Freemont Ford--118
San Joaquin River at Hills Ferry--21
San Joaquin River at Hwy 132--115
San Joaquin River at Hwy 4--25
San Joaquin River at Lander Avenue--119
San Joaquin River at Patterson--119
San Joaquin River at Sack Dam--22
San Joaquin River at Vernalis--255
San Joaquin River Ship Channel @ Light 18--11
San Joaquin River Ship Channel @ Light 24--11
San Joaquin River Ship Channel @ Light 36--11
San Joaquin River Ship Channel @ Light 41--11
San Joaquin River Ship Channel @ Light 45--11
San Luis Drain at Terminus2--23
Stanislaus River at Caswell Park2--21
Stanislaus River at Knight's Ferry--7
TID 5 Harding Drain at Carpenter Road--25
Tom Paine Slough at Paradise Road--19
Tuolumne River at Shiloh--23
Turner Slough at Fourth Ave--19
Turning Basin San Joaquin Ship Channel--11
Volta Wasteway at Ingomar Grade--7
Yuba River at Marysville--14

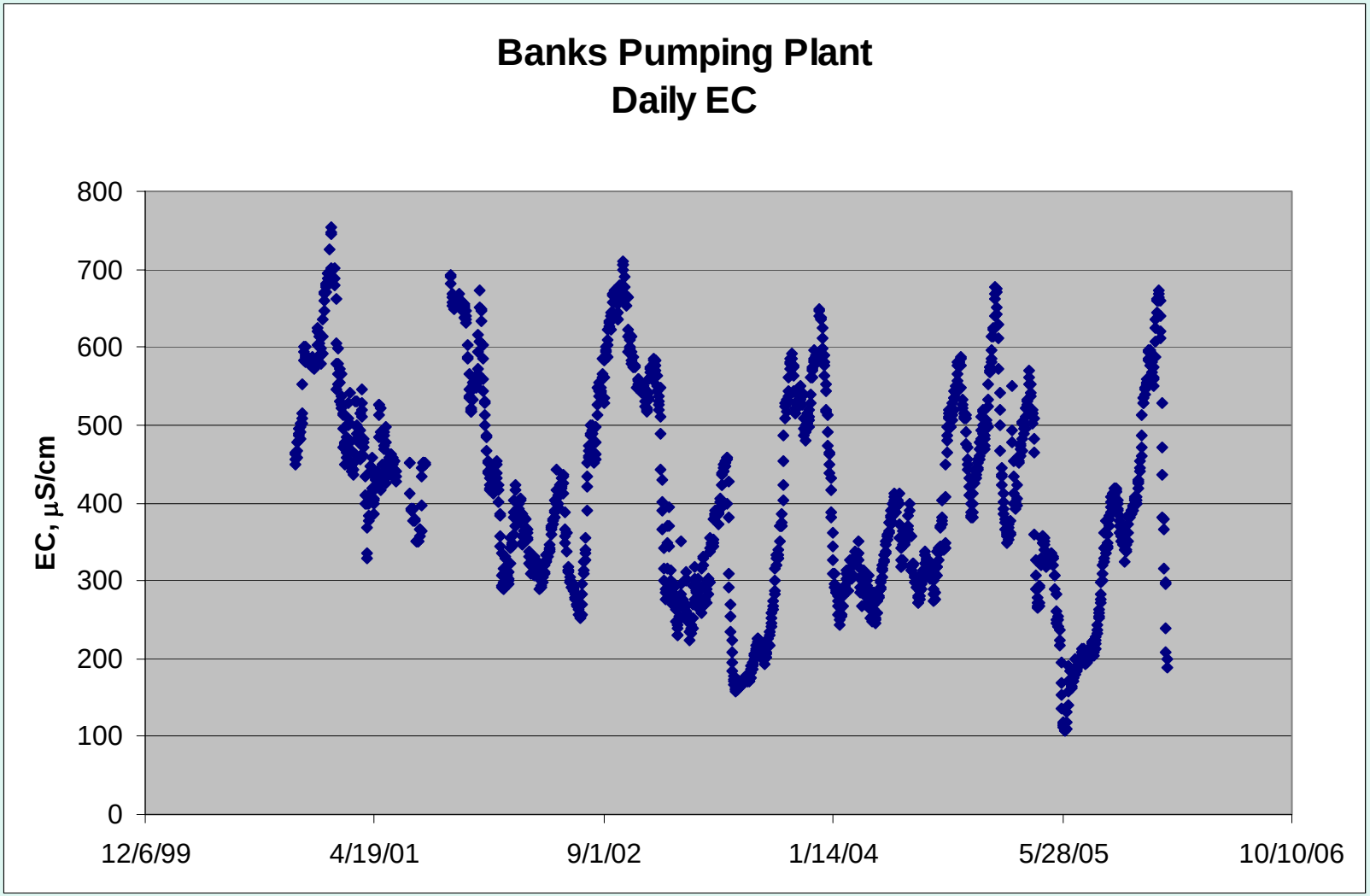
Stations

0 5 10 15 20 25 30

TOC (mg/l)

Box Plot Description (Bar thickness proportional to number of datapoints)
Upper and lower box: 25th and 75th percentile; Whiskers: 10 and 90th percentile
Symbols: Outliers; Solid line: Median

Characterizing salinity



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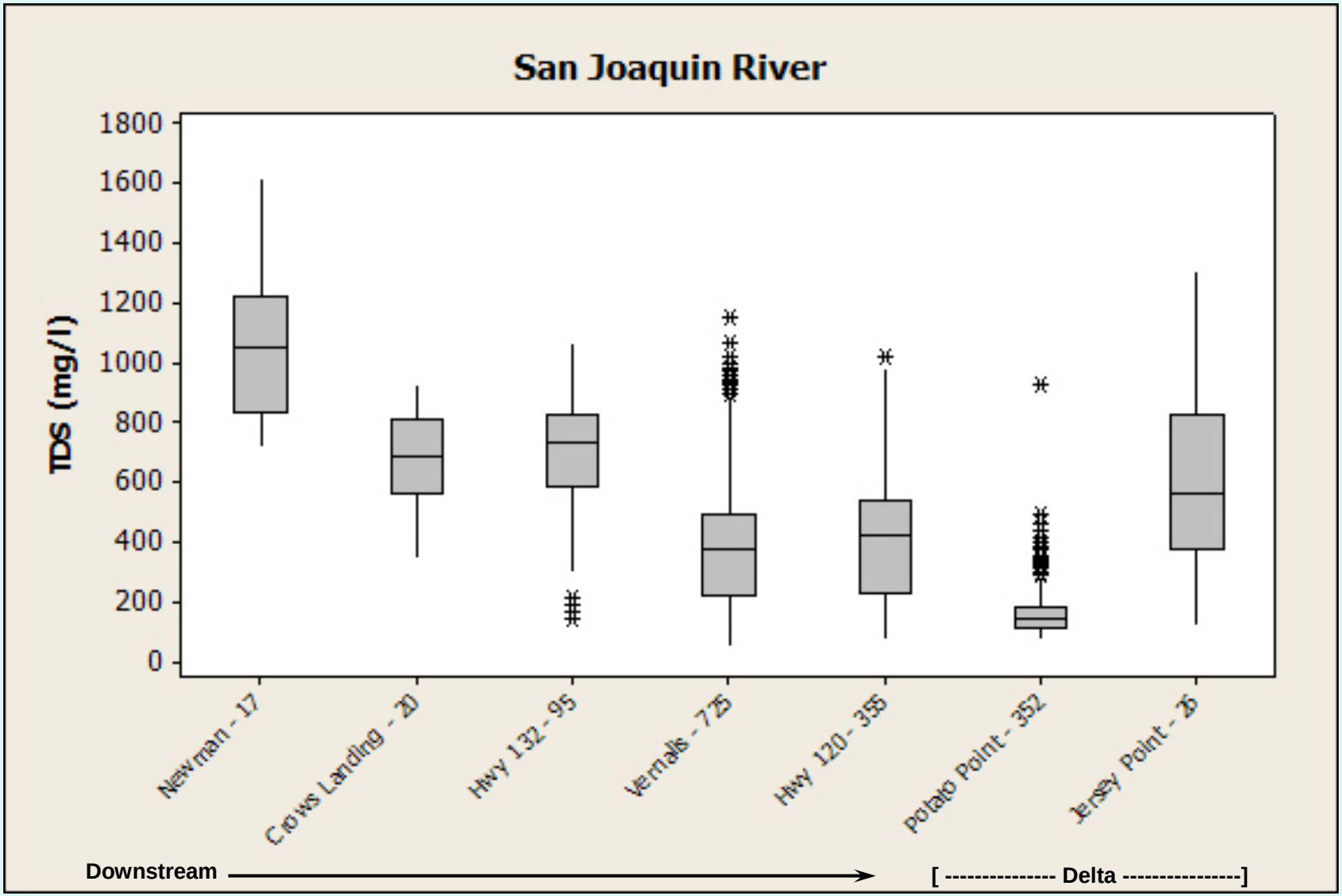
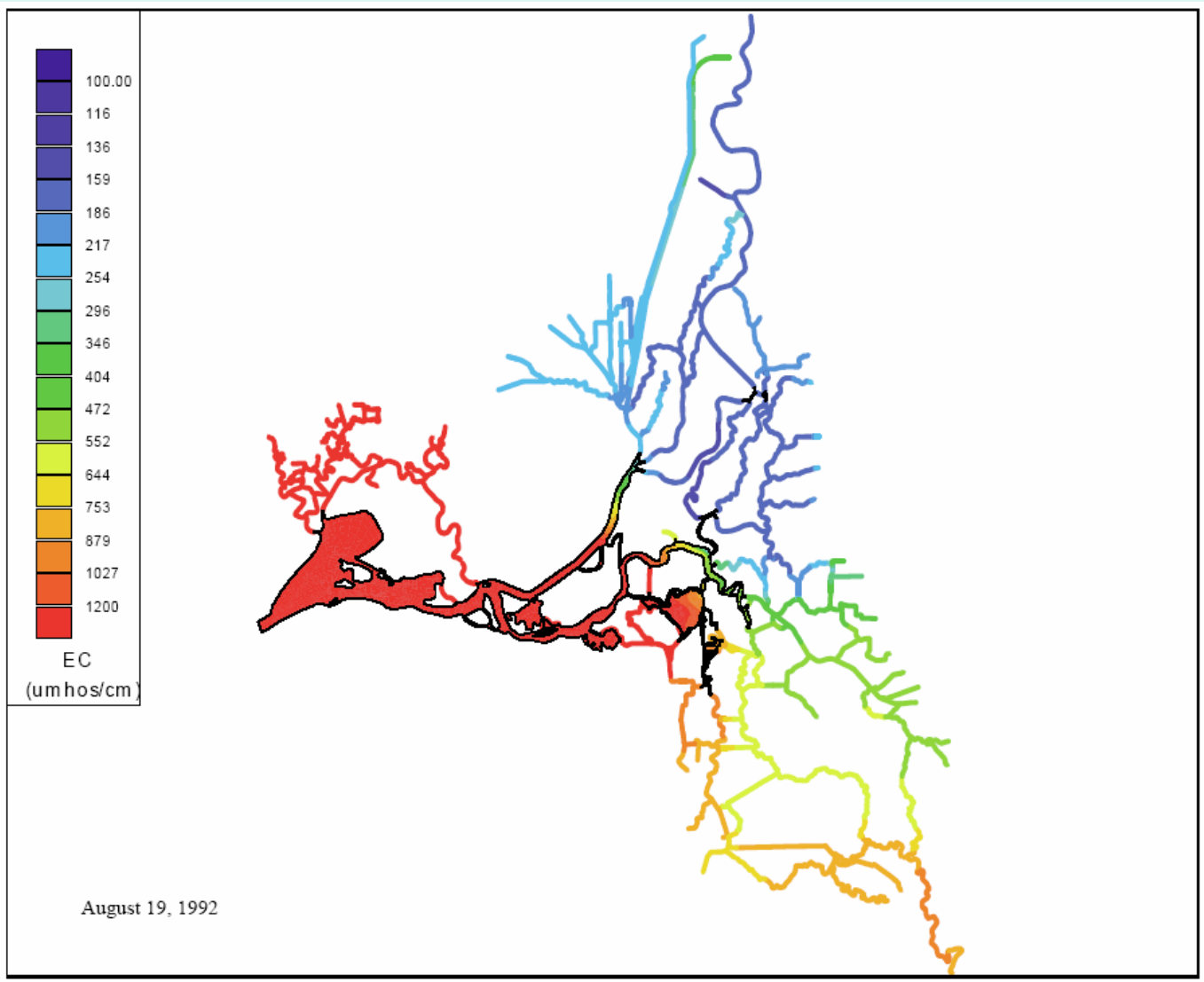


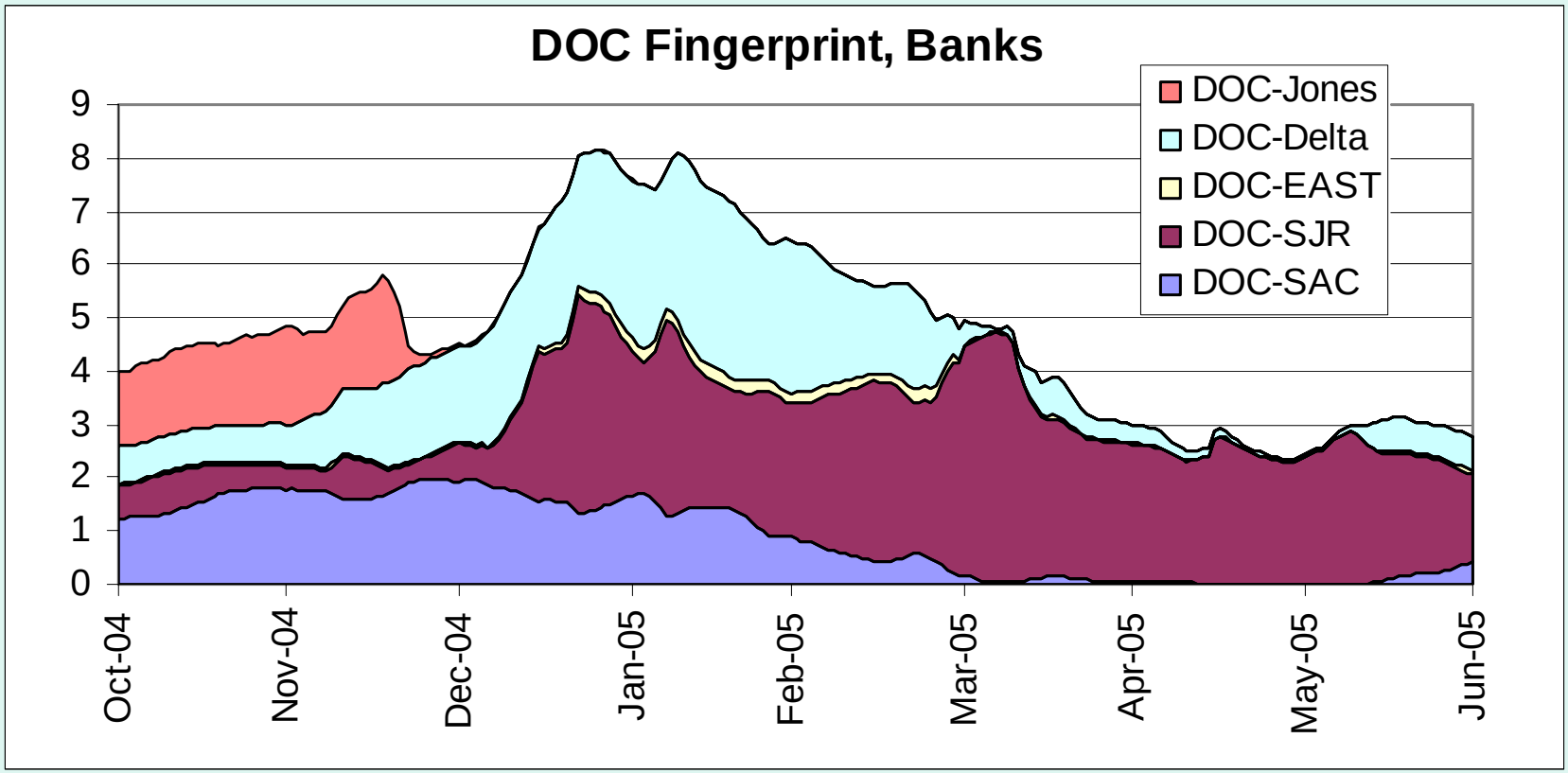
Characterizing salinity



RMA, 2006

Fingerprinting – linking Source to Diversion

With fingerprinting, we hope to investigate the timing and magnitude of the largest sources, and just focus further analysis on time periods and areas of interest.



Drinking Water Next Steps

- Prioritize sub basins in watershed by loads and timing (if data available)
- Identify gaps and uncertainties, develop monitoring plan
- Focus further technical analysis on sub basins with highest load and highest potential for improvements
- Focus future grants on highest potential improvements and test potential/track progress

Key Messages

- Drinking water quality program has made most progress, due to work for priority end-of-Stage 1 decisions and other funded projects.
- Recommend collaboration of agencies -- *especially water quality and ecosystem* – to develop integrated indicators.
- Water quality and ecosystem agencies currently lack resources to progress far on indicators for fish/wildlife and human health.

Issues and questions

- What constitutes a good “core indicator” (or suite of indicators)?
- At what level of detail would the ISB like to consider and advise on indicators/performance measures?
- Given limited information and resources, the ecosystem work has started with a few constituents. What steps might we take to ensure that further work has appropriate scope (integrates across objectives, tracks key management and science issues, e.g.)?
- What methods can be used to “validate” linkages between actions taken and “performance measure” indicators?

- Other discussion?