DRAINAGE WITHOUT A DRAIN

TOWARD A PERMANENT, RESPONSIBLE SOLUTION TO THE AGRICULTURAL DRAINAGE PROBLEM IN THE SAN JOAQUIN VALLEY

This Briefing Book was developed by a coalition of environmental groups and local agencies downstream of the San Joaquin Valley, including:

The Bay Institute
Contra Costa County
Contra Costa County Water Agency
Contra Costa Water District
Environmental Defense

Printed January 2003

COVER PHOTO: Photos by USDA, Gerald and Buff Corsi © California Academy of Sciences, The Nature Conservancy, CCC Department of Agriculture, and Patricia Matthews.

EXECUTIVE SUMMARY

Agricultural drainage problems in California's San Joaquin Valley have been a threat to the environment and to agriculture for at least the last forty years. Though some improvements have been made, inaction - not progress - has been the most characteristic result of efforts to deal with the problem. A recent federal appeals court ruling has focused the debate by establishing that there is no legal mandate to build the San Luis Drain and granting the federal government discretion to propose the best means of providing drainage service. This Briefing Book explores opportunities to break the decades-old political logjam and proposes a strategy for making long-needed progress on the agricultural drainage problem in the San Joaquin Valley.

ORIGINS OF THE DRAINAGE PROBLEM: The history of the agricultural drainage problem in the San Joaquin Valley is long, complicated, and controversial, but may be roughly summarized as follows:

- The groundwater problems in the western San Joaquin Valley were forecast and planned for - the environmental consequences were not.
- Death and deformation of animals at the Kesterson National Wildlife Refuge revealed the danger of selenium bioaccumulation and led to the closure of the partially constructed San Luis Drain.
- Lawsuits have dominated the implementation of drainage policy since the disaster at Kesterson. Though individual farmers and districts have developed and tested new tools to manage drainage, little progress has been made on addressing the drainage problem in a comprehensive way.

BREAKING THE IMPASSE: After more than 30 years of conflict over an ill-conceived proposal to build a drain that discharges to the Delta, the debate should be refocused on the key public policy question: What is the best way to quickly and efficiently address the drainage problem in the San Joaquin Valley? In this Briefing Book, we suggest initial steps and a process by which to resolve this difficult problem. The following principles underlie our proposals:

1) The debate over how to address the drainage problem has gone on too long, threatening the health of both agriculture and the environment. Consequently, our next steps should be guided by the desire to address as much of the problem as possible as quickly as possible.

2) Exporting pollution from one area to another is unjust and unjustified.

3) Knowledge and tools necessary to solve the drainage problem are available now.

Projections in the state-federal Rainbow Report show that existing, environmentally-benign, in-valley tools, namely improved irrigation, drainage reuse, and land retirement, are adequate to address more than 90% of the drainage problem waters in the Westlands area. Improved irrigation also results in increased productivity and long-term cost savings for farmers.

BUILD ON LOCAL PROGRESS: The final report of the San Joaquin Valley Drainage Program (1990), known as the "Rainbow Report," was produced jointly by California State and US agencies through a broad-based stakeholder process. The Report provides a pragmatic blueprint for addressing the drainage problem. These detailed technical and policy recommendations are based on the premise that "…management logically begins in the valley with a broadly shared effort to reduce the amount of drainage water, to place the remaining water under control, and to contain and isolate toxicants such as selenium." Technological advances could further increase the effectiveness of these tools and address an even larger portion of the drainage problem. While the Rainbow Report can and should be updated periodically, its findings have been validated by ad hoc implementation of key techniques. More comprehensive implementation has not been realized.

Innovative farmers and irrigation districts have independently implemented tools recommended in the Rainbow Report and have added their own new techniques. Two noteworthy examples include:

- The Grassland Bypass Project: Farmers in this area have developed institutions to coordinate drainage management within a 100,000-acre area and to meet selenium load limits. The farmers have pioneered the use of economic incentives to promote effective and economical technologies to reduce, manage, and treat drainage.
- Red Rock Ranch: The owner of this farm is developing a method for sequentially reusing drainage on marketable crops to eventually reduce salts to a solid. Additional refinements are needed to avoid harm to birds, but the approach offers inherent protections that are not available with evaporation ponds.

Tools described in the Rainbow Report and adapted by local farmers should be applied to other areas and implemented comprehensively. However, individual farmers cannot implement all of the Rainbow Report's tools alone. For instance, though there is now widespread support to retire the most severely impaired lands, this critical element of a drainage solution is generally best accomplished with the participation of government agencies or the cooperation of water districts. Increasingly, retirement of drainage impaired lands is being explored as an important part of the overall solution. The potential benefits of retiring these lands for managing drainage are enormous.

OUR RECOMMENDATION: We recommend a coordinated, phased approach to alleviating the drainage problem that is locally managed, flexibly applied, and not limited to one-size-fits-all prescriptions. The overall framework we propose, the drainage Four R's, is summarized below.

- **REDUCE** the volume of drainage problem water.
- **REUSE/MANAGE** drainage within the region where it is produced.
- **RETIRE** lands with significant drainage impairment by purchasing lands from willing sellers, while assuring environmentally sound management of retired lands.

While these proven economical tools are implemented more widely, techniques should be studied and developed to:

- **RECLAIM** solid salts through treatment, bird-safe solar ponds, and on-farm methods.

As we apply existing tools to address more than 90% of the drainage problem, technical and policy review should be initiated of methods for reclaiming salts to address the remainder of the drainage problem economically and in an environmentally-responsible manner.

The drainage problem can be solved effectively and affordably starting right now without building environmentally damaging disposal facilities. While proven techniques are implemented comprehensively, new technologies, management measures, and financial incentives can be developed to address the small portion of the drainage problem that cannot be solved immediately.

DRAINAGE WITHOUT A DRAIN

TOWARD A PERMANENT, RESPONSIBLE SOLUTION TO THE AGRICULTURAL DRAINAGE PROBLEM IN THE SAN JOAQUIN VALLEY

This briefing book was developed by a coalition of environmental groups and local agencies downstream of the San Joaquin Valley, including:

The Bay Institute
Contra Costa County
Contra Costa County Water Agency
Contra Costa Water District
Environmental Defense

I. The Agricultural Drainage Problem in the San Joaquin Valley

What is the Drainage Problem?

For Farmers: The problem is the threat of waterlogged, nonproductive fields.

- Semi-permeable layers of clay underlie several hundred thousand acres of intensively irrigated land on the arid west side of the San Joaquin Valley.

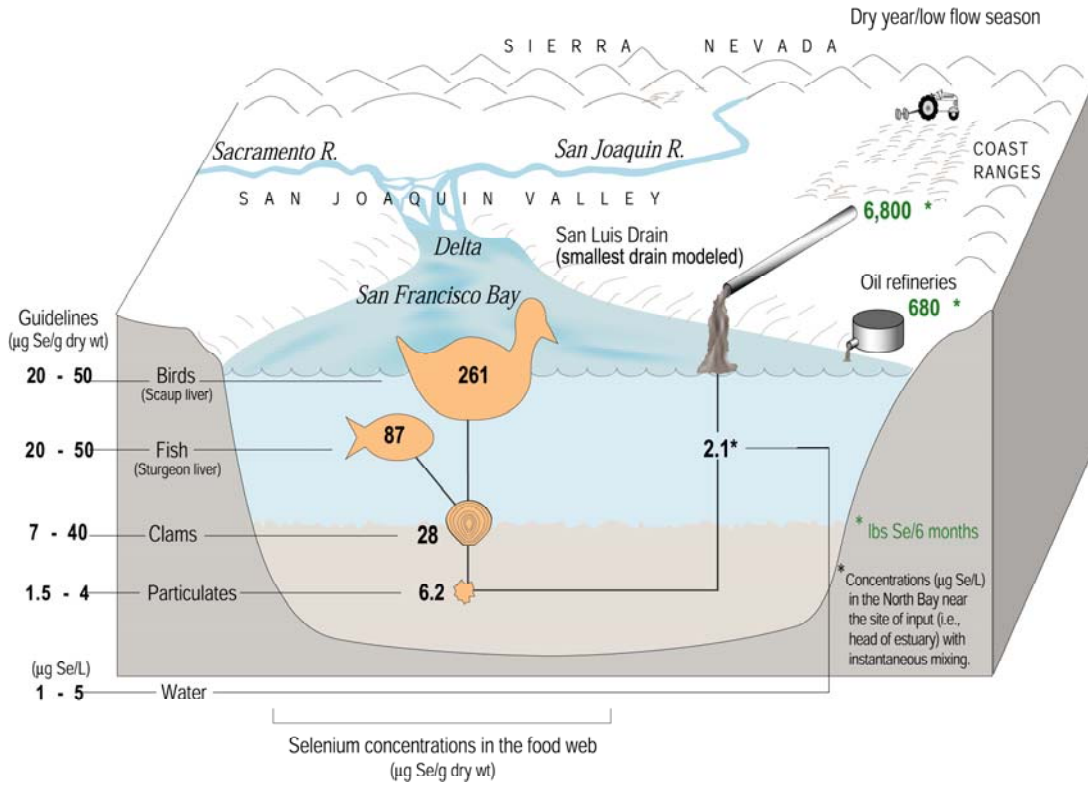
- Irrigation water not absorbed by plants seeps down through the soil until it reaches the clay layers. After years of intensive irrigation, this shallow ground water can rise to the level of the crop root zone, water-logging the roots, over-exposing plants to salts, and crippling productivity.

- Many farms on the Westside have underground tile drains and pump systems to remove the problem groundwater from their property before it reaches damaging levels; others don't have tile drains now, but want them installed. The largely unanswered question is: Where should the water go once it is pumped from the ground?

For the Environment: The problem is that agricultural drainage contains an array of substances harmful to people, fish, and wildlife.

- Soils in the Westside contain high concentrations of selenium, a naturally occurring element toxic to humans and wildlife at trace concentrations. When these soils are irrigated, selenium and other elements are concentrated in the drainage water. Selenium concentrations as high as 7400 parts per billion (ppb) have been measured in subsurface drainage from the Westside.

FIGURE 1: SELENIUM BIOMAGNIFICATION FORECAST FOR THE SAN FRANCISCO BAY-DELTA



This figure illustrates how rapidly selenium biomagnifies in the food web. Even the smallest drain modeled in the USGS study would threaten fish and birds, and it would trigger human health advisories against eating them.
Based on USGS Open-File Report 00-416, Forecasting Selenium Discharges to the SF Bay-Delta Estuary: Ecological Effects of Proposed San Luis Drain Extension, by Samuel N. Luoma and Theresa S. Presser, see URLs: http://sfbay.wr.usgs.gov/access/bioavail/no_bay/ and http://pubs.water.usgs.gov/ofr00-416/

The federal standard for selenium in surface waters is 5 ppb. The criterion for protecting aquatic wildlife is 2 ppb.

- Selenium bioaccumulates in the food chain. As animals consume plants or other animals, they ingest and retain what they eat. A recent study by the U.S. Geological Survey modeled selenium biomagnification in the San Francisco Estuary, predicting impacts to top predators even when selenium concentrations in the water were far below the 5 parts per billion standard (see Figure 1, page 1).

- Selenium is causing problems today even though most of the Westside is not draining to the river or the Delta. Selenium levels in the San Joaquin River system regularly exceed water quality objectives, forcing farmers to aggressively curtail existing discharges. Selenium has also been a problem in larger water bodies with higher dilution rates.

- The California Department of Health Services has maintained a health advisory on the consumption of diving ducks from parts of the Bay since 1986 due to dangerous selenium exposure. Both oil refineries and agriculture contribute to selenium problems in the Bay.

- Agricultural drainage is high in salts and substantially aggravates the salinity problem in the San Joaquin River and Delta. Overall water quality in the Delta is a major concern as it is a source of drinking water for about 2/3 of California residents.

- Boron, molybdenum, pesticides, and fertilizer residue in drainage water are also potential threats to water quality.

For the State and Federal Governments: The problem is how best to fulfill their missions to support agriculture and protect the environment.

Panoche Water District: Discharge of agricultural drainage from a tile drain to an irrigation canal. Photo: Susan Austin

ORIGINS OF THE DRAINAGE PROBLEM

The history of the drainage problem is long, complicated, and controversial (see Figure 2, page 3).

The Westside's groundwater problems were forecast and planned for - the environmental consequences were not.

The existence of the Corcoran clay layers and the threats posed to crops by elevated groundwater levels were well known by the late 1950s. The San Luis Act of 1960 reflected this understanding. The Act provided for construction of an interceptor drain, that came to be called the San Luis Drain, as part of a package of irrigation canals and reservoirs. Subsequent planning for the Drain identified Chipps Island, near the confluence of the Sacramento and San Joaquin Rivers, and just offshore of the cities of Antioch and Pittsburg, as the intended discharge location. Contra Costa Water District has a drinking water intake at the same location and has been extremely concerned about the public health impacts of this proposed discharge.

The federal government began construction of a middle section of the San Luis Drain in the Westlands area in 1968. Construction halted after 81 miles of the drain had been built, 107 miles short of completion. Serious economic and environmental concerns fac-

tored into the decision to halt construction of the project.

The Disaster at Kesterson National Wildlife Refuge

When work stopped, the San Luis Drain had been constructed as far north as the site of the planned Kesterson Regulating Reservoir. To make use of what had been built, the regulating reservoir was designated as a terminal reservoir and assigned a secondary role as a national wildlife refuge. Drainage from a limited area of the San Luis Unit began to flow into the multi-use system in 1981.

In 1982, biologists noticed an alarming number of dead and deformed birds within the refuge. Fish in the reservoir were tested and found to have the highest tissue concentrations of selenium ever recorded. Biologists began to suspect this relatively unknown agricultural drainage constituent was the culprit. The ecological tragedy worsened over the next few years, capturing the attention of the national media.

Sixty Minutes aired a segment on the debacle in March of 1985. Five days later, advised that federal officials could be prosecuted under the Migratory Bird Treaty Act, the Secretary of the Interior ordered the Drain closed.

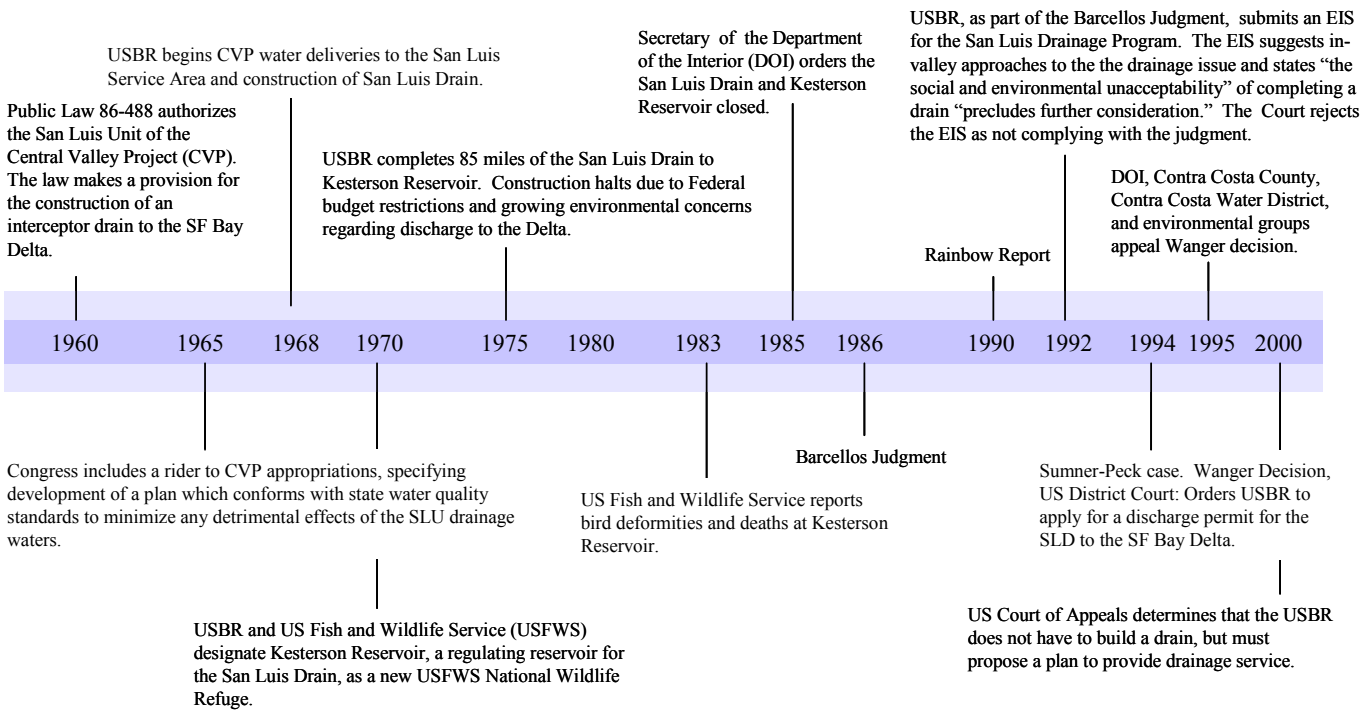
This episode has had a profound and lasting impact, awakening the state and the nation to the perils hidden in agricultural drainage water.

Kesterson bird deformity, Photo by H. M. Ohlendorf, USFWS, 1983

20 Years of Lawsuits and Studies

Since the disaster at Kesterson and the closure of the Drain, lawsuits have dominated the debate on how to dispose of the drainage. Farmers in the San Luis Unit sued the federal government for not providing a drain, and in a 1986 ruling, commonly referred to as the Barcellos Judgment, a federal judge directed the U.S. Bureau of Reclamation (USBR) to develop and implement a drainage plan.

FIGURE 2: TIMELINE OF SAN LUIS DRAIN CONTROVERSY



EXPORTING DRAINAGE TO THE SACRAMENTO-SAN JOAQUIN ESTUARY: AN OUTDATED PROPOSAL WITH UNACCEPTABLE CONSEQUENCES

Threatens a Crucial Ecosystem

- The Sacramento-San Joaquin Delta is the largest estuary on the West Coast. Its huge freshwater-salt water mixing zone and great diversity of water and wetland habitats are a unique biological engine supporting a wide variety of plants and wildlife, including a large number of threatened and endangered species.
- A study by the U.S. Geological Survey of the impacts of the proposed San Luis Drain predicts substantial harm to the food web from increased discharge of selenium to the Bay-Delta. The study also predicts degradation even when selenium concentrations are well below existing legal standards, a prediction that is substantiated by current monitoring. Several species of birds in the estuary are already impaired by selenium though refineries are the only significant source at present and ambient selenium concentrations are low relative to the nationwide water quality standard.

Clapper Rail, Photo: USGS

Impacts to the Largest Drinking Water Source in the State

- Drinking water for 2/3 of California residents comes from the Delta. The quality of this water is already of concern; discharge of millions of gallons of toxic, salt-laden drain water near Antioch or the Benicia Bridge -- within a few miles of drinking water intakes -- would have severe consequences.

Photo: USGS

Undermines Taxpayer Investment in the Bay-Delta

- Largely to reduce conflicts between a collapsing ecosystem and agricultural water users, state and federal taxpayers are spending billions of dollars to restore the Bay-Delta environment and to improve water quality. Constructing a drain would undermine these efforts and waste huge past and future investments.

S.F. Bay Delta, Photo: USGS

Threatens Human Health

- Health advisories are already in effect in portions of the Bay-Delta for human consumption of diving ducks. Increased pollution would aggravate the health threat and harm the hunting and fishing industries.

Photo: CA Department of Fish and Game

In response, the Bureau released a draft plan in 1992 that did not include a drain to the Delta and considered only limited future discharge to the San Joaquin River, all from sources already discharging to the River. The federal court subsequently invalidated the draft plan as inconsistent with the Barcellos Judgment.

Farmers then brought a separate suit, commonly referred to as the Sumner-Peck case. In an early ruling in this case in 1994, Judge Oliver Wanger of the U.S. District Court found that the San Luis Act required, not authorized, the Bureau to construct the San Luis Drain. He further found that federal environmental statutes such as the Migratory Bird Treaty Act did not automatically preclude such construction and ordered the Bureau to apply to the State Water Resources Control Board for a discharge permit for the San Luis Drain.

The U.S. Department of Interior (DOI) and many of the organizations that collaborated on this Briefing Book appealed Judge Wanger's ruling. **In February of 2000, the 9th Circuit Court of Appeals overturned the District Court in part, ruling that the DOI has no obligation to build the Drain.** They left the matter of how to provide drainage service up to the discretion of the U.S. Bureau of Reclamation and remanded the case back to Judge Wanger.

BREAKING THE IMPASSE

Unfortunately, the Bureau's court-supervised planning for providing drainage service has marginalized or ignored such essential drainage tools as source control, on-farm reuse, and land retirement, relying instead on constructing either an out-of-valley drain or an extensive in-valley complex of evaporation ponds.

After more than 30 years of conflict over an ill-conceived proposal to build a drain that discharges to the Delta, it is time to refocus the debate on one overriding question:

What is the best way to address the drainage problem in the San Joaquin Valley?

This Briefing Book provides suggestions for answering this question and developing a comprehensive solution. The following principles underlie our proposals:

1) The debate over what to do about the drainage problem has gone on too long, threatening both agriculture and the environment. Our next steps should be guided by the desire to address as much of the drainage problem as possible as quickly as possible.

2) Exporting pollution from one area to another is unjust and unjustified.

3) Much of the knowledge and many of the tools necessary to solve the drainage problem are available now.

Common Snipe, San Luis Wildlife Refuge
Photo: Gary Zahm, USFWS 1999

II. Agricultural Drainage Can Be Managed Responsibly

Despite the conflict over drains and drainage, individual farmers, some irrigation districts, and the state and federal governments have independently made progress toward solving this problem. This section summarizes some of the key innovations upon which a more complete resolution of the drainage problem can be built.

The Rainbow Report

Officially known as "A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley," the Rainbow Report was completed in 1990 by the San Joaquin Valley Drainage Program, a joint project of the State of California and U.S. Department of Interior.

The Report is both a technical document and a policy document. It presents the conclusions of a $50 million effort to define the nature of the drainage problem and to explore new and practical methods for controlling and reducing drainage. The report was prepared through an extensive public involvement process involving all concerned stakeholders.

Initiated in response to the disaster at Kesterson and the closure of the Drain, the Rainbow Report was a landmark in drainage policy, shifting the planning emphasis away from export drains and toward in-valley solutions.

Key Findings

The final report reflected a broad consensus among all parties. Some of the key contributions and findings of the Rainbow Report were:

- A technical analysis of the potential effectiveness of a range of drainage management strategies not widely practiced at that time, including: irrigation improvements, land retirement, and application of drainage water on salt-tolerant plants;

- Specific recommendations for each sub-area of the Westside detailing which suite of strategies should be employed where and predicting the net contribution of each management technique;

- Baseline information and maps documenting the extent of the groundwater problem in each region, including the spatial variation in the concentration of selenium and other constituents in the groundwater;

- A conclusion that agricultural drainage problems on the Westside could be managed for at least fifty years without export of drainage.

"...it is...generally agreed that the drainage problem is manageable and that this management logically begins in the valley with a broadly shared effort to reduce the amount of drainage water, to place the remaining water under control, and to contain and isolate toxicants such as selenium. Such actions would largely correct present problems of water logging of farmlands and could greatly reduce adverse impacts on fish and wildlife.

The in-valley actions recommended in the plan would also be necessary for any eventual export of salt from the San Joaquin Valley. The recommended actions would provide a regional drainage infrastructure that now exists only in scattered pieces. If the plan proposed here is implemented, a salt export decision need not be made for several decades."

- Excerpt from the Rainbow Report

Implementation of the Rainbow Report

Some of the Rainbow Report's recommendations have been implemented - though not in the way the plan's authors would have expected. Individual farmers and irrigation districts have been the primary actors.

Throughout the west side of the San Joaquin Valley, many farms already rely on recommended actions from the Rainbow Report to reduce and manage their drainage problem. Some farmers have even advanced drainage management technology beyond the Rainbow Report, adding refinements and developing new and innovative techniques.

There has also been a centralized, government-led effort to implement the Rainbow Report, an effort called the San Joaquin Valley Drainage Implementation Program. This effort has yielded technical advances and some institutional tools for drainage management.

CASE STUDIES

The Grassland Bypass Project and Red Rock Ranch drainage program are examples of successful decentralized implementation and extension of the Rainbow Report recommendations.

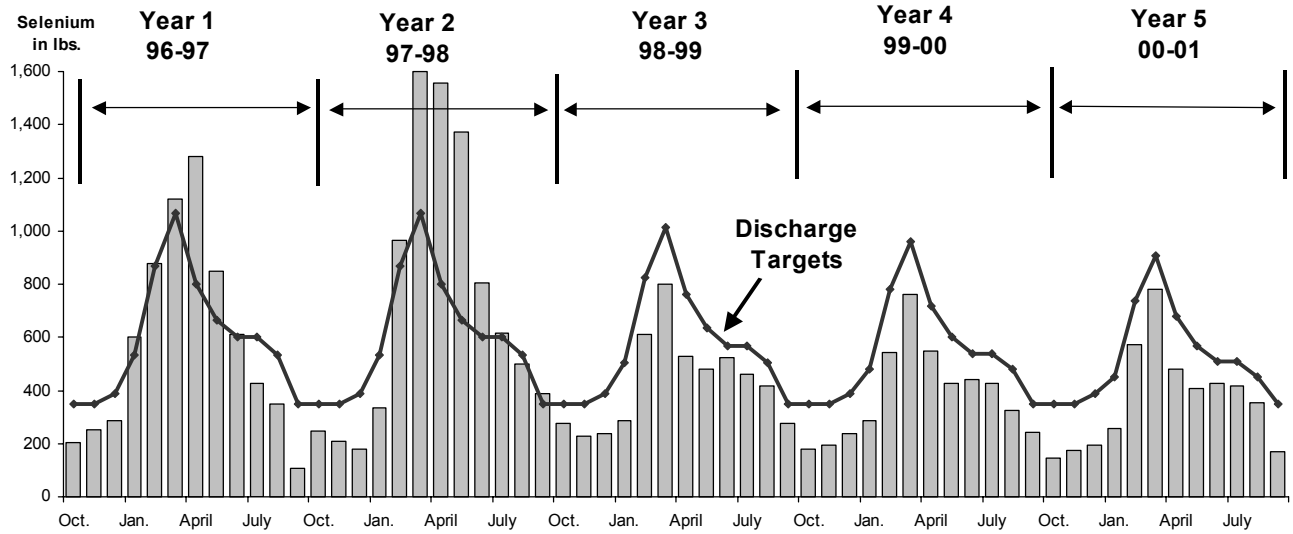
Grassland Bypass Project

The Grassland drainers within the San Joaquin Valley have made extensive progress in controlling and reducing its drainage problem.

This 100,000-acre area includes 7 irrigation districts and is unique among Westside agricultural areas in that it has historically drained into the San Joaquin River. Until recently, Grassland drainage flowed through irrigation canals that also supplied water to an array of national wildlife refuges and duck clubs before discharging to the river.

In 1996, in order to bypass the extensive wetland areas, Grassland's drainage was rerouted through an existing segment of the San Luis Drain before resuming its historic route to the River. In exchange for the right to make use of the Drain, farmers in the Grassland area were required to make a number of commitments to the environment, including a commitment to reduce selenium discharges by 15% over 5 years. As shown in Figure 3, Grassland area farmers have reduced

FIGURE 3: GRASSLAND AREA MONTHLY SELENIUM DISCHARGES



* February - June 1998 (Year 2) discharges were declared by the Grassland Bypass Oversight Committee as "unforeseeable and uncontrollable", due to record-breaking rainfall in the El Nino year.

Data Sources: San Francisco Estuary Institute Monthly Data Reports. All data are selenium loads at Station B.

their discharges as promised.

The plan to continue this plumbing arrangement beyond 2001 requires farmers to reduce drainage by as much as 85% from historic levels to meet selenium water quality objectives for the San Joaquin River. A compliance schedule for this reduction has been incorporated in a waste discharge requirement (state permit) adopted by the Central Valley Regional Water Quality Control Board. The new plan will also begin to reduce salt loads from historic levels.

To meet these requirements, the farmers and water districts have developed a number of innovative strategies for reducing and controlling their drainage problem, including:

- Forming a regional drainage entity to manage drainage flows and carry out environmental commitments made in order to use the Drain.
- Using economic incentives such as tiered water pricing to encourage farmers to use less water and produce less drainage.
- Using economic incentives such as tradable selenium discharge permits to optimize the regional cost-effectiveness of drainage management.
- Monitoring selenium concentrations on a farm-by-farm basis. Such monitoring results in individual farm accountability for drainage management and allows more efficient implementation of control efforts.
- Installing drip systems and other irrigation improvements to maximize efficiency and minimize drainage.
- Recycling surface run-off and subsurface drainage for irrigation. Recycling of surface run-off is required for farmers; Panoche Water District has installed a regional recycling facility.
- Purchasing lands with severe drainage problems for use as regional re-use facilities. One 4,000-acre facility is planted with salt tolerant crops and is irrigated with subsurface drainage from nearby farms.

Turlock Fruit Company drip irrigation filters
Photo: Susan Austin

Red Rock Ranch

This 640-acre farm within the Westlands Water District is a model of local drainage innovation. The basic premise of Red Rock's pioneering approach is to repeatedly use drainage water on increasingly salt tolerant crops. Additional refinements are needed to avoid harm to birds, but the approach offers some inherent protections not available with evaporation ponds. Here's a brief overview of the process:

Step 1: Irrigation water is applied to salt-intolerant crops such as vegetables. These high-value commercial crops cover almost 75% of the farm.

Step 2: Surface and subsurface drainage water from these planted areas is collected and used to grow salt-tolerant commercial crops such as cotton and alfalfa. These crops cover about 20% of the farm.

Step 3: The resulting drainage is next applied to salt-tolerant grasses covering about 2% of the farm.

Step 4: Halophytes like saltgrass and iodine bush consume drainage resulting from Step 3. These halophytes occupy less than 1% of the farm.

Step 5: Sprinklers spray the remaining brines into a solar evaporator, a flat area with tile drains underneath occupying 0.2% of the farm. The sprinklers are timed to avoid ponding that might attract and harm wildlife. This step eliminates all liquid effluent. Methods for commercial re-

use of the remaining salts are being explored.

The creative solution developed at Red Rock has coined a new name and acronym, Integrated On-Farm Drainage Management (IFDM).

The Red Rock Ranch IFDM system demonstrates an efficient and economical method of reusing drainage water. The IFDM system:

- makes productive use of about 90% of the drainage water;

- reduces irrigation needs by 18%, saving water and money for other uses;

- reduces the farm's annual effluent to 0.02 acre feet per acre of land irrigated with Central Valley Project water;

- pays for itself in 2 to 3 years, in part because the capital costs of installing the plumbing and other components of this system are relatively low, about $500 per acre; and

- increases net farm crop income by improving drainage conditions. (Red Rock's production increased by $280 per acre per year.)

Demonstration of a drainage recycling system in the Panoche Water District
Photo: Susan Austin

Two notes of caution regarding this approach:

1) The initial engineering and routine use of the solar evaporation must be carefully managed to avoid creating ponds that attract and poison wildlife.

2) The salts remaining after the final evaporation are currently considered waste, and research is needed to develop marketable products from this salt residue.

III. The Environmentally Preferred Solution

Given the clear need to act now, and based on the lessons of scientific research and recent experience, we offer the following observation: **More than 90% of the drainage problem in the San Joaquin Valley can be solved in 5 to 10 years using affordable, environmentally sound management tools.**

To seize this opportunity, we recommend a coordinated, phased approach to the drainage problem that is locally managed, flexibly applied, and not limited to one-size-fits-all prescriptions.

Our Recommendation: The Four R's

Four categories of actions hold the key to rapid progress: Reduce, Re-use, Retire and Reclaim. Each strategy is described in further detail in this section.

Reduce the volume of drainage problem water

A range of techniques is available to reduce drainage effluent before it becomes a problem. These include: installation of drip irrigation systems (or any alternative, similarly efficient technology), lining water delivery channels, reduced preseason watering, etc. These and other practices are underway in the Grassland area. In addition, land may be fallowed during dry years; operating costs can be defrayed by selling conserved irrigation water. Based on the analysis in the Rainbow Report, such drainage reduction techniques could collectively address about 36% of the drainage problem water in the Westlands area (see Table 1, page 10).

Reuse/Manage drainage within the region that it is produced

Reuse and management of drainage water on farms and within districts can minimize problem water and maximize efficiency. Reuse includes the strategies such as the Red Rock Ranch system of sequential reuse of drainage on increasingly salt-tolerant crops, limited recycling of drainage for irrigation, use of drainage for dust control (a Grassland innovation), and recycling of surface water runoff for use on ordinary crops. Such tools could address approximately 36% of the drainage problem water.

Reduction and Reuse strategies to manage drainage have the following advantages:

- **Proven technology**
  Tested, successful strategies can be directly exported to other areas without delay or uncertainty.

- **Economically viable**
  Many strategies, when imple-

Table 1: Effectiveness of Environmentally-Sound Drainage Options
Projection of amount of problem drainage water (acre feet) that can be effectively eliminated with environmentally sound drainage options.
Source: Rainbow Report, Table 32, p. 146

Environmentally-Sound Drainage Options	Year 2000 as projected in 1990	Year 2040 as projected in 1990
Source Control	29,400	55,800
Drainage Reuse	30,000	61,000
Land Retirement	13,600	24,800
Total Environmentally-Sound Drainage Options	73,000	141,600
Overall Drainage Reduction Target	81,200	153,200
Percentage of Target	**90%**	**92%**

mented, will pay for themselves quickly by increasing yields and reducing water costs. The Red Rock Ranch system paid for its own construction in just over two years, not including an 18% savings in irrigation water.

Solves more than 90 % of problem

As documented in Table 1, the Rainbow Report predicts that drainage reduction and drainage management can collectively address about 90% or more of the drainage problem. Practical experience at Red Rock Ranch has validated and exceeded these Rainbow Report predictions.

Taking these steps will allow adequate time for implementation of land retirement as well as research and development of a complementary long-term strategy to address 100% of the problem long in to the future.

Decentralized, locally controlled

Experience in the Grasslands area demonstrates that economic incentives and performance–based requirements induce farmers and districts to produce less drainage and manage it more effectively. This approach has spurred innovation in the area.

Retire lands with severe drainage impairment.

Voluntary retirement of lands with significant drainage impairment is an important step toward solving the drainage problem. Some areas are simply too severely impaired to irrigate. They disproportionately contribute to the degradation of water quality in both the aquifer and downstream lands.

Where land is retired by voluntary arrangement, and without using public funds, care should be taken to assure that the water acquired from the retired lands is not applied so as to exacerbate drainage problems elsewhere.

Land retirement can be an attractive alternative to drainage reduction and management, as well as salt reclamation, when:

- Lands have significant drainage impairment;
- Selenium or other toxic substances are particularly high;
- Retired land is managed responsibly and managed to assure that the drainage problem is corrected, not transplanted;
- Retired land could have significant value as habitat if it were restored; and/or
- Retirement of land frees up water for use in other water quality, conservation or restoration projects.

Passage of the Central Valley Project Improvement Act in 1992 created a funded program for buying, and retiring agricultural lands with drainage impairments and their associated water rights. However this program has only initiated a few pilot projects and needs to be more forcefully pursued by the Department of the Interior. A similar state land retirement program created at the same time also provides a vehicle for retiring drainage impaired lands but needs to be funded by the state legislature.

Interest in land retirement options has been expressed from stakeholders on all sides of the debate.

Both the Rainbow Report and the Central Valley Project Improvement Act demonstrate that land retirement is desirable from both a policy and fiscal perspective. Recently Westlands Water District has acknowledged that as much as 200,000 acres (about a third of the water district) should be retired as part of a drainage solution. This is ten times the amount of land retirement projected in the Rainbow Report.

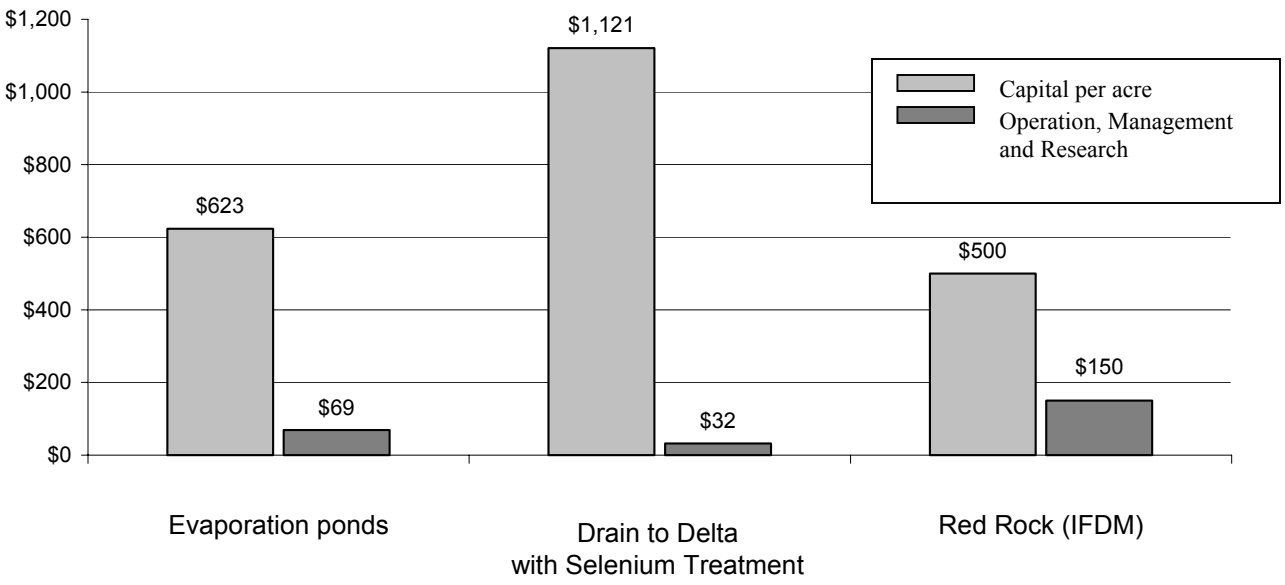
Reclaim Solid Salts

While these proven, economical tools are implemented more widely to control at least 90% of the drainage problem waters, techniques should be studied and developed to reclaim solid salts through treatment, bird-safe/bird-free solar ponds, and on-farm methods.

Reclamation of salts, selenium, and other substances of concern from water is relatively straightforward from a technical point of view. Doing so on a large scale in an affordable and environmentally sound manner is not. Promising methods include treatment technologies being explored in the Panoche Drainage District and in the dry evaporation system operating on Red Rock Ranch.

In contrast, traditional evaporation ponds are highly problematic, as such systems resemble Kesterson Reservoir in function. In these traditional systems, se-

FIGURE 4: PER ACRE COST COMPARISON OF DRAINAGE SERVICE OPTIONS



Sources:
1. San Luis Preliminary Alternatives Report, December 2001, Page ES-6
2. San Luis Preliminary Alternatives Report, December 2001, Page ES-6
3. Salt Utilization Technical CommitteeThe San Joaquin Valley Drainage Implementation Program and The University of California Salinity/Drainage Program, February 1999, Page 19
4. San Luis Preliminary Alternatives Report, December 2001, Appendix B, Page B18-B19

lenium-laden drain water is discharged to, and concentrated in ponds where wildlife impacts are impossible to avoid and expensive to mitigate. Many "ponds" are the size of small lakes. Even with treatment, the question of what to do with the solid remainder is unresolved. For these reasons, many existing ponds have been shut down by the Central Valley Regional Water Quality Control Board.

The state and federal governments could substantially aid resolution of the drainage problem not only by continuing to fund development of treatment technologies, but also by funding research and development of commercial uses of reclaimed salt.

The Four R's approach is cost-effective

These four management strategies: Reduce, Reuse, Retire and Reclaim form the core of the most cost-effective and environmentally-sound approach to addressing the drainage problem. Figure 4 compares the costs of one example of the Four R's approach with traditional evaporation ponds and a drain to the Delta. Because our approach utilizes proven on-farm technologies, it is significantly cheaper and faster to implement than the alternatives.

PLANS INTO ACTION

We support an overall drainage service and management plan that includes multiple approaches proceeding on parallel tracks. While water reduction and reuse technologies can be employed immediately, land retirement and reclamation are phased strategies.

More specifically, we propose that the following actions be taken now:

1) **The federal and state governments should support more rapid implementation of drainage reduction and drainage reuse/ management tools.** Significant public funds have already been committed to help support the implementation of these techniques (see Table 5, page 13). Access to public funds does not relieve farmers and districts of the obligation to pay for measures that directly benefit them, but a clearer state-federal policy initiative, increased technical support and continued funding with appropriate local cost-sharing are needed to speed the adoption of these techniques and move us closer to a solution to the drainage problem. While these techniques may not eliminate the drainage problem entirely, the Rainbow Report predicts they are sufficient to control the entire drainage problem for at least fifty years.

TABLE 5: EXISTING FUNDS POTENTIALLY AVAILABLE TO HELP SUPPORT WESTSIDE DRAINAGE REDUCTION, REUSE, RETIREMENT, AND RECLAMATION EFFORTS

Though farmers are responsible for managing their water use and drainage, substantial public funds have already been allocated to assist with drainage management.

State Funds	**Total Authorization***
2000 The Safe Drinking Water, Clean Water, Watershed Protection, and Flood Prevention Act (California Water Bond)	
Nonpoint Source Pollution Control Program	$100,000,000
Water Conservation Program (Agricultural Water Conservation)	$35,000,000
Bay-Delta Multi-purpose Management Program	$250,000,000
Water Recycling Program	$105,000,000
Federal Funds	**Approximate Annual Appropriations***
Central Valley Project Improvement Act	
Section 3408(h), Land Retirement	$3,000,000
USDA, Conservation Reserve Program	
Federal Conservation Reserve Program	$200,000,000 - $300,000,000 continually appropriated over several years
USDA, Natural Resources Conservation Service	
Environmental Quality Incentives Program	$6,000,000
Watershed Protection and Flood Prevention Program	$5,000,000
USDA, Farm Security and Rural Investment	
Section 3201	$9,000,000,000 through 2007
USEPA , Clean Water Act	
Clean Water State Revolving Fund	Portion of $152,000,000 - $268,000,000
USEPA, SWRCB, Clean Water Act	
Nonpoint Source Implementation Program	$5,600,000

* Not all of the money authorized and appropriated is available for addressing the problem drainage from the San Joaquin Valley.

Further, rather than prescribe specific actions for specific farms, it is more efficient and effective for the state and federal governments to provide a menu of options to farmers and districts. This flexibility is necessary to address the varying needs and problems of impacted farmers should allow farmers to optimize the cost effectiveness of drainage control.

2) Work with willing sellers in the area to initiate an active program to retire the most severely impaired lands. Both the US Congress and California's State legislature have recognized the importance of land retirement by creating new programs to acquire and retire drainage-impaired lands. However, neither the state or federal governments have implemented these programs aggressively.

Worse, recent proposals for substantial land retirement developed during lawsuit settlement negotiations have been linked to controversial provisions opposed by the environmental community.

Outside the courtroom, much of the land that has been retired has been purchased by individual districts. There are many more growers and districts willing to sell drainage-impaired lands at reasonable prices whose associated water supplies could also provide conservation benefits. The only element lacking is political will.

3) Begin immediately to research salt reclamation technology and markets for reclaimed salt products. A proven, responsible, and permitted method for addressing the 10% residual drainage does not exist. With continued research, such a method could exist in 5 to 10 years if the involved parties begin work now on a cooperative process to identify, test, fund, and permit a long-term solution.

TABLE 6: THE ENVIRONMENTALLY PREFERRED ALTERNATIVE VS. THE BUREAU OF RECLAMATION'S PREFERRED ALTERNATIVE

As this Briefing Book went to press, the Bureau of Reclamation released its "San Luis Drainage Feature Re-evaluation Report." This report identified a preferred alternative that includes ultimate construction of 5,063 acres of traditional evaporation ponds. The report does not include the environmentally preferred alternative presented in this Briefing book.

Technique	USBR Alternative	Environmental Alternative	Remarks
Incentives for farmers to produce less drainage	No	Yes	Tiered water pricing and other economic incentives -- such as tradable selenium or salt permits-- have been used successfully to decrease drainage discharges and spur innovation.
Performance requirements that cap drainage amounts	No	Yes	Farmers and districts in the Grasslands area of the San Luis Unit have successfully met their selenium discharge caps for six years.
Improvements in irrigation efficiency by farmers	No*	Yes	Better irrigation systems produce less drainage and require less water from the SF Bay -Delta. Money saved on water purchases defrays the costs of efficiency improvements.
On-farm recycling of surface runoff and drainage	Less	More	Recycling is already mandated in the Grasslands area.
On-farm reuse of drainwater for irrigation of salt tolerant crops	No*	Yes	Reuse has proved profitable for Red Rock Ranch. This farm produces zero drainage discharge.
Fallowing of cropland in dry years, perhaps with sale of conserved water	No*	Yes	Land fallowing during dry years decreases water imports from the SF Bay-Delta and/or allows water to be sold to others
District or regional recycling of drainage	Yes	Yes	Panoche Water District has already installed and successfully used a recycling system. The recycling system helps the district manage drainage discharge amounts and enables it to sell selenium discharge credits.
District or regional re-use facilities	Yes	Yes	Districts in the Grasslands area of the San Luis Unit already manage a 4,000 acre area where salt tolerant crops are irrigated with drainage. We prefer decentralized facilities to centralized, government-managed ones.
Lining water delivery channel	Yes	Yes	Lining of channels helps lower the regional groundwater table, minimize drainage, and decrease water imports from the SF Bay-Delta.
Voluntary land retirement	Less	More	A broad array of farmers and districts supports the concept of purchasing land from willing sellers, then retiring it permanently from irrigated agriculture. Westlands has proposed retiring 200,000 of its acres. Retired land does not actively produce drainage.
Treatment systems that remove selenium	Yes	Yes	Promising experimental systems have been developed by the Panoche Water District and others. Further research and development is required for scale-up.
Traditional evaporation ponds	Yes	No	Evaporation ponds with high selenium concentrations have been closed by regional authorities. Birds attracted to the ponds produce deformed young.
Aggressive product development and market research for reclaimed salt	No	Yes	The federal government should fund an in-house or extramural grant program to develop products from reclaimed salts and provide the market research required for successful sale.

* The Bureau of Reclamation's alternatives presume that the following techniques are not cost-effective and will not be implemented: improvements in irrigation efficiency, on-farm reuse of drainage for salt tolerant crops, and land fallowing. Drainage rates are predicted to be 0.5 - 0.6 a-f/acre/year.

CONCLUSION

The drainage problem in the San Joaquin Valley can be solved effectively and affordably starting right now without building environmentally damaging disposal facilities. While proven techniques are implemented comprehensively, new technologies, management measures, and financial incentives can be developed to address the small portion of the drainage problem that cannot be solved immediately. We recommend immediate actions to quickly address the bulk of the problem and concurrent research toward the development of long-term strategies to address what remains after existing tools have been fully utilized. Let's get started today on a solution that benefits everyone. ♦