Overview
Sacramento/San Joaquin Delta Water Quality

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► Review of Delta Water Quality Issues ◄

Presented at CA/NV AWWA Fall Conference, Sacramento, CA, October (2007)
Overview of Sacramento-San Joaquin River Delta
Water Quality Issues

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June 22, 2004

Available on the internet at:
Map of Delta
(CA Dept Fish & Game, 2005)
CWA 303(d) Requirements

- Monitor Waterbodies to Determine Exceedances of Water Quality Standards
- If Exceedance Found:
  - List Waterbody as CWA Section 303(d) “Impaired”
  - Develop a TMDL (Total Maximum Daily Load) for Pollutant(s) Exceeding Water Quality Standard
Delta Waterways
October 19, 2004
### 2006 CWA 303(d) List of "Impaired" Delta Waterbodies (SWRCB, June 2007)

<table>
<thead>
<tr>
<th>Pollutant*/Stressor</th>
<th>Location (see key below)</th>
<th>Potential Sources (see key below)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorpyrifos</td>
<td>CD ED SE ND NW SD SC WD SJ MS OR MR MDR</td>
<td>Ag R/S SU AM Other</td>
</tr>
<tr>
<td>Diazinon</td>
<td>X X X X X X X X X X X X X X X X X X</td>
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<tr>
<td>DDT</td>
<td>X X X X X X X X X X X X X X X X X X</td>
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<tr>
<td>Group A Pesticides</td>
<td>X X X X X X X X X X X X X X X X X X</td>
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<tr>
<td>(legacy)</td>
<td>X X X X X X X X X X X X X X X X X X</td>
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<tr>
<td>EC/TDS</td>
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<tr>
<td>Exotic Species</td>
<td>X X X X X X X X X X X X X X X X X X</td>
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<tr>
<td>Mercury</td>
<td>X X X X X X X X X X X X X X X X X X</td>
<td></td>
</tr>
<tr>
<td>Unknown Toxicity</td>
<td>X X X X X X X X X X X X X X X X X X</td>
<td></td>
</tr>
<tr>
<td>Dioxin/Furan</td>
<td>X X X X X X X X X X X X X X X X X X</td>
<td></td>
</tr>
<tr>
<td>Pathogens</td>
<td>X X X X X X X X X X X X X X X X X X</td>
<td></td>
</tr>
<tr>
<td>PCBs</td>
<td>X X X X X X X X X X X X X X X X X X</td>
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<tr>
<td>Low DO</td>
<td>X X X X X X X X X X X X X X X X X X</td>
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<tr>
<td>Copper</td>
<td>X X X X X X X X X X X X X X X X X X</td>
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<tr>
<td>Zinc</td>
<td>X X X X X X X X X X X X X X X X X X</td>
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<tr>
<td>Boron</td>
<td>X X X X X X X X X X X X X X X X X X</td>
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</tr>
<tr>
<td>Toxaphene</td>
<td>X X X X X X X X X X X X X X X X X X</td>
<td></td>
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</tbody>
</table>

### Location Designations
- CD - Central Delta
- ED - Eastern Delta
- SE - South Delta export area
- ND - North Delta
- NW - Northwestern Delta
- SD - Southern Delta
- SC - Stockton Ship Channel
- WD - Western Delta
- SJ - Lower San Joaquin River
- MS - Mormon Slough
- OR - Old River - South Delta
- MR - Lower Mokelume River
- MDR - Middle River

### Group A Pesticides
- Aldrin
- Heptachlor epoxide
- Dieldrin
- Hexachlorocyclohexane
- Chlor dane
- (incl. lindane)
- Endrin
- Endosulfan
- Heptachlor
- Toxaphene

### Source Designations
- Ag - Agriculture
- R/S - Urban runoff/Storm sewers
- SU - Source unknown
- AM - Abandon mine
- WWTP - Domestic wastewaters

### Pyrethroids
- Bifenthrin
- Lambda cyhalothrin
- Efenvlrate/fedvlarate
- Permethrin

* Violates water quality objective
## Delta Impaired Waters Not Listed on CWA 303(d)

<table>
<thead>
<tr>
<th>Should Be Listed</th>
<th>Known Impairments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrients - N &amp; P</td>
<td>Excessive growth of algae &amp; macrophytes</td>
</tr>
<tr>
<td>TOC/DOC</td>
<td>Trihalomethanes formed in water treatment</td>
</tr>
<tr>
<td>Pyrethroid pesticides used in agriculture &amp; urban areas</td>
<td>Watercolumn &amp; sediment toxicity</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Could Be Listed - Need Investigation for Potential Impacts</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBDE - polybrominated diphenylethers</td>
<td>Domestic wastewater discharges</td>
</tr>
<tr>
<td>PPCP - pharmaceutical &amp; personal care products</td>
<td>Domestic wastewater discharges</td>
</tr>
<tr>
<td>Pharmaceuticals &amp; hormones</td>
<td>Dairy &amp; animal husbandry operations</td>
</tr>
<tr>
<td>Other unregulated chemicals</td>
<td>Various</td>
</tr>
</tbody>
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## 2006 CWA 303(d) List of Water Quality Limited ("Impaired") Reaches of San Joaquin River (SWRCB, June 2007)

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<tr>
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</tr>
<tr>
<td>Selenium</td>
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### River Reach Designations
- **FMP** - Friant Dam to Mendota Pool
- **MPB** - Mendota Pool to Bear Creek
- **BMS** - Bear Creek to Mud Slough
- **MSM** - Mud Slough to Merced River
- **MTR** - Merced River to Tuolumne River
- **TRS** - Tuolumne River to Stanislaus River
- **SDB** - Stanislaus River to Delta Boundary

### Group A Pesticides
- aldrin
- heptachlor epoxide
- dieldrin
- hexachlorocyclohexane
- chlordane
- (incl. lindane)
- endrin
- endosulfan
- heptachlor
- toxaphene

### Source Designations
- **Ag** - Agriculture
- **SU** - Source unknown
- **RE** - Resource Extraction

CWA - Clean Water Act
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**Source Designations**
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CWA - Clean Water Act
* Violates water quality objective
### SJR & Downstream Downstream of Vernalis Impaired Waters Not Listed on CWA 303(d)

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<td>PCBs</td>
<td>Excessive bioaccumulation in edible fish</td>
</tr>
<tr>
<td>Pathogen-indicator organisms — <em>E. coli</em>, fecal coliforms</td>
<td>Contact recreation</td>
</tr>
<tr>
<td>Nutrients (nitrogen &amp; phosphorus compounds)</td>
<td>Excessive fertilization High pH (photosynthesis/respiration) Low DO in Delta (algal decomposition)</td>
</tr>
<tr>
<td>Alternatives to OP pesticides (including pyrethroid-based pesticides*)</td>
<td>Watercolumn toxicity Sediment toxicity</td>
</tr>
<tr>
<td>Total organic carbon &amp; other chemicals such as bromide</td>
<td>Disinfection byproducts (trihalomethanes) developed in treatment of downstream waters for domestic water supply</td>
</tr>
<tr>
<td>Excessive sediment</td>
<td>Erosion, turbidity</td>
</tr>
</tbody>
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**Pyrethroids**

- bifenthrin
- lambda cyhalothrin
- efenvalerate/fedvalerate
- permethrin
Sacramento River 303(d) Listings

- Sacramento River Is Only Listed as “Impaired” by “Unknown Toxicity” and, in Some Sections, by Mercury
  - Also, TMDLs Adopted for
    - OP Pesticides
      - Diazinon
      - Chlorpyrifos
- Overall, Sacramento River Has High Water Quality Compared with Delta and San Joaquin River
  - Especially for Domestic Water Supply Use
Summary of Delta Water Quality Issues

Current (Active) SJR Watershed TMDLs

- **Selenium**
  - Source: Agricultural Drainage
  - Concern: Aquatic Life and Water Fowl

- **Salinity at Vernalis**, Total Dissolved Solids (TDS), Electrical Conductivity (EC)
  - Source: Agricultural Drainage & Other Sources
  - Concern: Adverse to Agriculture & Domestic Water Supplies

- **Boron**
  - Source: Agricultural Runoff/Drainage
  - Concern: Adverse to Agriculture

- **Organophosphorus (OP) Pesticides** (Diazinon, Chlorpyrifos)
  - Source: Agricultural Runoff
  - Concern: Toxic to Aquatic Life

- **Oxygen-Demanding Substances** (BOD/Algae, Ammonia, Organic N)
  - Source: Agricultural Drainage/Runoff
  - Concern: Low DO in DWSC & South Delta; Adverse to Aquatic Life
Summary of Delta Water Quality Issues

Pending TMDLs (to Be Developed)

- **Mercury**
  - Source: Former Gold & Mercury Mining Activities
  - Concern: Bioaccumulation in Edible Fish
  - Neurotoxin to Fetuses & Young Children
  - Sulfate Impacts Bioaccumulation of Mercury

- **Organochlorine “Legacy” Pesticides** (e.g., DDT, Chlordane, Dieldrin, Toxaphene)
  - Source: Agricultural Drainage/Runoff
  - Concern: Excessive Bioaccumulation in Edible Fish – Cancer in Humans

- **PCBs** - Industrial Chemicals
  - Source: Industrial Discharges
  - Concern: Excessive Bioaccumulation in Edible Fish – Cancer in Humans

- **Dioxins/Furans**
  - Source: Industrial Chemicals; Combustion Byproduct
  - Concern: Excessive Bioaccumulation in Edible Fish – Cancer in Humans
Summary of Delta Water Quality Issues

Pending TMDLs (to Be Developed)

- **Pathogen-Indicator Organisms** (*E. coli*, Fecal Coliforms)
  - Source: Agricultural & Urban Runoff/Discharges
  - Concern: Diseases (Contracted from Contact Recreation - Swimming)
    Drinking Water Quality

- **Toxicity of Unknown Cause**
  - Source/Cause: Unknown
  - Concern: Adverse to Aquatic Life

- **Salinity** Upstream of Vernalis
  - Source: Agricultural Drainage/Runoff
  - Concern: Adverse to Agriculture & Domestic Water Supplies

- **Heavy Metals**
  - Copper and Zinc
  - Source: Former Mining
  - Concern: Aquatic Life Toxicity
Summary of Delta Water Quality Issues

Based on Water Quality Problems in the Delta & Downstream, Need Water Quality Objectives for Some Potential Problems

- **Nutrients** – Excessive Fertilization (Nitrogen and Phosphorus Compounds)
  - Source: Agricultural & Urban Drainage & Discharges
  - Concern: High pH, Low DO (Associated with Photosynthesis/Respiration)
    - Hyacinths and Egeria - Impair Recreation, Domestic Water Supplies Tastes and odors

- **Alternative Pesticides** to OP Pesticides (Including Pyrethroid-Based Pesticides)
  - Source: Agricultural & Urban Drainage & Discharges
  - Concern: Causing Toxicity to Aquatic Life; Watercolumn & Sediment Toxicity

- **PBDEs** - Fire Retardants
  - Source: Urban Sources - Wastewaters & Stormwater Runoff
  - Concern: Excessive Bioaccumulation in Edible Fish – Cancer in Humans

- **Total Organic Carbon** & Other Chemicals That Develop into Disinfection Byproducts (Trihalomethanes) in Treated Domestic Water Supplies (e.g., Bromide)
  - Source: Agricultural, Wetland & Urban Drainage/Discharge
  - Concern: Cancer in People Who Use Treated Domestic Water Supplies
Summary of Delta Water Quality Issues

Potential Future TMDLs (to Be Evaluated)

- **Excessive Sediment, Erosion, Turbidity**
  - Source: Erosion from Agricultural Lands
  - Concern: Shoaling Water Depth
    - Adverse to Light Penetration

- **Herbicides**
  - Source: Agricultural & Roadside Drainage/Runoff
  - Concern: Toxicity to Algae & Other Aquatic Plants

- **Sediment Toxicity Aquatic** (Pesticides, Nutrients/Algae/Sediment Pollutants Ammonia, Heavy Metals, PAHs and other Chemicals)
  - Source: Agricultural & Urban Discharges/Runoff
  - Concern: Toxicity to Aquatic Organisms; Human Health Effects

- **Unrecognized Pollutants** (Pharmaceuticals & Other Unregulated Chemicals Discharged by Confined Animal Facilities (e.g., Dairies, Feedlots) & Domestic Wastewaters)
  - Source: Agricultural & Urban Wastewater Discharges
  - Concern: Toxicity / Sublethal Impacts on Aquatic Life
    - Human Health Effects
Typical Environmental Sample Analysis

“TARGET” RECOGNIZABLE Large portion of naturally occurring and ARTIFACT anthropogenic chemicals of varied toxicity TICs = tentatively identified compounds

Figure from: Daughton, C. C., “The Critical Role of Analytical Chemistry,” July (2002)
http://www.epa.gov/nerlesd1/chemistry/pharma/critical.htm
Impact of Export Projects

- Up to 13,500 cfs Exported from Southwestern Delta for Domestic & Agricultural Water Supply by Federal (USBR) & State (DWR) Projects
- Impacts:
  - Exports Allowed to Occur without Evaluation of Impact on Delta Water Quality
  - IEP Monitoring Has Not Evaluated Impacts Even Though Required by SWRCB Water Rights Decision D-1641
  - Low Water Levels in South Delta Impair Recreation & Availability of Irrigation Water
Impact of Export Projects

Flow Patterns in Delta Greatly Changed
  - Draw Sacramento River Water through Central Delta
  - Low Primary Production in Areas of Delta Dominated by Sacramento River Water
  - Contribute to SJR DWSC & South Delta Low DO Problems – Dead Zones in South Delta
  - Alter Location and Impacts of Pollutants
Impact of Export Projects (Cont)

- Loss of Chinook Salmon Homing Signal
  - SJR Watershed Home Stream Water Signal in Western Delta & San Francisco Bay during Fall & Winter
- Contribute to Pelagic Organism Decline (POD)?
  - Delta Smelt & Other Fish
  - Capture at Export Pumps
    - Court Ruling That Exports Must Be Reduced during Winter to Protect Fish
Altered Conveyance
“Peripheral Canal”

- Drastically Change Delta Water Quality
- Poor Water Quality in SJR to Be Much Larger Factor in Delta Water Quality
- Currently: Large Amounts of Sacramento River Water Drawn to Export Pumps - Dilutes Adverse Impacts of SJR-Derived Pollutants in Central & Southern Delta
- Increased Adverse Impacts of Pollutants from SJR & within Delta
  - Increase in Selenium, TOC/DOC, Salinity, Nutrients
  - Bioaccumulation of Hg as Influenced by Sulfate in SJR
  - OCIs/PCBs Bioaccumulation, Etc.
- Change in Location of Aquatic Life Toxicity Could Be Significant at Critical Location for Certain Types of Fish
Future

- Delta Water Quality Problems Difficult to Correct through TMDLs, for Most Pollutants
- Future Export Manipulations — via Peripheral Canal or Through Delta Conveyance
  - Will Change Water Quality
- Needs Careful Evaluation
Further Information
Consult Website of
Drs. G. Fred Lee and Anne Jones-Lee

http://www.gfredlee.com
http://www.gfredlee.com/psjriv2.htm