



1-1-1996

# Selenium in San Joaquin Valley Agricultural Drainage: A Major Toxic Threat to Fish and Wildlife Inadequately Addressed by the Central Valley Project Improvement Act

Scott M. Rennie

*University of the Pacific; McGeorge School of Law*

Follow this and additional works at: <https://scholarlycommons.pacific.edu/mlr>



Part of the [Law Commons](#)

## Recommended Citation

Scott M. Rennie, *Selenium in San Joaquin Valley Agricultural Drainage: A Major Toxic Threat to Fish and Wildlife Inadequately Addressed by the Central Valley Project Improvement Act*, 27 PAC. L. J. 303 (1996).

Available at: <https://scholarlycommons.pacific.edu/mlr/vol27/iss2/6>

This Comments is brought to you for free and open access by the Journals and Law Reviews at Scholarly Commons. It has been accepted for inclusion in McGeorge Law Review by an authorized editor of Scholarly Commons. For more information, please contact [mgibney@pacific.edu](mailto:mgibney@pacific.edu).

**Selenium in San Joaquin Valley Agricultural Drainage:  
A Major Toxic Threat to Fish and Wildlife Inadequately  
Addressed by the Central Valley Project Improvement  
Act**

Scott M. Rennie\*

TABLE OF CONTENTS

I. INTRODUCTION . . . . . 304

II. HISTORICAL DEVELOPMENT OF AGRICULTURE IN THE CENTRAL VALLEY . . . . . 307

    A. *Transformation of the Central Valley* . . . . . 307

    B. *The Central Valley Project* . . . . . 311

III. THE NATURE OF THE PROBLEM . . . . . 314

    A. *A Stage Set for a Toxic Drainage Problem* . . . . . 314

        1. *Soils of the West Side: Latent Toxins Beneath the Surface* . . . 315

        2. *Clay Beneath the Soil: Buildup of Shallow Ground Water* . . . 316

        3. *Imported Water* . . . . . 317

    B. *Consequences of Irrigating the West Side of the Valley* . . . . . 319

        1. *Toxic Drainage* . . . . . 320

        2. *The Kesterson Disaster* . . . . . 321

    C. *What Is Threatened by the Drainage Problem* . . . . . 322

        1. *Irrigated Agriculture* . . . . . 323

        2. *Ecological Interests* . . . . . 325

IV. INHERENT DIFFICULTIES IN MANAGING THE SELENIUM CONTAMINATION OF AN AQUATIC ENVIRONMENT . . . . . 328

    A. *Bioaccumulative and Toxic Properties of Selenium* . . . . . 328

    B. *Accurately Measuring Selenium Contamination in an Aquatic Environment* . . . . . 330

    C. *The Buildup of Selenium in an Aquatic Ecosystem* . . . . . 331

    D. *Conclusions* . . . . . 332

---

\* A.B. 1990 (*cum laude*), Princeton University; J.D. candidate 1996, University of the Pacific, McGeorge School of Law.

V. THE CENTRAL VALLEY PROJECT IMPROVEMENT ACT . . . . .	334
A. <i>Introduction</i> . . . . .	334
B. <i>A Limited Response to the Drainage Problem</i> . . . . .	335
VI. THE NEED FOR CONGRESSIONAL LEADERSHIP . . . . .	338
A. <i>Introduction</i> . . . . .	338
B. <i>Failures of the Past and the Need to Clarify CVP         Operation Policy</i> . . . . .	340
VII. CONCLUSION . . . . .	345

## I. INTRODUCTION

Selenium is a naturally occurring trace element found in abundance in the soils of the western San Joaquin Valley. Selenium is flushed out of the soil by irrigation and can be highly toxic to fish and wildlife—even at very low levels in water.<sup>1</sup> The toxic problems posed by selenium are very different from other forms of water pollution.<sup>2</sup> Scientific discoveries in the last dozen years reveal that selenium in agricultural drainage<sup>3</sup> can be at least equally harmful to fish and wildlife as extracting too much water from rivers.<sup>4</sup>

Most irrigation water used on west-side San Joaquin Valley lands comes from the Federal Central Valley Project (CVP). The Central Valley Project is one of the largest federal water projects in the country.<sup>5</sup> Originally conceived as a state water project in the early 1900s, the CVP was designed to capture the surplus waters of the Sacramento River Valley that were “wasting into the sea” and transport them to the arid San Joaquin Valley.<sup>6</sup> The imported water was to have a two-fold purpose in the San Joaquin Valley: to provide irrigation water for the

---

1. See *infra* notes 185-98 and accompanying text (summarizing the toxic characteristics of selenium); *infra* notes 79-84 and accompanying text (noting the role of irrigation in liberating from the western valley soils naturally occurring deposits of selenium).

2. See *infra* notes 183-225 and accompanying text (describing the unique contamination problems associated with selenium).

3. Agricultural drainage is a by-product of irrigation. See *infra* notes 79-84, 108-13 and accompanying text (identifying irrigation as the source of drainage).

4. See *infra* notes 183-225 and accompanying text (detailing the unique toxic dangers selenium poses to fish and wildlife and the difficulties associated with controlling selenium contamination).

5. BETTY BRICKSON, WATER EDUCATION FOUNDATION, LAYPERSON'S GUIDE TO THE CENTRAL VALLEY PROJECT 2 (1994).

6. See *infra* notes 46-66 and accompanying text (describing the CVP). See generally Harrison C. Dunning, *Confronting the Environmental Legacy of Irrigation Agriculture in the West: The Case of the Central Valley Project*, 23 ENVTL. L. 943, 946-50 (1993) (summarizing the “putting-water-to-work” ethic).

west side of the valley, and to replace water taken out of the San Joaquin River by irrigation diversions on the east side of the valley.<sup>7</sup>

Although agricultural drainage has always been a smoldering issue in the operation of the CVP, the controversy prior to the mid-1980s centered on the impact of poor drainage conditions on crop productivity, not on the toxic impact to fish and wildlife.<sup>8</sup> The 1983 discovery of dead and deformed birds at Kesterson National Wildlife Refuge, poisoned by selenium in agricultural drainage, forced state and federal agencies to undertake a new assessment of the potential toxic impact of agricultural drainage.<sup>9</sup> Post-Kesterson biological studies suggest selenium contamination of an ecosystem is not abated by diluting the selenium concentration in water.<sup>10</sup> On-going investigations indicate the toxic danger from selenium must be addressed more directly, either by reducing the absolute quantity of selenium in agricultural drainage discharged into aquatic ecosystems or by eliminating the discharge of selenium into aquatic environments altogether.<sup>11</sup>

Addressing the selenium problem should begin with the operation of the Central Valley Project. Because of naturally shallow groundwater, the use of plentiful CVP irrigation water has exacerbated poor drainage conditions on the west side of the San Joaquin Valley.<sup>12</sup> CVP irrigation water has also accelerated the leaching of toxic elements, including selenium, from the west side soils.<sup>13</sup> These toxic elements collect in the shallow ground water and emerge in agricultural drainage, posing a serious threat to fish and wildlife.<sup>14</sup> Legislating new CVP operational policy has the potential to ameliorate a significant portion of the

---

7. See *infra* notes 46-53 and accompanying text (describing the functions and basic operation of the CVP). The CVP's capture and diversion of northern and central California waters out of their natural watershed has had a devastating effect on local environments. See *infra* notes 54-66 and accompanying text (surveying the environmental damage caused by CVP diversions). CVP dams and diversions have depleted many rivers and streams of water, blocked migrating fish, destroyed riparian and wetland habitats, and reduced flows into the Sacramento-San Joaquin Delta, which has contributed to significant salt water intrusion problems. See *infra* notes 56-61.

8. See *infra* notes 67-182 and accompanying text (discussing the problem of agricultural drainage as it affects both farmers and wildlife).

9. See *infra* notes 124-34 and accompanying text (describing the Kesterson disaster). Located in the middle of the San Joaquin Valley, Kesterson utilized agricultural drainage to provide aquatic habitat for migratory birds. *Id.*

10. See *infra* notes 183-225 and accompanying text (discussing the natural mechanisms that cause selenium to accumulate and not flush out of an aquatic system).

11. *Id.*

12. See *infra* notes 79-97 and accompanying text (describing soil and groundwater conditions in the San Joaquin Valley).

13. See *infra* notes 79-115 and accompanying text (discussing the presence of toxic elements in the soil and the effect of irrigation in mobilizing selenium).

14. See *infra* notes 79-115 and accompanying text (summarizing how toxic elements enter the groundwater and emerge in agricultural drainage); *infra* notes 127-37 and accompanying text (describing the impact of selenium laden drainage on Kesterson National Wildlife Refuge); *infra* notes 185-98 and accompanying text (discussing the toxic properties of selenium).

environmental harm wrought by the CVP-induced agricultural drainage. By encouraging more environmentally sound water and land use practices, mitigation is possible without unreasonably hampering the valley's agricultural productivity.<sup>15</sup>

The Central Valley Project Improvement Act (CVPIA)<sup>16</sup> was the first major legislative attempt to promote new CVP policy in order to protect fish and wildlife and correct many of the environmental harms caused by the CVP. Unfortunately, congressional lawmakers failed to forcefully pursue a major element of the problem—the toxic threat posed by agricultural drainage. The environmental reparative measures in the CVPIA concentrate primarily on the damage done to fish and wildlife by dam-encumbered and over-diverted rivers and streams.<sup>17</sup> Dams and water diversions that cause reduced flows and habitat loss are perhaps more visible ills than unseen toxic pollutants in drainage water.

The passage of the CVPIA came after repeated unsuccessful attempts by federal, state, and local entities to agree on a solution to the drainage problem. Further congressional leadership is needed to extricate the Bureau of Reclamation—the federal agency in charge of CVP operations—from conflicting federal water and land use policies, and to facilitate movement toward resolution of the drainage problem. The Federal government is a key source of the problem and must be the leader in the search for a solution.

The problems farmers face from agricultural drainage are well documented and are not meant to be the primary focus of this discussion. Instead, this comment will concentrate on the problems faced by fish and wildlife from agricultural drainage, focusing the discussion on what has been a vaguely acknowledged and poorly addressed problem by CVP reclamation law—selenium in agricultural drainage of the San Joaquin Valley. Part II provides a brief history of agricultural development in the Central Valley and the role the CVP plays in the agricultural drainage problem. Part III explores the nature of the drainage problem as it affects farmer, fish, and wildlife. Part IV examines the unique habitat contamination issues raised by the presence of selenium in the aquatic environments and the difficulties faced in attempting to regulate selenium's toxic effects. Part V analyzes the CVPIA and its limited response to the drainage issue. Part VI identifies the Bureau of Reclamation's three major unsuccessful attempts to solve

---

15. See Dunning, *supra* note 6, at 957 (suggesting that a "safe yield" of the Valley's water resources which balances environmental values with irrigation, municipal, and industrial uses without jeopardizing long-term economic interests is possible).

16. The Central Valley Project Improvement Act is the name given to Title 34 of the Reclamation Projects Authorization and Adjustment Act of 1992, Pub. L. No. 102-575, 106 Stat. 4600 [hereinafter Reclamation Projects Act].

17. See *infra* notes 56-66 and accompanying text (describing the impact of CVP operation on fish and wildlife); *infra* note 230 and accompanying text (highlighting some of the more notable measures contained in the CVPIA aimed at fish and wildlife mitigation, protection, and restoration).

the drainage problem and the need for Congress to clarify its policy regarding CVP operations.

## II. HISTORICAL DEVELOPMENT OF AGRICULTURE IN THE CENTRAL VALLEY

Passage of the CVPIA came at the end of a long period of very profitable agricultural development in California's Central Valley.<sup>18</sup> Unfortunately, the Central Valley's farming success is overshadowed by profound injury inflicted on the valley's natural environment by irrigated agriculture. Most of the environmental damage is the result of manipulating the Central Valley's land and water resources for agricultural production in disregard of the impacts to plant, fish, and wildlife habitat.<sup>19</sup> Substantial amounts of the harm, which is permanent or practically irreversible, are traceable to rapid conversion of the valley's wilderness into farmland.<sup>20</sup> However, a major portion of the damage is due to the continuing operation of the federal CVP and its influence on the land-use practices of farmers.<sup>21</sup>

The CVP provided irrigators the means to fundamentally alter the shape of the Central Valley's land and water resources. CVP water allowed irrigation of lands previously too dry to farm, which in turn lead to the agricultural drainage problem in the San Joaquin Valley. The following history will trace the CVP's role in the restructuring of the Central Valley landscape, and will attempt to convey the enormity of the changes wrought.

### A. Transformation of the Central Valley

The Central Valley is the most productive agricultural region in the world today.<sup>22</sup> To achieve this success, the aboriginal landscape was fundamentally altered, sacrificing much of the valley's wildlife habitat in the process. First, the conversion of wildlife habitat into farmland required tremendous reshaping of the

---

18. The oblong Central Valley stretches over 400 miles north-to-south through the interior of California and averages 50 miles wide west-to-east. See BRICKSON, *supra* note 5, at 5; MID-PACIFIC REGION, BUREAU OF RECLAMATION, U.S. DEP'T OF INTERIOR, CENTRAL VALLEY PROJECT: ITS HISTORICAL BACKGROUND & ECONOMIC IMPACTS 1 (1981). The valley is bordered on the north and east by the Cascade and Sierra Nevada mountain ranges, and on the west by the Coast Range. The Central Valley is divided into three distinct drainage regions: The Sacramento Valley composes the northern third of the valley and is drained by the Sacramento River flowing north-to-south while the southern two-thirds of the valley is composed of the San Joaquin Valley and is drained by the San Joaquin River flowing west and north. The Sacramento and San Joaquin Rivers converge in a vast maze of islands, forming the Sacramento-San Joaquin Delta, which drains into the San Francisco Bay and out to the Pacific Ocean. *Id.* at 1-2.

19. See *infra* notes 22-66 and accompanying text (depicting the aboriginal landscape and the changes wrought by converting the valley to agricultural uses).

20. *Id.*

21. *Id.*

22. See *infra* notes 140-51 and accompanying text (summarizing the valley's agricultural output).

valley's land resources. Vital wildlife habitats, such as riparian woodlands and wetlands, were eliminated in order to make the land productive. Second, to furnish a supply of water for crops, it was necessary to massively relocate water resources; nearly the entire flow of many rivers and streams were funneled into irrigation canals.

Two events played a dramatic role in the transformation of the valley from wilderness to farmland: rapid settlement of the valley following the California Gold Rush and the construction of the federal CVP. Both events profoundly restructured the valley's environment.

The historic Central Valley was a very different place from the now-familiar seemingly endless open expanse of farm fields.<sup>23</sup> Today, marshaled rows of crops stretch uninterrupted to the horizon where great stands of riparian woodlands once stood to arrest the surveying eye and spread a vast maze of wetlands, lakes, and grasslands to waylay the unsuspecting traveler. Snow-melt waters flowing from the Sierra Mountains through the Sacramento and San Joaquin Rivers were the life-blood of the Central Valley's formerly vast plant and wildlife populations, as they are now for its gigantic agricultural resources.<sup>24</sup>

Overflowing river waters profoundly shaped the landscape. In the Tulare Basin of the southern San Joaquin Valley, lakes covered nearly 1000 square miles.<sup>25</sup> Upwards of 4.5 million acres of permanent and seasonal wetlands stretched along the valley floor.<sup>26</sup> As much as half of a million acres of riparian forest grew along the Sacramento River.<sup>27</sup> The enormous seasonal flooding of the valley floor by these rivers sustained habitat so rich with wildlife that they were compared to the Serengeti Plain of East Africa—millions of antelope and tule elk, thousands of grizzly bears and fur bearing mammals, millions of salmon spawning in untamed rivers, and a multitude of migratory waterfowl and aquatic birds so vast as to darken the sky when they took flight.<sup>28</sup> So plentiful was the natural bounty of the Central Valley that in the 1800s, the San Joaquin Valley alone supported the commercial harvest of waterfowl, fur-bearing mammals, and

---

23. See NORRIS HUNDLEY, JR., *THE GREAT THIRST, CALIFORNIANS AND WATER 1770s-1990s*, at 1-24 (1992) (presenting a richly detailed account of the aboriginal California landscape and settlement patterns of Native American peoples).

24. *Id.*

25. BUREAU OF RECLAMATION, U.S. DEP'T OF FISH & GAME, U.S. DEP'T OF THE INTERIOR & CALIFORNIA RESOURCES AGENCY, *A MANAGEMENT PLAN FOR AGRICULTURAL SUBSURFACE DRAINAGE AND RELATED PROBLEMS ON THE WESTSIDE SAN JOAQUIN VALLEY: FINAL REPORT OF THE SAN JOAQUIN VALLEY DRAINAGE PROGRAM 56* (1990) [hereinafter *SJVDP*].

26. BUREAU OF RECLAMATION, U.S. DEP'T OF THE INTERIOR, *DRAFT ENVIRONMENTAL IMPACT STATEMENT, SAN LUIS UNIT DRAINAGE PROGRAM, CENTRAL VALLEY PROJECT, CALIFORNIA 156* (1992) [hereinafter *SLUDP*]; Dunning, *supra* note 6, at 945.

27. BRICKSON, *supra* note 5, at 15.

28. See Dunning, *supra* note 6, at 944-45 (summarizing the descriptions of the Central Valley made by Marc Reisner and Sarah Bates in their book *OVERTAPPED OASIS: REFORM OR REVOLUTION FOR WESTERN WATERS* (1990)); HUNDLEY, JR., *supra* note 23, at 5.

fish. Moreover, the San Joaquin Valley was home to the densest population of Native Americans in North America not relying upon agriculture for food production.<sup>29</sup>

The California Gold Rush brought the first major changes in the valley's environment. Two years after the discovery of gold in 1848, California's population multiplied more than six-fold, from 15,000 to 93,000; by 1870 the population had reached over half a million.<sup>30</sup> Disenchanted with prospecting, or perhaps in recognition of the potential for riches in California's fertile soil, many settlers turned to farming and ranching. As the state's population continued to grow, rapid conversion of the valley's wilderness to farmland followed, along with agricultural water diversions that caused great losses of habitat and drastically altered plant and wildlife populations. Even though a great diversity of species still existed by the early twentieth century, their numbers had been significantly reduced, and many were driven out or nearly eliminated from the valley.<sup>31</sup>

While the first farmers were able to tame the land, they were unable to gain substantial control of the Central Valley's water resources. Water could be both a blessing and a curse for valley farmers. Drought years were often followed by flood years, with years of average water supply more the exception than the norm.<sup>32</sup> Successive drought years could force farmers to abandon their land while seasonal flooding destroyed both farm and town property.<sup>33</sup> In addition, although the San Joaquin section of the Central Valley contained two thirds of the irrigable land, it received only one third of the "average" annual rainfall.<sup>34</sup> Thus, while the Sacramento section of the Central Valley might have a great abundance of river water in a given year, the San Joaquin section of the valley did not have enough water to develop its agricultural potential.<sup>35</sup>

Beginning in the late 1800s, private landowners in the San Joaquin Valley attempted to compensate for the lack of rain and river water by pumping groundwater from the shallow aquifer beneath the valley and constructing storage facilities in the hills above the valley to trap heavy spring river flows, thereby

---

29. SJVDP, *supra* note 25, at 56.

30. BRICKSON, *supra* note 5, at 5. As of 1992, California's population had reached 31.3 million. See SUE MCCLURG, WATER EDUCATION FOUNDATION, LAYPERSON'S GUIDE TO THE DELTA 5-8 (1993) (noting population growth and predicted growth rates).

31. See SJVDP, *supra* note 25, at 21.

32. BRICKSON, *supra* note 5, at 5-6; see *id.* (describing the drought and flood problem); see also HUNDLEY, JR., *supra* note 23, at 232-34 (discussing the irregular and unpredictable nature of the Central Valley water supply).

33. See HUNDLEY, JR., *supra* note 23, at 232-34.

34. BRICKSON, *supra* note 5, at 5-6; see *id.* (contrasting the climate of the Sacramento Valley with the San Joaquin Valley).

35. See HUNDLEY, JR., *supra* note 23, at 232-33 (describing the disparity between the supply of river water in the Sacramento and San Joaquin Valleys); see also BRICKSON, *supra* note 5, at 5-6 (summarizing climate and water sources in the Central Valley).



increasing the water supply available throughout the growing season.<sup>36</sup> Pumping of groundwater, however, lead to massive overdrafting<sup>37</sup> of the shallow aquifer which, in turn, caused the land over the pumped sections of the aquifer to sink as the groundwater level dropped.<sup>38</sup> Other problems began to develop as well. Because of the reduced volume of the heavily diverted Sacramento and San Joaquin Rivers, salty ocean water in the San Francisco Bay was able to move further up into the Sacramento-San Joaquin Delta during the low-flow summer months, threatening the fresh water supply of half a million acres of Delta farmland as well as drastically affecting the Delta ecosystem.<sup>39</sup>

Even before the turn of the century, Californians realized that over the course of a full year, enough water flowed though the Central Valley to irrigate the whole valley.<sup>40</sup> The difficulty was in timing the supply to correspond with irrigation needs during the dry summer months. Over-abundant spring flows could supply enough water throughout the summer if they could be captured and stored until needed. Wet years could compensate for drought years if the storage facilities were large enough to carry over “surplus” waters from year to year. Capturing spring flows could also provide flood protection, an alternative source of water to replace groundwater, thereby alleviating overdrafting, and a means of regulating river flow during the summer to help prevent salt water intrusion in the Delta. Unfortunately this realization translated into the sentiment that Sacramento Valley water not put to agricultural or domestic use was simply being wasted.<sup>41</sup> The value of water as sustenance for ecological resources was not fully appreciated.

Beginning around the turn of the century, plans for a Central Valley water system were proposed.<sup>42</sup> Studies were made and a state-developed project began to take shape by the 1930s.<sup>43</sup> The Great Depression, however, prevented

---

36. Dunning, *supra* note 6, at 945-46; *see id.* (describing early private attempts to develop water reserves).

37. The term “overdrafting” as used here is meant to describe a rate of groundwater withdrawal that results in a substantial lowering of the water level in the aquifer. The California Supreme Court has given the term “overdrafting” a broader definition that hinges on withdrawal causing an “undesirable result.” *City of Los Angeles v. City of San Fernando*, 14 Cal. 3d 199, 280, 537 P.2d 1250, 1309, 123 Cal. Rptr. 1, 60 (1975); *see* Gregory S. Weber, *The Role of Environmental Law in the California Water Allocation and Use System: An Overview*, 25 PAC. L.J. 907, 918 n.70 (1994) (summarizing the Court’s definition of overdrafting).

38. SJVDP, *supra* note 25, at 29-30; *see id.* (detailing groundwater resources in the San Joaquin Valley). New technology accelerated groundwater pumping in the 1920s and 1930s and by the late 1950s overdraft reached 750,000 acre feet a year and caused groundwater levels to drop by over 200 feet. *Id.*

39. BRICKSON, *supra* note 5, at 5; *see id.* (discussing salt water intrusion in the Delta).

40. *See* HUNDLEY, JR., *supra* note 23, at 232-43.

41. *See* HUNDLEY, JR., *supra* note 23, at 238 (noting the sentiment expressed by proponents of early water development); *see generally* Dunning, *supra* note 6, at 946-51 (sketching the contours of the traditional water-use ethic).

42. *See generally* Dunning, *supra* note 6, at 946-48 (summarizing the events which lead to the development of the Central Valley Project).

43. *Id.*

California from taking the project on without federal financial assistance.<sup>44</sup> Federal funding was provided in 1935 for initial construction, and in 1937 the federal government took over the project.<sup>45</sup>

### B. The Central Valley Project

The federal Central Valley Project was designed to solve many of the Central Valley's water control and supply needs.<sup>46</sup> The goals of the CVP, as enacted by the reauthorization of the Rivers and Harbors Act of 1937, were: to regulate river flow for flood control and navigation improvement, to develop water for agricultural and municipal uses, and to generate hydroelectric power.<sup>47</sup> The CVP accomplishes these objectives while augmenting the San Joaquin watershed through a complex system of dams, canals, reservoirs, and pumping stations which operate to capture, divert, store, and distribute the abundant spring snow-melt flows from the Coast Range and Sierra Mountains to the southern part of the Central Valley.<sup>48</sup>

Today, in a normal year, the CVP captures and distributes about 7 million acre feet of water, composing more than 20 percent of the state's developed

---

44. *Id.*

45. *Id.*

46. Act of Aug. 26, 1937, ch. 832, 50 stat. 844, 850.

47. *Id.*

48. The CVP functions as both a water augmentation system (increasing the total amount of water available in the valley) and as a water exchange system (replacing waters within the valley that are diverted from their original channels). See generally SLUDP, *supra* note 26, at 68-80; Dunning, *supra* note 6, at 949. To accomplish the first task of augmenting the water supply, the CVP utilizes a gigantic plumbing system to distribute over 7 million acre feet of water a year. The heavy spring flows that form the Pit and McCloud rivers and the headwaters of the Sacramento River are captured and stored behind Shasta Dam, impounding as much as 4.5 million acre feet. BRICKSON, *supra* note 5, at 8. The waters of the Trinity River, 2.5 million acre feet, on the west side of the Coastal Range are diverted east under the mountains through a 14 mile series of tunnels to augment the supply of available water below Shasta. American River dams collect and release into the Sacramento River contributing additional waters. When water is needed in the San Joaquin Valley, it is released from Shasta and the other dams and allowed to flow down the Sacramento River to the Sacramento-San Joaquin Delta where it is diverted into the Delta Cross Channel. From there it flows to the South Delta at Tracy and is pumped 197 feet up into the Delta-Mendota Canal. Once in the canal, it then flows south down the west side of the San Joaquin Valley past the San Luis Reservoir where water is distributed via the San Luis Canal to consumers on the west side of the valley. The operation of San Luis Reservoir is part of a joint federal and state initiative. Once past the San Luis Reservoir, the water flows east across the valley to the Mendota pool to supplement the depleted San Joaquin River. *Id.* at 9-11.

As part of its second principle function of exchanging water, the CVP constructed Friant Dam on the San Joaquin River in the Sierra foothills. The river's waters are diverted by the dam north into the Maderia Canal and south into the Friant-Kern Canal for use in irrigating the east side of the valley. The San Joaquin River below Friant Dam receives only minimal releases of water from the dam, sufficient to satisfy the water rights of riparian users below the dam. *Id.* at 8-9. Past the riparian users, the river is completely dewatered for 22 miles until the Mendota Pool. Dunning, *supra* note 6, at 949. At the Mendota Pool, CVP water from the Sacramento River is delivered to restore water to the San Joaquin River. BRICKSON, *supra* note 5, at 9.

water.<sup>49</sup> Roughly 80 percent of the CVP's yield is used to irrigate 2.8 million acres of farmland, representing 30 percent of all water used for irrigated agriculture.<sup>50</sup> Approximately 13 percent of the CVP yield goes to 2 million urban residents and industrial uses.<sup>51</sup> Flood control benefits gained from the CVP, based on estimates of prevented flood damage, equal \$5.45 billion for the period of 1950 to 1992.<sup>52</sup> In addition, the CVP is an important source of electric power, generating, on average, 5.3 billion kilowatt hours per year.<sup>53</sup>

The CVP's benefits have not come without environmental cost. The CVP has damaged the environment both directly, as a result of its physical manipulation of water resources, and indirectly, as a result of its supplying water to irrigated agriculture. Operation of the CVP directly impacts river flow, habitat, and species of most major river systems in central and northern California.<sup>54</sup> The effect on many species' habitats and on the species themselves, has been devastating.<sup>55</sup>

The fate of the Sacramento and San Joaquin river salmon runs provides a graphic example of the negative impacts to species caused by the CVP. Between 1873 and 1910, there were 21 canneries on the Sacramento and San Joaquin rivers, producing approximately 5 million pounds of salmon yearly.<sup>56</sup> The largest single year catch on the Sacramento river was 12 million pounds in 1882.<sup>57</sup> However, the winter-run Chinook salmon on the Sacramento, which numbered about 100,000 in the 1960s, was listed under the state and federal Endangered Species Act in 1989 and numbered only 191 fish in 1991.<sup>58</sup> A variety of factors

---

49. See BRICKSON, *supra* note 5, at 2 (summarizing the CVP's benefits).

50. *Id.* at 2.

51. *Id.* at 14.

52. *Id.*

53. *Id.* Electric power generation is also an important source of revenue to help pay for project costs, providing \$232 million of the \$435 million invested in CVP power generation facilities. *Id.*

54. See generally BETTY BRICKSON & JEANNE DUCAN, WATER EDUCATION FOUNDATION, LAYPERSON'S GUIDE TO CALIFORNIA RIVERS AND STREAMS 2-9 (1992) (profiling California's major and more significant rivers).

55. There are many dramatic examples of the CVP's effects on habitat and species. The CVP's Friant Dam effectively dewatered a 22-mile stretch of the San Joaquin river below it, destroying all river habitat and fish species dependent on that habitat. BRICKSON, *supra* note 5, at 8-9. The flow in several sections of the San Joaquin river below Friant Dam is now exclusively derived from agricultural drainage water. SJVDP, *supra* note 25, at 29. Reduced fresh water flows in the San Joaquin river have increased the concentrations of salts and toxins, effectively decreasing the river's capacity to assimilate pollutants. MCCLURG, *supra* note 30, at 9. Shasta Dam, when completed, blocked off half of the Sacramento river's traditional spawning grounds for salmon and steelhead. BRICKSON, *supra* note 5, at 8. The flow of the Trinity River was reduced by 90 percent with a corresponding severe impact to its native Coho and Chinook salmon runs. The Tracy Pumps, in addition to actually causing reversed flow in the Delta, are responsible for the death of millions of fish killed each year by the operation of the pump facility. *Id.* at 9-10; see *id.* (detailing the Tracy Pumping plant); MCCLURG, *supra* note 30, at 17 (describing fish losses due to operation of the pumps); *supra* note 48 (summarizing the role of the Tracy Pumps in the operation of the CVP).

56. MCCLURG, *supra* note 30, at 5.

57. *Id.* at 11. The Sacramento river has four salmon runs, all of which have drastically declined. BRICKSON, *supra* note 5, at 16.

58. BRICKSON, *supra* note 5, at 16.

could have contributed to this loss: drought, over-fishing, the introduction of predatory fish species, dams, habitat destruction, migratory obstacles, pollution, and increased water temperature.<sup>59</sup> However, CVP induced impacts are believed to be a major contributor.<sup>60</sup> The Bureau of Reclamation, the federal agency in charge of the CVP, has attempted to compensate for loss of salmon habitat by constructing fish hatcheries on critically affected rivers. Unfortunately, hatcheries do not provide a long-range means to maintain salmon populations because of the loss of genetic diversity in hatchery-reared salmon.<sup>61</sup> Generally speaking, Bureau-initiated attempts at mitigating the negative environmental effects of the CVP to date have been only moderately successful.<sup>62</sup>

Operation of the CVP has also facilitated the overall expansion of irrigated agriculture, indirectly causing an increase in agricultural water pollution from surface and subsurface drainage, the further loss of habitat from reduced natural water supplies, and intrusion of irrigated agricultural into undeveloped lands.<sup>63</sup> In particular, the availability of subsidized imported water has encouraged farmers on the west side of the San Joaquin Valley to develop portions of the valley which could not be farmed for lack of water as well as to irrigate marginal land which could not otherwise be farmed at a profit.<sup>64</sup> Much of these west side lands are the primary source of selenium, which is leached out of the soil by CVP supplied irrigation water and into the watershed, poisoning tributaries, wetlands, the San Joaquin River, and the Sacramento-San Joaquin Delta.<sup>65</sup> The CVP thus has seriously impacted fish and wildlife habitat in the Central Valley.<sup>66</sup>

---

59. *Id.*

60. *Id.*

61. Genetic diversity is considered critical to species survival in the wild. *Id.*

62. See generally *id.* at 8-12, 15-16 (describing CVP features, their impacts, and effectiveness of mitigation measures); MCCLURG, *supra* note 30, at 8-9, 11-12, 14-17 (detailing the CVP's impact on the Delta's natural resources and mitigation efforts).

63. See SJVDP, *supra* note 25, at 50-61 (describing the growth of agriculture and its impact on natural resources); *infra* notes 98-115 and accompanying text (describing the effects of imported water on the quantity and quality of agricultural drainage on the west side of the San Joaquin Valley).

64. Hamilton Candee, *The Broken Promise of Reclamation Reform*, 40 HASTINGS L.J. 657, 658 (1989); BRICKSON, *supra* note 5, at 7 (noting that "cheap water injects value into land that it otherwise does not have").

65. See *infra* notes 79-84 and accompanying text (describing the soil composition of the west side of the valley).

66. Today, of the Central Valley's historic natural resources, less than 1 percent of freshwater lakes, 7 percent of riparian forests, and 15 percent of wetlands remain. See SJVDP, *supra* note 25, at 56-57 (noting that loss of habitat is the result of widespread agricultural development); see also *infra* notes 158-82, and accompanying text (detailing many species at risk in the Central Valley from agricultural drainage); *supra* notes 22-29 and accompanying text (describing the resources of the historic Central Valley); Dunning, *supra* note 6, at 950-54.

### III. THE NATURE OF THE PROBLEM

Disposal of spent irrigation water is a problem confronting both the farming industry and ecology of the San Joaquin River Valley. From an agricultural perspective, the problem is the buildup of spent irrigation water, high in salts and trace elements, within the root zone of crops.<sup>67</sup> Unabated, this drainage water can cause loss of crop productivity, force conversion to less valuable salt-tolerant plants, and eventually force land out of production.<sup>68</sup> Ecologically, the problem is the discharge of spent irrigation water, high in toxins, into the wildlife habitat of the San Joaquin Valley.<sup>69</sup> The discharge of spent irrigation water can poison fish, wildlife, and their habitats and threaten the health of the San Joaquin River and Bay-Delta estuary ecosystems.<sup>70</sup> Although the situation is perceived differently by the agriculturist and the ecologist, the common concern of both is this so-called *problem water*.<sup>71</sup>

#### A. *A Stage Set for a Toxic Drainage Problem*

Anyone driving through California's San Joaquin Valley<sup>72</sup> would never suspect that the region has a severe drainage problem. Most often, drainage problems are caused by the channeling of storm water or the draining of swamp water on surface lands. In contrast, the San Joaquin Valley receives very little rain—only five to ten inches a year,<sup>73</sup> and has few wetland areas.<sup>74</sup> Hot, dry

---

67. See *infra* notes 91-97 and accompanying text (noting the effects of shallow ground water, high in salts and trace elements, on crop productivity).

68. *Id.*

69. See *infra* notes 158-82 and accompanying text (describing ecological resources at risk).

70. *Id.*

71. The term *problem water* was coined by the San Joaquin Valley Drainage Program to represent the subsurface water which "exists when there is a condition of too much shallow ground water occurring in the root zone of crops—associated often with concentrations of dissolved salt . . . in that water that reduce crop production and/or increase farm management costs." SJVDP, *supra* note 25, at 75. This *problem water*, when it is removed from the farmer's fields by subsurface drainage systems, is the same water which constitutes the drainage high in salts and toxic elements that poison the ecology. *Id.* Hence, the same *problem water* is a source of concern for both farmers and ecologists.

72. The San Joaquin Valley forms the southern two thirds of the Central Valley of California; the Sacramento Valley forms the northern third. See *supra* note 18 (describing the Central Valley). The San Joaquin Valley is bounded by the Sacramento-San Joaquin Delta on the north and by the Tehachapi Mountains just south of Bakersfield and the Kern River on the south. To the east, the San Joaquin Valley is bounded by the Sierra-Nevada mountains and on the west by the Coast Range. The valley is 250 miles long, 45 miles wide, has a mild, dry climate, and productive soils. See generally SJVDP, *supra* note 25, at 15-18.

73. SJVDP, *supra* note 25, at 27.

74. The absence of wetlands in the San Joaquin Valley is actually the result of agricultural development. Prior to agricultural water diversions and storage dams, the seasonal flooding of Central Valley rivers supported vast permanent and seasonal wetlands, more than 3.6 million acres. BRICKSON, *supra* note 5, at 15. Only ten percent of the valley's original wetlands have survived the conversion of the aboriginal valley to farmland over the last hundred fifty years. *Id.*

summers and the native vegetation, which remains brown and dry for half the year, give the impression that the valley is more a parched grassland than a waterlogged marsh. However, appearances can be deceptive, and the San Joaquin Valley is no exception.

The current drainage problem in the San Joaquin Valley is caused by a complex set of natural and man-made conditions. There are three principle components of the drainage problem: (1) high natural concentrations of salts and potentially toxic trace elements in the soils of the west side of the valley, (2) a naturally shallow groundwater table, and (3) the artificial importation of water to the valley.<sup>75</sup> These factors combine to cause soggy, saline soil conditions that inhibit root development and activity, posing a serious threat to crop productivity.<sup>76</sup> The farmer's solution is to drain the soils and periodically apply extra water to leach out the salts.<sup>77</sup> But when the soils are allowed to drain, both naturally and through artificial subsurface drainage systems, drainage water contaminated by the salts and toxins enters the surrounding surface and groundwater, polluting water used for irrigation and drinking, as well as poisoning fish and wildlife habitat.<sup>78</sup>

### 1. Soils of the West Side: Latent Toxins Beneath the Surface

Toxic drainage is an unavoidable by-product of irrigating the west side of the San Joaquin Valley because of its indigenous soil characteristics.<sup>79</sup> West-side soils are derived from marine sediments intrinsically high in salts and trace elements.<sup>80</sup> Under the normally dry conditions of the Coast Range's eastern

---

75. SJVDP, *supra* note 25, at 30-42. Local groundwater pumping from the deep aquifer, though technically not imported from outside the area, is included in this category of imported water in terms of the effects its application has on the shallow groundwater table. *Id.*

76. *Id.* at 75.

77. See *infra* notes 117-23 and accompanying text (summarizing the drainage management options employed by farmers).

78. See SJVDP, *supra* note 25, at 58-61 (describing the constituents of subsurface drainage water and the toxic risk to wildlife); *id.* at 61 (noting that some ground water sources of drinking water in the valley are sufficiently contaminated with drainage water so as to create a human health hazard).

79. The west and east sides of the valley are roughly separated by the San Joaquin river. The San Joaquin river is the principle watershed in the valley, with its headwaters in the Sierras, it flows west down into the valley and then north along the valley floor to the Sacramento-San Joaquin Delta and into the San Francisco Bay. *Supra* note 18; see BRICKSON, *supra* note 5, at 5.

80. Ancient seas from the Cretaceous period invaded what is now central California, forming deposits of marine sandstone and shale. After these seas retreated, the weathering of the exposed marine rock formed the alluvial deposits which dominate the soils of the west side of the valley. Theresa S. Presser, *The Kesterson Effect*, 18 No. 3 ENVTL. MGMT. 437, 438-39 (1994) [hereinafter Presser, *Kesterson Effect*]; SLUDP, *supra* note 26, at 64-65. West side marine sediments tend to be thick (850 feet) along the upper slopes, decreasing below to only a few feet on the valley floor. SJVDP, *supra* note 25, at 25-42. This sediment is rich in salts and trace elements. Four elements are of particular concern: selenium, boron, molybdenum, and arsenic. *Id.* Of the four, selenium is of the greatest concern because it is widely spread throughout the west side of the valley and represents the greatest toxic threat to fish and wildlife. *Id.* at 40; A. Dennis Lemly, *Guidelines For Evaluating*

slopes, salts and trace elements leach out of the soil very gradually.<sup>81</sup> When these elements come into contact with water, they dissolve and are free to move with the water.<sup>82</sup> Leaching occurs when large quantities of water enter the soil, dissolving and mobilizing the toxic soil constituents. The leached salts and trace elements are carried away in the drainage water, either on the surface with runoff or beneath the surface in underground flows. The subsurface flows either percolate into the groundwater, collect in buried artificial drains, or naturally emerge on the surface and mingle with runoff, eventually draining into the watershed.<sup>83</sup> Irrigation on the west side of the valley, while essential for crop production, causes the release of salts and trace elements from the soil, which in turn threaten the buildup of salts and trace elements in the groundwater and surrounding watershed.<sup>84</sup>

## 2. Clay Beneath the Soil: Buildup of Shallow Ground Water

The second principle cause of the drainage problem is the presence of a layer of Corcoran Clay lying beneath almost the entire San Joaquin Valley floor.<sup>85</sup> The clay layer is relatively impermeable and greatly slows water from traveling deeper into the ground.<sup>86</sup> Water entering the ground above the clay is effectively trapped on top of the clay, saturating the soil and forming a semi-confined aquifer above the clay.<sup>87</sup> The effect is like a bathtub where the drain in the bottom cannot empty

---

*Selenium Data From Aquatic Monitoring and Assessment Studies*, 28 ENVTL. MONITORING & ASSESSMENT 83, 94 (1993) [hereinafter Lemly, *Guidelines*]. Waterborne selenium concentrations as low as 5 parts per billion (ppb) can cause reproductive failure and death in many fish species. *Id.*; see *infra* notes 185-98 and accompanying text (highlighting the toxic effects of selenium on fish and wildlife). For a detailed discussion of the west side's geologic history and sources of selenium, see Presser, *Kesterson Effect*, *supra*, at 437-54.

In contrast, east side soils are derived from Sierra sediments, which are dominated by granite and are extremely low in salts and trace elements. SLUDP, *supra* note 26, at 64.

81. Characteristically low annual precipitation generates ephemeral streams and debris flows which rarely have sufficient quantity to reach the valley floor. Hence, the release of salts and trace elements from the eastern slopes due to natural water sources is very gradual. See Presser, *Kesterson Effect*, *supra* note 80, at 440-42.

82. *Id.*

83. SJVDP, *supra* note 25, at 29-30.

84. *Id.* at 18-42. Groundwater quality is most severely affected by saline conditions in depths that range from 20-200 feet below the soil surface. Groundwater above and below tends to have lower concentrations of salts and trace elements. In most cases, groundwater within 20 feet of the land surface is the source of subsurface drainage water. Even though the water within 20 feet of the surface tends not to have the highest concentration of salts and trace elements, concentrations of these constituents still tend to be relatively high. *Id.*

85. *Id.* at 25. The Corcoran Clay layer underlies most of the west side of the valley, and is made up of a series of clay layers 200-500 feet below the surface of the valley trough. The clay was left behind by an ancient lakebed some 600,000 years ago. The primary clay layer varies in thickness from 20-200 feet. *Id.*

86. *Id.* at 25-27.

87. *Id.*

the water as fast as it comes out of the faucet.<sup>88</sup> Water beneath the clay forms a second isolated zone of groundwater that cannot move out of its confined area.<sup>89</sup> Over the last forty years, intensive irrigation has caused the soil above the clay to become saturated in much of the west side of the valley, in many cases raising the groundwater table to within five feet or less of the soil surface.<sup>90</sup>

The elevated groundwater table poses a substantial threat to the agricultural economy of the west side of the valley.<sup>91</sup> Crops are damaged by the prolonged saturation of their roots with water.<sup>92</sup> The damage to crops is increased when the water contains high levels of salts and trace elements.<sup>93</sup> A farmer can take steps to limit the impact of shallow groundwater on crop productivity, but all of the farmer's options result in a loss of farm income.<sup>94</sup> The farmer can institute drainage management, but doing so increases overhead costs and reduces competitiveness and profits.<sup>95</sup> A farmer can convert to salt-tolerant crops, but such crops tend to be less valuable and yield less income.<sup>96</sup> Finally, a farmer can do nothing that results in damaged crops, yielding less income and possibly insufficient income for profitable farming of the land.<sup>97</sup>

### 3. Imported Water

The third principle cause of the drainage problem is the importation of irrigation water. The main sources of imported water in the San Joaquin Valley are the federal Central Valley Project (CVP) and the California State Water Project (SWP).<sup>98</sup> Initial deliveries of CVP water to irrigators in the northern end

---

88. TERRY F. YOUNG & CHELSEA H. CONGDON, ENVIRONMENTAL DEFENSE FUND, *PLOWING NEW GROUND: USING ECONOMIC INCENTIVES TO CONTROL WATER POLLUTION FROM AGRICULTURE*, app. A-2 (1994).

89. This zone is referred to as a confined aquifer because the clay layer prevents water from moving out of or into the lower zone beneath the clay. SJVDP, *supra* note 25, at 25.

90. *Id.* at 15-16. The problem of soil saturation is not unique to the last 40 years but has been recurring as a result of irrigation since the first attempts to farm the valley in the 1800's. *Id.* As a result of such intensive irrigation, by 1990 the groundwater table rose within 5 feet of the surface in more than a third of the west side of the valley (817,000 acres). *Id.* at 29-31. Under current conditions, by the year 2000, the number of adversely effected irrigable acres is expected to rise to 1 million, 40% of irrigated land in the San Joaquin Valley. *Id.* at 20-21.

91. *See id.* at 30-39 (summarizing the effects of shallow groundwater on agricultural production).

92. *Id.* at 75.

93. In addition to the naturally high salt content of the valley's west side soils, dissolved salt in imported water is a second source, adding 1.6 million tons of salt annually to the valley's soils. *Id.* at 30. Groundwater can be a third source of salt. Dissolved salts leached by irrigation or precipitation can get into the groundwater. When the groundwater is pumped for irrigation, it becomes a third source of salt. Overall, only half the dissolved salts in the root zones of plants comes from the soil. *Id.* at 38-42.

94. *See id.* at 75.

95. *Id.*

96. *Id.*

97. *Id.*

98. *Id.* at 16-19, 27-30; *see id.* (describing the valley's water resources).



of the valley began in 1951.<sup>99</sup> In 1968, the CVP's San Luis Unit and the SWP began supplying water to the southern half of the valley.<sup>100</sup> The CVP currently delivers water to over three million acres of farmland annually throughout the Central Valley.<sup>101</sup>

Importing water into the west side of the valley magnifies the existing problem of toxins in the soils and the accumulation of shallow ground water in several ways. First, imported water allows a larger area of the irrigable land to be farmed by providing more water than is normally available from the San Joaquin watershed.<sup>102</sup> Previously unirrigated lands higher up the western slope of the valley, where deposits of marine sediment high in salts and trace elements are thicker, are irrigated with imported water.<sup>103</sup> The imported water has increased the quantity of salts and trace elements leached into surface and groundwater because a larger area of land is irrigated.<sup>104</sup> Second, the imported irrigation water itself is a significant source of salt, contributing to the salinity of the soil, surface water, and ground water.<sup>105</sup> Third, the greater quantity of applied water produces a higher volume of surface and subsurface drainage contaminated by salts and selenium.<sup>106</sup> Fourth, imported water accelerates the buildup of the groundwater table toward the soil surface, increasing the threat to agricultural productivity.<sup>107</sup>

In sum, the drainage problem in the San Joaquin Valley is the direct result of irrigation. Without irrigation, the naturally high concentrations of salts and trace elements in the soil would remain relatively immobile, releasing very gradually over a long period of time with negligible adverse impact to water quality and wildlife habitat.<sup>108</sup> Without irrigation, the groundwater table would remain relatively stable and would not rise toward the soil surface, leaving salts and trace

---

99. *Id.* at 29. The northern end of the valley is serviced by the Delta-Mendota Canal. These areas are referred to in the SJVDP as the Northern and Grasslands subareas. The southern half of the valley consists of Westlands, Tulare, and Kern subareas. Most of Westlands is serviced by the San Luis Canal. The majority of Kern and Tulare are serviced by the California State Water Project. The east side of the valley is predominately serviced by the Friant-Kern Service area of the federal Central Valley Project (CVP) from waters of the San Joaquin River. *Id.* at 2.

100. *See supra* note 72 (describing the geographic areas of the San Joaquin valley).

101. BRICKSON, *supra* note 5, at 2.

102. *See generally* SJVDP, *supra* note 25, at 27-30 (discussing limited surface and ground water supplies).

103. *See id.* at 25-26 (describing the geology of the western San Joaquin Valley).

104. *See generally id.* at 25-42 (identifying the geologic and hydrologic sources of salts and trace elements on the west side of the valley and how the salts and trace elements are leached by irrigation).

105. *See supra* note 93 (outlining sources of salt). Imported water deposits approximately 1.2 tons of salt per acre annually on the valley's west side. NANCY HANSON, WATER EDUCATION FOUNDATION, LAYPERSON'S GUIDE TO AGRICULTURAL DRAINAGE 4 (Rita Schmidt Sudman et al., eds., 1991).

106. SJVDP, *supra* note 25, at 30-42; *see id.* (discussing the leaching of salts and trace elements from the soils caused by irrigation).

107. *Id.* at 30; *see also supra* notes 91-97 and accompanying text (summarizing the effects of shallow groundwater on agricultural productivity).

108. *See supra* note 81.

elements undisturbed.<sup>109</sup> With irrigation, however, water mobilizes the naturally occurring toxins in the soil and causes the rapid buildup of a contaminated groundwater table beneath the soil surface.<sup>110</sup> The combination of toxins and shallow water buildup in the root zone of crops destroys agricultural productivity.<sup>111</sup> Built-up water high in toxins is eventually discharged by subsurface and surface flows into the watershed, adversely affecting surface water quality and threatening wildlife habitat.<sup>112</sup> Salts and trace elements are leached by deep percolation into the groundwater, degrading the water quality.<sup>113</sup>

For a farmer who is experiencing soil salinity and shallow groundwater problems, one solution might be to not irrigate. Yet, lucrative farming of the San Joaquin Valley is impossible without irrigation.<sup>114</sup> While the San Joaquin is one of the world's most productive agricultural lands, nearly all farming requires irrigation to compensate for the lack of rain throughout the growing season.<sup>115</sup> From an agricultural perspective, irrigation of the west side of the valley *must* be supplemented by a means of managing both the spent irrigation water to prevent groundwater buildup and the removal of salts and trace elements to prevent soil salinity. Ecologically, the scope of a farmer's management methods for disposal of contaminated drainage water must be broad enough to consider the impacts to regional surface and groundwater quality, as well as to fish and wildlife habitat.

### *B. Consequences of Irrigating the West Side of the Valley*

Realizing the productive potential of farmland on the west side of the valley means irrigating the land.<sup>116</sup> However, the decision of a west side landowner to irrigate her land begins a chain of events which inevitably leads to one problem—what to do with the spent irrigation water contaminated by salts and trace elements? Economically, the most attractive solutions to the farmer are those that require a minimum of time and resources to implement. Discharging

---

109. See SJVDP, *supra* note 25, at 16 (linking the rise of the groundwater table in the San Joaquin Valley with the application of irrigation water).

110. See *id.* at 30.

111. *Id.* at 75.

112. See A. Dennis Lemly, *Subsurface Agricultural Irrigation Drainage: The Need for Regulation*, 17 REG. TOXICOLOGY & PHARMACOLOGY 157, 174 (1993) [hereinafter Lemly, *Irrigation Drainage*]; see also *id.* at 170 (arguing that subsurface irrigation drainage must be considered a toxic waste).

113. SJVDP, *supra* note 25, at 30.

114. See *id.* at 18 (highlighting the dependence of crop farming on irrigation); DORIS O. DAWDY, CONGRESS AND ITS WISDOM: THE BUREAU OF RECLAMATION AND THE PUBLIC INTEREST, STUDIES IN WATER POLICY AND MANAGEMENT No.13 at 104 (Westview Press 1989) (describing how the availability of cheap irrigation water and with it the ability to raise higher value field crops made irrigated farming a much more profitable enterprise from the landowners' perspective than raising cattle).

115. SJVDP, *supra* note 25, at 18.

116. See *supra* notes 114-15 and accompanying text (highlighting the dependence of San Joaquin farmers on irrigation).

collected drainage water to adjacent sloughs and streams of the San Joaquin River system provides a simple solution. Incurring additional costs to prevent environmental damage to water quality, fish, wildlife, and habitat is not in the economic interest of the farmer if it adds no value to her crops.

### *1. Toxic Drainage*

A farmer on drainage-affected land has three choices: grow more salt-tolerant plants at less profit, abandon irrigated agriculture on the affected land, or apply drainage management. Drainage management usually means installing artificial drains beneath the soil surface to remove the subsurface drainage water.<sup>117</sup>

Subsurface drains provide irrigators with an effective method of removing drainage water from their fields.<sup>118</sup> The drains not only intercept and carry away irrigation water from beneath the surface but carry off the leached salts and trace elements that have dissolved in the water as well.<sup>119</sup> The problem then becomes the disposal of the drainage water and the potentially toxic elements, which have leached from the soil with the drainage water.

Most irrigators on the west side of the valley follow one or more of several options for drainage water disposal.<sup>120</sup> One option is to discharge the drainage water into creeks and sloughs, which feed into the San Joaquin River and eventually flow into the Bay-Delta Estuary.<sup>121</sup> A second option is to discharge the drainage water to evaporation ponds where concentrations of salts and trace elements are allowed to buildup.<sup>122</sup> A third is to reuse the water either as irrigation water for salt tolerant plants, or in conjunction with fresh water for management of wetlands habitat.<sup>123</sup> The common thread in each of these disposal options is simply to take the potentially toxic drainage water generated by irrigation and pass it on to another site.

---

117. SJVDP, *supra* note 25, at 75; *see id.* (discussing management options).

118. HANSON, *supra* note 105, at 4.

119. *Id.*; Lemly, *Irrigation Drainage*, *supra* note 112, at 158. The drainage water is collected using pumps or by simple gravity flow into surface canals, or more rarely, into pipelines. *Id.*

120. *See generally* HANSON, *supra* note 105, at 5 (identifying drainage management options for irrigators).

121. *See* SJVDP, *supra* note 25, at 87-97 (describing management options for disposal of drainage water). Most irrigators on the west side of the valley below the Grasslands subarea do not have direct access to tributaries of the San Joaquin River. This is because the valley is divided into two hydrologic basins which characterize the flow of surface water: the San Joaquin basin in the north which drains into the San Joaquin River, and the Tulare Basin in the south. In extremely wet years the Tulare Basin drains into the San Joaquin Basin, otherwise it is hydrologically closed (any water that collects on the surface either evaporates or percolates into the ground water). *Id.* at 15. The San Luis Drain was intended to provide a drainage conveyance out of the valley to the ocean. *See infra* notes 260-68 and accompanying text (describing the San Luis Drain).

122. *See* SJVDP, *supra* note 25, at 39.

123. *See id.* at 42-49. Reusing drainage water is actually a volume reduction strategy. By reusing the water, less drainage is generated. However, after one or more reuse cycles, the concentrations of salts and trace element increase such that the water is no longer usable for irrigation, requiring an actual disposal option. *Id.*

Beginning around 1980, CVP irrigators in the northern half of the San Joaquin Valley's west side began disposing of subsurface drainage water by discharging it to the San Luis Drain (SLD).<sup>124</sup> The SLD then carried the drainage water to Kesterson Reservoir.<sup>125</sup> Within two years, selenium in the drainage water caused a major environmental disaster at Kesterson, killing thousands of fish and migratory birds.<sup>126</sup> The Kesterson disaster provoked intensified study of selenium in the scientific community and forced the Bureau of Reclamation—the federal agency responsible for the CVP—to rethink the disposal options for drainage water.

## 2. *The Kesterson Disaster*

Farmers and ranchers throughout much of the west have known for over a hundred years that soils with high concentrations of selenium pose a toxic risk to human and animal health.<sup>127</sup> Despite this general knowledge, little was known about the specifics of selenium toxicity in animals.<sup>128</sup> The extent of selenium's toxic effects on wildlife was made clear to the public in 1983, with the discovery of dead or deformed waterfowl at Kesterson National Wildlife Refuge (NWR).<sup>129</sup> The refuge is located along the Pacific Flyway, an important migratory bird route.<sup>130</sup>

---

124. *Id.* at 16-17. The San Luis Drain (SLD) was originally planned as a means of draining 95,000 acres—later increased to 300,000—of irrigation land on the west side of the valley. The SLD was to run 188 miles north along the valley to drain into the San Francisco Bay-Delta Estuary. Only the southern 85 miles of the drain have been built, the north end terminating in Kesterson Reservoir. When operating, the SLD serviced 5000 acres of buried tile drains on 42,000 acres of land. *Id.*; see *infra* notes 262-68 and accompanying text (discussing the drain in more detail).

125. SJVDP, *supra* note 25, at 16-17. Kesterson was originally intended as a regulating reservoir to be located midway along the San Luis Drain. When construction on the SLD was suspended, Kesterson became the north end of SLD and operated as an evaporation pond complex for disposal of agricultural drainage water. Before the toxic effects of subsurface drainage were known, Kesterson National Wildlife Refuge used the evaporation ponds as a source of wildlife habitat. *Id.* Kesterson at first received mostly surface drainage, but beginning in 1982, received subsurface drainage water at an average rate of 7000 acre feet per year (afa). DAWDY, *supra* note 114, at 98.

126. DAWDY, *supra* note 114, at 113-27.

127. *Id.*; see *id.* (discussing the history of scientific surveys of selenium conducted throughout the west).

128. How selenium interacted with the food chain was unknown prior to the Kesterson tragedy. Theresa S. Presser, *Bioaccumulation of Selenium from Natural Geologic Sources in Western States and Its Potential Consequences*, 18 ENVTL. MGMT. (No. 3) 423, 423-26 (1994) [hereinafter Presser, *Bioaccumulation*].

129. DAWDY, *supra* note 114, at 97-102. Studies indicated that as many as 65 percent of developing young waterfowl and aquatic birds nesting at Kesterson were suffering from deformities symptomatic of selenium poisoning. *Id.* For an in-depth analysis of selenium's effects on fish generally, see A. Dennis Lemly, *Teratogenic Effects of Selenium in Natural Populations of Freshwater Fish*, 26 ECOTOXICOLOGY & ENVTL. SAFETY 181, 181-204 (1993).

130. DAWDY, *supra* note 114, at 101.

It is estimated that from 1983 to 1985 a minimum of one thousand migratory bird deaths at Kesterson directly resulted from selenium poisoning.<sup>131</sup> From 1983 to 1984, an avian cholera epidemic, which killed thousands of birds, was believed to have been exacerbated by elevated selenium levels in the birds.<sup>132</sup> The poisoning of migratory waterfowl raised fears that the Interior Department Secretary and others might be criminally liable for violation of the Migratory Bird Treaty Act (MBTA).<sup>133</sup> The threat of potential liability under the Act led the Secretary to order an end to drainage water deliveries and eventual closure of Kesterson in 1985.<sup>134</sup>

The impact of selenium poisoning on fish and wildlife has not been confined to Kesterson NWR. Selenium poisoning in the Grasslands was severe enough to have a noticeable impact on the populations of fish and frogs as well as ducks and other waterfowl.<sup>135</sup> As a result, the appraised worth of the land, valued as wildlife habitat, declined significantly.<sup>136</sup> Other areas in the valley, particularly around evaporation ponds, also show evidence of selenium poisoning.<sup>137</sup>

### C. What Is Threatened by the Drainage Problem

The drainage problem threatens many important human and ecological interests. Significant human interests include: the regional and state economy (including jobs and tax revenue, maintaining farmland productivity), recreational

---

131. *Id.* at 102; *see id.* (citing the deaths of adults, chicks, and embryos). Chicks and embryos suffered extensive birth defects with many missing beaks, wings, and legs as a result of selenium poisoning. *Id.* at 119.

132. *Id.* at 102.

133. Act of July 3, 1918, ch. 128, 40 Stat. 755 (codified at 16 U.S.C.A. §§ 703-08, 709a, 710, 711); *see* Barcellos & Wolfson, Inc. v. Westlands Water Dist., No. CV 79-106-EDP at 3 (E.D. Cal. 1986) (settlement notice) (consolidated with Westlands Water Dist. v. United States, No. CV F-81-245-EDP) (noting that the Department of Interior Solicitor advised the Secretary that he could not assure him the MBTA was not being violated).

134. *See* SJVDP, *supra* note 25, at 17. Kesterson was never "cleaned up" in the sense that the selenium was never permanently sequestered or removed. Instead, the vegetation was plowed under and low lying areas were filled with top soil. *Id.* The Kesterson "cleanup" cost the federal government 50 million dollars plus 10 million dollars to provide replacement habitat. Lemly, *Irrigation Drainage*, *supra* note 112, at 165.

135. Wetlands management programs, located adjacent to the Grasslands, used drainage water for a third or more of their total water supply in the early and mid-1980s. DAWDY, *supra* note 114, at 73-74. In 1984, water entering the Grasslands averaged 40 parts per billion (ppb) selenium. Roger L. Holthem, *Reproductive Success of Birds in the Grasslands*, in SELENIUM & AGRICULTURAL DRAINAGE: IMPLICATIONS FOR THE SAN FRANCISCO BAY AND THE CALIFORNIA ENVIRONMENT, PROCEEDINGS OF THE FOURTH SELENIUM SYMPOSIUM 72 (Alice Q. Howard ed., 1987) [hereinafter SELENIUM & AGRICULTURAL DRAINAGE].

136. DAWDY, *supra* note 114, at 73-74.

137. Selenium poisoning in California is not isolated to the San Joaquin Valley and Bay-Delta regions. Selenium contamination of the Salton Sea, a inland water body located in southeast California and fed by agricultural drainage from Imperial Valley farms, was recently blamed for the deaths of shore bird embryos. *Wildlife Threat at Salton Sea*, FRESNO BEE, May 1, 1995, at A3. *See infra* note 182 and accompanying text (describing the evidence of selenium contamination throughout the San Joaquin Valley); Dunning, *supra* note 6, at 959 (stating that although thousands of private evaporation ponds in the valley are creating adverse impacts on waterfowl, violators are not being prosecuted).

opportunities, surface and groundwater suitable for irrigation and drinking, as well as general health concerns.<sup>138</sup> Ecological interests include water quality in San Joaquin River system as well as the Sacramento-San Joaquin Delta and San Francisco Bay, and breeding and feeding habitats for local and migratory fish and wildlife, especially endangered and threatened species.<sup>139</sup> In many ways, these interests symbiotically overlap. Recreation activities such as fishing, bird watching, nature walking, and hunting, as well as commercial harvesting of fish and marine species require preservation of breeding and feeding habitats. In addition, recreation and commercial harvesting generate jobs and revenue.

The following examination of the threat from drainage water to irrigated agriculture provides a useful indicator of the threat to such specific human interests as food production, jobs, and revenue generation. An examination of the threat from drainage water to ecological interests provides a contrasting perspective of the threat to human interests as well as the threat to plants and wildlife.

### 1. Irrigated Agriculture

Agriculture is critical to the San Joaquin Valley and the state of California as a source of jobs, exports, revenue, and food.<sup>140</sup> The San Joaquin Valley is part of the most productive agricultural region in the world.<sup>141</sup> Overall, the San Joaquin Valley grows 10 percent of all crops and 21 percent of all irrigated crops in the nation.<sup>142</sup> The west side of the valley accounts for roughly one-third of the San Joaquin Valley's agricultural production.<sup>143</sup> Four of the country's top five agricultural producing counties are located in the San Joaquin Valley: Fresno, Tulare, Kern, and Stanislaus Counties.<sup>144</sup> They represent 56 percent of the state's

---

138. See *infra* notes 140-57 and accompanying text (describing agricultural based human interests); *infra* notes 158-82 and accompanying text (describing ecologically based human interests); see generally SJVDP, *supra* note 25, at 50-68 (discussing regional interest in the San Joaquin Valley).

139. See *infra* notes 158-82 and accompanying text (describing ecologically based human interests); see generally SJVDP, *supra* note 25, at 50-68 (discussing regional interests in the San Joaquin Valley).

140. See SJVDP, *supra* note 25, at 50-55 (describing the contribution of agriculture).

141. BRICKSON, *supra* note 5, at 14. California has over 30 million acres of *farmland*, of which 10.5 million are in the San Joaquin Valley, and of which 3.4 million are on the west side of the valley. SJVDP, *supra* note 25, at 52. The San Joaquin Valley has a total of 4.3 million acres of irrigated *cropland*, of which 1.7 million acres are on the west side of the valley. *Id.*

142. SJVDP, *supra* note 25, at 51-52.

143. See generally *id.* at 50-53 (discussing overall land use and production in the San Joaquin Valley and on the west side of the valley). In 1987, west side crops grown on irrigated cropland by percentage of acreage included: cotton—43 percent; field crops (feed grains, hay, wheat, sugar beets, dry beans, oilseeds, and rice)—38.4 percent; vegetables—10.3 percent; nuts and fruit—8.3 percent. *Id.* at 53. A large portion of the field crops are both highly water consumptive and mainly grown for export. DAWDY, *supra* note 114, at 85.

144. BRICKSON, *supra* note 5, at 14.

1991 agricultural revenue of \$17.9 billion.<sup>145</sup> Fresno County alone accounted for \$2.6 billion in farm produce sales.<sup>146</sup> All four counties are serviced by the CVP.<sup>147</sup>

In addition to revenue from agricultural sales, roughly one-third of all jobs in the Central Valley are associated with farming or farming-related industries.<sup>148</sup> In seven of eight counties in the San Joaquin Valley, agricultural-induced employment represented 50 percent or more of the jobs in the county during 1987.<sup>149</sup> Overall, agricultural induced employment accounted for 48.6 percent of jobs in the San Joaquin Valley in 1987.<sup>150</sup> However, the economic worth of agricultural jobs should be taken into consideration. These jobs are not high paying and have not created prosperity for the valley's residents, whose average income is roughly half the average income for the state.<sup>151</sup>

Currently, 847,000 acres of irrigated land on the west side of the valley have problem water within five feet of the land surface.<sup>152</sup> Affected acreage is expected to increase to 1 million by the year 2000, resulting in reduced crop productivity, increased drainage management costs, land forced out of production, and loss of farm related income and revenue.<sup>153</sup> In Westlands Water District alone, nearly 200,000 of its 600,000 acres have problem water within ten feet of the land surface.<sup>154</sup> Westlands crop production losses in 1987, due to problem water, were approximated at \$35 million. This represented an annual income loss of \$70 million for the valley or \$95 million statewide, including losses sustained by agricultural service, supply, and sales industries.<sup>155</sup> Under the current trend of conditions, by the year 2040, the San Joaquin Valley is expected to lose \$441 million in crop value, \$63 million in retail sales, and \$123 million in personal

---

145. *Id.* Fifty-six percent of the state's 1991 agricultural revenue of \$17.9 billion is equal to \$10.1 billion in revenue. *Id.* Agricultural makes up 53% of California's commodity exports. SJVDP, *supra* note 25, at 52.

146. BRICKSON, *supra* note 5, at 14.

147. *Id.*

148. *Id.*; *see id.* (reflecting 1990 statistics).

149. SJVDP, *supra* note 25, at 51.

150. *Id.*

151. SLUDP, *supra* note 26, at 182-83. California's median family income in the late 1980s was approximately \$37,700, whereas in most San Joaquin Valley communities, the median ranged between \$16,000 and \$19,000. *Id.* In 1980, the farm workers in Westlands were some of the poorest people in California with 10-21% percent living below the poverty line. *See* DAWDY, *supra* note 114, at 83. Unemployment in agribusiness counties from January 1982 to December 1984 was double the state rate. *Id.* The community of Mendota, located in the heart of the valley, with only 6000 permanent residents received \$8 million in unemployment benefits for 1984 (paid to permanent residents, not migrant workers). *Id.* at 84.

152. SJVDP, *supra* note 25, at 20; *see supra* note 71 (defining "problem water").

153. SJVDP, *supra* note 25, at 21.

154. HANSON, *supra* note 105, at 8.

155. *Id.*

income.<sup>156</sup> This results in a total loss of \$627 million with a corresponding loss of 9200 jobs.<sup>157</sup>

## 2. Ecological Interests

The San Joaquin Valley plays an enormous role in the life cycle of a great diversity of wildlife species. Birds are especially dependent on the valley's natural environs. Migratory birds of the Pacific flyway rely on the valley's river system to provide critical winter habitat.<sup>158</sup> Millions of birds, including 30 percent of all migratory waterfowl in the Central Valley, winter in the Grasslands' wetlands in the San Joaquin Valley.<sup>159</sup> Grasslands supports 200 species of birds including seventeen listed by either the Federal or California governments as endangered, threatened, candidates for endangered listing, or species of concern.<sup>160</sup> Besides birds, many species of fish depend on the San Joaquin River and its tributaries. The river is home to a fall-run of chinook salmon, which may soon be proposed for protection under the federal Endangered Species Act.<sup>161</sup> Approximately 200,000 acres of land and wetlands throughout the valley,

---

156. SJVDP, *supra* note 25, at 83.

157. *Id.* at 83-84. Despite the estimates of specific impacts to the existing structure of the agriculture based economy, it is uncertain what the net effects to the agricultural and general economy in the future will be. *See id.* at 83-85. Changes in cropping patterns, land use, and the freeing up of more water could create opportunities to restructure and reinvest in higher value agricultural products or other non-agricultural industries, services, or uses. *See generally id.* at 50-56, 83-85 (detailing agricultural based interests and corresponding threatened losses).

158. Presser, *Bioaccumulation*, *supra* note 128, at 433; *see id.* (explaining that wetlands provide food and habitat to both migratory and resident birds).

159. BRICKSON, *supra* note 5, at 14; U. S. FISH & WILDLIFE SERVICE, U. S. DEP'T OF INTERIOR & DEP'T OF FISH & GAME, STATE OF CALIFORNIA, SAN JOAQUIN BASIN ACTION PLAN/KESTERSON MITIGATION PLAN 5 (1989) [hereinafter ACTION PLAN]. Millions of migratory waterfowl, cranes and shorebirds spend all or part of the winter in the Grasslands, including 42 species of ducks, geese, cranes, hawks, herons, owls, stilts, egrets, avocets, curlews, harriers, kites, and kestrels. Eleven species of ducks breed, and more than seventy species of birds nest in the Grasslands. *Id.*; *see supra* note 99 (describing the Grasslands sub area as part of the divisioning of the valley).

160. ACTION PLAN, *supra* note 159, at 5. Of the seventeen species, there are: three federally listed endangered species—Aleutian Canada goose, southern bald eagle, and peregrine falcon; two California listed threatened species—Swainson's hawk and greater sandhill crane; three federal candidate species—white-faced ibis, tricolored blackbird, and fulvous whistling duck; and nine California species of concern—western snowy plover, white pelican, double-crested cormorant, sharp-shinned and Cooper's hawks, golden eagle, prairie falcon, willow flycatcher, and yellow warbler. *Id.* As of 1990, there were a total of 29 plant and animal species in the San Joaquin Valley listed by the federal or California governments as endangered. SJVDP, *supra* note 25, at 57.

161. McCLURG, *supra* note 30, at 11. The flow of discharged subsurface drainage into the San Joaquin River from Grasslands tributaries has been significant enough to attract salmon to swim up into these polluted waters, away from their natural spawning grounds on the Merced River. SJVDP, *supra* note 25, at 85-86.



including nine major public wildlife areas, are managed primarily for the benefit of fish and wildlife.<sup>162</sup>

The San Joaquin River plays a similarly important role in the vitality of the Sacramento-San Joaquin Delta. The Delta is formed by the convergence of the San Joaquin and Sacramento Rivers, with its waters flowing into the San Francisco Bay.<sup>163</sup> The Delta is one of the most important habitats for fish in California.<sup>164</sup> The Delta supports 130 species of fish, 380 species of animals, and provides important wintering habitats to millions of ducks and geese on the Pacific flyway.<sup>165</sup> The Delta is also home to several fish species that are listed or proposed for listing as threatened species.<sup>166</sup> Fresh San Joaquin River water flowing into the Delta is crucial for the maintenance of Delta fish and other wildlife habitat.<sup>167</sup>

Healthy fish and wildlife habitats in both the San Joaquin Valley and the Delta are dependent upon water sources that contain at most very low levels of selenium.<sup>168</sup> Selenium entering habitats used by fish and wildlife can buildup in the food sources at many times the concentration of the surrounding water and pose a major threat to fish and wildlife species.<sup>169</sup> Agricultural drainage from farms on the west side of the San Joaquin Valley is a primary source of selenium.<sup>170</sup> How irrigators choose to dispose of the drainage water—such as discharge to wetlands, river tributaries, or evaporation ponds—determines which habitats in the region are impacted by selenium and to what degree.

Irrigators in the northern portion of the west side of the San Joaquin Valley are able to discharge directly to the San Joaquin River system.<sup>171</sup> Only a portion of the northern area, however, is responsible for most of the selenium in the

---

162. SJVDP, *supra* note 25, at 21. Included in this area are six national wildlife refuges: the San Joaquin River NWR, the San Luis NWR, the Kern NWR, the Kesterson NWR, the Merced NWR, and the Pixley NWR. There are three state wildlife areas—the Los Banos WA, the Mendota WA, and the Volta WA; and 75,000 acres of wetlands in the Grasslands Resource Conservation District near Los Banos. *Id.* at 22. As of 1990, firm freshwater supplies equaled only 30% of the 400,000 acre feet of freshwater needed per year to optimally manage these areas. *Id.* at 57.

163. MCCLURG, *supra* note 30, at 2-3.

164. *Id.* at 2. It is estimated that 25% of all warm water and migrating sport fish species as well as 80% of California's commercial fishery species either live in, or migrate through the Delta. *Id.*

165. *See id.* at 12.

166. *Id.* The Delta smelt is listed as threatened under both state and federal endangered species acts. The Sacramento splittail and longfin smelt are candidate species for ESA protection. *Id.*

167. *See id.* at 7 (summarizing the role of fresh water from both the Sacramento and San Joaquin Rivers in the creation Delta habitats).

168. *See infra* notes 185-98 and accompanying text (describing selenium's toxic threat to fish and wildlife).

169. *See id.* (discussing how selenium can quickly accumulate in fish and wildlife to toxic levels).

170. *See supra* notes 79-84 and accompanying text (identifying geologic sources of selenium in the San Joaquin Valley).

171. The San Joaquin Basin forms the northern of half of the San Joaquin Valley and drains to the San Joaquin River. *See supra* note 121 (discussing the valley's two drainage basins).

river.<sup>172</sup> Eighty-one percent of selenium in the San Joaquin River comes from the subsurface drainage of 94,480 acres.<sup>173</sup> The selenium in the drainage from this relatively small agricultural area has played a significant role in making the San Joaquin River the most seriously affected major river in California.<sup>174</sup> Drainage discharges into the San Joaquin River likewise imperils the health of fish and wildlife in the Sacramento-San Joaquin Delta.<sup>175</sup>

Irrigators in much of the western portion of the valley are outside of the San Joaquin River's drainage basin.<sup>176</sup> Because these irrigators are unable to discharge to the river, they are forced to rely on evaporation ponds to dispose their drainage water.<sup>177</sup> By their evaporative nature, these ponds concentrate constituents such as selenium to levels many times that of incoming drainage waters.<sup>178</sup> Moreover, these ponds attract aquatic birds, waterfowl, as well as predator species.<sup>179</sup> The level of selenium in many of these ponds poses an extremely serious contamination hazard to wildlife.<sup>180</sup>

Accurately estimating the ecological threat from selenium laden subsurface drainage is difficult because of uncertainty concerning the degree of exposure and

---

172. Gerald E. Johns, *Executive Summary: Regulation of Agricultural Drainage to the San Joaquin River*, in SELENIUM & AGRICULTURAL DRAINAGE, *supra* note 135, at 198, 202; see SJVDP, *supra* note 25, at 28, 33 (depicting selenium concentrations found in the soils and shallow groundwater of the west side).

173. Johns, *supra* note 172, at 202. Prior to 1985, most subsurface drainage was either discharged to evaporation ponds or mixed with surface drainage and freshwater for use in wetlands management. SJVDP, *supra* note 25, at 18. Discharges of subsurface drainage to wetlands such as in the Grasslands provided a buffer to the San Joaquin river against rapid loading of selenium. See Michael K. Saiki, *Selenium and Other Trace Elements in Fish from the San Joaquin Valley and Suisun Bay*, in SELENIUM & AGRICULTURAL DRAINAGE, *supra* note 135, at 35-36. In 1984, water entering Grasslands wetlands averaged 40 ppb selenium. Holthem, *Reproductive Success*, in SELENIUM & AGRICULTURAL DRAINAGE, *supra* note 135, at 72-73. This average is eight to twenty times the no-effect level for fish and wildlife. See *infra* notes 185-98 and accompanying text (discussing selenium toxicity in fish and wildlife). After the 1985 closure of Kesterson Reservoir evaporation ponds, wetlands managers, fearing the toxic effects of selenium, discontinued the use of subsurface drainage for habitat management, electing instead to discharge directly to the San Joaquin river. Saiki, *supra*, at 36. As a result of these changes in the management of Grasslands wetlands, selenium levels doubled in the San Joaquin river immediately downstream of the Grasslands with a corresponding two and a half fold increase in the annual selenium loading of the river. *Id.* As much as 56,000 acre feet annually of subsurface drainage continues to be discharged from the Grasslands area to the San Joaquin river. SJVDP, *supra* note 25, at 18.

174. See BRICKSON & DUCAN, *supra* note 54, at 15 (summarizing water quality problems in the San Joaquin River).

175. The San Joaquin River is the single biggest source of selenium in the Delta, depositing 4.2 metric tons annually. HANSON, *supra* note 105, at 7.

176. See *supra* note 121 and accompanying text (discussing the valley's two drainage basins). Evaporation ponds used mainly in the Tulare Basin at the southern end of the valley continue to increase. See SJVDP, *supra* note 25, at 59.

177. SJVDP, *supra* note 25, at 59.

178. See *id.* at 41.

179. *Id.* at 85.

180. *Id.*

individual species' resistance to selenium.<sup>181</sup> However, recent studies indicate that potentially toxic levels of selenium are collecting in fish and wildlife in regions from the southern San Joaquin Valley to the San Francisco Bay.<sup>182</sup>

#### IV. INHERENT DIFFICULTIES IN MANAGING THE SELENIUM CONTAMINATION OF AN AQUATIC ENVIRONMENT

The Kesterson disaster demonstrated the extreme sensitivity of fish and wildlife to selenium poisoning and the need for tough regulation of selenium levels in aquatic environments. Since Kesterson, efforts to minimize exposure of fish and wildlife to selenium has focused on regulating the concentration of selenium found in water.<sup>183</sup> However, the ambient selenium concentration in a water body is both difficult to determine and is not an accurate indicator of the total amount of selenium to which fish and wildlife are exposed within an aquatic environment.<sup>184</sup> In essence, managing selenium levels in water bodies to prevent harm to fish and wildlife is a three-fold problem.

##### A. Bioaccumulative and Toxic Properties of Selenium

Fish and wildlife are both very sensitive to selenium, and naturally accumulate selenium within their tissues. For many organisms, including humans and other mammals, selenium is both an essential-nutrient and a toxin.<sup>185</sup> How

---

181. See Perry L. Herrgesell, *Selenium Monitoring in Fish and Water-Related Birds in California: 1986 Results*, in SELENIUM & AGRICULTURAL DRAINAGE, *supra* note 135, at 50, 56-57; See also Harry M. Ohlendorf et al., *Environmental Contaminants and Diving Ducks in San Francisco Bay*, in SELENIUM & AGRICULTURAL DRAINAGE, *supra*, at 62, 62-68; Saiki, *Selenium and Other Trace Elements in Fish from the San Joaquin Valley and Suisun Bay*, in SELENIUM & AGRICULTURAL DRAINAGE, *supra*, at 39-47 (describing selenium toxicity).

182. Significant adverse biological effects from contaminated drainage have been documented in 58% of the ponds studied (representing 60% of all the valley's evaporation ponds). SJVDP, *supra* note 25, at 59. Biological monitoring of the Kesterson Reservoir area found selenium in every animal species coming in contact with Kesterson including fish, birds, insects, frogs, snakes, and small mammals. Lemly, *Irrigation Drainage*, *supra* note 112, at 160-61. Although many of these animals have not displayed serious effects from selenium bioaccumulation, the presence of selenium in them is, nonetheless, of concern because they form the food chain of predatory birds and the endangered San Joaquin Kit Fox, which may be much more susceptible to selenium poisoning. *Id.*; see also HANSON, *supra* note 105, at 11 (suggesting that Kesterson is not an isolated selenium poisoning phenomenon but only the tip of the iceberg).

183. See 40 C.F.R. § 131.36 (1995).

184. The San Joaquin Valley Drainage Program's Final Report acknowledges that the regulation of water-borne selenium concentrations alone may not be sufficient to protect fish and wildlife values. SJVDP, *supra* note 25, at 70; see *id.* ("Efforts are under way to increase protection from additional potentially harmful substances introduced into the environment and to lower the permissible concentration of a toxicant or contaminant in the environment . . . [i]t is possible that even more stringent standards for environmental protection may apply in the future.")

185. Richard M. Jacobs, *Selenium: Foods and Man*, in SELENIUM & AGRICULTURAL DRAINAGE, *supra* note 135, at 180, 181. In human adults, intake of selenium below 15 micrograms per day can result in Keshan disease, a selenium deficiency syndrome, while intake of selenium above 200 micrograms per day is considered

ever, there is a delicate balance between selenium nutrition and poisoning.<sup>186</sup> Selenium has the smallest margin of any essential element between what is safe and what is toxic.<sup>187</sup> Yet, many organisms bioaccumulate<sup>188</sup> selenium at many times the concentration of the surrounding levels in the environment.<sup>189</sup> As a result, a slight increase of selenium in the surrounding environment can cause a disproportionate increase of selenium in organisms, rapidly crossing the threshold from benign nutrient to deadly toxin.<sup>190</sup> The bioaccumulation process typically begins at the bottom of the food-chain.<sup>191</sup> Lower food chain organisms take up relatively low levels of selenium mainly from organic particles and sediment.<sup>192</sup> Selenium concentrations bioaccumulate in the lower-food chain organisms,<sup>193</sup> often to levels 500 times the concentration of the surrounding water.<sup>194</sup> Feeding organisms higher in the food-chain ingest these lower-organisms, often

---

the upper safe limit by the National Academy of Sciences. *Id.* Dr. Jacobs, former chief of the Nutrient Toxicity Section of the Center for Food Safety and Applied Nutrition in Washington D.C., currently works for the Food and Drug Administration. *Id.* at 180.

186. See A. Dennis Lemly, *Cycling of Selenium in the Environment*, in SELENIUM & AGRICULTURAL DRAINAGE, *supra* note 135, at 113, 113-21.

187. Presser, *Kesterson Effect*, *supra* note 80, at 450.

188. Bioaccumulation is "[t]he process by which an individual organism concentrates a substance within its tissues to a level greater than that found in the surrounding environment." HANSON, *supra* note 105, at 3.

189. See Lemly, *Cycling of Selenium in the Environment*, in SELENIUM & AGRICULTURAL DRAINAGE, *supra* note 135, at 115-18 (describing how selenium is bioaccumulated by organisms).

190. *Id.* at 113-21. The toxic effect of selenium on fish and wildlife has various manifestations depending on the level of selenium in the animal. See A. DENNIS LEMLY, AQUATIC CYCLING OF SELENIUM: IMPLICATIONS FOR FISH AND WILDLIFE 5 (U.S. Dep't of the Interior, Fish & Wildlife Service / Fish & Wildlife Leaflet 12, 1987) [hereinafter LEMLY, AQUATIC CYCLING]. Lesser levels of selenium can cause complete reproductive failure in adults without adult mortality. Higher levels of selenium can cause adult mortality or reduce immunity to other deadly ailments. *Id.* Generally, 5 parts per billion (ppb) in water will bioaccumulate to routinely cause reproductive failure in adult fish. However, several factors, such as water temperature, nutrition, differences in species sensitivity, disease, and other biologic stresses can significantly alter the amount of selenium accumulation in a species needed to cause toxic effects. *Id.* See generally A. Dennis Lemly, *Metabolic Stress During Winter Increases the Toxicity of Selenium to Fish*, 27 AQUATIC TOXICOLOGY 133, 133-58 (1993) (providing analysis of seasonal factors effecting selenium toxicity to fish); Lemly, *Guidelines*, *supra* note 80, at 94 (recommending establishment of safe waterborne levels of selenium at 2 ppb); Presser, *Bioaccumulation*, *supra* note 128, at 430 (noting that the United States Fish and Wildlife Service is currently considering 2.3 ppb waterborne selenium as the standard necessary for protection of fish and wildlife).

191. Lemly, *Guidelines*, *supra* note 80, at 90. The pathway for selenium to enter fish and birds is predominately dietary, not directly from water. Even so, small increases in waterborne selenium indirectly can cause substantial accumulations in the fish and wildlife. *Id.*; LEMLY, AQUATIC CYCLING, *supra* note 190, at 3-5.

192. LEMLY, AQUATIC CYCLING, *supra* note 190, at 2-3. Rooted plants, bottom dwelling invertebrates, and bottom feeding fish take up the selenium, cycling it into the food chain. Plants absorb the selenium through their roots. *Id.*

193. In other words, selenium builds up in the lower-organisms. See *supra* note 188 and accompanying text (defining "bioaccumulation").

194. LEMLY, AQUATIC CYCLING, *supra* note 190, at 4-5.

bioconcentrating<sup>195</sup> selenium to concentrations four times that of their food source.<sup>196</sup> The selenium concentration in the higher-feeding organism in this example would be 500 multiplied by 4, or 2000 times the concentration of the water.<sup>197</sup> Thus, higher-feeding organisms, such as fish, birds, and mammals can receive toxic quantities of selenium in their diets even though the concentration in water is low.<sup>198</sup>

*B. Accurately Measuring Selenium Contamination in an Aquatic Environment*

The extreme sensitivity of fish and wildlife to selenium demonstrates the need to limit fish and wildlife exposure to selenium in order to protect them from poisoning. To determine if poisonous concentrations of selenium are present, a regulatory program must have a method for measuring the quantity of selenium available to fish and wildlife in their environment. However, for the reasons presented below, it is difficult to accurately determine the amount of selenium in a given aquatic environment. This makes it difficult to know if poisonous concentrations of selenium are present.

There are three primary reasons why selenium contamination is difficult to accurately measure. First, selenium is chemically dynamic—it is able to chemically bond with many different substances.<sup>199</sup> Sampling for selenium in a limited number of chemical forms may not provide an accurate estimate of its presence.<sup>200</sup> This makes accurate detection of selenium laborious because it requires testing for selenium in different chemical forms.<sup>201</sup> Second, selenium accumulates in three different media: water, sediments, and organisms.<sup>202</sup> This

---

195. Bioconcentration is “[t]he process by which a substance is passed up the food chain resulting in an especially high level of the substance at upper levels of the food chain.” HANSON, *supra* note 105, at 3.

196. LEMLY, *AQUATIC CYCLING*, *supra* note 190, at 4-5.

197. *Id.*

198. *Id.* Waterborne levels as low as 0.5 to 3.0 ppb can buildup in fish and wildlife to toxic levels of 10 to 20 ppm. Lemly, *Guidelines*, *supra* note 80, at 92-94. In 1983, the drainage water entering Kesterson Reservoir contained about 300 ppb selenium. Holthem, *Reproductive Success of Birds in the Grasslands*, in *SELENIUM & AGRICULTURAL DRAINAGE*, *supra* note 135, at 72.

199. See Presser, *Bioaccumulation*, *supra* note 128, at 423-25 (discussing the chemical nature of selenium).

200. See *id.* at 424-25 (noting that the guidelines given for selenium contamination do not specify the chemical form).

201. See *id.* at 423-25 (describing the chemical movement of selenium in an aquatic environment and the varying chemical forms in which it is encountered). In the past, the Bureau of Reclamation has found it difficult to accurately measure selenium in water samples and has had to ask the U. S. Geologic Survey to perform sampling and supervise the Bureau's sampling. DAWDY, *supra* note 114, at 115-16.

202. LEMLY, *AQUATIC CYCLING*, *supra* note 190, at 1-4; Lemly, *Guidelines*, *supra* note 80, at 93-94; see Presser, *Bioaccumulation*, *supra* note 128, at 432-33 (detailing the accumulation of selenium in food-chain pathways).

requires cross-sampling in an ecosystem in order to accurately measure the total presence of selenium from all three media.<sup>203</sup>

Finally, selenium concentrations in organisms, water, and sediments vary under localized conditions.<sup>204</sup> This increases the difficulty of accurately measuring selenium within an ecosystem.<sup>205</sup> Under stable conditions, selenium cycles between water and sediment at a constant rate, eventually establishing an equilibrium.<sup>206</sup> However, local environmental factors that effect the nature of a habitat, including the type of bottom sediment, water speed, and depth, create unique, localized equilibria and concentrations of selenium in the water and sediment.<sup>207</sup> Consequently, the degree to which selenium accumulates in fish and wildlife varies among habitats according to intensity of use, type of use, and the relative contributions of the environmental factors that effect selenium cycling.<sup>208</sup> Sampling of selenium within an ecosystem to determine the total amount present, therefore, must consider the role of the physical environment in the selenium cycle and its effect on the variability of selenium to fish and wildlife.<sup>209</sup>

### C. The Buildup of Selenium in an Aquatic Ecosystem

The rate that selenium leaves an aquatic environment is typically slower than the rate it enters, causing a buildup of selenium in the ecosystem.<sup>210</sup> Selenium entering an aquatic environment goes through several physical stages whereby it either enters the food chain through consumption by plants and microorganisms or accumulates in sediment on the bottom of the water body, preventing its timely exit from the ecosystem.<sup>211</sup> Whether selenium entering an aquatic environment is

---

203. Presser, *Bioaccumulation*, *supra* note 128, at 432-33.

204. LEMLY, AQUATIC CYCLING, *supra* note 190, at 3-4 (noting the effects of environmental variables on selenium concentration).

205. *Id.*

206. *Id.* at 8. In slow-moving or still-water habitats and wetlands, nearly 90% of the total selenium in the aquatic system may collect within the upper inch of sediment. *Id.* at 2. However, the sediment is eventually reintroduced into the water by agitation from wind, current, and the feeding action of microorganisms, fish, and birds. *Id.* The mixing causes the settled selenium to move out of sediment and into the water. *Id.* at 2-3.

207. *Id.* at 3-4; see Presser, *Bioaccumulation*, *supra* note 128, at 432-33 (noting that the capacity of sediment to incorporate selenium varies depending upon the nature of the sedimentary material). See generally Presser, *Bioaccumulation*, *supra*, at 424-33 (describing chemical and biological variables involved in the uptake of selenium into the food-chain).

208. LEMLY, AQUATIC CYCLING, *supra* note 190, at 3-4.

209. *Id.* at 4; Presser, *Bioaccumulation*, *supra* note 128, at 430; see SJVDP, *supra* note 25, at 71 (proposing that the "basic strategy of monitoring should be to identify and collect information on biota, soils, and the water regime").

210. See generally LEMLY, AQUATIC CYCLING, *supra* note 190, at 1-8 (describing how selenium becomes incorporated into aquatic plants, sediment, and organisms, and is slow to leave the ecosystem).

211. *Id.* at 1-2. Selenium entering an aquatic environment—such as at Kesterson—tends to become incorporated into bottom sediment. This process of immobilization occurs when selenium reacts with rich organic matter found in the drain water and sediment material. *Id.*; see Presser, *Bioaccumulation*, *supra* note 128, at 432 (noting that organic matter is found to increase selenium loading in sediment).

incorporated in bottom sediment or consumed by organisms, the measurable selenium concentration in the water may eventually decrease to very low levels.<sup>212</sup>

However, the total amount of selenium throughout the surrounding environment may remain very high due to the accumulation of selenium in plants, aquatic organisms, and sediment.<sup>213</sup> Thus, the water concentration of selenium in biologically active water bodies does not provide an accurate scale for measuring the total quantity of selenium present.<sup>214</sup> Water sampling may give a very misleading indication of the amount of selenium exposed to fish and wildlife.<sup>215</sup> The selenium continues to cycle between organisms, sediment, and solution, causing sustained high levels in plants, fish, and wildlife long after the importing of selenium has ceased.<sup>216</sup>

#### *D. Conclusions*

The combination of these three management problems creates significant uncertainty in determining the actual level of selenium present in the ecosystem, amplifying the possibility that a drainage water disposal plan will accidentally overload an aquatic environment with a toxic quantity of selenium. This has prompted some in the scientific community to call for a definition of selenium contamination that is formulated on an ecosystem level and not simply measured by selenium concentrations in water.<sup>217</sup>

---

212. LEMLY, *AQUATIC CYCLING*, *supra* note 190, at 1.

213. *Id.*

214. Presser, *Bioaccumulation*, *supra* note 128, at 432.

215. *See id.*

216. LEMLY, *AQUATIC CYCLING*, *supra* note 190, at 1. Ecosystem-wide recovery to non-toxic levels is estimated to take anywhere from several years to several decades since selenium is not easily removed from an aquatic environment. *Id.* at 8. Recovery time tends to be longer in a standing or slow moving water environment. *Id.* Evaporation ponds, drainage canals, and some tributaries and sections of the San Joaquin River itself fall into the category of slow moving or still water. While this environment provides optimal conditions for selenium buildup in sediment, it is also ideal for feeding and breeding habitats. *Id.* at 3-4. Under these conditions, the bioaccumulative process is both accelerated by intensive habitat use, and prolonged by the cycling of sedimentary selenium. *Id.* There are four ways selenium is naturally removed from an ecosystem: "(1) movement of selenium-contaminated organisms out of the system, as when fish and wildlife emigrate or aquatic insects emerge; (2) release of volatile selenium from plants and water directly to the atmosphere; (3) removal by sediment and water transport (flushing) and groundwater seepage; and (4) burial by the process of sedimentation." *Id.* at 8. Removal of selenium under each process however requires some other environment to receive the selenium. However, removal of selenium from an ecosystem does not mean the contamination threat from selenium is neutralized. Rather, the threat is passed from one environment to another. For example, water current flushing of selenium in the San Joaquin River simply moves the selenium from the source streams that feed the selenium into the river to the lower reaches of the river and the Bay-Delta Estuary, where it continues to pose a toxic threat.

217. *See* Presser, *Bioaccumulation*, *supra* note 128, at 433 (concluding that selenium contamination must be approached from an ecosystem level); Lemly, *Guidelines*, *supra* note 80, at 94 (stating that in addition to a waterborne analysis of selenium, tissue sampling is needed to provide an accurate assessment of selenium levels and ecosystem health). *See generally* Johns, *Executive Summary: Regulation of Agricultural Drainage to the San Joaquin River*, in *SELENIUM & AGRICULTURAL DRAINAGE*, *supra* note 135, at 202-07 (recognizing

Relying on water as the medium in which to measure selenium in an ecosystem, and hence on which to focus regulation, only gives a partial and potentially very misleading picture of the selenium threat to fish and wildlife.<sup>218</sup> The toxic risk from selenium to an ecosystem comes from the total quantity of selenium present throughout the ecosystem in water, sediment, plants, microorganisms, fish, and wildlife.<sup>219</sup> Although drainage water and the accompanying sediment are the primary sources of selenium entering a water body, the toxic impact of selenium delivered to an aquatic ecosystem is a function of the absolute quantity of selenium in the incoming sediment and drainage water, *not* simply its water concentration in the receiving environment.<sup>220</sup> Dilution may reduce the rate of absorption into an ecosystem, however, it does not necessarily prevent the same quantity from being absorbed.<sup>221</sup> In other words, reducing the concentration of selenium in drainage water by adding freshwater does not necessarily increase the assimilative capacity<sup>222</sup> of the surrounding environment.<sup>223</sup> Pollution control regulations for disposal of drainage water that rely on dilution to prevent serious threats to fish and wildlife from selenium poisoning may in fact be fatally flawed.<sup>224</sup> Because fish and wildlife are so sensitive to minor increases in waterborne and sedimentary selenium, disposal options for

---

the importance of considering characteristics of water bodies as well as the bioaccumulative process in managing selenium contamination).

218. See *supra* notes 210-16 and accompanying text (describing how selenium levels decrease in water while selenium in the surrounding environment remains high).

219. See *supra* notes 188-98 and accompanying text (outlining how selenium entering an aquatic environment is absorbed by fish and wildlife); *supra* notes 211-16 and accompanying text (summarizing how selenium collects in sediment and cycles between sediment, water, plants, lower organisms, fish, and wildlife).

220. See LEMLY, AQUATIC CYCLING, *supra* note 190, at 4-5 (describing how waterborne selenium eventually enters the food chain, reducing the water concentration of selenium, by becoming incorporated into sediment, plants, and other organisms); Lemly, *Guidelines*, *supra* note 80, at 90 (reporting that most researchers agree that selenium enters organisms primarily through diet, not directly from water); *id.* at 92-94 (noting that there is generally a substantially higher concentration of selenium in the food-chain organisms than water).

221. See generally Lemly, *Irrigation Drainage*, *supra* note 112, at 174. Dilution of dissolved selenium in a moving body of water could reduce absorption in the immediate surrounding environment (the selenium would be carried away before it could enter sediment, bind with organic particles, or be taken up by the food chain). See *id.* Of course, relying on dilution in moving water simply rids one environment of selenium by polluting another.

222. Assimilative capacity is the ability to incorporate a substance without adverse impact.

223. See Lemly, *Irrigation Drainage*, *supra* note 112, at 174 (suggesting that receiving waters generally have almost no capacity to provide effective dilution of selenium arriving in drainage).

224. See Presser, *Bioaccumulation*, *supra* note 128, at 424 (proposing that there is a fundamental problem with disposal of drainage water to wetlands); see also Lemly, *Irrigation Drainage*, *supra* note 112, at 174 (stating that even slight increases in waterborne selenium can begin the bioaccumulative/toxicity cascade).



selenium laden drainage that utilize dilution and discharge to fish and wildlife habitats may not be possible in any form without serious adverse effects.<sup>225</sup>

## V. THE CENTRAL VALLEY PROJECT IMPROVEMENT ACT

### A. Introduction

In the fall of 1992, President George Bush signed into law the Reclamation Projects Authorization and Adjustment Act of 1992.<sup>226</sup> Title 34 of this new act was given its own name by lawmakers—the Central Valley Project Improvement Act (CVPIA).<sup>227</sup> The CVPIA is a notable milestone in western reclamation legislation. Devoted entirely to reform rather than the initiation of new federal water development projects, the CVPIA marks the emergence of a new environmental sensitivity in CVP reclamation law.<sup>228</sup> Yet, while the CVPIA represents a long awaited paradigm shift in the thinking behind federal water policy, it fails to take meaningful action toward solving the problems posed by agricultural drainage to fish and wildlife in the San Joaquin Valley.

The CVPIA was intended to address the environmental harms caused by the CVP.<sup>229</sup> In many ways, the CVPIA is a remarkably bold piece of legislation. Most significantly, the Act advances an enlightened understanding of the value of leaving water in-stream in order to maintain healthy fish and wildlife environ-

---

225. See Lemly, *Irrigation Drainage*, *supra* note 112, at 174 (suggesting that the unique toxic nature of selenium warrants a departure from the typical National Pollutant Discharge Elimination System (NPDES) permit process, which relies on estimated minimum dilution factors to qualify discharge as safe).

226. Reclamation Projects Act of 1992, Pub. L. No. 102-575, §§ 3401-3412, 106 Stat. 4600.

227. § 3401, 106 Stat. at 4706.

228. See Dunning, *supra* note 6, at 943-44 (proposing that the CVPIA represents a major shift in thinking about federal water policy in California). See generally DAWDY, *supra* note 114, at 7-17 (discussing the early political and legislative history surrounding the 1902 Reclamation Act).

229. Reclamation Projects Act of 1992, Pub. L. No. 102-575, §§ 3401-3412, 106 Stat. 4600, 4706-31. The purposes of the Act are broad as announced, with an overriding theme to redress the negative impacts of the CVP on fish and wildlife resources:

The purposes of this title shall be —

(a) to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley and Trinity River basins of California;

(b) to address impacts of the Central Valley Project on fish, wildlife, and associated habitats;

(c) to improve the operational flexibility of the Central Valley Project;

(d) to increase water-related benefits provided by the Central Valley Project to the State of California through expanded use of voluntary water transfers and improved water conservation;

(e) to contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary;

(f) to achieve a reasonable balance among competing demands for use of Central Valley Project water, including the requirements of fish and wildlife, agricultural, municipal and industrial and power contractors.

§ 3402, 106 Stat. at 4706.

ments throughout Central Valley rivers and the Bay-Delta Estuary.<sup>230</sup> This new way of thinking officially rejects the original premise of the CVP: that the waters of the Central Valley allowed to flow to the sea were simply being wasted.<sup>231</sup> Since its inception, the de facto goal of the Bureau of Reclamation has been to “put every drop of water to work.”<sup>232</sup> Work was essentially synonymous with “beneficial use,” which traditionally meant, among other things, irrigation, domestic uses, and power generation.<sup>233</sup> Under the CVPIA, the definition of “beneficial use” is effectively expanded to include fish and wildlife protection and restoration.<sup>234</sup> Hence, the de facto slogan remains but its meaning has changed. Water allowed to flow down stream in significant quantities is recognized as performing a vital function: working to maintain fish and wildlife habitat.

### B. A Limited Response to the Drainage Problem

In comparison to its progressive acknowledgment of the importance of allocating water to maintain fish and wildlife, the CVPIA is relatively non-assertive in its efforts to remedy other types of environmental impacts created by the CVP. Specifically, the CVPIA practically ignores the generation of agricultural drainage and its significant deleterious effects on crops, as well as fish,

---

230. The Act contains numerous measures to increase the quantity of water and the quality of aquatic habitat for fish and wildlife. Some of the more notable measures include the following: setting a goal to double existing anadromous fish (salmon and steelhead) populations by the year 2002, § 3406(b)(1), 106 Stat. at 4714; dedicating 800,000 acre-feet of CVP water for fish and wildlife habitat restoration purposes, § 3406(b)(2), 106 Stat. at 4715-16; meeting flow standards and diversion limits set by California and federal law, § 3406(b)(7), 106 Stat. at 4717; installing a structural temperature control device at Shasta Dam to better regulate water temperature in order to protect anadromous fish in the upper Sacramento River, § 3406(b)(6), 106 Stat. at 4717; making pulse flow releases of water from project dams to increase survival of migrating fish, § 3406(b)(8), 106 Stat. at 4717; improving fish passage at the Red Bluff Diversion Dam, § 3406(b)(10), 106 Stat. at 4717-18; making fish hatchery improvements and operations modifications for efficient operation during flow releases, § 3406(b)(11), 106 Stat. at 4718; developing a comprehensive program to provide flows from Whiskeytown Dam to improve reproductive success of salmon and steelhead, § 3406(b)(12), 106 Stat. at 4718; providing firm water supplies of sufficient quality so as to maintain and improve Central Valley wildlife refuges, § 3406(d), 106 Stat. at 4722-24.

231. See generally Dunning, *supra* note 6, at 946-51 (sketching the contours of the traditional water use ethic).

232. *Id.* at 949; see *id.* (quoting California Governor Earl Warren in his speech to the California Water Conference in 1945).

233. Act of August 26, 1937, ch. 832, 50 Stat. 850; see *id.* (authorizing construction, repair, and preservation of certain public works on rivers and harbors, among other purposes).

234. Under CVP authorization legislation, project preferences are divided into three tiers of priorities: the first tier of preferences includes only navigation improvement, flood control, and river regulation; the second tier includes irrigation and domestic uses; the third tier includes power generation. See Act of Aug. 26, 1937, ch. 832, 50 Stat. at 850 (describing preferences in each tier). The CVPIA elevates fish and wildlife mitigation, protection, and restoration to the second tier, the same level of priority as irrigation and domestic uses. See Reclamation Projects Act, § 3406(a)(1), 106 Stat. at 4714. Fish and wildlife enhancement are elevated to the third tier, the same level as power generation. See § 3406(a)(2), 106 Stat. at 4714.

wildlife, and their habitats.<sup>235</sup> Agricultural drainage is expressly addressed by the Act in only three sections.<sup>236</sup> These sections do little to directly confront the drainage problem.

Under section 3405(e), the Secretary of the Interior is only required to promote drainage source reduction that is *reasonably achievable* as defined by cost-effectiveness and *best management practices*.<sup>237</sup> The goal of section 3405 is primarily water conservation.<sup>238</sup> Thus, the terms of section 3405 apply to agricultural drainage only in the context of reducing drainage volume as the result of applying less water. The section does not address drainage toxicity or the prevention of toxic constituents of drainage water from being introduced to wildlife habitat.<sup>239</sup>

Section 3405(c) places responsibility for compliance with water quality standards on the agency or district contracting for CVP water.<sup>240</sup> This section may be of marginal value, if any. First, the section does not supersede the Bureau's obligations to provide drainage service.<sup>241</sup> Second, compliance with water quality standards produces results only as good as the standards. As discussed in Part IV, above, current water quality standards may be inadequate.<sup>242</sup>

---

235. See *Agricultural Drainage Issues in the Central Valley, California: Oversight Hearing before the Subcomm. on Oversight and Investigations of the Comm. on Natural Resources*, 103rd Cong., 1st Sess. 13 (1993) (statement of Daniel P. Beard, Commissioner, Bureau of Reclamation) [hereinafter *Oversight Hearing*] (testifying that the CVPIA did little to address the drainage problem).

236. See Reclamation Projects Act, § 3405(e)(3), 106 Stat. at 4713-14 (directing the Secretary to give substantial deference to the recommendations for drainage source reduction contained in the Final Report of the San Joaquin Valley Drainage Program when developing water conservation best management practice criteria); *id.* § 3405(c), 106 Stat. at 4712 (requiring CVP contracts to provide that the contracting district or agency be responsible for compliance with all applicable State and Federal water quality standards applicable to surface and subsurface agricultural drainage discharges); *id.* § 3408(h), 106 Stat. at 4729 (authorizing purchase of land causing or impacted by the drainage problem from willing sellers).

237. § 3405(e), 106 Stat. at 4713-14. "The Secretary shall . . . promot[e] the highest level of water use efficiency reasonably achievable by project contractors using best available cost-effective technology and best management practices." *Id.* § 3405(e)(1) at 4713.

238. Section 3405(e), entitled "Water Conservation Standards," reads in pertinent part, "[t]he Secretary shall establish and administer an office of Central Valley Project water conservation best management practices that shall . . . develop criteria for evaluating the adequacy of all water conservation plans developed by project contractors . . ." § 3405(e), 106 Stat. at 4713-14.

239. Water conservation practices may in fact increase the concentration of toxic constituents in receiving waters. SJVDP, *supra* note 25, at 95.

240. § 3405(c), 106 Stat. at 4712. "All Central Valley Project water service or repayment contracts . . . entered into, renewed, or amended . . . shall provide that the contracting district or agency shall be responsible for compliance with all applicable State and Federal water quality standards applicable to surface and subsurface agricultural drainage discharges generated within its boundaries. This subsection shall not affect or alter any legal obligation of the Secretary to provide drainage services." *Id.*

241. § 3405(c), 106 Stat. at 4712. Contractors continue to claim that it is the Bureau's obligation to provide a drainage option that will allow them to comply with water quality standards. See generally *Oversight Hearing*, *supra* note 235, at 32 ("There is a presumption on the books, at the present time, that this is a federal responsibility [to provide drainage service], especially with respect to the San Luis Unit.").

242. See *supra* notes 183-225 and accompanying text (discussing the inherent problems using water-based quality standards to regulate selenium).

Section 3408(h) gives the Secretary only limited authority to purchase drainage impacted land for the purposes of retiring the land from irrigated agriculture.<sup>243</sup> First, the Secretary may only purchase land from willing sellers, and cannot forcibly purchase land causing severe drainage problems. Second, the program is limited by the availability of funds, which under current fiscal conditions associated with budgetary down-sizing, are unlikely to be committed in sufficient amount.<sup>244</sup> Third, land retirement is perhaps the most politically charged solution of the proposed alternatives, and hence the Bureau is more likely to encounter fierce resistance than willing sellers.<sup>245</sup>

In addition to the three sections that explicitly mention agricultural drainage, the Act contains several general references to studying and improving water quality in aquatic ecosystems.<sup>246</sup> These latter sections are of questionable value because the terms only indirectly apply to agricultural drainage issues, and are vague or couched in precatory language.<sup>247</sup>

The sparse treatment given to agricultural drainage issues demonstrates that Congress has distinguished between the problems directly caused by the CVP's capturing water for distribution and other indirect problems caused by users of the

---

243. § 3408(h), 106 Stat. at 4729. See *Oversight Hearing*, *supra* note 235, at 13 (noting that the CVPIA provided "limited authority to purchase lands causing drainage problems").

244. See *Oversight Hearing*, *supra* note 235, at 31-36, 43 (discussing the availability of funds for land retirement).

245. See *id.* at 31 ("I don't know if this is accurate or not, but I think politically it would appear that land retirement is the most restrictive and perhaps the harshest.").

246. See § 3406(b)(1), 106 Stat. at 4715 ("[T]he Secretary shall make all reasonable efforts . . . to address *other identified adverse environmental impacts* of the Central Valley Project not specifically enumerated in this section") (emphasis added); § 3406(c)(1), 106 Stat. at 4721 (directing the Secretary to "develop a comprehensive plan, which is *reasonable, prudent, and feasible*, to address fish, wildlife, and habitat concerns on the San Joaquin River, including . . . water quality improvements that would be needed to reestablish where necessary and to sustain naturally reproducing anadromous fisheries. . .") (emphasis added); § 3406(e)(6), 106 Stat. at 4724 (directing the Secretary to investigate and provide recommendations of "*other measures* which . . . would protect, restore, and enhance natural production of salmon and steelhead trout in tributary streams of the Sacramento and San Joaquin Rivers . . .") (emphasis added); § 3406(f), 106 Stat. at 4724 (instructing the Secretary to "investigate and report on *all effects* of the Central Valley Project on anadromous fish populations and the fisheries, communities, tribes, businesses and other interests and entities that have now or in the past had significant economic, social or cultural association with those fishery resources") (emphasis added); § 3406(g), 106 Stat. at 4725 (providing that the Secretary shall "develop readily usable and broadly available models and supporting data to evaluate the *ecologic and hydrologic effects* of existing and alternative operations of public and private water facilities and systems in the . . . San Joaquin" watershed for the purposes of improving scientific understanding of "(2) *related water quality conditions and improvement alternatives* . . . [and] (8) opportunities to protect and restore wetland and upland habitats throughout the Central Valley") (emphasis added).

247. Oddly, in one section, the CVPIA identifies drainage as an environmental problem for fish, but addresses only impacts of drainage on water temperatures, without mentioning other drainage related water quality issues such as selenium contamination. See § 3406(e)(1), 106 Stat. at 4724. To acknowledge drainage as an environmental issue but then to omit any express action regarding selenium in that section or any other sections demonstrates an apparent unwillingness by Congress to confront the problem of selenium contamination. See also *Oversight Hearing*, *supra* note 235, at 13 (highlighting the provisions of the CVPIA addressing agricultural drainage).

removed CVP irrigation water.<sup>248</sup> In this respect, the Act focuses more on the effects in the source stream caused by removing water, than on impacts elsewhere caused by the use of removed water. Insofar as this focus reflects Congress' intent only to remedy CVP impacts on fish and wildlife, deferring legislative action on the agricultural drainage problem, as it effects the farming industry, is understandable. The CVPIA's primary goal, under section 3402, is to remedy CVP impacts on fish and wildlife, not farmers.<sup>249</sup> Enacting legislation to resolve the farmers' drainage problem would have added another dimension to the CVPIA. However, Congress's failure to address the significant impacts of agricultural drainage on fish and wildlife will limit the Act's ability to achieve its stated purposes "to protect, restore, and enhance, fish, wildlife, and associated habitats . . ." and "to address impacts of the [CVP] on fish, wildlife and associated habitats."<sup>250</sup> As discussed in sections III and IV, agricultural drainage water poses a serious threat to fish and wildlife—a threat which current regulations are inadequately devised to handle.<sup>251</sup>

One explanation as to why Congress chose to defer action on the drainage issue is that legislators did not want to tackle the drainage problem piecemeal by dealing with only the fish and wildlife side of the issue. A second explanation might be that the drainage problem is too complex and too politically and emotionally charged to attempt to solve one side at a time.<sup>252</sup> Furthermore, a battle over a drainage solution suitable to irrigators and ecologists alike might have compromised the passage of the significant in-stream remedial measures. In any event, the full benefit of the Act's restoration measures will not be realized until the continuing damage from agricultural drainage is addressed.

## VI. THE NEED FOR CONGRESSIONAL LEADERSHIP

### A. Introduction

The solution to the drainage problem in the San Joaquin Valley necessarily involves the federal government because it is both a primary cause of the problem

---

248. This one causal step is a very small step indeed considering that one of the primary functions of the CVP is to provide irrigation water to the west side of the San Joaquin Valley. *See* San Luis Unit Act of 1960, Pub. L. 86-488, 74 Stat. 156. Moreover San Luis Unit authorization legislation contemplated the obligation of the Federal government to provide drainage service to San Joaquin Valley CVP irrigators. *Id.*

249. *See supra* note 229 (presenting the text of § 3402, 106 Stat. at 4706).

250. Reclamation Projects Act, § 3402(a), (b), 106 Stat. at 4706.

251. *See supra* notes 183-225 and accompanying text (discussing the selenium threat to fish and wildlife and problems with water-based standards).

252. For a detailed description of the political wrangling over CVP water and drainage service obligations and prices, see *Barcellos & Wolfson, Inc. v. Westlands Water Dist.*, Civ. No. 79-106-EDP at 3 (E.D. Cal. 1986) (class notice) (consolidated with *Westlands Water Dist. v. United States*, Civ. No. F-81-245-EDP). *See generally* Candee, *supra* note 64, at 664 (describing political opposition to reclamation reform generally under the Reagan Administration).

and a necessary part of the solution. The government's participation in the drainage problem is plain: the authorization of the CVP and its administration by the Federal Bureau of Reclamation played a predominate role in bringing about the magnitude of the agricultural drainage problem by facilitating and promoting irrigated agriculture.<sup>253</sup>

It is equally obvious that the federal government must also play a part in the solution. However, the role the government must play is complex since the Bureau of Reclamation—the principle federal agency responsible for operating the CVP—is charged with competing responsibilities in administering reclamation law. On the one hand, the Bureau and other federal agencies are obligated under both federal statutes and California law to protect the environment from the agricultural drainage that CVP irrigation water has created.<sup>254</sup> On the other hand, the Bureau is contractually obligated to provide drainage service to farmers on the west side of the San Joaquin Valley receiving CVP water.<sup>255</sup> When it comes to agricultural drainage, the economic self-interest of individual farmers and the best interests of the environment typically are not harmonious.<sup>256</sup> The most cost effective methods of agricultural drainage disposal—direct discharge to the San Joaquin river system or to evaporation ponds—threatens fish and wildlife with selenium poisoning, yet drainage management efforts to protect

---

253. See *supra* notes 63-66, 98-115 and accompanying text (discussing the role of the CVP in bringing about the current drainage problem).

254. Federal agencies are bound by a number of environmental protection laws designed to address the hazards of agricultural CVP induced drainage, including: the Fish and Wildlife Conservation Act of 1980, 16 U.S.C.A. §§ 2901-2911 (West 1988 & Supp. 1996); the Migratory Bird Treaty Act, Law of July 3, 1918, ch. 128, § 2, 40 stat. 755 (codified at 16 U.S.C.A. §§ 703-712 (West 1988)); the National Environmental Policy Act of 1969, 42 U.S.C.A. §§ 4321-4370d (West 1988 & Supp. 1995); the Resource Conservation and Recovery Act of 1976, 24 U.S.C.A. §§ 6901-6992k (West 1994 & Supp. 1995); Federal Endangered Species Act, 16 U.S.C.A. §§ 1531-1544 (West 1984 & Supp. 1995); and the Clean Water Act, 33 U.S.C.A. §§ 1251-1377 (West 1987 & Supp. 1995). See SJVDP, *supra* note 25, at 68-70. The CVPIA mandates that the Bureau comply with all California laws in the operation of the CVP. See Reclamations Project Act, § 3406(b), 106 Stat. at 4714 (requiring operation of the CVP to “meet all obligations under State and Federal law, including but not limited to the Federal Endangered Species Act, 16 U.S.C. 1531, et seq., and all decisions of the California State Water Resources Control Board establishing conditions on applicable licenses and permits for the project.”); Weber, *supra* note 37, at 934 n.157 (noting authority that supports the proposition that the Bureau of Reclamation is obligated to comply with California laws). In addition to decisions of the State Water Resources Control Board, primary California laws relevant to the drainage problem include: the California Environmental Quality Act, codified at CAL. PUB. RES. CODE §§ 21000-21178.1 (West 1986 & Supp. 1996); California Administrative Code, codified at CAL. CODE REGS. tit. 26, §§ 22-66260.1 to 22-67450.15 (Hazardous Wastes), tit. 14, §§ 1.05-4961 (Natural Resources) (1992); Porter-Cologne Water Quality Control Act, codified at CAL. WATER CODE §§ 13000-14076 (West 1992 & Supp. 1996); Toxic Pits Cleanup Act, codified at CAL. HEALTH & SAFETY CODE §§ 25208-25208.17 (West 1992 & Supp. 1996); California Endangered Species Act, codified at CAL. FISH & GAME CODE §§ 2050-2098 (West 1984 & Supp. 1996). See SJVDP, *supra* note 25, at 68-70.

255. The San Luis Unit Act of 1960, Pub. L. 86-488, 74 Stat. 156.

256. See *supra* notes 138-82 and accompanying text (discussing the agricultural and ecological interests at stake); *supra* notes 94-97, 116-23 and accompanying text (describing farmers' options for dealing with drainage-affected land).

fish and wildlife can add significant cost to agricultural production.<sup>257</sup> Hence, the Bureau must be able to reconcile its apparently conflicting objectives if it is to fulfill its crucial role in the solution to the drainage problem. To date, it has been unsuccessful.<sup>258</sup>

*B. Failures of the Past and the Need to Clarify CVP Operation Policy*

Solutions to the agricultural drainage problem have not been forthcoming. The need for Congressional action to resolve the agricultural drainage problem has been repeatedly demonstrated by the failure of federal, state, and local entities to agree on a long-term solution.<sup>259</sup> Prior to the CVPIA, the Bureau attempted to execute three major proposed solutions to the drainage problem. The first was the San Luis Drain.<sup>260</sup>

The San Luis interceptor drain was developed in response to Bureau contractual obligations to provide drainage service contained in the San Luis Unit Authorization Act.<sup>261</sup> The drain was to collect drainage from the west side of the San Joaquin Valley and transport it to the Delta for disposal.<sup>262</sup> A 1965 CVP appropriations bill reflected concern over the environmental impact of the drain, stating "the final point of discharge for the interceptor drain for the San Luis Unit shall not be determined until development by the Secretary of the Interior and the State of California of a plan which shall conform with the water quality standards of the State of California as approved by the Administrator of the Environmental Protection Agency."<sup>263</sup> Without an agreed upon terminus, construction of the drain began in 1968 and, by 1975, 85 of the projected 188 miles had been completed.<sup>264</sup> But federal budget constraints and environmental opposition stymied completion of the drain.<sup>265</sup> In 1975, the Bureau of Reclamation, California Department of Water Resources, and the State Water Resources Control Board formed the San Joaquin Valley Interagency Drainage Program to study the possibility of a San Joaquin Valley drain. The group recommended

---

257. See *supra* notes 94-97, 116-23 and accompanying text (describing farmers' options for drainage effected land).

258. See *Oversight Hearing*, *supra* note 235, at 13 ("The solutions identified by the Bureau of Reclamation and the Department of the Interior have not been accepted. In the absence of an agreed-upon framework for reducing the discharge of pollutants from irrigation drainage water, progress on the drainage problem in the valley has stalled."); see also *id.* at 30-43 (displaying the difficulties and conflicting pressures faced by the Bureau of Reclamation in addressing the drainage problem).

259. See generally *id.* at 11-14 (summarizing the efforts and lack of progress made toward finding a solution to the drainage problem).

260. See *Barcellos & Wolfsen, Inc. v. Westlands Water Dist.*, Civ. No. 79-106-EDP at 3 (E.D. Cal. 1986) (settlement notice) (providing a detailed history of the drain).

261. Pub. L. 86-488, 74 Stat. 156.

262. SJVDP, *supra* note 25, at 16.

263. *Id.*; see Pub. L. No. 89-299, 79 Stat. 1096, 1101 (1965).

264. SJVDP, *supra* note 25, at 16.

265. *Id.* at 17.

completion of the San Luis Drain.<sup>266</sup> However, in the interim, without an outfall to the Delta, the drain simply terminated at Kesterson Reservoir which resulted in the massive poisoning of migratory waterfowl.<sup>267</sup> The Kesterson disaster forced the eventual closure of the drain and Reservoir and curtailed consideration of using the drain and the Reservoir to handle agricultural drainage.<sup>268</sup>

The Bureau's next attempt at a solution was its participation in the San Joaquin Valley Drainage Program (Drainage Program), a second joint state and federal effort organized in 1984 to study the drainage problem after the Kesterson disaster.<sup>269</sup> The Drainage Program's committee and team membership consisted of a host of public and private entities and represented a broad diversity of interests.<sup>270</sup> Years of political consensus building shaped the Drainage Program efforts. The Drainage Program's 1990 Final Report presented a comprehensive list of thoroughly developed pragmatic recommendations to attack the drainage problem. Solutions were tailored to be region-specific and to spread responsibilities broadly.<sup>271</sup>

The Final Report was developed using two primary planning objectives: (1) focusing on in-valley solutions, and (2) meeting water quality objectives of the State of California.<sup>272</sup> The Final Report recommended a range of strategies to manage drainage related issues. The major components are as follows:

*Source control.* This option [uses mainly on-farm] improvements in the application of irrigation water to reduce the source of deep percolation. These improvements will in turn reduce the amount of potential problem drainage water.

*Drainage reuse.* This option calls for a planned system of drainage-water reuse on progressively more salt-tolerant plants. Reuse will reduce the volume of drainage water and concentrate salts and trace elements for easier containment and safe disposal.

*Evaporation systems.* This option uses drainage-water evaporation ponds planned to store and evaporate drainage water remaining after reuse on salt-tolerant plants. Four types of ponds are included: (a) non-toxic ponds in which selenium in drainage-water inflow is less than 2

---

266. *Id.*

267. See *supra* notes 124-26 and accompanying text (describing the drain's role in the Kesterson disaster).

268. See *supra* notes 127-34 and accompanying text (highlighting the events that lead to the closure of Kesterson and the drain).

269. The Drainage Program's efforts resulted in a series of recommendations entitled, "A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley: Final Report of the San Joaquin Valley Drainage Program." *Supra* note 25.

270. See SJVDP, *supra* note 25, at xi-xiii.

271. *Oversight Hearing, supra* note 235, at 12.

272. SJVDP, *supra* note 25, at 71.



ppb; (b) selenium-contaminated ponds (inflow water containing selenium in the range of 2 to 50 ppb) that must include safeguards for wildlife and an equivalent area of alternative freshwater habitat; (c) small selenium-contaminated ponds designed with facilities to greatly accelerate the rate of evaporation, thereby reducing the pond surface area; and (d) temperature-gradient solar ponds that generate electricity by using water from other ponds containing very high salt and trace-element concentrations.

*Land retirement.* This option ceases irrigation of areas in which underlying shallow ground water contains elevated levels of selenium and the soils are difficult to drain.

*Ground-water management.* This option calls for planned pumping from deep within the semi-confined aquifer, in places where near-surface water tables can be lowered and the water pumped is of suitable quality for irrigation or wildlife habitat.

*Discharge to the San Joaquin River.* This option uses controlled and limited discharge of drainage water from the San Joaquin Basin portion of the study area to the San Joaquin River, while meeting water-quality objectives.

*Protection, restoration, and provision of substitute water supplies for fish and wildlife habitat.* This option calls for the provision of freshwater supplies to substitute for drainage-contaminated water previously used on wetlands and to allow protection and restoration of contaminated fisheries and wetland habitat.

*Institutional change.* This option includes tiered water pricing, improved scheduling of water deliveries, water transfers and marketing, and formation of regional drainage management organizations to aid in implementing other plan components.<sup>273</sup>

Unfortunately, the Drainage Program's recommendations were limited by both their focus on short-term solutions and by assumptions formulated on incomplete understandings of the environmental consequences.<sup>274</sup> In discussing the option of discharge to the San Joaquin River, the Final Report assumes the assimilative capacity of the river will not be exceeded and recognizes that the opportunity to discharge agricultural drainage to the river depends on a combination of many variables including being able to meet water quality requirements.<sup>275</sup> As previously discussed in part IV, to avoid poisoning fish and wildlife the capacity of the San Joaquin River to assimilate selenium must be

---

273. *Id.* at 2-3.

274. *See generally id.* at 1-14 (summarizing the plan and recommendations).

275. *Id.* at 70, 92, 141.

measured ecosystem wide, and not just by selenium's concentration in water.<sup>276</sup> Moreover, the river may not have additional assimilative capacity to absorb selenium without harm to fish and wildlife.<sup>277</sup> The study's Final Report candidly acknowledged that its usefulness must be measured against environmental uncertainties.<sup>278</sup> The Final Report noted that many unknowns remain unaccounted for, especially the long-term effects on fish and wildlife from contaminants such as selenium.<sup>279</sup> In particular, a caveat in the Final Report anticipated that the feasibility of discharging agricultural drainage to the San Joaquin River may be foreclosed in the future by more stringent water quality standards.<sup>280</sup>

Putting aside its flaws, the Final Report of the Drainage Program was an all-out effort to hammer out conscientious, well-developed recommendations on which all could agree. Nevertheless, this apparent best effort failed to be widely embraced.<sup>281</sup> The inability of the Final Report's recommendations to take hold is demonstrated by their unsuccessful application to the Bureau's third major attempt at a solution—the Barcellos Judgment settlement.<sup>282</sup>

On December 30, 1986, the United States District Court for the Eastern District of California entered what is now commonly called the Barcellos Judgment in the consolidated settlement of *Barcellos & Wolfson, Inc. v. Westlands Water District*,<sup>283</sup> and *Westlands Water District v. United States*.<sup>284</sup> The litigation was the result of ongoing disputes between the federal government and CVP contractors over water and drainage service prices and obligations.<sup>285</sup> The judgment called for, *inter alia*, the Bureau of Reclamation to prepare a drainage service plan for the San Luis Unit by December, 1991, and for Westlands to establish a drainage trust fund to help finance the provision of drainage services.<sup>286</sup> To facilitate preparation of the plan, the San Luis Unit Drainage Program was formed,<sup>287</sup> and a draft report was prepared, utilizing an approach

---

276. See *supra* notes 183-225 and accompanying text (discussing the difficulties of accurately measuring and regulating selenium in an aquatic environment).

277. See *supra* notes 217-25 and accompanying text (suggesting that the San Joaquin River may not have more than minimal capacity to assimilate selenium).

278. SJVDP, *supra* note 25, at 70-71.

279. *Id.* at 71; see *id.* at 12 (noting the need to continue to study selenium).

280. *Id.* at 92; see *id.* at 70 (“[T]he trend of scientific discovery is toward revealing an increasingly complex natural environment. It is possible that even more stringent standards for environmental protection may apply in the future. . . . [T]he Drainage Program has assumed that water-quality objectives will be set in terms of concentrations of substances allowable in receiving water, rather than in terms of the total load allowed in drainage water. This is a subject assumption, not a declaration of a preference”).

281. *Oversight Hearing*, *supra* note 235, at 13.

282. *Barcellos & Wolfson, Inc. v. Westlands Water Dist.*, Civ. No. F-79-106-EDP (E.D. Cal. 1986).

283. *Id.*

284. *Westlands Water Dist. v. United States*, Civ. No. F-81-245 EDP (E.D. Cal. 1986).

285. For the court's detailed analysis of the origin of the dispute, see *Barcellos*, Civ. No. F-79-106-EDP at 1-5 (class notice).

286. See *id.* at 9 (settlement notice) (Issue 11).

287. See SLUDP, *supra* note 26 (containing the Program's proposed solution).

similar to the San Joaquin Valley Drainage Program.<sup>288</sup> However, the plan was unacceptable to Westlands who, by terms of the judgment, were able to reject the proposal and withdraw the trust funds.<sup>289</sup>

Progress in efforts to solve the drainage problem have stalled, and the CVPIA's provisions are inadequate to restart them.<sup>290</sup> The Bureau has attempted without success to initiate a solution to the drainage problem. The San Joaquin Valley Drainage Program, a thorough, complex, and issue-sensitive effort, failed to gain wide-spread approval. The CVPIA did little to assist the efforts begun by the Drainage Program, "[o]ther than encourage water conservation and authorizing water transfers, and providing limited authority to purchase lands causing drainage problems, the [CVPIA] was silent on the issue of drainage."<sup>291</sup> Unassisted by clear congressional policy directions, the Bureau and other federal agencies have been left to navigate through a political minefield of conflicting policy considerations. Faced with this dilemma, Bureau Commissioner Daniel P. Beard, in the year following the enactment of the CVPIA, was forced to go to Congress to seek policy clarification on a host of fundamental drainage issues:

The questions that need to be addressed by this Administration and the Congress include such items as:

What should be the objective of our agricultural drainage policy in the San Joaquin Valley? Are the goals outlined in the San Luis Unit Authorization Act still relevant?

How much should be spent to solve these problems by the Federal, the State governments, and local interests?

What solution or solutions should be used to solve drainage problems? When should these solutions be implemented, and by whom?

What impacts will various solutions have on production from agricultural lands?

What are the economic and environmental costs and benefits of various solutions?<sup>292</sup>

The Commissioner's list suggests some additional questions. What are the broader objectives of CVP water and land resource policies in the San Joaquin Valley? What factors are to be used in striking that balance between competing resource uses? Given the Bureau's conflicting responsibilities, should all of the

---

288. *Id.* at 8-9.

289. See *Barcellos*, Civ. No. F-79-106 EDP at 10 (settlement notice) (Issue 11) (providing the conditions under which Westlands could reject the settlement agreement).

290. See *Oversight Hearing*, *supra* note 235, at 13 ("In the absence of an agreed-upon framework for reducing the discharge of pollutants from irrigation drainage water, progress on the drainage problem in the valley has stalled.").

291. *Id.*

292. *Id.*

responsibility to translate politically controversial congressional policy into regulations fall on the Bureau? Should Congress be more active in the actual resolution process?

The need to resolve these questions is clear. From an agricultural perspective, “[w]ithout adequate drainage, the long-term outlook for . . . the [San Joaquin Valley]’s western side is in question.”<sup>293</sup> Shallow groundwater buildup high in salts and toxic elements such as selenium threatens crop production.<sup>294</sup> Ecologically, the continued use of fish and wildlife habitat as depositories for agricultural drainage imperils the health of Valley and Delta ecosystems. A multitude of species are at risk, including threatened and endangered species.<sup>295</sup>

## VII. CONCLUSION

The conversion of Central Valley wilderness to farmland can never be reversed. Returning the valley to its original state would be economically impractical as well as socially incompatible with the land use needs of society. But while reversion of the valley to its aboriginal state is an impossibility, the extreme reduction or elimination of the valley’s wildlife resources because of selenium-laden drainage is neither necessary for viable agricultural development nor desirable as a land use goal.

Federal reclamation law and CVP regulations have an enormous influence on the continuing land use patterns in the Central Valley. Though many of the impacts from development are irreversible, the detrimental effects of water reallocation are continuous and subject to reconsideration, and thus can be partially mitigated by legislative action. The CVPIA provided Congress such an opportunity—to reassess what had been a relatively one-sided CVP water management policy in favor of agriculture. Although the Act addressed many important areas, Congress chose to bypass the issue of agricultural drainage almost entirely.

By not addressing the environmental consequences of agricultural drainage head-on in the CVPIA, Congress has left the burden of resolving the drainage problem on the shoulders of the Bureau of Reclamation. The burden is weighty. Maintaining safe levels of selenium in aquatic environments even with heightened controls on discharges may not be possible. More drastic measures, such as forcing land with high concentrations of selenium in the soils and shallow ground water into retirement, may be necessary. The Bureau continues to face staunch resistance to adjusting water and land use priorities.

---

293. *Id.* at 12.

294. *See supra* notes 91-97 and accompanying text (describing the impact of shallow groundwater on crops).

295. *See supra* notes 158-82 and accompanying text (summarizing the fish and wildlife resources threatened by the drainage problem).

The Bureau has shown that it is inadequately positioned to take on the political consequences of aggressive agricultural drainage reform. Caught between its obligations and traditional loyalties to irrigators on the one hand, and required compliance with environmental protection statutes and the ever-growing environmental awareness of the public on the other, the Bureau is paralyzed to resolve the issue by itself. If the drainage problem is to be mastered, more direct legislative action is required.



