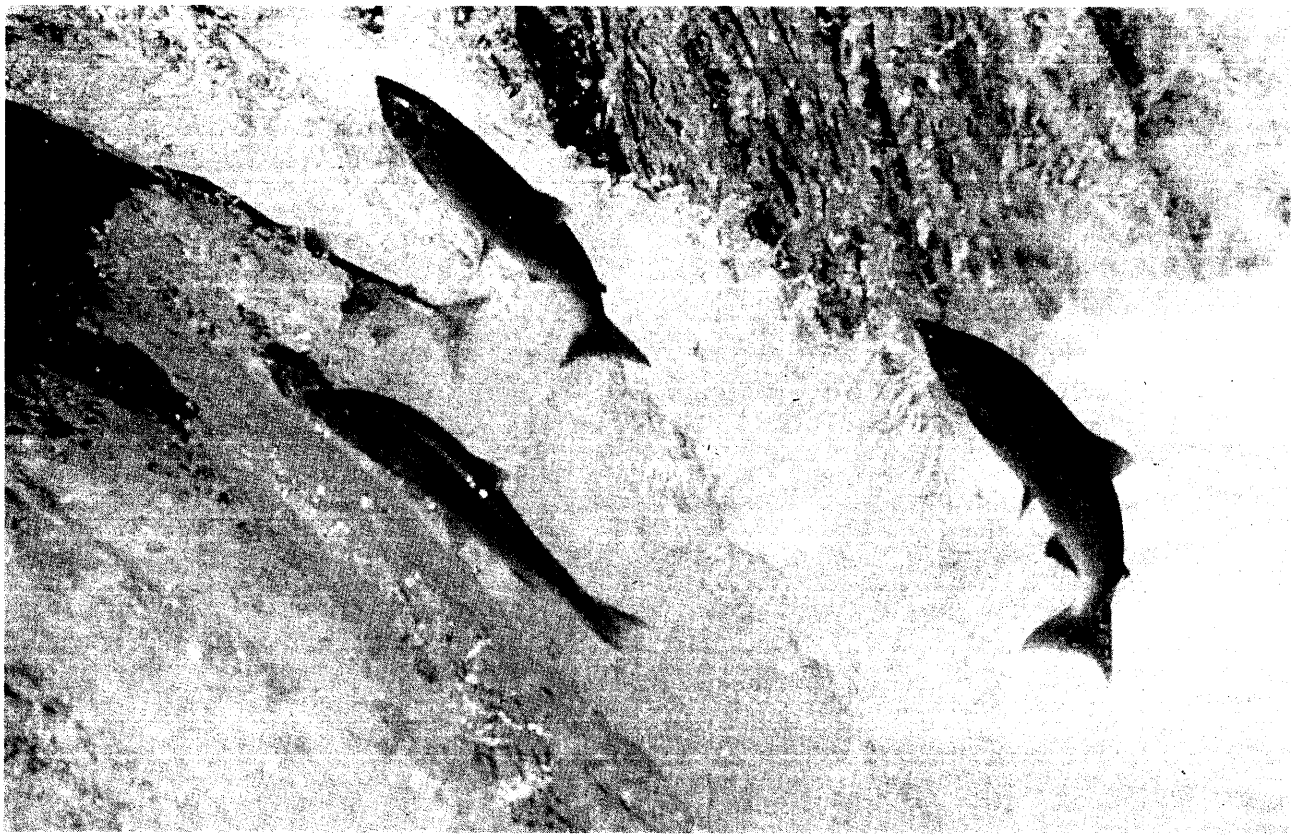
# TOXIC POLLUTION OF THE SACRAMENTO RIVER



## SACRAMENTO RIVER INFORMATION CENTER
## RESEARCH REPORT NO. 1
## MARCH, 1993

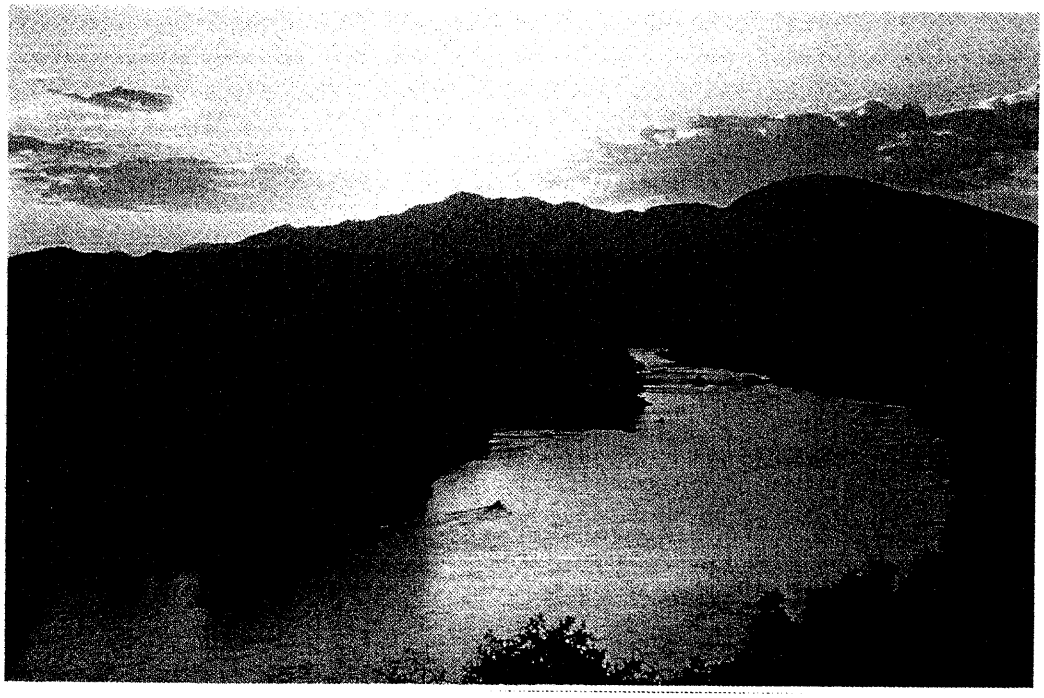
## FOREWORD

The Sacramento River Information Center and its governing body, Shasta Natural Science Association, gratefully acknowledge the strengthening suggestions and financial support of the following organizations in preparation and publication of this summary report:

California Department of Fish and Game
California Rice Industry Association
Central Valley Regional Water Quality Control Board
Sacramento River Council
Simpson Paper Company

This is the first in a series of research reports we plan to produce to fulfill the Sacramento River Information Center's mission to *gather, analyze, display and disseminate data on Sacramento River ecology and conservation/restoration activities, in order to inform and stimulate action by a broad public about the condition, needs and future of the ecosystem.* We hope that you find the report useful. Any comments or questions can be addressed to us at P.O. Box 990185, Redding, CA 96099.

Tryg Sletteland
Director



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## INTRODUCTION

The following report briefly summarizes some current knowledge about toxic pollution of the Sacramento River between Keswick Dam and Collinsville, located as shown on Map 1, page 10 of this report. This is the entirety of the Sacramento River proper that runs freely and is accessible to sea-run fisheries such as salmon and steelhead trout. In this 302 mile stretch of the river, there are many major dischargers of effluents containing substances classified as hazardous to fish, wildlife, and man. There are also countless minor dischargers of substances which in the aggregate pose a serious threat to aquatic life and other beneficial uses of the river.

The toxics and other harmful substances being discharged into the Sacramento River include heavy metals, polynuclear aromatic hydrocarbons, sediments, dioxins, pesticides, and warm water lethal to incubating salmon eggs. Some have been the targets of very effective clean up programs; others, to the detriment of the river's health, have either been largely ignored or are currently being addressed by regulatory agencies and/or conservation action groups.

## SOURCES OF INFORMATION

Data on river pollution are available as a result of the permits required for all facilities that discharge waste directly to California surface water bodies. These are known as National Pollution Discharge Elimination System (NPDES) and Waste Discharge Requirement (WDR) permits. The Central Valley Regional Water Quality Control Board (Regional Board), a State agency, administers these permits for discharges into the Sacramento River.

A 1990 Regional Board report provides an extensive inventory of point source discharges to the Sacramento River. See footnote (1) on page 9. Data on 86 major point source dischargers operating under NPDES/WDR permits are characterized and categorized in Table 1 on page 11 of this report.

## EFFLUENT TYPES

Sewage from wastewater treatment plants contribute 51.9 percent of the total volume of permitted discharges to the Sacramento River, with over one-quarter of the total NPDES inflow to the river -- 180 million gallons per day (MGD) -- coming from one source, the Sacramento Regional Wastewater Treatment Plant. Other cities discharging treated wastewater include Redding (8.8 MGD), Red Bluff (1.90), Corning (2.46), Chico (5.0), Oroville/Butte County (6.50), Yuba City (7.0), Beale Air Force Base (5.0), Roseville (18.0), West Sacramento/Yolo County (5.0), and Vacaville (8.0).

Other point source effluent types that contribute high inflows include fish hatchery waste (32.4 percent of total NPDES inflow to the river), storm water discharge (8.9 percent), and plant cooling water (5.3 percent). The other types of NPDES dischargers listed in Table 1 contribute the remaining 1.5 percent of the total.

## THE DILUTION FACTOR

The U.S. Environmental Protection Agency (EPA), which assesses the toxicity of effluents contributed to the Sacramento River, stresses the importance of calculating dilution ratios for point source dischargers. With most pollutants, a point source is not considered dangerous if the dilution is greater than 1 part effluent to 10,000 parts river water. A discharger is considered a potential problem if dilution is less than 10,000:1.

Table 2 lists the major point source dischargers to the Sacramento River, using worst-case dilution factors calculated for the periods of the year with the lowest flow volumes. The Sacramento Regional Wastewater Treatment Plant has the lowest dilution factor of any point source discharger, ranging from 80:1 in a high river flow year to 37:1 in a low flow year. Coleman National Fish Hatchery in Shasta County has the next lowest dilution ratio, ranging between 88:1 and 56:1.

While NPDES point source dischargers contribute less than one percent of total Sacramento River inflow during dry years, non-point source dischargers of agricultural drain water contribute up to 30 percent of the total inflow to the river during the low flow season of a dry year. The remainder of the inflow is from tributaries, principally the Feather and American rivers. Problems resulting from drain water containing agricultural pesticides have occurred in the stretch from Colusa to the American River confluence, particularly during low flow periods when dilution ratios are in the 3:1 range.

## STATUS OF REMEDIAL ACTIONS

### Heavy Metals

The primary point source of heavy metals discharged to the Sacramento River is Iron Mountain Mine, located nine miles northwest of Redding. This EPA Superfund site is the largest discharger of toxic heavy metals (principally copper, zinc, and cadmium) to surface waters of the entire United States. After several years of study and some disputes among the responsible parties, the EPA has selected a neutralization treatment plant as the interim cleanup strategy to control acid mine runoff from the site. The treatment plant is scheduled to begin operation in late 1993 and will virtually eliminate the existing threats to the Sacramento River fishery and Redding municipal water supply. After the 1993 water year, massive dilution releases from Shasta Dam will no longer be needed to prevent major fish kills during uncontrolled spills of toxic mine drainage. This approach will buy time to devise and implement a permanent cleanup program.

### Urban Runoff

Storm runoff from urban areas is a significant point source of heavy metals and several organic pollutants, including petroleum hydrocarbons.(2) In 1975, levels of cadmium, chromium, copper, lead, and zinc were found in Sacramento area urban runoff at levels exceeding EPA criteria to protect freshwater aquatic life.(3)

Serious problems also exist with polynuclear aromatic hydrocarbons (PAHs), which are synthetic organic chemicals commonly found in urban runoff. They are the residue of asphalt wear, auto oil drippings, and illegal disposal of used crankcase oil. In 1985, high levels of PAHs were found in Sacramento area storm drains, and lower levels were found sixty miles downstream at Collinsville. Striped bass collected from the river at Collinsville in 1983 contained elevated levels of PAHs in their body tissue. The Regional Board has concluded that "...the Sacramento regional urban storm drain system is a major source of the PAHs found in the Sacramento River." However, little has apparently been done to reduce the hazardous levels of either heavy metals or PAHs in Sacramento area urban runoff.(4)

Sediment

Another major threat to the health of the Sacramento River aquatic ecosystem -- sediment loading -- is a direct result of land disturbance activities along the river and its tributaries. Among other effects, the eroded topspoil which washes into the river system destroys spawning habitat, burying gravels which could otherwise be used by reproducing trout and salmon. Additional efforts are needed to reduce sediment discharge from agriculture and subdivision developments.(6) Stream protection and rehabilitation projects are also needed to correct livestock grazing problems.

The largest forest fire in California in 1992, the Fountain Fire, destroyed over 80,000 acres of critical watershed in Eastern Shasta County. The bare slopes along Hatchet and Montgomery creeks may discharge large quantities of ash and sediment into the Pit River above Shasta Reservoir. Pit River trout and their spawning habitat are likely to be adversely affected. The Regional Board has been working with the California Department of Forestry to stabilize denuded slopes and control erosion resulting from the fire, which will have little if any direct impact on the Sacramento River.

Dioxin

The Regional Board has described levels of dioxin and furans in pulp and paper mill effluents currently being discharged to the Sacramento River as follows:

> Simpson Paper Company has achieved a significant reduction (approximately 98 percent) in the discharge rate of dioxins and related compounds in the last two years. In order to comply with existing waste discharge requirements and proposed State dioxin standards, Simpson has pursued chlorine usage reduction and elimination of dioxin precursors. The effect of these reductions has resulted in reduced concentrations in fish tissue of approximately 80-90 percent. The current health advisory on consumption of fish taken from the river between Redding and Red Bluff may soon be lifted.(6)

Pesticides

The Regional Board continues to view herbicides and pesticides as a major source of Sacramento River pollution. However, while rice pesticides were once viewed as a major component of this problem, their levels in the City of Sacramento's water supply have decreased 99.5 percent over a recent 9-year period.(7) The California Rice Pesticide Management Program reduced total pesticide loads in the river attributable to rice production from 40,560 pounds in 1982 to 218 pounds in 1991. Herbicides, which are classified as a type of pesticide, are included in the above-quoted figures.

Warm Water

In 1988 the Regional Board found the U.S. Bureau of Reclamation in violation of adopted Sacramento River basin plan standards by releasing warm water from Shasta Reservoir.(8) During the period 1988 through 1992, millions of incubating chinook salmon eggs died each year from the release of water at Keswick Dam too warm to meet the required 56 degrees F. standard at downstream control points. Under Water Right Orders made by the State Water Quality Control Board (State Board) in 1990, 1991, and 1992, the Bureau has been required to meet, but has failed to meet, temperature requirements at various control points below Keswick. (9,10,11)

Temperature standards have not been met at Red Bluff Diversion Dam, the control point designated in the basin plan. This dam, 59 miles below Keswick Dam, is the downstream terminus of prime salmon spawning habitat that can be influenced by temperature control operations in the Central Valley Project's Shasta and Trinity divisions. Since the Bureau has run out of cold water by depleting the reservoir in 1988, 1990, 1991, and 1992, temperature control points have had to be temporarily moved upstream to Balls Ferry, 25.9 miles below Keswick, and Clear Creek, only 12.8 miles below Keswick. Still, even in these greatly reduced spawning areas, the Bureau has been unable to meet the temperature standards required for successful salmon egg incubation. In 1992, warm water releases from Shasta killed an estimated 18 percent of the endangered winter run, 21 percent of the commercially valuable fall run, and 52 percent of the imperiled spring run. A coalition of fishing and conservation groups sued the Bureau over its warm water releases in 1992, and was prepared to do so again in 1993 to enforce adopted Sacramento River temperature standards.

To insure that Sacramento River water temperature standards are met in 1993 and future years, at least 2.0 million acre feet of water must be held in Shasta Reservoir through September, and conservative criteria should be used in estimating available water supplies during the allocation process. (13,14,15,16) In addition, installation of temperature control devices at Shasta Dam and Whiskeytown Lake is essential for effective management of cold water reserves.

Cantara Toxic Spill

The massive 1991 herbicide spill into the upper Sacramento River occurred above Shasta Reservoir and is thus beyond the geographic scope of this report. While it eliminated all life from the 45 miles of river between the Southern Pacific Railroad's Cantara grade and Shasta Reservoir, the spill has never affected the Sacramento River below Shasta Dam. Before it was broken into harmless consituent parts, the toxic metam sodium was found in the upper four miles of the Sacramento River arm for a period of two weeks after it reached Shasta Reservoir.

## CONCLUSION AND RECOMMENDATIONS

The Regional Board has described the Sacramento River as "still relatively clean for a major river in the U.S.," but also noted "significant water quality problems", as described in this brief report.(17) Following are recommendations addressing these problems. Many of them were made in the State Board's final report on their Sacramento River Toxic Risk Assessment Project (SRTRAP).(18)

### Heavy Metals

1. The water quality criteria for copper, cadmium and zinc included in the SRTRAP final report should be considered by the Regional Board in developing water quality objectives for the protection of aquatic life and in implementing controls to reduce the discharge of these chemicals to the river below Hamilton City.

2. The U.S. EPA should take all necessary steps to keep on schedule with construction of the treatment plant selected to reduce the risk of release of uncontrolled spills from the Iron Mountain Mine Superfund site into the Sacramento River at Keswick Reservoir.

3. The Regional Board should continue to take action where necessary in the Redding/Shasta Lake region to control the flow of heavy metal trace elements from sources other than Iron Mountain Mine into the Sacramento River system.

4. The Regional and State boards should work with the U.S. EPA, State Departments of Health Services and Fish and Game, and other agencies to obtain chronic toxicity data on copper, cadmium, and zinc that are needed to (a) fully evaluate the sensitivity of resident species under local water conditions and (b) more fully evaluate the toxicity of ambient waters.

5. The Regional Board should continue to work with NPDES dischargers to lower analytical detection levels for trace metals.

### Urban Runoff

6. The Regional Board should continue to work with local agencies in Sacramento and other urban areas to monitor synthetic organics from storm drain runoff and NPDES permitted facilities where applicable.

7. The Regional Board should continue to work with the City and County of Sacramento to reduce and eventually eliminate the deleterious effects of urban runoff on water quality in the Sacramento River and its tributaries.

8. The Regional Board should expand its consideration of the deleterious effects of urban runoff to other metropolitan areas likely to affect water quality in the Sacramento River system.

### Sediment

9. The Regional Board and other responsible agencies should continue to monitor and recommend improvements in stream protection and implement rehabilitation projects to correct problems caused by logging and livestock grazing in the Sacramento River watershed.

10. The Regional Board should expand its work with the State Department of Fish and Game and other state and local agencies to reduce sediment discharge from agriculture and subdivision developments.

Dioxin

11. The Regional Board should continue to monitor the dioxin content of pulp and paper mill effluent to insure that levels in the Sacramento River continue to meet state and federal safety criteria.

Pesticides

12. The Regional Board should require agricultural practices that result in reduced mass loading of chemicals used on all crops grown in the Sacramento River system. Reductions should be comparable to those achieved through improved management practices on rice chemicals.

Warm Water

13. The Regional Board should seek to reinstate Waste Discharge Requirement 88-043 in order to properly implement maintenance of the Sacramento River basin plan temperature standard of 56°F or less at Red Bluff Diversion Dam from April 15 through the end of November.

14. The U.S. Bureau of Reclamation should implement for the 1993 water year the new federal law to "reevaluate existing criteria in order to maintain minimum carryover storage at Sacramento and Trinity River reservoirs to protect and restore the anadromous fish of the Sacramento and Trinity Rivers..." (19)

15. The U.S. Bureau of Reclamation should "use a 95-percent probability of exceedance forecast in setting its February 15 water delivery commitments. Subsequent updates of water delivery commitments (should) be based on a 99-percent probability of exceedance forecast. (20)

General Recommendations

16. The Regional Board should continue to work with both point source (NPDES permitted) and non-point source dischargers (i.e., the agricultural industry) to increase whole effluent and ambient receiving water toxicity testing.

17. Use of sensitive monitoring techniques such as resin column concentrating methods, in-situ bivalve monitoring, and the EPA three species bioassay should be expanded to obtain information on biologically significant levels of toxic substances in the Sacramento River system.

18. The State and Regional boards should expand the baseline monitoring program providing data necessary to assess the effects of point and non-point sources of toxic substances.

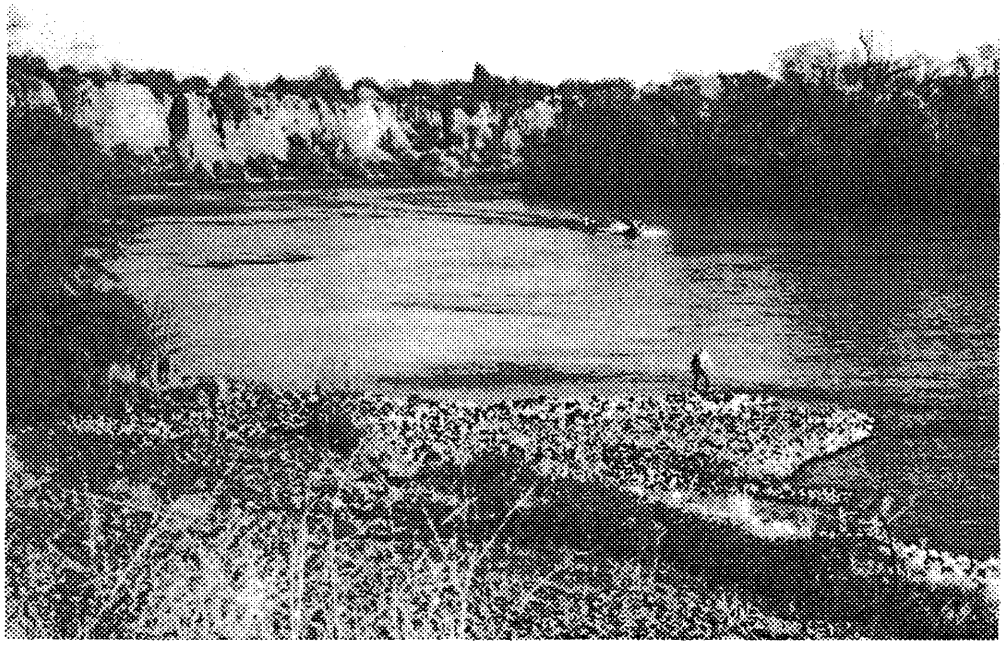
19. The State Board Tissue Substances Monitoring Program, the primary source of data on tissue residue levels of toxic substances in biota of the Sacramento River system, should continue to sample biota from the system, and should consider the need to expand the program.

Status Reports

20. Every three years, the State Board should produce follow-up reports on its Sacramento River Toxic Chemical Risk Assessment Project detailing progress made on the recommended actions listed above.

21. The first of these status reports on Sacramento River toxics should be released to the public by the State Board within one year of publication of this report.

22. A follow-up to this report should be produced by an independent entity by mid-1993, after release of the Regional Board's final report on its multi-year, 3-species biotoxicity testing program, conducted in many locations between Redding and Collinsville.



## REFERENCES


(1) State Water Resources Control Board (SWRCB), *Sacramento River Toxic Chemical Risk Assessment Project, Final Project Report*, 90-11WQ, with Appendices, State of California, Sacramento, October, 1990.

(2) U.S. EPA, *Results of the nationwide urban runoff program, Final Report*, vol. I, Washington, D.C., 1983.

(3) Sacramento Regional County Sanitation District (SRCSD) and Sacramento Area Consultants, *Stormwater Control System Project Report and Draft EIR*, Sacramento Regional Wastewater Management Program, Sacramento, August, 1975.

(4) SRCSD, Ibid., p. I-43.

(5) Central Valley Regional Water Quality Control Board (CVRWQCB), *Major Pollutant Discharges into the Upper Sacramento River*, State of California, Redding, October, 1992.

(6) CVRWQCB, Ibid., p. 2.

(7) California Environmental Protection Agency, "Rice pesticides virtually eliminated from Sacramento drinking water supply", CAL EPA Press Release, Sacramento, February 26, 1982.

(8) CVRWQCB, Waste Discharge Requirement 88-043, State of California, Redding, 1988.

(9) SWRCB, Water Right Order 90-05, State of California, Sacramento, May 2, 1990.

(10) SWRCB, Water Right Order 91-01, State of California, Sacramento, January 10, 1991.

(11) SWRCB, Water Right Order 92-02, State of Calif., Sacramento, 1992.

(12) Sacramento River Council, "Bureau facing another salmon protection lawsuit", Press Release, Redding, December 21, 1992.

(13) Hydrosphere Resource Consultants, *Evaluation of Economic Impacts of Alternatives for Designation of Winter-Run Chinook Salmon Critical Habitat in the Sacramento River*, Boulder, Colorado, July 31, 1991.

(14) California Department of Fish and Game, *Water Quality and Water Quantity Needs for Chinook Salmon Production in the Upper (sic) Sacramento River*, page 9, Exhibit No. 14, Prepared for the 1992 Hearing Process on the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, Sacramento, 1992.

(15) Balance Hydrologics, *Effects of Shasta Lake Carryover Storage and Annual Releases on Meeting Sacramento River Temperature Objectives: Initial Studies*, Draft Report Prepared for the Sacramento River Council, Berkeley, February, 1993.

(16) SWRCB, *Draft Water Right Decision 1630, San Francisco Bay/ Sacramento-San Joaquin Delta Estuary*, December, 1992.

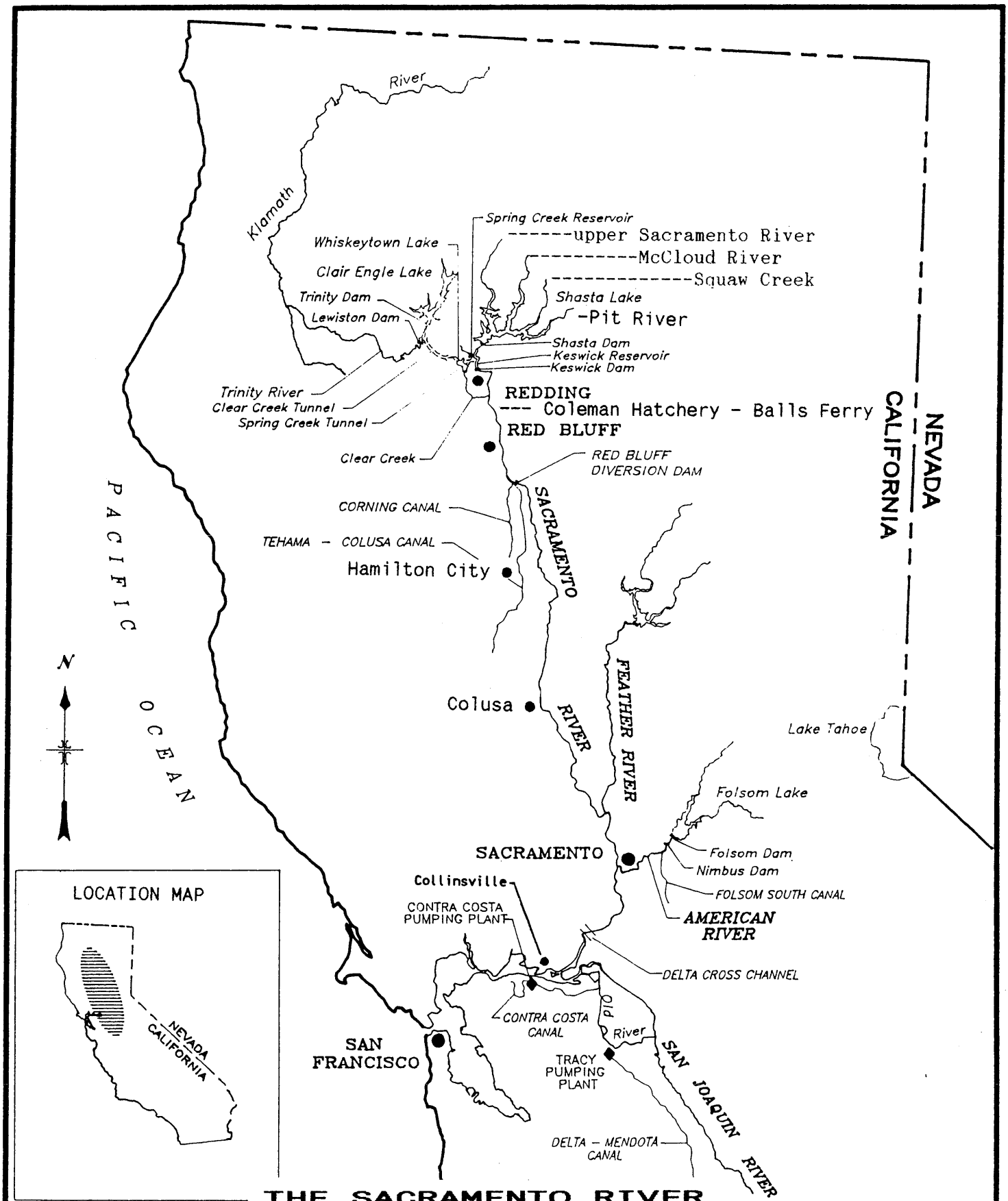
(17) CVRWQCB, op. cit., p. 3.

(18) SWRCB - 90-11-WQ, op. cit., pages xvii and xviii.

(19) U.S. Congress, *Reclamation Projects Authorization and Adjustment Act of 1992 (P.L. 102-575)*, Title XXXIV (Central Valley Project Improvement Act), Section 3406(b)(19) Washington, D.C., October 30, 1992.

(20) SWRCB - D-1630, op. cit., page 67.

Map 1 : from *CVP Operations Criteria & Plan*, U.S. Bureau of Reclamation, 1992




# THE SACRAMENTO RIVER
including
## FEATURES OF THE CENTRAL VALLEY PROJECT

TABLE 1

PERMIT REQUIREMENTS SUMMARIZED BY EFFLUENT TYPE

| Effluent type | Total Permits | NUMBER OF PERMITS WITH REQUIREMENT | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Flow | BOD | DO | pH | Temp. | Tur. | Set. Mat. | Susp. Mat. | Total Coliform | Res. Cl | EC | COD |
| Sewage/Wastewater Treatment Plant | (36) | 36 | 35 | 30 | 36 | 17 | 10 | 36 | 36 | 36 | 34 | 27 | 1 |
| | | Toxicity: Bioassay (14), TDS (11), standard minerals (9), oil & grease (3), MBAS (2), water supply (2), chloride (2), heavy metals (3), NH4-N (3), priority pollutants (1), cyanide (1), groundwater monitoring (2), river dilution (2), N (1), PCBs in sludge (1) | | | | | | | | | | | |
| Plant Cooling Water | (14) | 11 | 3 | 7 | 14 | 13 | 3 | 4 | 8 | 0 | 0 | 11 | 7 |
| | | Toxicity: oil & grease (4), heavy metals (2), TDS (2), water supply monitoring (2), volatile organics (3), bioassay (1), TOC (1), minerals (1), phenol (1), cyanide (1), nitrogen (1), priority pollutants (1), groundwater monitoring (1) | | | | | | | | | | | |
| Fish Hatcheries Waste | (10) | 10 | 0 | 4 | 9 | 3 | 4 | 10 | 6 | 0 | 2 | 0 | 0 |
| | | Toxicity: daily log of chemical useage (8), chloroform (1) | | | | | | | | | | | |
| Logdeck Runoff (winter only) | (9) | 1 | 0 | 1 | 8 | 0 | 8 | 7 | 7 | 0 | 0 | 0 | 3 |
| | | Toxicity: bioassay (6), tannins & lignins (7), TDS (1), oil & grease (1), PCP (1) | | | | | | | | | | | |
| Stormwater Discharge (winter only) | (6) | 2 | 1 | 3 | 6 | 4 | 5 | 2 | 5 | 1 | 1 | 4 | 4 |
| | | Toxicity: oil & grease (3), groundwater monitoring (2), TDS (2), volatile organics (2), heavy metals (2), cyanide (2), bioassay (1), tannins & lignins (1), TOC (1), phenol (1), minerals (1), priority pollutants (1) | | | | | | | | | | | |
| Water Treatment Plant | (4) | 4 | 0 | 0 | 4 | 0 | 4 | 4 | 1 | 0 | 1 | 0 | 0 |
| | | Toxicity: river flow (1), chromium (1), aluminum (1) | | | | | | | | | | | |
| Food Processing Wastes | (4) | 4 | 3 | 2 | 4 | 3 | 0 | 3 | 3 | 1 | 0 | 2 | 1 |
| | | Toxicity: groundwater monitoring (1), soil sampling (1) | | | | | | | | | | | |
| Pulp Paper Process Waste | (2) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 0 | 1 | 0 |
| | | Toxicity: mercaptans (1), resin acids (1), sulfate soaps (1), nitrogen (1), total P (1), color (1), bioassay (1) | | | | | | | | | | | |
| Industrial Yard Stormwater Runoff (winter only) | (2) | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | | Toxicity: oil & grease (2) | | | | | | | | | | | |
| Treated Industrial Steam Cleaning Waste | (2) | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | Toxicity: heavy metals (1), groundwater monitoring (1) | | | | | | | | | | | |
| Treated Ground Water | (1) | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 |
| | | Toxicity: acetone, methyl ethyl ketone, methyl isobutal ketone, heavy metals, cyanide, aldrin, phenol, bioassay, volatile organics, priority pollutants | | | | | | | | | | | |

ABBREVIATIONS

Total permits: 86. Total permits in table: 89 (three contain more than one type of effluent).

Updated through 31 December 1987.

* Effluent type:
FHW- Fish Hatchery Waste
FPW- Food Processing Waste
IYS- Industrial Yard Storm Runoff
LDR- Logdeck Runoff
PCW- Plant Cooling Water
PPW- Pulp Paper Process Waste
STP/WWTP- Sewage/Wastewater Treatment Plant
SWD- Storm Water Discharge
TIS- Treated Industrial Steam Cleaning Waste
TGW- Treated Ground Water
WTP- Water Treatment Plant

Discharge values listed are design flows, and may be greater than average flows.

W: winter flow only

* Permit abbreviations:
D: measured daily
W: measured weekly
M: measured monthly
Q: measured quarterly
E: measured for each event
2xW, etc: measured twice a week
C: monitored continuously
AR: measured as required

BOD: biological oxygen demand
DO: dissolved oxygen
Temp: temperature
Tur: turbidity
Set Mat: settlable matter
Susp Mat: suspended matter
Res chlorine: residual chlorine
EC: electrical conductivity
COD: chemical oxygen demand
TDS: total dissolved solids

from Tables 1-3 and B-1, State Water Resources Control Board, *Sacramento River Toxic Chemical Risk Assessment Project, Final Project Report*, 90-11-WQ, with Appendices, State of California, Sacramento, October, 1990

TABLE 2

DILUTION OF NPDES/WDR POINT SOURCE DISCHARGES INTO THE SACRAMENTO RIVER.

| River Segment<br>Discharger (effluent) | Average Flow, ac-ft/day | Dilution Factor<br>Sept-Oct 1976 (low flow) | Sept-Oct 1979 (medium flow) | Sept-Oct 1982 (high flow) | Toxic Chemical Monitoring |
|---|---|---|---|---|---|
| I. Shasta Dam to Bend Bridge | | | | | |
| City of Redding (STP/WWTP) | 27.0 | 425 :1 | 438 :1 | 670 :1 | King salmon bioassay |
| Simpson Paper Company (PPW) | 45.6 | 252 :1 | 260 :1 | 396 :1 | Bioassay, mercaptans, resin |
| Darrah Springs Fish Hatchery (FHW) | 81.9 | 140 :1 | 144 :1 | 221 :1 | Daily log of chemical use |
| Coleman Fish Hatchery (FHW) | 205.6 | 56 :1 | 58 :1 | 88 :1 | None |
| II. Bend Bridge to Hamilton City | | | | | |
| Mt. Lassen Trout Farm (FHW) | 8.3 | 1157 :1 | 2040 :1 | 2056 :1 | Daily log of chemical use |
| Packaging Company of Ca (PPW) | 11.0 | 873 :1 | 1539 :1 | 1551 :1 | % survival of salmon eggs |
| III. Hamilton City to Colusa | | | | | |
| City of Chico (STP/WWTP) | 15.3 | 662 :1 | 677 :1 | 1163 :1 | 96-hour bioassay |
| IV. Colusa to Verona | | | | | |
| Sewerage Comm. Oroville (STP/WWTP) | 19.9 | 968 :1 | 1116 :1 | 1835 :1 | 96-hour bioassay |
| Yuba City Water Rec Plant (STP/WWTP | 21.5 | 896 :1 | 1032 :1 | 1698 :1 | 96-hour bioassay |
| NEC Electronics (PCW) | 2.3 | 8379 :1 | 9649 :1 | 15873 :1 | Toxic organics, etc |
| V. Verona to Freeport | | | | | |
| City of Roseville (STP/WWTP) | 55.2 | 369 :1 | 487 :1 | 790 :1 | 96 organics, bioassay, etc |
| Aerojet General Corp (SWD) | 147.3 | 139 :1 | 183 :1 | 238 :1 | 96 organics, 17 metals, etc |
| State Heating Plant (PCW) | 24.1 | 849 :1 | 1116 :1 | 1810 :1 | Iron |
| Sacramento Regional WWTP (STP/WWTP) | 552.4 | 37 :1 | 49 :1 | 80 :1 | Bioassay, standard minerals |
| Proctor & Gamble (PCW) | 19.9 | 1018 :1 | 1344 :1 | 2192 :1 | None |

Notes: 1 acre-foot/day = 0.325851 million gallons/day (MGD)
Dilution factor = river flow/discharge flow
River flows taken at the bottom of each river segment.

from Table 1-4, State Water Resources Control Board, *Sacramento River Toxic Chemical Risk Assessment Project, Final Project Report*, 90-11-WQ, with Appendices, State of California, Sacramento, October, 1990

# AFTERWORD

*Toxic Pollution of the Sacramento River* is a publication of the Sacramento River Information Center, part of the new River Museum, Aquarium and Science Center. This is a project of Shasta Natural Science Association in cooperation with the Alliance of Redding Museums. The Redding Museum Park is currently in its schematic design phase. Preparatory project construction began at Turtle Bay in 1992.

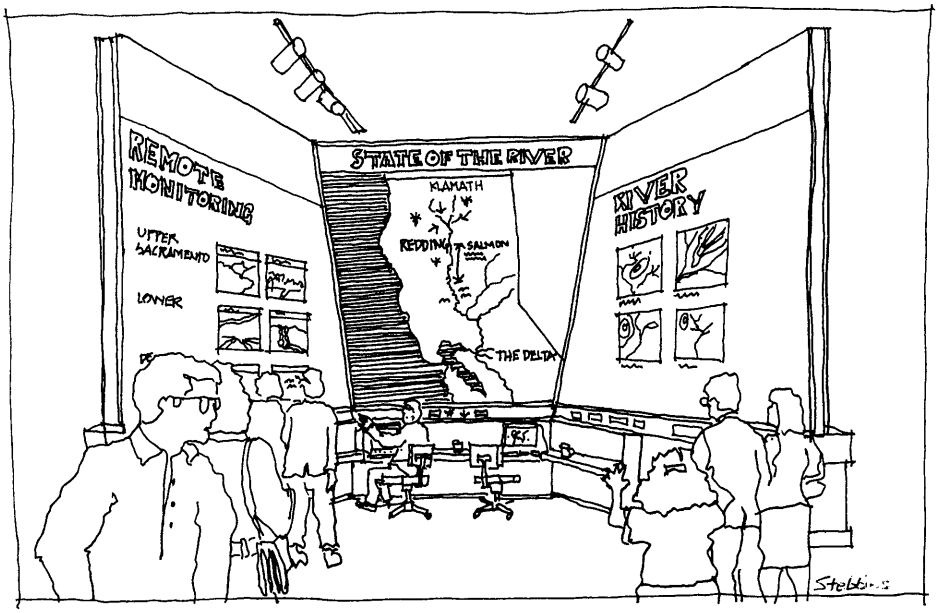
The goals and objectives of the River Information Center are to:

1. Inform the public about the ecological health of the Sacramento River and adjacent riparian habitat.

2. Serve as a clearinghouse and repository for public access to information on the Sacramento River.

3. Independently monitor and evaluate results of fish and wildlife restoration activities and programs.

4. Describe and report on the present state of the river.




*State of the River Room*

*The Sacramento River is depicted on a large interactive electronic map that flashes "hot spots" where important current events or developments are occuring. This exhibit is supported by laser disc and other state of the art mass media technology, working as a sort of CNN of the Sacramento River.*

*An interactive timeline exhibit shows the past, present and future states of the river. The public sees what is happening at key locations with dam releases, river flows, water temperatures, diversions, pollution content, and the effects of these manmade factors on the life stages of each of the five salmon and steelhead runs in the river at that time.*

*Special attention is given to depicting the fishery and riparian habitat restoration work underway as a result of federal legislation. Periodic updates chart progress toward meeting the restoration program's goals.*

5. Project and report possible future states of the river.

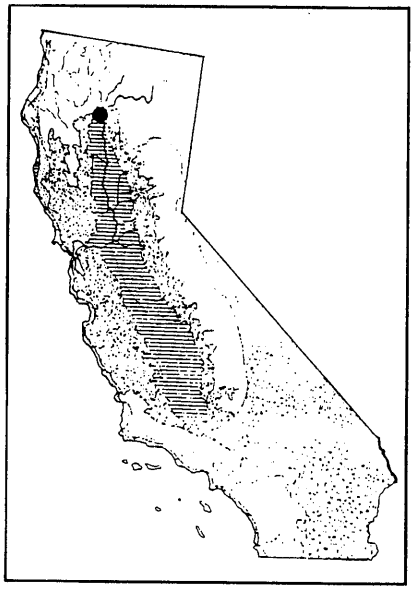
6. Function as an integral part of the River Museum and Science Center at Turtle Bay, Redding.

7. Advise the River Museum and aquarium to ensure accuracy and timeliness of exhibits, outreach, and other programs.

8. In conjunction with the aquarium, provide the opportunity for biological research.

9. Develop and make available a PC compatible temperature modeling system for the Sacramento River, permitting independent monitoring of river temperature models to ensure optimal conditions for Sacramento River fisheries.

10. Assist and support restoration activities and programs.



*By virtue of its location at the bulls-eye of Sacramento River salmon spawning habitat, Redding is is the ideal location for a fishery information and monitoring center.*

Shasta Natural Science Association is starting up a 3-year program in which the River Information Center will monitor the cleanup of heavy metals draining from the Iron Mountain Mine Superfund site. This problem is described on page two of this report. A grant which is currently in the process of being approved by the U.S. Environmental Protection Agency provides for contracting with technical experts and educating the public about progress with remedial action at the mine.

Shasta Natural Science Association is also currently seeking an appropriation of restoration trust funds as authorized by the Central Valley Project Improvement Act of 1992. The Act sets up a 10-year Central Valley fish and wildlife restoration program. It further requires the Secretary of the Interior to "establish, in cooperation with independent entities and the State of California, a comprehensive assessment program to monitor fish and wildlife resources in the Central Valley to assess the biological results and effectiveness of actions implemented pursuant to (the Act)." The Sacramento River Information Center will ensure the effectiveness of these assessment and restoration programs by fulfilling its purpose to serve as an independent, public-interest "watch dog".