Fl-051

BROADVIEW WATER DISTRICT

July 28, 1997

CALFED Bay-Delta Program
1416 Ninth Street, Suite 1155
Sacramento, CA 95814

Subject: Proposal for CALFED Category III Funding for
Biological Treatment of Selenium from Agricultural Drainage Water in the Western San Joaquin Valley

Ladies and Gentlemen:

The Broadview Water District is pleased to present the enclosed proposal for CALFED Category III funding for *Biological Treatment of Selenium from Agricultural Drainage Water in the Western San Joaquin Valley*. We believe the proposed project will provide significant progress towards the goal of selenium removal from agricultural drain water, which will be very useful in improving water quality in the San Joaquin Valley and the Bay-Delta ecosystem. This project fits well within the objectives of the CALFED program and offers significant potential environmental benefits.

The Broadview Water District has assembled a highly qualified team to carry out this important project, and is planning to provide agricultural drainage water and land on which to construct the proposed treatment facility. We urge the CALFED Bay-Delta Program to fund this very important project.

Sincerely,

David G. Cone
Manager

DWR WAREHOUSE
97 JUL 28 AM 11:07

Enclosure

CALFED01.WPS

P.O. BOX 95 • FIREBAUGH, CALIFORNIA 93622
(209) 659-2004 FAX (209) 659-3526

I. EXECUTIVE SUMMARY

Project Title and Applicant Name: The proposed project is entitled: *Biological Removal of Selenium from Agricultural Drainage Water in the Western San Joaquin Valley*. The applicant is the Broadview Water District, Firebaugh, California.

Project Description and Primary Biological/Ecological Benefits: In the western San Joaquin Valley of California, agricultural drain water carries high loads of selenium derived from the parent material of the soils. Selenium is known to cause embryonic deformities in waterfowl, and therefore its concentration in drain water and in discharge to waterways leading to the Bay-Delta region is of great concern.

The first element in the treatment program would be a flow-through marsh environment. Marsh plants such as cattail, sedge, and selected grasses, in concert with soil microflora that thrive in the wet, nutrient-rich environment of the marsh, can volatilize up to 70% of the selenium that enters the system. The second element would utilize the recaptured water from the marsh to irrigate a moderately salt-tolerant crop species such as alfalfa. Alfalfa would uptake approximately 30% of the remaining selenium in the irrigation water, and has a high evapotranspiration rate, which would result in drain water further reduced in volume and in selenium load, although with an increasingly high salt concentration. The third element of the program would use selected halophytes irrigated with the alfalfa drain water. Salicornia and saltgrass tolerate high levels of salinity in irrigation water, both volatilize and uptake selenium, and transpire actively. This element would serve to further concentrate the water and to remove yet more selenium. Finally, the resulting drain water would be delivered to a series of brine ponds constructed for the aquaculture of hypersaline organisms. Brine shrimp would be cultured here, along with the algae and diatoms that they feed upon. The algae uptake selenium, which would be consumed by the shrimp which would then be harvested for market. The small volume of water that would emerge as effluent from the aquaculture operation would be so greatly reduced in selenium load that it could be diluted with fresh water until the selenium concentration is low enough to allow for discharge into existing waterways or to wetlands constructed for wildlife enhancement. Alternatively, the remaining water could be captured in evaporation ponds, and the resulting solid salts would be periodically removed.

Approach/Tasks/Schedule: Our approach utilizes biological processes operating in natural and agricultural settings that promote uptake and volatilization of selenium by soil microflora, algal species, and higher plants. These individual remediation strategies have been thoroughly researched in the laboratory and in some field demonstration projects, and will be integrated through this project into a treatment program involving constructed flow-through marshlands, cultivation of salt-tolerant plants and of halophytes, and aquaculture in hypersaline pond environments. Together, these elements could significantly reduce drain water volume and selenium load to levels potentially acceptable for discharge into existing waterways or for physical removal from the watershed. The project is designed as a phased program, to allow for expertise and learning generated by early phases to be promptly incorporated into later stages to improve efficiency and effectiveness, and to reduce cost. The program will begin with development and construction of a prototype project, and progress to a full production project designed to handle the treatment of agricultural drain water on a regional scale. It will also include demonstration and education facilities designed to teach on-farm application of the project elements, as well as a small research facility. The final objective is a treatment facility capable of treating agricultural drain water on a regional scale, complying fully with existing laws and regulations regarding water quality.

Phase I of the program would be completed during the first 12 months following funding. This phase would involve conceptual plan development, project design, appropriate agency consultation, and the construction of a model project of 120 acres, including each of the above elements, which would be designed to receive water from 2,000 acres of existing drained farmland from Broadview. Phase II, the subsequent 18 months, would consist of an expansion of the initial prototype facility, incorporating lessons learned during Phase I. The final phase will expand the project to achieve greater economies of scale and prove the feasibility of regional treatment.

Justification for Project and Funding by CALFED: This proposal will develop a program for the biological remediation of selenium-contaminated drain water. Our program will apply a variety of recent research regarding the natural processes and functions of selenium uptake and volatilization. The program could result in a dramatic reduction in the selenium load in these drain waters, and could thereby enhance the water quality in the San Joaquin drainage that could allow for improvement in lower watershed beneficial uses in the Bay-Delta region.

Budget Costs and Third Party Impacts: The costs for the project are estimated at $960,000 for Phase I, $1,000,000 for Phase II, and $350,000 for Phase III, for a total estimated project cost of $2,300,000. Funding would be reevaluated at the end of each phase to account for accumulated experience. No negative third party impacts are anticipated.

Applicant Qualifications: The Broadview Water District has been an active participant in many agriculture and water quality research programs, many funded by the California Department of Water Resources and the U.S. Bureau of Reclamation. The District has assembled a highly qualified team of consultants to assist with program implementation, including: Bookman-Edmonston Engineering, Inc., a leading water resources and civil engineering consulting firm, based in Sacramento, CA; Agrarian Research and Management, a consulting firm with 25 years of experience in land reclamation and farm/ranch construction and operation; and Carla Scheidlinger, a plant ecologist who has worked with extremes of halophyte cultivation, and is a seasoned manager of scientifically based projects. Additional consultants to the team include Dr. James Ayars, a soil salinity expert; Dr. Norman Terry, a specialist in plant uptake and volatilization of selenium; and Andreas Schmidt, a commercial producer of brine shrimp in the South Bay. Together, this team is uniquely qualified to provide a affordable solution to the problem of selenium contamination in the priority seasonal wetland and aquatic habitats of the Bay-Delta region. This project will advance the solution out of isolated laboratory and test plots to the regional scale necessary to realize critical and direct ecological and economic benefits.

Monitoring and Data Evaluation: Detailed audits of soil and water constituents, mainly selenium and salts, would be conducted according to accepted scientific standards. Evaluations of reduction of selenium load and in volume of drain water at each project element would be made on a monthly basis in order to assess the effectiveness of that element in water quality remediation.

Biological Removal of Selenium from Agricultural Drain Water in the Western San Joaquin Valley

Broadview Water District
P.O. Box 95
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Organization Type: California Water District
Tax Status: Local Public Agency
Tax Identification Number: 94-6027536

Technical and Financial Contact Person: David G. Cone
Manager, Broadview Water District

RFP Project Group Type: Other Services

III. PROJECT DESCRIPTION

IIIa. Project Description and Approach

Agriculture in the San Joaquin Valley developed during the early decades of this century under conditions of irrigation. The combined effects of irrigation, naturally saline soils, and a climate that produces a high evapotranspirative rate have degraded thousands of acres of formerly productive land in the San Joaquin Valley. By the year 2040, it is estimated that 75,000 acres of agricultural land may have to be retired due to the effects of salinization, and 60,000 additional acres will require drainage if they are to retained as productive farms.

Although drainage is a natural solution for problems of salinization, both salts and selenium, which occur naturally in the soils of the San Joaquin Basin, concentrate in drain water. When agricultural drain water was used to create a wetland at Kesterson, birth deformities were detected in unprecedented numbers in waterfowl attracted to these wetlands. The defects were traced to selenium contamination, and Kesterson has been closed to drain water reception since 1985. Since then, agricultural drain water has been strictly regulated for selenium load and concentration, and farmers must either reduce the acreage drained, discharge drain water into evaporation ponds, or comply with load limits in allowable discharge into natural waterways. The result has been stress on the agricultural economy of the region, as well as ongoing contamination of waterways with both selenium and salt.

The Broadview Water District proposes the development of a drain water treatment facility that would receive drain water generated by a large acreage of land, and treat it by applying it to a series of crop species and wetland settings that would concentrate the water, remove selenium by the natural biological processes of volatilization and uptake, and return a considerably reduced volume of water with a diminished selenium load to a concentrated brine pond that could in turn produce a potentially marketable product. A process flow chart which illustrates the projected land requirements, water volumes, and water quality for each stage is included.

Our general approach is to use carefully designed biological rather than chemical or physical processes to concentrate and purify the drain water. Monitoring of incoming solutes would be stringent, and detailed balances of salt, selenium, and other elements of concern would be kept for the project to assure that the project itself is self-contained and does not leak potential contaminants into the surrounding land or into the underlying water table. The result would be an extension of the surrounding farmland, where the surface would be covered with crop, grass, or wetland species, tillage patterns would be compatible with those on other parcels of the region, water delivery structures and drains would be similar in design to the surrounding agricultural land, and the brine pools would retain a low profile and have net coverings to protect the aquaculture species within them and eliminate undesirable incidental use by waterfowl. The project size would occupy less than 10% of the area of the cropland from which drainage water is being treated. The project would produce immediate as well as long-term benefits for both the agricultural economy and the ecological systems, as seasonal wetland habitat would be incorporated into an agroecological system in the region.

PHASE I TREATMENT FACILITY

PROJECTED Se DISCHARGE LOADS & CONCENTRATION

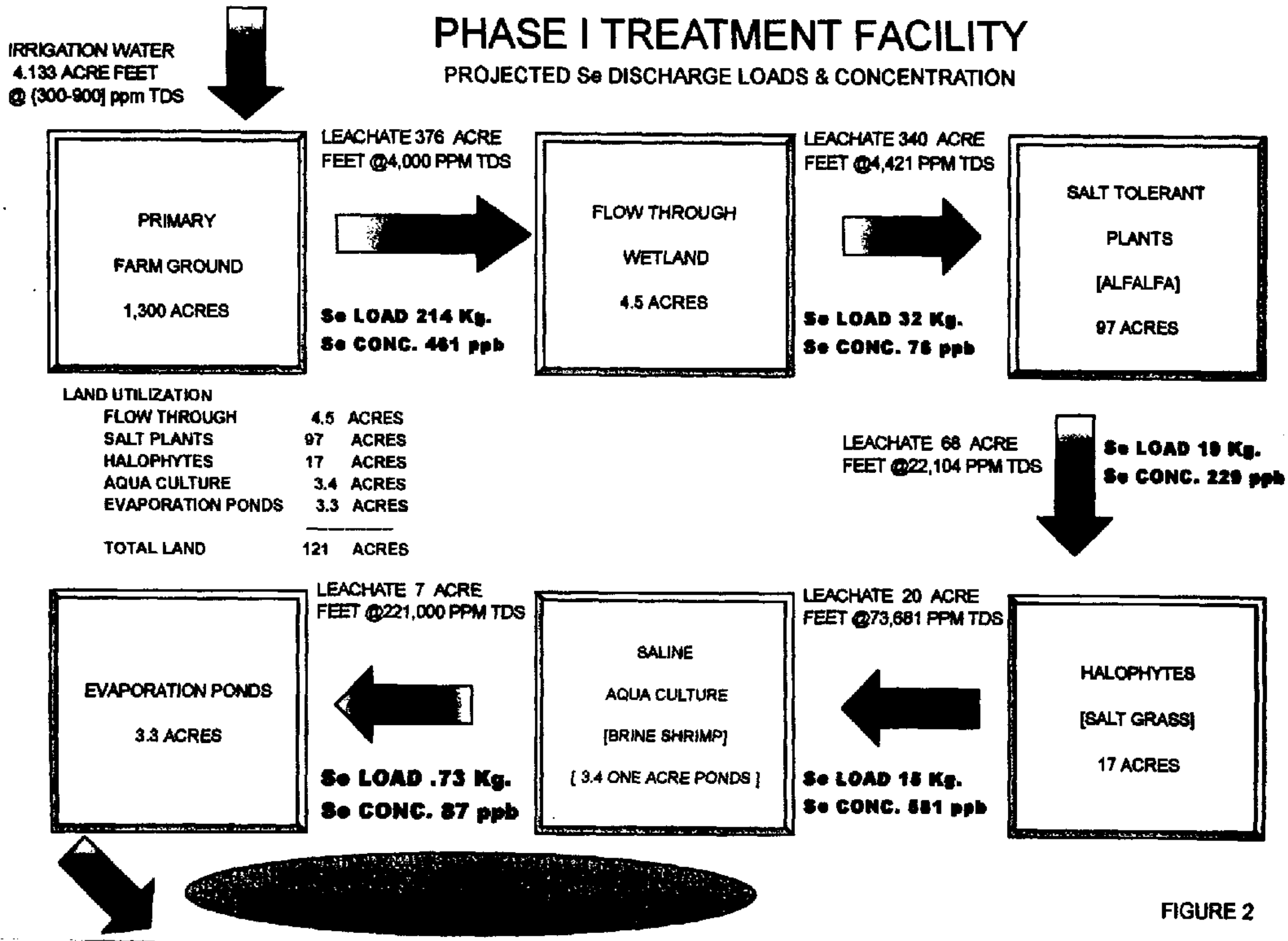

FIGURE 2

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The cropping patterns and species on the Broadview Water District would remain unchanged. Crops are grown on land already supplied with tile drain, and the drain water is collected separately from tail water or from other water inputs. The drain water would be delivered to Component 1 of the project, which would be a flow-through wetland. Such wetlands are distinguished from conventional "habitat" wetlands in that the plant cover is more dense, allowing for a minimum of open water, and the water delivered to them maintains a slow, constant flow that does not allow for ponding or for selenium concentration. Research has shown that such wetlands are extremely effective at volatilizing Se, with removal rates of up to 80% of the original selenium. This fresh-water wetland would contain species such as cattail, tule, rabbitfoot grass, and sedges, and provides habitat for a variety of seasonal wetland species.

Water flowing out of the wetland area would be delivered to Component 2 which would be moderately salt-tolerant crops. This component represents a return to a more or less conventional cropping strategy, where the crops are selected for their tolerance for elevated salinity and for their ability to remove selenium from the water through either volatilization and/or uptake. Potential crops that have already been screened for these characteristics are cotton, sugar beet, alfalfa, barley, and wheatgrass. In additional selected tree species such as athel (*Tamarix* aphylla) could be used. This component would be constructed on fields equipped with tile drains. Drain water generated here would be delivered to Component 3, which would consist of halophytes. This component would utilize extremely salt-tolerant species such as salt grass (*Distichlis spicata*), cordgrass (*Spartina*), pickleweed (*Salicornia*), and/or quailbush (*Atriplex lentiformis*). The component would constructed on drained land, and the drain water would be delivered to Component 4.

Component 4 would be a series of brine ponds with brine shrimp. The brine shrimp *Artemia* thrives in saline waters of up to 4-5 times the concentration of sea water. They consume unicellular algae and diatoms that also grow in such conditions. Some of these algae are known to concentrate selenium. By consuming them, the brine shrimp also concentrate selenium. The brine shrimp could be cultured for harvest as fish food, and as cattle feed supplements. In addition, the hypersaline conditions of these ponds support various species of bacteria, among them some known to be active volatilizers of selenium. These ponds would need to be protected by netting from birds, both to prevent bioaccumulation of selenium in the birds themselves, and to relieve predation pressure from the brine shrimp populations. When the water becomes too saline for the *Artemia*, it would be discharged to Component 5.

Component 5 would be solar evaporation ponds, which represent the final step of the treatment system. By this time, the drain waters would be concentrated to less than 1% of their original volume, and the selenium load would have been reduced by 95%. Salt load, however, would be undiminished, except for the amount that would have precipitated in the brine shrimp ponds. The evaporation ponds could be the last step in the system, in which case the salt would need to be collected and trucked away. Alternatively, the remaining water could be diluted with fresh water until the selenium concentration has been reduced to levels at or below 5 parts per billion (ppb), at which point it may be acceptable for discharge.

IIIb. Location of Project.

The project would be constructed on the Broadview Water District, which is located to the northwest of Firebaugh, CA in the western San Joaquin Valley. The District occupies 9,515 acres, on which cotton, wheat, cantaloupes, seed alfalfa, tomatoes, sugar beets, barley, and beans are currently grown. The proposed site of the treatment facility is shown on the enclosed map of the Broadview Water District.

IIIc. Expected Benefits

The toxic effects of selenium on wildlife have resulted in a serious disposal problem for drain water generated from the leaching of agricultural land in this region. Drain water from the Broadview Water District is discharged directly into the San Joaquin River, and the District is currently limited to a maximum allowable discharge of 852 pounds of selenium per year. If total drain water exceeds this load, it must be retained on-farm, or drainage water volume must be reduced. Broadview farmers have had to convert cropping patterns from high value crops such as melons, tomatoes, and alfalfa seeds that can be grown on fertile soils to lower value crops such as cotton and sugar beets that can tolerate conditions of higher soil salinity in the absence of adequate drainage. Therefore, the drain water problem has negatively impacted both the environment, as selenium continues to be discharged into the waterways, and the farmer. This project will significantly reduce the selenium load of drain water added to the San Joaquin River, and thereby improve water quality for beneficial uses, thus providing a direct environmental benefit to the region. It will also make possible an expansion of drainage infrastructure in the Broadview District, resulting in direct benefits to the local economy.

IIId. Background and Technical Justification

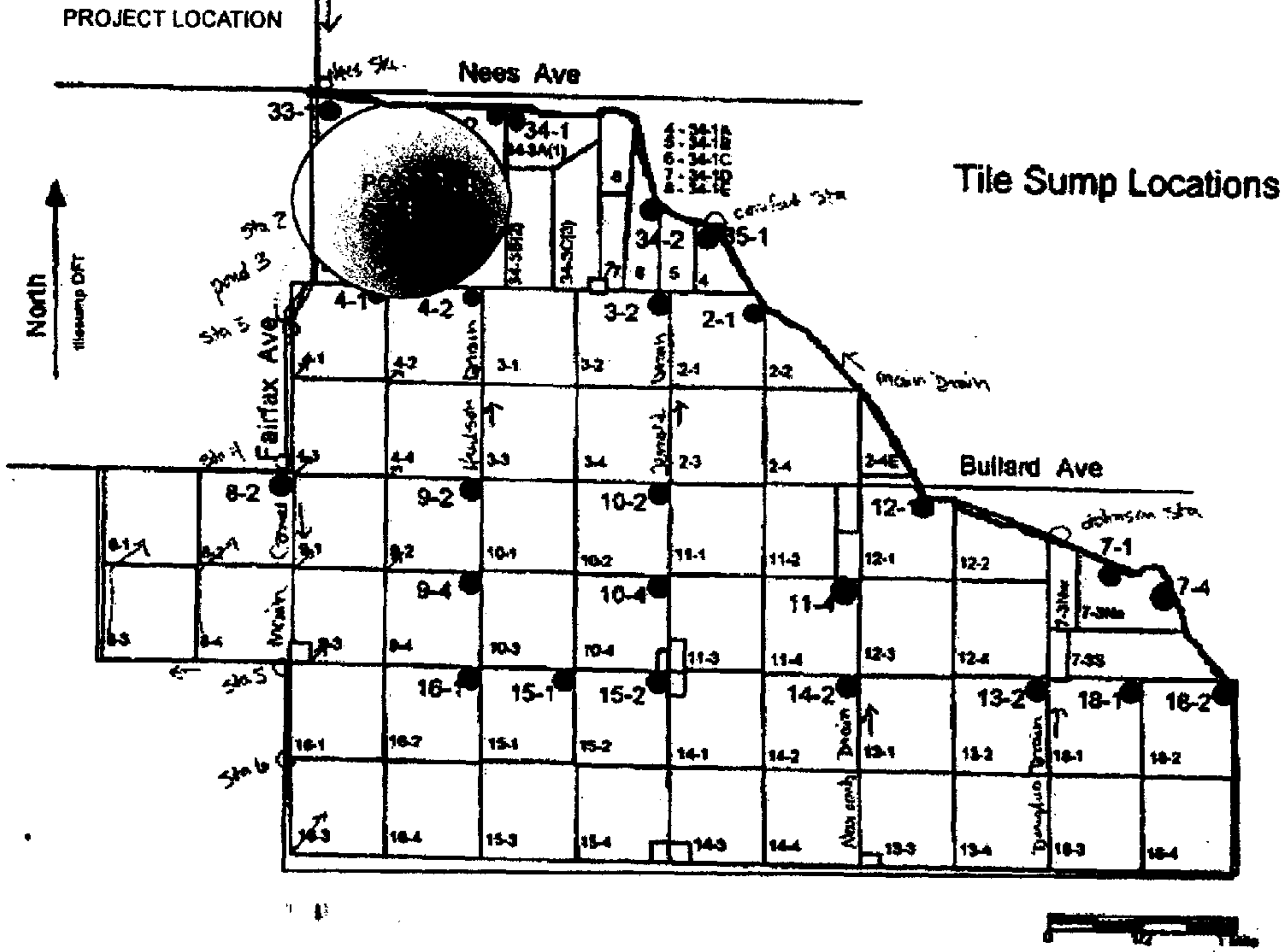
Since 1985, a great deal of research has been conducted in the search for solutions to the problem of drain water disposal in the San Joaquin region. Approaches have been in three general areas:

- water conservation strategies that can be implemented by farmers to reduce the volume of drain water generated by crops;
- the reuse of drain water from the crops on salt-tolerant plantings, thereby reducing the amount of drain water requiring disposal; and
- the reduction of the load of toxic elements, specifically selenium, in end-product drain water.

Small scale tests of all of these strategies have been implemented at various locations in the region, and some preliminary results are promising. This project would address all three approaches. Water conservation strategies have been explored at Broadview in consultation with the USDA, and these strategies would be retained. Water reuse strategies have also been developed in small experimental settings at the Red Rock Ranch and Murietta Farms near Mendota, and at the demonstration projects operated by the Tulare Lake Drainage District on

BROADVIEW WATER DISTRICT

Tile Sump Locations



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the Boswell Farms, as well as on the Broadview District itself. The strategies in these projects are similar to some of those outlined in the Project Description. To date, however, there have been no integrated projects of this type treating water on a regional or district-wide scale.

Selenium reduction methods have probably received the greatest amount of research dollars, and there are many avenues for treating drain water for the removal of heavy metals. Physical methods such as reverse osmosis, and chemical measures such as fixed-film reactors and iron filing treatments have been investigated, but no projects beyond "lab-bench" scale research have been implemented. In contrast, field biological treatment methods have far greater promise for both treatment success and cost-effectiveness. This kind of biological treatment relies on the ability of certain species of bacteria, algae, and higher plants to uptake, volatilize and/or precipitate selenium. Selenium taken up by higher plants can be physically removed from the affected location by harvest, thus reducing the load of selenium transported downstream. Crop species known to be capable of reasonably high levels of selenium uptake include various grasses such as wheat, tall fescue, and saltgrass, in addition to many members of the mustard family such as broccoli, cabbage, and wild brown mustard.

Volatilization is the conversion of selenium from a solid to a gaseous form. There are many bacteria as well as some fungi that are capable of high rates of selenium volatilization in the soil, and bare soil surfaces, if treated properly, can volatilize significant amounts of selenium when they are irrigated with selenium-enriched water. Not only soil microflora, but also unicellular and filimentous species of aquatic algae, as well as some aquatic bacteria, are capable of volatilization and uptake of selenium. In particular, halophytic species of diatoms and of unicellular green algae both volatilize and reduce toxic forms of selenium. The utility of these species in brine ponds as a food source for brine shrimp as well as in potential end-stage evaporation ponds is an important component of the proposed project. Higher plants are also capable of selenium volatilization. Alfalfa as well as some grasses such as saltgrass and tall fescue have been shown to volatilize selenium. Finally, wetland species such as cattail, sedge, and rabbitfoot grass are very effective at removing selenium from water. Preliminary work with halophytes such as pickleweed and cordgrass indicate that these species are active volatilizers as well.

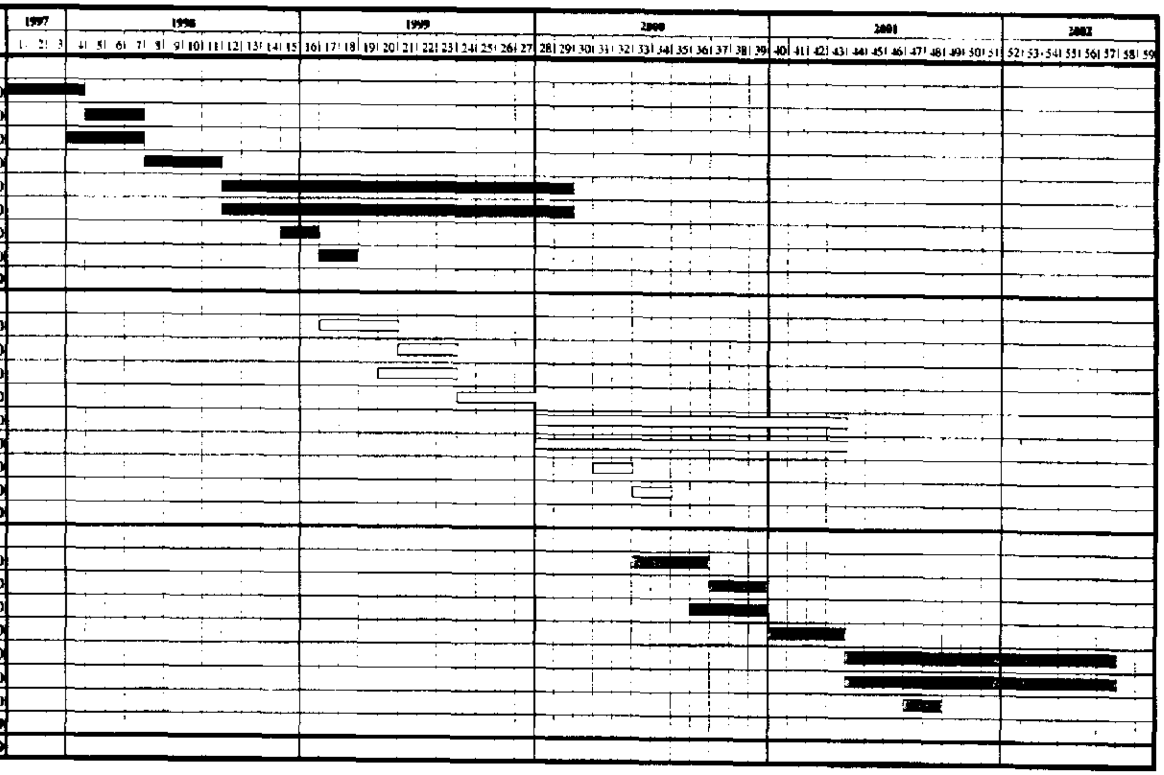
These research results suggest a promising avenue of drain water treatment. The concepts of drain water reuse can be expanded and optimized to produce a series of parcels using crops of increasing salt tolerance, whereby the volume of drain water continues to be reduced at each application. The selection of crops for salt tolerance, economic return, and ability to process selenium either by uptake or volatilization could result in a dramatic reduction in the selenium load of the drain water after it has passed through successive applications to appropriate plants. This implementation strategy will be detailed below.

IIIe. Scope of Work

The project is designed for distinct phases, following the project development program diagrammed in the enclosed schedule. Phase I would be conceptual plan development, design, and construction of a model project of 120 acres designed to receive water from 2000 acres. Phase II would refine the strategies researched in Phase I, select the most viable

BIOLOGICAL REMOVAL OF SELENIUM FROM AGRICULTURAL DRAINAGE WATER IN THE WESTERN SAN JOAQUIN VALLEY SCHEDULE

	Cost ($)
PHASE I	
Planning	$212,600
Design	$136,000
Environmental	$44,700
Construction	$324,500
Operation	$71,500
Monitoring	$109,000
Evaluation and Reporting	$42,300
Redesign	$18,100
Total, Phase I	**$958,700**
PHASE II	
Planning	$221,500
Design	$141,600
Environmental	$46,600
Construction	$338,000
Operation	$74,400
Monitoring	$113,500
Evaluation and Reporting	$44,000
Redesign	$18,800
Total, Phase II	**$998,400**
PHASE III	
Planning	$79,700
Design	$51,000
Environmental	$16,800
Construction	$121,700
Operation	$26,800
Monitoring	$40,900
Evaluation and Reporting	$15,900
Total, Phase III	**$352,800**
TOTAL COST	**$2,309,900**



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candidate species or communities, and expand the treatment facility to a total of 320 acres. The third phase would incorporate lessons learned during Phase II, and expand the treatment facility to total of 500 acres. At the completion of Phase III, drainage water from approximately 4,800 acres would be treated. This phased process would demonstrate both effectiveness and economic viability and result in a fully functional production scale project as described above.

The following work plan describes that specific tasks that the Broadview Water District team would undertake to successfully complete the first two phases of this project. The phases of the project development would be sequential. During the course of the work, interested agencies and parties would have the opportunity to review the progress on the work and to provide input. The requirements of environmental compliance will be especially important in this review process.

The primary objectives of Phase I are: (1) to prepare a development plan based on laboratory and field research experience that can be presented to regulatory bodies for preliminary approval and permits; (2) development of research and monitoring protocols; and (3) design, construction, and operation of the 120-acre prototype treatment facility.

Phase II of the project would implement the results of the Phase I prototype, and would proceed only after the information and data generated by the model have been fully analyzed and reported. Emphasis in this phase would be on critical modifications to the project based on experience generated during Phase I. Such modifications could include adjustments in the drainage construction based on experience in the project site soils; changes in data gathering to reflect the need for an increasingly accurate audit of water and of solutes; changes in surface treatment and soil amendments to maximize selenium uptake, volatilization, and/or consumptive use requirement of the crop; and modifications to the brine pond system to increase productivity in this system. Marketing evaluation for the end products of the elements of the project will begin at this point. Phase III would expand the project to a pre-production size, to prove the feasibility of treatment of a large volume of drainage water.

IIIf. Monitoring and Data Evaluation

Monitoring on the project would be for three primary data sets. The first is technical feasibility, which will deal with actual selenium reductions and salt balances in each project element. Second, we will also careful track expenses, to address the issue of economic viability, so that the end product will be a viable business venture. To this end, the project must accurately appraise the capital requirements necessary to construct, operate, and maintain such a facility. In order to carry the project to its conclusion as a fully operative drain water treatment facility, it would be necessary to develop construction and operational specifications, methods, and procedures that would be detailed and subjected to peer review. These specifications, methods, and procedures would deal with drain water collection and audit demonstrating minimal losses to deep percolation, evaluation of water quality, and routine and accurate data collection protocols. At the end of Phase I, each candidate species or community will be subjected to review, and the most successful ones would be incorporated into the succeeding phases of the project, resulting finally in a production scale project that will be available for full review. Criteria for success at each phase would relate directly to the goals for reducing specified stresses to habitats based on water quality: assured and certain compliance with water quality standards, rapid treatment of water that allows for drain water to be treated as fast as it is generated to prevent the need for storage of untreated water; and fully effective methods that result in maximum reduction of both volume and selenium load. The result would be a long-term solution to selenium contamination in agricultural drain water, and substantial benefits to the restoration and health of downstream habitats.

IIIg. Implementability

A critical criterion for success for the proposed project will be active interfacing with the regulatory bodies involved in drainage management as well as with researchers whose work has already begun to address the problems we are seeking to solve. The Broadview Water District team is uniquely qualified to work creatively and effectively with these groups and individuals to assure smooth and effective communication with all responsible agencies and involved individuals or groups. We are very well aware of the political, social, economic, legal, environmental, and natural resources issues that need to be considered in planning and implementing a drain water treatment program in this region. Success will involve the close communication with and cooperation a number of entities. To date, we have secured support and encouragement from the California Department of Food and Agriculture (CDFA). Other agencies that will need to be consulted include all those involved in the CalFed Bay-Delta Program. The legal and regulatory responsibilities, economic interests, and environmental sensitivities represented by these diverse groups will all need to be considered during the conceptual design phase.

IV. COSTS AND SCHEDULE

Phases I, II, and III of the proposed project are estimated to cost approximately $960,000, $1,000,000, and $350,000, respectively, for a total of $2,300,000. These figures include all costs of planning, design environmental documentation and permitting, construction, operation and maintenance, evaluation of the project. Phase I would be operational approximately 12 months after funding is approved and work is begun, with Phases II and III becoming operational about 29 months and 43 months, respectively, following the commencement of work.

A detailed budget and schedule are attached. The flexibility inherent in the phased approach to the scope of work and project implementation will allow many opportunities to evaluate results, and revise the work scope, budget, and schedule if necessary.

V. QUALIFICATIONS

The Broadview Water District team is composed of highly qualified individuals who are committed to the successful implementation of the proposed project. Many of them have cooperated on projects in the past, and they all have proven track records of creative and effective solutions to practical environmental, agricultural, and engineering problems. An organization chart is attached.

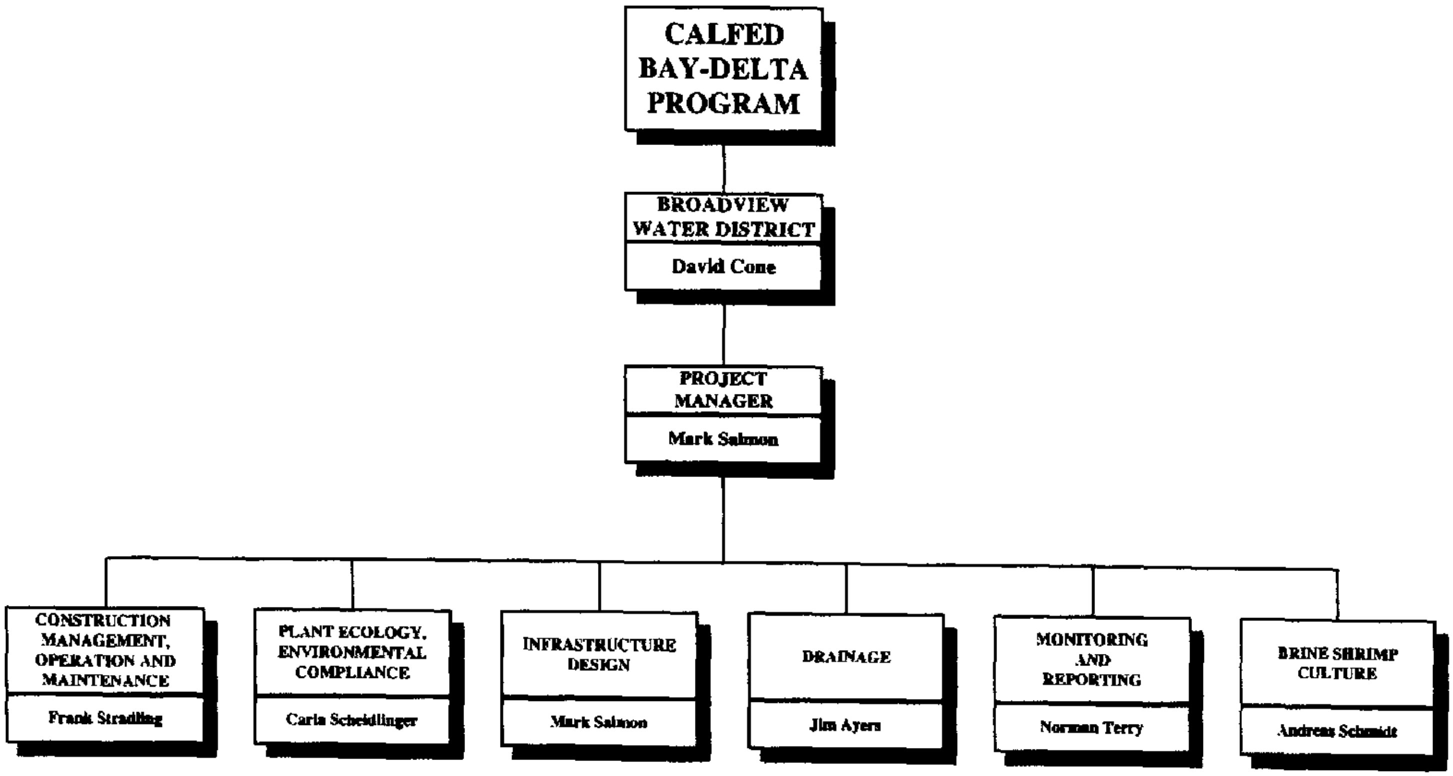
Principal Consultant Team Members

Mark Salmon, Principal Engineer with Bookman-Edmonston Engineering, Inc., is an experienced civil engineer and project manager with over 13 years of experience in water resources development, water quality issues, design, and construction management. Mr. Salmon has extensive experience in design and construction of the infrastructure needed to construct the proposed treatment facility. Mr. Salmon is also very familiar with regulatory requirements and institutional issues regarding water quality in the San Joaquin Valley. As project manager, Mr. Salmon will direct the project team and be responsible for coordination with CALFED.

Frank Stradling, president and owner of Agrarian Research and Management, will be responsible for land and soil reclamation, irrigation system design, establishing vegetation, and farming operations. Mr. Stradling has over 25 years of experience in agriculture and natural resource development. He has extensive experience in farm management; irrigation system design and construction, and agricultural operations on salt-affected soils.

Carla Scheidlinger is a plant ecologist with scientific and technical specialties in population ecology, rare plant population dynamics, halophyte cultivation, and habitat creation and restoration. She pioneered vernal pool habitat restoration and mitigation in San Diego County, and developed management strategies for a variety of rare coastal plant species. More recently, she conceived and implemented halophyte (saltgrass) cultivation techniques on the exceedingly hostile substrate of the Owens Dry Lake playa as a component of a fugitive dust mitigation program. As a research director and project manager, she has supervised teams of scientists and technicians on a variety of projects based both in academic, private, and agency settings, and handles proposal preparation as well as reporting, documentation, and publishing of results. Ms. Scheidlinger also has extensive experience in dealing with sensitive environmental issues on a regional scale. She was an active participant in the drafting and negotiation of the 1990 cooperative groundwater management agreement between the City of Los Angeles and Inyo County. She also negotiated an out-of-court settlement with the above parties that involved several public interest groups relating to water extraction and habitat enhancement in the Owens Valley. This settlement ended a 27-year litigation between Los Angeles and Inyo County, and provided for some far-reaching environmental benefits for the Owens Valley, such as the rewatering of 50 miles of the Lower Owens River. Ms. Scheidlinger retains an active involvement in the planning and implementation of these environmental projects. Additionally, she has been involved in the formation and activities of consensus-based groups involving land and resource use, especially grazing and water use.

ORGANIZATION CHART



Dr. James Ayars will serve as a consultant regarding soil water management and drainage system design and operation. Dr. Ayars is an agricultural engineer with the USDA-ARS, Water Management Research Lab in Fresno, CA. His research activities include: field studies of irrigation and drainage water management to reduce drain flow; reuse of saline drainage water for irrigation;, water management studies for irrigation districts; studies of the effects of irrigation management strategies on drainage water quality. He has special expertise in salt transport in soil-water solutions.

Dr. Norman Terry is a professor of biology at the University of California Berkeley. He has become an acknowledged expert in all aspects of selenium uptake and volatilization by both higher and lower plants. He and his associates have developed state-of-the art equipment and procedures for measuring selenium volatilization from soil surfaces and from various species of higher plants, concentrating on crop species grown in California's Central Valley. His pioneering work on flow-through wetlands has suggested extremely successful methods for selenium reduction in water, and the genetic research that is on-going in his laboratory identifies the most promising plant species and genotypes for use in selenium reduction cropping methods. His participation in the project assures us of the ability to tap leading-edge research, and makes available a complete-service laboratory for all aspects of selenium analysis and monitoring.

Andreas Schmidt is currently the president of San Francisco Bay Brand, Inc. in Newark, California, which is the largest brine shrimp (*Artemia franciscana)* biomass harvester in the country. Mr. Schmidt has supervised a commercial scale, intensive brine shrimp culture system in San Diego as well as serving as project manager for a semi-intensive brine shrimp culture project on 32 acres near the Salton Sea. This latter project included outdoor culture ponds for diatoms and algae as food sources for the brine shrimp. Mr. Andreas brings to the project this extensive expertise on the infrastructural, physical, chemical, and biological requirements for successful cultivation of brine shrimp in an outdoor, semi-natural setting using algal food sources. In addition, his experience in the harvest and marketing of brine shrimp as biomass rather than as cysts will be of value in the economic analysis of the project.

VI. COMPLIANCE

Our review of Attachment D of the Request for Proposals (RFP) indicates that none of the forms included in the RFP are applicable to public agencies under the Services/Consulting/ Preconstruction/Research category at the proposal stage. We acknowledge that certain standard terms and conditions may apply during the contract negotiation stage or advanced stages of project implementation, and are prepared to meet CALFED's requirements at the appropriate time.