STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD

In the Matter of the Petition of ROBERT JAMES CLAUS For Review of Inaction of California Regional Water Quality Control Board, Central Valley Region. Our File No. A-354.	ORDER NO. WQ 89-16

BY THE BOARD:

This is the fifth in a series of orders adopted by the State Water Resources Control Board (State Board or Board) concerning Kesterson Reservoir. This matter is presently before the Board because the Bureau of Reclamation (Bureau), an agency of the United States Department of Interior, has submitted a Final Cleanup Plan for the site. This order approves the plan and remands the matter to the California Regional Water Quality Control Board, Central Valley Region (Central Valley Regional Board).

I. BACKGROUND

The need to cleanup Kesterson Reservoir was first brought to the Board's attention as a result of a petition filed by Robert James Claus on April 27, 1984. Claus, an owner of land adjacent to the reservoir, alleged in his petition that the

Central Valley Regional Board had improperly failed to regulate the discharge of subsurface agricultural drainage, or tile drainage, to the facility. At that time, Kesterson Reservoir, feature of the San Luis Drain, received irrigated agricultural drainage flows from farmlands in Westlands Water District.[1]

In response to the petition, on February 5, 1985, the State Board adopted Order No. WQ 85-1 and Cleanup and Abatement Order No. 85-1. These orders concluded that operation of Kesterson Reservoir had resulted in conditions of pollution and nuisance. The principal constituent of concern in the wastewat discharged to the reservoir was selenium, a naturally occurring trace element. The orders found that exposure of waterfowl to selenium had resulted in an abnormally high incidence of reproductive failures, embryo and chick deformities and mortalities. The Bureau, as the owner and operator of Kesterso Reservoir, was therefore directed to cleanup pollution at the site by no later than February 5, 1988.

The Bureau subsequently elected to close Kesterson, a all discharges of tile drainage were terminated in June 1986. Order No. WQ 85-5, the State Board directed the Bureau to subm a final closure plan for the site by December 1, 1986. The Bureau submitted the required plan in a timely manner, and on

1 See State Board Order No. WQ 85-1 for a more detailed discussion of the history of development of the San Luis Drain and Kesterson Reservoir.

March 19, 1987, the Board adopted Order No. WQ 87-3 approving one of the closure alternatives proposed by the Bureau in its closure plan. Order No. WQ 87-3 directed the Bureau to fully implement the approved plan, the Onsite Disposal Plan, by August 19, 1988.

In the Spring of 1988 the State Board, at the request of the Bureau, reconsidered Order No. WQ 87-3. Reconsideration was prompted by new monitoring data revealing that selenium concentrations in the seasonal wetlands, or ephemeral pools, at Kesterson were extremely high and posed a substantial threat to biota at the site. Order No. WQ 88-7, adopted by the Board on July 5, 1988, in response to the Bureau's request for reconsideration, concluded that implementation of the Onsite Disposal Plan would not address this acute environmental hazard and might, in fact, exacerbate the problem. The Bureau was, accordingly, ordered to undertake several actions, which are the subject of this order.

Specifically, Order No. WQ 87-3 directed the Bureau to do the following:

(1) fill all ephemeral pool areas to six inches above rising ground water by January 1, 1989, and submit a report to the Board by April 1, 1989, evaluating the success of the fill program;

(2) submit a report by December 1, 1988, on the viability of microbial volatilization as a cleanup technique for Kesterson;

(3) submit a final cleanup plan by April 1, 1989; and

(4) conduct a comprehensive upland habitat assessment and provide the Board with a final report on the assessment by April 1, 1989.

The Bureau complied with the Board's directive and prepared the four required reports in a timely manner. On June 28, 1989, the Board conducted a hearing to receive evidence on whether the Board should approve the Bureau's Final Cleanup Plan.

II. ANALYSIS OF REPORTS

A. Microbial Volatilization Report

Microbial volatilization is a natural biological process which results in the depletion of soil selenium through volatilization to the atmosphere. Through microbial action, soil microorganisms convert various species of selenium to volatile species, primarily dimethylselenide. The results of prior research conducted by the Bureau's consultants indicated that the microbial production of selenium could be stimulated by specific management techniques, including the application of organic carbon amendments.

The Bureau's consultants performed both field and laboratory experiments to determine the optimum conditions for promoting the production of dimethylselenide. Field trials were begun on July 28, 1987, in Ponds 4 and 11 at Kesterson

Reservoir.[2] Pond 4, a southern pond, represented a highly contaminated area whereas Pond 11, a northern pond, was less severely impacted. The two sites were staked into subplots, and the subplots were treated with different soil amendments, including citrus pulp, cattle manure, straw, and proteins. All of the subplots were regularly rototilled, and moisture was applied through sprinkler irrigation.

Twenty months of field investigation revealed rates of volatilization up to 200 times greater than background levels. Seasonal and daily variation in emission rates was evident. The highest seasonal rates were recorded in the summer months. The daily peak of volatile selenium emission was always detected in midafternoon. These results indicate that maximum emission rates correspond to soil temperature. Aeration and moisture are also important factors.

In the Pond 4 experiments the data on soil depletion of selenium showed that the most effective treatment was with a combination of molasses and casein, a milk protein. The data revealed that 61 percent of the selenium inventory within the upper six inches was removed with this treatment, as compared to 44 percent soil depletion with moisture and tillage alone. In the Pond 11 experiments the moisture only treatments proved the

2 The levees separating the 12 ponds which formerly made up Kesterson Reservoir have now been removed as part of the fill operation. Only the exterior dikes remain.

most effective. In general, the results of the laboratory experiments were consistent with the field experiments.

Although the research results are promising, several significant uncertainties remain regarding the microbial volatilization process. At the present time, it is not possible to establish the length of time that volatilization enhancement techniques would have to be implemented before a site could be considered cleaned up. The Bureau's consultants estimate that volatilization could require up to about ten years to achieve a soil cleanup goal of 4 parts per million (ppm) of selenium throughout the reservoir. This estimate is based upon a number of questionable assumptions, however, and must therefore be considered speculative.

Secondly, the scientists have identified a discrepancy between the soil depletion data and the gas emission data. Two possible causes for this discrepancy have been identified. One theory is that the decline in soil selenium levels in the test plots may be attributable to the dilution effects of the continuous rototilling operation. Another possible cause may be the effects of wetting and drying the soil on the release of selenium. The consultants hypothesize that a management scheme involving irrigation with wetting and drying cycles could maximize the production and release of dimethylselenide.

As a result of these uncertainties, the Bureau's consultants recommend further study to achieve a better

understanding of the process and to improve management of volatilization as a bioremediation technique for selenium removal. The consultants indicate that they are ready to move from field trials to a larger scale operation, but that there are too many uncertainties to move to a full scale operation.

B. Assessment of Fill Operation

The day after Order No. WQ 88-7 was adopted by this Board, the Bureau issued a contract for the filling of an estimated 589 acres of ephemeral pools at Kesterson. The hauling of fill material was completed on November 16, 1988, about one and one-half months prior to the January 1, 1989, deadline specified in Order No. WQ 88-7. At the conclusion of the contract, the contractor had placed a total of 1,050,437 cubic yards of fill material on 713 acres of low-lying areas at Kesterson Reservoir.

On April 1, 1989, the Bureau submitted a report to the Board describing the fill operation and evaluating its effectiveness. This analysis looked at the observed effectiveness of the fill operation over the 1988-89 winter season as well as its projected effectiveness in future years.

The objective of the fill operation was to raise the elevation of the ground surface above the maximum height of the water table. The fill operation was undertaken in order to prevent the formation of ephemeral pools at Kesterson as a result

of rising ground water. The Bureau's report indicates that the operation was successful in achieving this goal.

The elevation of the water table underlying Kesterson Reservoir has been influenced by a number of factors, including precipitation, evapotranspiration, ground water pumping, and, most importantly, flooding of the adjacent seasonal wetlands. Past records indicate that seasonal fluctuations of the water table were on the order of five feet, with the highest elevations occurring between February and March. Water-level data collected prior to the construction of Kesterson indicated that in a typical water year the water table would rise above the original ground surface, creating several hundred acres of ephemeral pools.

Water level data were collected from 300 wells in and around Kesterson Reservoir during the 1988-89 winter season. According to this data, the water table peaked around March 1. The available data indicates that, as a result of the fill operation, the soil surface at the reservoir ranged from 1.5 to 4.5 feet above the 1988-89 winter ground water elevation. The operation, therefore, satisfied the criterion in Order No. WQ 88-7 that all ephemeral pool areas be filled to a minimum of six inches above rising ground water. Consequently, no ephemeral pools formed at Kesterson during the past winter season due to rising ground water.

Predictably, however, numerous shallow puddles formed on top of the fill as a result of rainfall events. These surface puddles were created where there were slight topographic depressions and where soils were heavily compacted. Persistent puddles, that is, puddles lasting longer than about a week to ten days, covered about three acres or about 0.5 percent of the filled areas and were present at the site over the entire winter season. Fifty-three samples of water in these rainwater puddles were collected from throughout the reservoir. Selenium concentrations in these samples ranged from less than 1.0 parts per billion (ppb) to 50 ppb, with a geometric mean of 4.0 ppb. For comparison purposes, the selenium concentrations in ephemeral pool areas during the 1987-88 winter season ranged from 10 to 2,400 ppb with an average of 159 ppb.

The Bureau has attempted to assess future hydrologic conditions at Kesterson in order to predict the potential for surface ponding in future years. This effort involves consideration of several complex factors and is somewhat speculative.

The prediction starts with the assumption that the seasonal water table rise is primarily caused by application of surface water to the surrounding duck clubs. These lands are flooded and drained in a similar manner every year; therefore, the impact of flooding on water table elevations in future years is expected to be similar to the impact during the previous

winter season. For this reason, the Bureau anticipates that flooding of the duck clubs will not be sufficient to cause ephemeral pool formation in future years.

Rainfall is another contributing factor to increases in water table elevations. The average estimated annual rainfall at Kesterson is 9.5 inches. Pan evaporation rates during the winter months average 2.4 inches per month, approximately equal to the monthly rainfall averages. In years with normal and below normal precipitation, consequently, local rainfall is not expected to contribute significantly to a rise in water table elevations.

In years with heavy rainfall or following prolonged rainfall events, the situation may be quite different. When precipitation exceeds evaporation, the pore space between the water table and the soil surface will become saturated and surface ponding will occur. Based upon a simplistic mass balance, the Bureau predicts that above-normal rainfall years with a return frequency of about three years will cause surface ponding on unvegetated soils in some areas of the reservoir. Rainfall in excess of 13 inches, which is expected to occur about once in seven years, may fully saturate unvegetated soils in most parts of Kesterson. Years with rainfall totals exceeding 16 inches, which could be expected to cause ponding in most vegetated areas, would be predicted to occur no more than once in about 20 years. While the Bureau's calculations may not be entirely accurate, it can reasonably be concluded that some

persistent pools will form during high rainfall years. The probability of occurrence and the extent of pooling is expected to decrease with time as the filled areas become more vegetated.

While it is clear that future pooling will occur as a result of rainfall events, it is not possible to confidently predict the concentration of selenium which will be present in these pools. The persistent pools should consist primarily of rainfall rather than of the highly seleniferous water displaced from the vadose zone by rising ground water. The water quality in the rainwater puddles will depend largely on the soluble salts and selenium present in the soil surface. With the conversion of the reservoir to a dry environment, oxidation of previously insoluble selenium is expected to slowly occur. In addition, the shallow ground water and the high evapotranspiration rate in the area will generate an upward hydraulic gradient, which will tend to transport soluble materials to the surface. Therefore, a trend of increasing salinity and, probably, of soluble selenium in reservoir soils is expected to occur. These processes may be offset, in part, by plant uptake, natural volatilization, and seasonal leaching.

Overall, quantitative predictions of the redistribution of salts and selenium are not possible. At present, soluble selenium in bare soils at Kesterson have concentrations which, if dissolved in rainfall pools, would easily exceed a surface water quality goal of 2 ppb. Due to the large selenium inventory at

the site, the Bureau anticipates that a significant fraction of the rainfall puddles will have selenium concentrations greater than 2 ppb. Moreover, it is likely that, without any management measures, the mass of soluble selenium at the soil surface will increase.

C. Upland Habitat Assessment

In the past, most of the biological assessments at Kesterson Reservoir focused on wetland habitat impacts. The fill operation conducted by the Bureau transformed the reservoir from a combined wetland and upland habitat to an upland habitat. The purpose of the upland habitat assessment was to determine if the selenium load at the reservoir was adversely impacting upland habitat values.

A report detailing the findings of the assessment was submitted to the State Board on April 1, 1989, as required by Order No. WQ 88-7. The findings are necessarily tentative because bird and mammal reproductive seasons for 1989 were not completed at the time the report was prepared, and only a limited amount of data was available since filling of the ephemeral pools was completed in December 1988. A more complete analysis will be available in December 1989 when the Bureau submits its annual biological monitoring report to the Central Valley Regional Board.

Presently, Kesterson Reservoir consists of three habitat types - grassland, filled, and open habitats. The grassland habitat consists of higher elevation areas at Kesterson that were not filled. The dominant vegetation in the grassland habitat is saltgrass. The second type, the filled habitat, consists of formerly low-lying areas that were filled to prevent the occurrence of seasonal wetlands. Annual grasses, burning bush, prickly lettuce, clover and mustard are presently the dominant vegetation in these areas. The third type, open habitat, consists of cattail areas that were disked to prevent use by tricolored blackbirds. Clover, burning bush, and prickly lettuce dominate this habitat type. The grassland habitat covers approximately 30 percent of the reservoir, about 60 percent is filled habitat, and 10 percent is open habitat.

Data from samples of vegetation in the three habitat types indicated that the geometric mean selenium concentration in grassland and filled habitat plants was near or below 3 ppm. This level was previously proposed by the Bureau as a selenium cleanup goal for potential bird and mammal food, although the Bureau is continuing to conduct research on an appropriate safe selenium level for wildlife food. More specifically, selenium concentrations in all above-ground vegetative portions of grassland habitat sampled since August 1988 ranged from 0.1 to 17.7 ppm, with a geometric mean of 2.6 ppm. Selenium

concentrations in annual grasses collected from the fill areas ranged from 0.7 to 2.9 ppm, with a geometric mean of 1.3 ppm.

On the other hand, clover collected from the open habitat had a geometric mean concentration of 12.3 ppm, with concentrations ranging from 6.1 to 27 ppm. These higher concentrations may be associated with higher soil selenium concentrations in the open habitat, as opposed to the grassland or filled habitats.

Sample data on invertebrates are currently available only for the grassland habitat. The geometric mean selenium concentration for invertebrates, excluding sowbugs, collected in this habitat type since August 1988 was 8.4 ppm, with concentrations ranging from 1 to 51 ppm. The overall geometric mean selenium concentration in sowbugs was 56.6 ppm, and concentrations ranged from 23 to 210 ppm. These high levels are thought to be related to the similarly high levels in soil litter where sowbugs live and forage. Research conducted by the Bureau to date has not indicated that sowbugs constitute a significant food source for birds or mammals at Kesterson.

Since the completion of filling, the bird species using Kesterson have changed from mainly aquatic species to terrestrial species. The Bureau's sampling efforts, therefore, focused on terrestrial species. Among the nests of other terrestrial species, 27 barn swallow nests, 15 killdeer nests, 5 western meadowlark nests, and 1 mourning dove nest were discovered at

Kesterson in 1988. The mean selenium concentrations in killdeer and meadowlark eggs were higher than that expected to be found in uncontaminated areas. The concentrations were at a level associated with embryonic mortality and deformity at Kesterson in the past; however, no selenium-related embryotoxicity was found in terrestrial bird species at the site during the 1988 nesting season. The Bureau speculates that the lack of observed toxicity may be due to several factors, including changes in the matrix of contaminants at the reservoir since the delivery of drainwater stopped, species-specific responses to selenium, or other changes in environmental conditions.

The selenium levels in livers of adult western meadowlarks collected at Kesterson were also elevated over levels in livers of meadowlarks collected at Volta Wildlife Area. The Bureau's assessment indicated that the levels may be high enough to cause reproductive problems; however, none were observed in the five meadowlark nests identified at Kesterson in 1988.

Selenium levels in small mammals collected at Kesterson in 1988 were similar to those found during a 1984 survey. The 1984 study found no adverse reproductive or growth impacts to small mammals at Kesterson although elevated selenium levels were detected. The study concluded that elevated selenium concentrations in small mammals might threaten their predators, such as the endangered San Joaquin kit fox.

The results of a recently completed San Joaquin kit fox study, however, found minimal use of Kesterson by the small population of the kit fox in the Kesterson area. Therefore, elevated selenium levels in the small mammal prey base at the reservoir are not considered a threat to kit fox populations.

As part of the kit fox study, eleven coyotes were collected between November 1986 and January 1988. Liver samples from Kesterson Reservoir coyotes were about 6.5 times, blood samples 20 times, and hair samples 3.5 times higher than those of eastern Merced County coyotes. Two of the coyotes had liver selenium levels within the range associated with chronic selenium toxicosis in domestic dogs, and one of the coyotes had physical symptoms of selenium toxicosis. The Bureau speculates that the elevated selenium levels detected in the coyotes may be due to consumption of contaminated coots at the reservoir. Coots were part of the aquatic food chain at Kesterson, which has been eliminated as a result of the fill operation.

As stated previously, the conclusions in the Bureau's upland habitat assessment must be considered tentative because of the limited amount of data on which the assessment is based. Whether the data is representative of future conditions at Kesterson is, therefore, uncertain. Despite this uncertainty, the data does support the conclusion that operation of the reservoir as upland habitat will pose less of a threat to biological communities in the area than its past operation as a

wetland. Nevertheless, some toxic impacts and selenium tolerance species selection can be expected to occur at Kesterson Reservoir in the future due to the high selenium concentrations found in some organisms at the site.

D. Final Cleanup Plan

Order No. WQ 88-7 required the Bureau to submit a final cleanup plan by April 1, 1989, that will achieve cleanup goals by April 1, 1990, and that can be approved under the State Board's land disposal regulations (the Subchapter 15 regulations). See 23 California Code of Regulations Section 2510 et seq. In response, the Bureau submitted a cleanup plan on April 1. The plan is based upon a number of critical assumptions. The first is that there are no reasonable, short-term means of removing the soil selenium inventory at Kesterson Reservoir. Because of this, the Bureau concludes that continued site management is necessary to avoid potential threats to wildlife and water quality in the future.

The Bureau's cleanup plan notes that two significant cleanup actions have already taken place at the site. These are the cessation of drainwater discharge at the site and the fill operation described previously. The Bureau intends to implement a cleanup plan with three components: active site management, continued monitoring, and continued research.

Specific site management actions to be taken this year, prior to the 1989-90 wet season, will address the problems of persistent rainwater puddles and elevated selenium levels in vegetation in the open areas. Treatment of the puddle areas may consist of several actions, including grading and filling, discing the soil, or adding gypsum to the soil to enhance infiltration. The open areas will be disced to minimize vegetation and habitat.

In future years, the Bureau will develop an annual site management plan based upon the results of the continuing monitoring and research program. The Bureau proposes to submit the annual management plan along with the other monitoring reports routinely provided to the Central Valley Regional Board.

The Bureau intends to continue the present monitoring program at Kesterson. The Bureau will place continued emphasis on biological monitoring to detect any adverse impacts to wildlife associated with dry habitats. In addition, in the event of heavy rainfall resulting in surface ponding, the Bureau will intensively monitor in order to identify any potential aquatic exposure pathways.

The last component of the Bureau's plan consists of continued research into long-term techniques to dissipate the selenium inventory at Kesterson. Dissipative processes include microbial volatilization, volatilization from plants, plant uptake, and leaching. The ongoing research program is seeking to identify ways of accelerating these processes.

III. ANALYSIS

A. Subchapter 15

This Board previously concluded, in Order No. WQ 85-1, that Kesterson Reservoir was a surface impoundment subject to regulation under the Board's Subchapter 15 regulations. Consequently, closure of the facility had to be in compliance with the regulatory constraints of Article 8 of Subchapter 15, governing closure of waste management units.

State Board Order No. WQ 88-7 directed the Bureau to submit a final cleanup plan which could be approved by the Board under Subchapter 15. Specifically, the Bureau was required to demonstrate that its plan could be approved under Section 2510(b) of Subchapter 15 as an alternative to the requirements in the subchapter for closure of a surface impoundment.

Article 8 provides two methods for closure of a surface impoundment. These are: (1) removal of all contaminated waste and contaminated natural geologic material and disposal at an approved waste disposal site; and (2) closure of the impoundment as a landfill, provided that the facility meets the Subchapter 15 criteria for the siting and construction of a landfill. See id. Section 2582.

Section 2510(b) of Subchapter 15, however, authorizes the State Board and California Regional Water Quality Control Boards (Regional Boards) to approve alternatives to the construction and prescriptive standards contained in the

subchapter. Therefore, the boards are authorized to approve alternatives to the closure requirements of Article 8 under appropriate circumstances. These are:

(1) The discharger must demonstate that the closure standards are not feasible, and

(2) The discharger must demonstrate that there is a specific engineered alternative that is consistent with the performance goal addressed by the closure standards and that affords equivalent protection against water quality impairment.

To establish that a standard is not "feasible", the discharger must show that compliance with the standard is either:

(1) unreasonably and unnecessarily burdensome and will cost substantially more than a specific engineered alternative meeting the criteria specified above; or

(2) impractical and will not promote attainment of applicable performance standards.

In evaluating feasibility, the boards must consider all relevant technical and economic factors, including, but not limited to, present and projected costs of compliance, potential costs for remedial action in the event that waste is released to the environment, and the extent of ground water resources which could be affected.

The Bureau contends that the closure alternatives specified in Article 8 of Subchapter 15 are infeasible for Kesterson. If the Bureau were to implement the first closure alternative, the Bureau estimates that, excluding the new fill

material, approximately 8.3 million cubic yards of material would have to be excavated. If these materials were placed in an on-site landfill, the estimated cost would be $150 million. The costs would be significantly higher if the wastes were taken to an off-site landfill. Thus, the Bureau argues that this option is unreasonably and unnecessarily burdensome and extremely costly. The second closure option specified in Article 8 is not possible at Kesterson because the site does not meet the Subchapter 15 requirements for a landfill.

The Bureau further contends that the fill operation, in conjunction with its cleanup plan, meets the Section 2510(b) requirement for a specific engineered alternative. In Order No. WQ 87-3, this Board found that the performance goal of Section 2582 was to prevent the escape of residual wastes from a surface impoundment upon closure. P. 16. The Bureau notes that the Board has already concurred in the Bureau's conclusion, based upon extensive monitoring and research data, that pollution of the ground water with selenium is not a significant concern. Id. at 37. Further, runoff of surface water is effectively blocked by exterior dikes, which were constructed to provide 100-year flood protection for the site. Therefore, the Bureau maintains that it has met the applicable performance goal.

The Bureau also argues that its cleanup plan provides protection against water quality impairment equivalent to that provided by the closure options in Article 8. The Bureau recognizes that surface ponding due to heavy rainfall events will

occur but states that equivalent protection will be provided through continued actions to prevent the reestablishment of wetland habitat.

In addition to the requirements of Section 2510(b), the Board, in Order No. WQ 88-7, specified that the Bureau's final cleanup plan had to achieve cleanup goals by April 1, 1990. The cleanup goals referred to by the Board were the selenium concentration goals previously proposed by the Bureau for water and food chain items. For surface water, the goal was 2-5 ppb total selenium, and for waterfowl and mammal food chain items the goal was 3 ppm (dry weight). Although the food chain goal of 3 ppm was established for wetland habitat species, the Bureau plans to use this goal for the upland environment as well due to the lack of research evidence indicating that the goal is inappropriate. The Bureau's cleanup plan indicates that the agency cannot meet this goal by April 1, 1990. Likewise, the Bureau anticipates that selenium concentrations in rainfall pools will exceed the surface water goal of 2 to 5 ppb.

This Board agrees with the Bureau that complete removal and disposal of all contaminated material from Kesterson at an on-site or off-site landfill would be unreasonably and unnecessarily burdensome and costly. While the Bureau's estimates of the quantity and cost of excavation and disposal are open to question, it is clear that the magnitude and costs of such an operation would be substantial. In addition, we note that the fill operation has made the bulk of the selenium

inventory at the reservoir less accessible. We have already concluded that pollution of the ground water with selenium is not a significant concern. The cessation of drainwater discharges to Kesterson and the fill operation have greatly alleviated threats to waterfowl and other wildlife, which were associated with a wetland habitat. Although the Bureau has not eliminated all risks to wildlife at the site, the Board finds, after considering the factors listed in Section 2510(b), that the first closure alternative of Article 8, that is, excavation and disposal of all contaminated materials, is not a rational alternative under the circumstances of this case.

The second criterion of Section 2510(b), that the alternative selected by the discharger meets the specified performance goal and provides equivalent water quality protection, is more troublesome. We conclude that the Bureau's cleanup plan can, nevertheless, be approved under Section 2510(b) after considering several factors. First, the Board agrees with the Bureau that there does not appear to be any reasonable, short-term cleanup technique capable of achieving cleanup goals by April 1, 1990. The Bureau has studied several long-term cleanup techniques; however, the Board is unable to conclude that any one of these techniques should be mandated at the present time. The Board previously found that one of these techniques, controlled flooding of the reservoir, was too speculative and posed unacceptable risks to wildlife. See Order No. WQ 87-3, Pages 28-58. As discusssed previously, microbial volatilization

appears promising as a method to remove the selenium inventory at the reservoir; however, uncertainties remain regarding the process by which selenium is depleted and the optimum conditions for enhancing selenium volatilization. Other techniques for removing the selenium inventory at Kesterson, such as selective cropping and wetting and drying the soil, also hold promise but are in the experimental stage.

Balanced against these considerations are the facts that the site does not appear to pose a threat to ground water and that the Bureau has eliminated most aquatic food pathways. And, although a substantial selenium inventory remains at the site, the data collected to date in the dryland habitat does not demonstrate selenium-related adverse impacts to wildlife.

Kesterson Reservoir continues to pose a potential threat to the environment because of the selenium inventory at the site. This threat could be eliminated in the short-term only by excavation and disposal of the contaminated soils and vegetation at the site. Having rejected this alternative, the Board concludes, under all of the circumstances of this case, that approval of a cleanup plan involving site management, continued monitoring and continued research is appropriate.

The Board will, therefore, approve the Bureau's final cleanup plan, with one condition. The Bureau will be required to obtain the approval of the Central Valley Regional Board before implementing the Bureau's annual site management plan. The Board would like to stress that the Bureau and the Central Valley

Regional Board should give serious consideration to implementation of the microbial volatilization technique in the open areas, where selenium concentrations in the vegetation are highest. In addition, the Central Valley Regional Board should carefully review the Bureau's monitoring program for the rainwater puddles to determine if the monitoring program is adequate and allows the Bureau sufficient response time to take appropriate action if aquatic pathways are re-established.

B. Wetland Mitigation

Several individuals testified at the Board's hearing on June 28, 1989, on the need for wetland mitigation. We wish to reiterate our concern, expressed in Order No. WQ 87-3, about the loss of wetland acreage and values at Kesterson and the continuing need for appropriate mitigation. The Board is encouraged by the efforts of the Central Valley Regional Board to ensure that adequate mitigation is implemented by the Bureau and will continue to monitor such efforts.

C. Remand to the Central Valley Regional Board

In Order No. WQ 88-7, this Board ordered that the waste discharge requirements adopted by the Central Valley Regional Board in Order No. 87-149, excluding the monitoring program and wetland mitigation provisions, be held in abeyance pending final action by the Board on the Bureau's final cleanup plan. Having concluded that the Bureau's plan should be approved, we remand

this matter back to the Regional Board for action consistent with this order.

IV. CONCLUSIONS

1. The Bureau's final cleanup plan should be approved on condition that the Bureau obtain the approval of the Central Valley Regional Board prior to implementation of the Bureau's annual site management plan.

2. This matter should be remanded to the Central Valley Regional Board for appropriate action consistent with this order.

V. ORDER

IT IS HEREBY ORDERED THAT the Bureau's final cleanup plan is approved on condition that the Bureau obtain the approval of the Central Valley Regional Board, on an annual basis, prior to implementation of the site management plan.

IT IS FURTHER ORDERED THAT this matter is remanded to the Central Valley Regional Board for action consistent with this order.

IT IS FURTHER ORDERED THAT State Board Orders Nos. WQ 85-1, 85-5, 87-3, and 88-7 are amended in accordance with the provisions of this order.

CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true,

and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on September 21, 1989.

AYE:	W. Don Maughan Darlene E. Ruiz Edwin H. Finster Eliseo M. Samaniego Danny Walsh
NO:	None
ABSENT:	None
ABSTAIN:	None

Maureen Marché
Administrative Assistant to the Board