MINUTE ITEM
This Calendar Item No. 02
was approved as Minute Item
No. 02 by the State Lands
Commission by a vote of 2
to 0 at its 6-8-92
meeting.

CALENDAR ITEM

A 34

S 15

02

06/08/92
W 24777
S. Sekelsky
Frey

AUTHORIZE EXECUTION OF CONTRACTS
TO PROVIDE SERVICES FOR MITIGATION OF DUST
AT OWENS LAKE

PARTIES:

Regents of the University of California
Crocker Nuclear Laboratory
University of California
Davis, California 95616

Great Basin Unified Air Pollution
Control Board
157 Short Street, Suite 6
Bishop, California 93514

AREA, TYPE LAND AND LOCATION:

Approximately 13,960 acres of State-owned sovereign lands in the dry bed of Owens Lake, Inyo County.

LAND USE:

Experimental mitigation and dust abatement program to limit particulate pollution from the dry bed of Owens Lake.

AB 884:

N/A

OTHER PERTINENT INFORMATION:

1. At its May 5, 1992 meeting, the State Lands Commission (SLC) approved a General Permit - Public Agency Use, a Memorandum of Agreement, and a Joint Power Agreement with the Great Basin Unified Air Pollution Control Board (GBUAPCB) for an experimental dust mitigation program on Owens Lake. The subject contracts between the SLC, GBUAPCB, and the University of California Regents (UC Davis) provide for the encumbering and transfer of monies to fund the dust mitigation program as outlined in the project descriptions and approved budgets.

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2. The Commission, at its May 5, 1992 meeting, also determined that the program, as analyzed in EIR ND 587 State Clearinghouse No. 92032104, will not have a significant effect on the environment.

EXHIBITS:

A. Land Description
B. Location Map
C. SLC - UCD Interagency Agreement for Research and Development Services (Dust Mitigation) C9175
D. Joint Powers Agreement between Great Basin Unified Air Pollution Control District and State of California, State Lands Commission for the Provision of Vegetation Research and Development Services
E. SLC - UCD Interagency Agreement for Vegetation Research and Development Services - C9176

IT IS RECOMMENDED THAT THE COMMISSION:

1. FIND THAT EIR ND 587 WAS ADOPTED ON MAY 5, 1992 FOR AN EXPERIMENTAL DUST MITIGATION PROGRAM AT OWENS LAKE; IT WAS DETERMINED THAT THE PROGRAM WOULD NOT HAVE A SIGNIFICANT EFFECT ON THE ENVIRONMENT AND THAT SUCH DOCUMENT AND FINDING APPLY TO THE PROPOSED ACTIVITY.

2. AUTHORIZE THE EXECUTIVE OFFICER, OR HIS DESIGNEE, TO ENTER INTO AND EXECUTE CONTRACTS BETWEEN THE STATE LANDS COMMISSION, GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT AND/OR REGENTS OF THE UNIVERSITY (U. C. DAVIS) IN SUBSTANTIALLY THE FORM ATTACHED AS EXHIBITS "C", "D", AND "E".

EXHIBIT A

All that portion of the following described lands lying waterward of the U.S. meander line of Owens Lake, Inyo County.

T. 16 S., R. 36 E., M.D.B. & M.

Projected Sections 13, 23, 24, 25, 26, 35 & 36

T. 16 S., R. 37 E., M.D.B. & M.

Projected Sections 15, 16, 17, 18, 19, 20, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 & 36

T. 17 S. R. 37 E., M.D.B. & M.

Projected Sections 1, 2, 3, 4, 5, 6, 10, 11, 12, 13, 14, 15, 24, 25, 35 & 36

T. 17 S., R. 38 E., M.D.B. & M.

Projection Sections 4, 5, 6, 7, 8, 9, 15, 16, 17, 18, 19, 20, 21, 22, 27, 28, 29, 30, 31, 32 & 33

T. 18 S., R. 37 E., M.D.B. & M.

Projected Sections 1, 2, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33, & 34

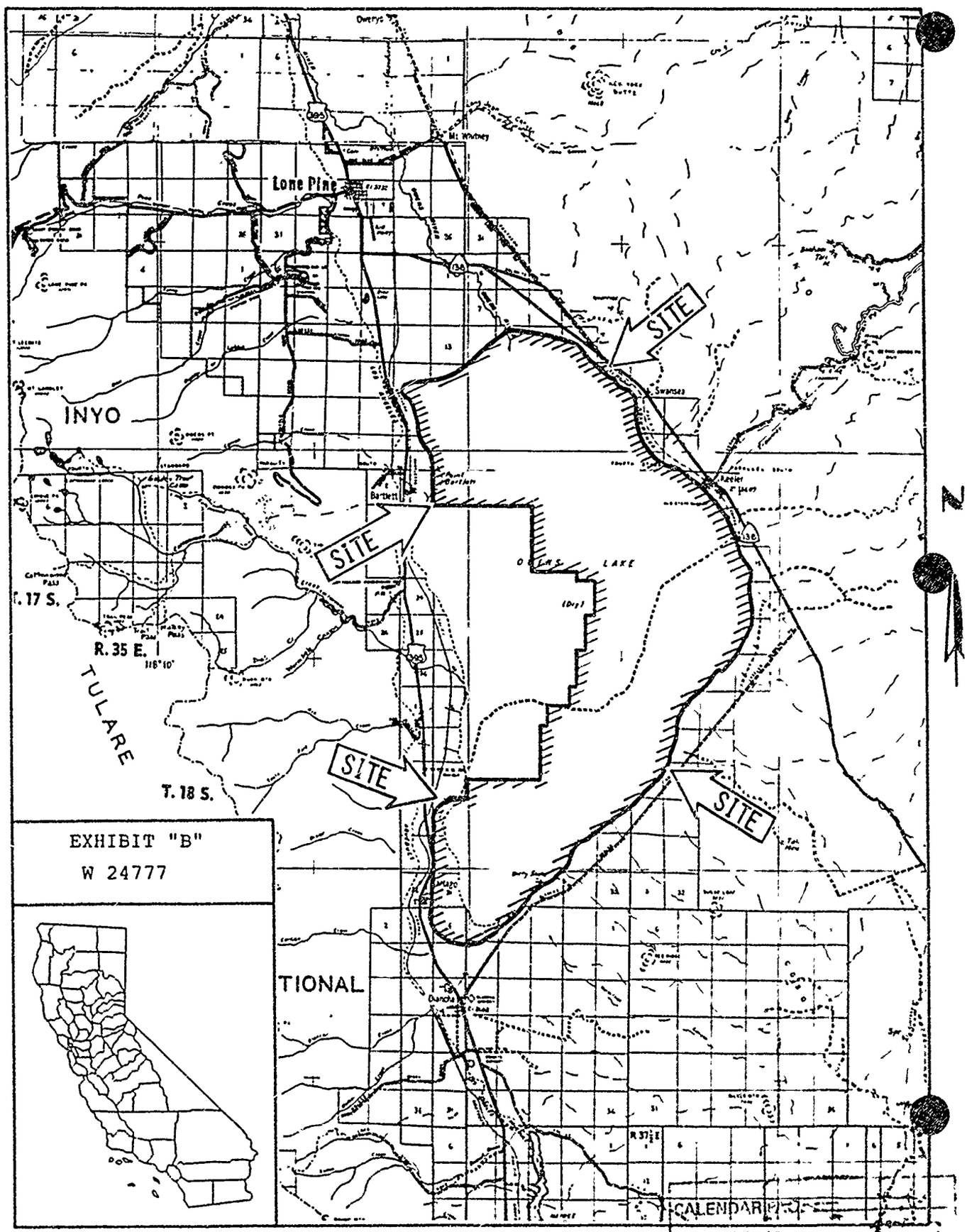
T. 18 S., R. 38 E., M.D.B. & M.

Projected Sections 5, 6, 7, 8, 18 & 19

T. 19 S., R. 37 E., M.D.B. & M.

Projected Sections 4, 5 & 6

Excepting all lands not under the jurisdiction of or presently under lease with State Lands Commission.


Lone Pine
Mt. Whitney
INYO
SITE
SITE
SITE
SITE
Swansea
Bartlett
OWENS LAKE
(Dry)
T. 17 S.
R. 35 E.
118°10'
TULARE
T. 18 S.
TIONAL
Olancha
R. 37½ E.
N
EXHIBIT "B"
W 24777
CALENDAR
MINUTE

STATE OF CALIFORNIA

INTERAGENCY AGREEMENT

STD. 13 (REV. 9-89)

EXHIBIT C

NUMBER
C 9175

THIS AGREEMENT is entered into this _____ day of _____, 19____, by and between the undersigned State Agencies:

Set forth services, materials, or equipment to be furnished, or work to be performed, and by whom, time for performance including the terms, date of commencement and date of completion, and provision for payment per (1225 and 8752-8752.1 SAM.)

Distribution:

- ☐ Agency providing services
- ☐ Agency receiving services
- ☐ Department of General Services (unless exempt from DGS approval)
- ☐ Controller

I. The University agrees to provide all personnel, labor, materials and equipment necessary to perform the work described in the following documents:

a. Attachment A to that certain agreement entitled "Joint Powers Agreement Between Great Basin Unified Air Pollution Control District And State Of California, State Lands Commission For The Provision Of Research And Development Services" and entered into between the State Lands Commission and the Great Basin Unified Air Pollution Control District on June _____, 1992. A copy of said Agreement is attached hereto and incorporated herein as Exhibit B to this Agreement and is hereafter referred to as the Joint Powers Agreement.

b. Mitigation of Windblown Dusts and Reclamation of Public Trust Values, Owens Lake, California, 1992-1993 - Partial Mitigation of PM-10 Dust Episodes Through Control of Saltating Particles and Reduction of Wind Shear, 1992-1993 by the Owens Lake Task Group, University of California, Davis under the direction of Mr. Thomas A. Cahill and dated April 28, 1992. A copy of this document is attached hereto as Exhibit C and hereinafter referred to as the Dust Mitigation Plan.

(Continued on _____ sheets which are hereby attached and made a part hereof)

NAME OF STATE AGENCY RECEIVING SERVICES	NAME OF STATE AGENCY PROVIDING SERVICES
State Lands Commission	University California, Davis
CALLED ABOVE (SHORT NAME)	CALLED ABOVE (SHORT NAME)
AUTHORIZED SIGNATURE ▷	AUTHORIZED SIGNATURE ▷
PRINTED NAME AND TITLE OF PERSON SIGNING	PRINTED NAME AND TITLE OF PERSON SIGNING
FUND NUMBER AND NAME	FUND NUMBER AND NAME

AMOUNT ENCUMBERED BY THIS DOCUMENT: $ 193,500	PROGRAM/CATEGORY (CODE AND TITLE)		FUND TITLE	
PRIOR AMOUNT ENCUMBERED FOR THIS CONTRACT: $	(OPTIONAL USE)			
TOTAL AMOUNT ENCUMBERED TO DATE: $	ITEM	CHAPTER	STATUTE	FISCAL YEAR
	OBJECT OF EXPENDITURE (CODE AND TITLE)			

I hereby certify upon my own personal knowledge that budgeted funds are available for the period and purpose of the expenditure stated above.

T.B.A. NO | B.R. NO

SIGNATURE OF ACCOUNTING OFFICER: X

DATE

Department of General Services Use Only

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II. The State agrees to compensate the University a total amount not to exceed $193,500.00 as consideration for the work performed and in accordance with the cost estimates contained in Exhibit B hereto.

III. For purposes of this Agreement the direct and indirect costs (with the indirect cost expressed as a percentage of direct costs) allowable for payment shall be as identified in this Agreement.

IV. The following documents are hereby incorporated and made a part of this Agreement by reference:

a. Exhibit A - Special Provisions.

b. Exhibit B - Joint Powers Agreement Between Great Basin Unified Air Pollution Control District And State Of California, State Lands Commission For The Provision Of Research And Development Services.

c. Exhibit C - Mitigation of Windblown Dusts and Reclamation of Public Trust Values, Owens Lake, California, 1992-1993 - Partial Mitigation of PM-10 Dust Episodes Through Control of Saltating Particles and Reduction of Wind Shear, 1992-1993.

V. In the event of an inconsistency in this Agreement, the inconsistency shall be resolved by giving precedence in the following order:

a. Interagency Agreement/Form 13.

b. Exhibit A.

c. Exhibit B.

d. Exhibit C.

Exhibit A - Special Provisions
State Lands Commission - University Of California
Interagency Agreement

1. **Cost:** Upon completion of the work described in Attachment A of Exhibit B the SLC shall pay the University an amount equal to the University's cost of performance as computed in accordance with Section 8752 of the State Administrative Manual and in accordance with cost estimates as presented in Exhibit B, and in an amount not to exceed $193,500.

2. **Payments & Invoices:** Payment shall be made monthly upon receipt of an invoice and progress report in triplicate. With respect to the payment period completed, the invoice shall set forth in detail, in accordance with the contract budget, charges for direct costs and overhead costs, including employee fringe benefits; and an itemization of time expended, the classification of personnel involved in such time expenditure, and the salaries and wages for such personnel by monthly, weekly or hourly rates, as appropriate. The invoice shall also contain an itemization of all travel and all equipment purchased from any source with SLC funds, or procured from the State, including the type of equipment, serial number and cost. Any reimbursement for travel expenses incurred under this agreement shall not exceed the rates established by the State Department of Personnel Administration regulations for civil service employees. Nothing herein contained shall preclude advance payments pursuant to Article 1, Chapter 3, Part 1, Division 3, Title 2 of the Government Code.

3. **Audits:**

   a. The University shall maintain books, records, documents, and other evidence pertaining to the reimbursable costs, and any matching costs and expenses, and hold them available for audit and inspection by the Auditor General for a minimum of four (4) years.

   b. The University grants the SLC, upon reasonable prior notice and identification of materials to be examined, permission to examine University records pertinent to direct costs payable under this Agreement solely for the purpose of determining that the direct costs are consistent with those identified in this Agreement.

4. **Retentions:** The SLC may withhold final payment of an amount not to exceed ten (10) percent of the total agreement cost until completion of all work and submission to the SLC of all

reports required by the Agreement.

5. **Term & Time Of Performance:** Performance shall not commence until final approval of this Agreement by all necessary State agencies. This Agreement shall be effective from the last of the approval dates and shall remain in effect until April 30, 1995 unless it is terminated sooner under the provisions of this Agreement.

6. **Modification Of Work Program:** Funding for this Agreement comes from two sources: a legislative grant to the SLC and payment from Great Basin Unified Air Pollution Control District (Great Basin). In the event that funding from Great Basin is reduced or cancelled, the SLC reserves the right to modify the work program to reflect such reduction or cancellation of funding.

7. **Termination:**

(a) Each party shall have the right to terminate this Agreement at its sole discretion upon thirty (30) days written notice to the other party. In case of early termination by the SLC, a final payment shall be made to the University upon receipt of an invoice in triplicate and report in triplicate covering services to the termination date. Such payment shall be for all incurred costs including time expended, equipment purchased or utilized to termination at the actual rates incurred including proration of indirect costs. However, the total amount shall not exceed the total contract amount.

(b) Portions of the funding of this Agreement come from the Great Basin Unified Air Pollution Control District (GBUAPCD). In the event that funding from GBUAPCD fails, is reduced, or is modified, the SLC shall have the option to cancel, reduce, or modify the scope of work in this Agreement upon thirty (30) days written notice to the University.

8. **Information & Research Data:**

a. The University prepare and submit to the SLC the reports described in Attachment A to the Joint Powers Agreement at the times designated in said Attachment A. Copies of such reports shall be submitted to the Great Basin Unified Air Pollution Control District at the same time as those to the SLC.

b. The SLC shall have the right at reasonable times during the term of this Agreement to inspect and reproduce any written or printed matter developed under this Agreement by the University.

c. Any information or research data generated under this Agreement shall become the joint property of the University and the SLC.

d. The University shall be entitled to release or make available reports, informatin or other data prepared or assembled by it pursuant to this Agreement in scientific journals and other publications and at scientific meetings, provided however, that a copy of the publication shall be submitted to the SLC for review and comment forth-five (45) days prior to such publication. Further, the University shall place the following disclaimer statement in a conspicuous place in all such reports or publications:

> The opinions expressed in this publication represent those of the University of California and not necessarily those of the State Lands Commission for whom the work was originally done.

Nothing in this provision shall be construed to limit the right of the SLC to release information obtained from the University or to publish reports, information or data in SLC publications.

9. **Equipment:**

a. Title to all personal property, fixtures and real property improvements purchased with funds under this Agreement shall be in the SLC unless released to the University.

b. The University shall maintain and administer, in accordance with sound administrative and industrial practice, a program for the utilization, maintenance, repair, protection and preservation of SLC equipment so as to assure its full availability and usefulness for the performance of this Agreement or as long as this equipment remains in the control or possession of the University.

c. The University shall provide, with the final invoice, a final equipment inventory to the SLC. Possession and control of personal property shall be delivered to the SLC within thirty (30) days of termination of this Agreement.

10. **Designation of Representatives:** The SLC and the University each hereby name a representative who shall represent it during the term of this Agreement. The SLC or the University may change its representative by notifying the other as provided for in Paragraph 11.

The SLC's representative for technical matters shall be:

Mr. Steve Sekelsky
State Lands Commission
1807 13th Street
Sacramento, CA 95814

The SLC's representative for contractual matters shall be:

Mr. David Brown
State Lands Commission
1807 13th Street
Sacramento, CA 95814

The University's representative for technical matters shall be:

Mr. Thomas Cahill
University of California, Davis
Crocker Nuclear Laboratory
Air Quality Group
Davis, CA 95616

The University's representative for contract matters shall be:

Mr. Keith Young
Office of Research
410 Mrak Hall
University of California, Davis
Davis, CA 95616

11. **Notice:** Any notice, communication, amendments, additions, or deletions to this Agreement, including change of address of either party during the term of this Agreement, which the SLC or the University shall be required or may desire to make shall be in writing and may be personally served or sent by prepaid first class mail to the respective parties as follows:

SLC: Owens Lake Project Coordinator
State Lands Commission
1807 13th Street
Sacramento, CA 95814

University: University of California, Davis
Crocker Nuclear Laboratory
Air Quality Group
Davis, CA 95616

12. **Disputes:** Except as otherwise provided in this Agreement, any dispute concerning a question of fact arising under or relating to the performance of this Agreement which is not disposed of by agreement shall be decided by the SLC's representative, who shall reduce his decision to writing and shall transmit a copy thereof to the University. The decision of the SLC's representative shall be deemed final and conclusive unless, within thirty (30) days from the date of receipt of such copy, the University transmits to the SLC a written appeal. Said appeal shall be supported with specificity. In connection with any appeal proceeding under this clause, the University shall be afforded an opportunity to be heard before the State Lands Commission and to offer evidence in support of its appeal. Pending the final resolution of any such dispute, the University shall proceed diligently with the performance of this Agreement and in accordance with the written decision of the SLC's representative which is the subject of the University's appeal.

Exhibit B

JOINT POWERS AGREEMENT BETWEEN GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT AND STATE OF CALIFORNIA, STATE LANDS COMMISSION FOR THE PROVISION OF RESEARCH AND DEVELOPMENT SERVICES

INTRODUCTION

WHEREAS, the Great Basin Unified Air Pollution Control District (hereinafter referred to as "District") has the need for the Research and Development services of the State of California State Lands Commission (hereinafter referred to as "State"), and in consideration of the mutual promises, covenants, terms, and conditions hereinafter contained, the parties hereby agree as follows:

TERMS AND CONDITIONS

1. **SCOPE OF WORK:**

The State shall furnish to the District, those services and work set forth in Attachment A, attached hereto and by reference incorporated herein.

Services and work provided by the State under this Agreement will be performed in a manner consistent with the requirements and standards established by applicable federal, state, and County laws, ordinances, regulations, and resolutions. Such laws, ordinances, regulations, and resolutions include, but are not limited to, those which are referred to in this Agreement.

2. **TERM:**

The term of this Agreement shall be from May 1, 1992 to April 30, 1995 unless sooner terminated as provided below.

3. **CONSIDERATION:**

A. Compensation.

District shall pay State in accordance with the Schedule of Fees (set forth as Attachment B) for the services and work described in Attachment A which are performed by State.

B. Travel and per diem.

Costs of all travel and per diem which State incurs in providing services and work under this agreement are included

in the compensation to be paid to State in the Schedule of Fees (Attachment B). State will not be entitled to any additional compensation for travel expenses or per diem incurred by State in performing this Agreement.

C. No additional consideration.

Except as expressly provided in this Agreement, State shall not be entitled to, nor receive, from District, any additional consideration, compensation, salary, wages, or other type of remuneration for services rendered under this Agreement. Specifically, State shall not be entitled, by virtue of this Agreement, to consideration in the form of overtime, health insurance benefits, retirement benefits, disability retirement benefits, sick leave, vacation time, paid holidays, or other paid leaves of absence of any type or kind whatsoever.

D. Limit upon amount payable under Agreement.

The total sum of all payments made by the District to State for services and work performed under this Agreement, shall not exceed $50,000.00 (hereinafter referred to as "contract limit"). District expressly reserves the right to deny any payment or reimbursement requested by State for services or work performed which is in excess of the contract limit.

E. Billing and payment.

Billing and Payment will be in accordance with the Schedule of Fees (set forth as Attachment B).

F. Federal and State taxes.

(1) District will not withhold any federal or state income taxes or social security from any payments made by District to State under the terms and conditions of this Agreement.

(2) District has no obligation to withhold any taxes or payments from sums paid by District to State under this Agreement. Payment of all taxes and other assessments on such sums is the sole responsibility of State. District has no responsibility or liability for payment of State's taxes or assessments.

4. WORK SCHEDULE:

State's obligation is to perform, in a timely manner, those services and work identified in Attachment A. State will coordinate with District to insure that all services and work will be performed within the time frame set forth by District.

5. REQUIRED LICENSES, CERTIFICATES, AND PERMITS:

State will be responsible for ensuring that any licenses, certificates, or permits required by the federal, state, county, or municipal governments for the services and work described in attachment A, are procured and valid at the time State begins performance of this Agreement. Further, during the term of this Agreement, State must ensure that such licenses, certificates, and permits remain in full force and effect. Licenses, certificates, and permits may include, but are not limited to, driver's licenses, professional licenses or certificates, and business licenses. Such licenses, certificates, and permits will be procured and maintained in force at no expense to the District. State will provide District, upon beginning performance of this Agreement, with evidence of current and valid licenses, certificates and permits which are required to perform the services identified in attachment A. Where there is a dispute between State and District as to what licenses, certificates, and permits are required to perform the services and work identified in attachment A, District reserves the right to make such determinations for purposes of this Agreement.

6. OFFICE SPACE, SUPPLIES, EQUIPMENT, ETC:

State shall provide such office space, supplies, equipment, vehicles, reference materials, and telephone service as is necessary for State to provide the services identified in Attachment A to this Agreement. District is not obligated to reimburse or pay State, for any expense or cost incurred by State in procuring or maintaining such items. Responsibility for the costs and expenses incurred by State in providing and maintaining such items is the sole responsibility and obligation of State.

7. DISTRICT PROPERTY:

A. Personal Property of District.

Any personal property such as, but not limited to, protective or safety devices, badges, identification cards, keys, etc. provided to State by District pursuant to this Agreement are, and at the termination of this Agreement remain, the sole and exclusive property of District. State will use reasonable care to protect, safeguard and maintain such items while they are in State's possession. State will be financially responsible for any loss or damage to such items, partial or total, which is the result of State's negligence.

B. Products of State's Work and Services.

Any and all compositions, publications, plans, designs, specifications, blueprints, maps, formulas, processes, photographs, slides, video tapes, computer programs, computer disks, computer tapes, memory chips, soundtracks, audio recordings, films, audio-visual presentations, exhibits, reports, studies, works of art, inventions, patents,

trademarks, copyrights, or intellectual properties of any kind which are created, produced, assembled, compiled by, or are the result, product, or manifestation of, State's services or work under this Agreement are, and at the termination of this Agreement remain, the sole and exclusive property of the State. However, State hereby grants to District an irrevocable non exclusive right to use any such products for any District purpose without payment of any further compensation or requirement of prior State approval.

8. **WORKERS' COMPENSATION:**

State shall provide worker's compensation coverage, in the legally required amount, for all State's employees utilized in providing work and services pursuant to this Agreement. By executing a copy of this Agreement, State acknowledges its obligations and responsibilities to its employees under the California Labor Code, and warrants that State has complied and will comply during the term of this Agreement with all provisions of the California Labor Code with regard to its employees. Further, State will ensure that any contractor whom it engages to perform work or services under this Agreement will provide workers' compensation coverage for its employees.

9. **INSURANCE:**

A. General Liability.

State shall procure, and maintain during the entire term of this Agreement, a policy of general liability insurance or a self insurance program which covers all the work and services to be performed by State under this Agreement. Such insurance policy or a self insurance program will have a per occurrence combined single limit coverage of not less than $6,000,000.00. Such policy or a self insurance program will not exclude or except from coverage any of the services and work required to be performed by State under this Agreement. Any policy of insurance will be issued by an insurer authorized to sell such insurance by the State of California, and having at least a "Best's" policyholder's rating of "A" or "A+." District will be named as "an additional named insured" on this policy. State will provide the District with evidence of a self insurance program or a copy of the policy and a certificate of insurance showing the District as "an additional named insured" and indicating that the policy will not be terminated, canceled, or modified without thirty (30) days written notice to the District.

B. Business Auto.

If State utilizes a motor vehicle in performing any of the work or services identified in Attachment A (Scope of Work), State shall cover such vehicle operations by a self insurance program or procure and maintain in force throughout the duration of this Agreement, a business auto liability

insurance policy with minimum coverage levels of $300,000.00 per occurrence, combined single limit for bodily injury liability and property damage liability. The coverage shall include all State owned vehicles and all hired and non-owned vehicles used in performing under this Agreement.

Evidence of a self insurance program or a certificate of insurance shall be provided to the District at least ten (10) days prior to the start of work under this Agreement. Any policy shall contain a provision prohibiting the cancellation or modification of said policy except upon thirty (30) days prior written notice to the District.

C. Professional Liability.

If State or any of its employees is required to be professionally licensed or certified by any agency of the State of California in order to perform any of the work or services identified in Attachment A (Scope of Work), State shall cover such professional liability with a self insurance program or shall procure and maintain in force throughout the duration of this Agreement, a professional liability insurance policy with a minimum coverage level of $1,000,000.00. Evidence of the self insurance program or proof of such insurance shall be provided to District at least ten (10) days prior to the start of any work by State.

10. **STATUS OF STATE:**

All acts of State, its agents, officers, and employees, relating to the performance of this Agreement, shall be performed as independent contractors, and not as agents, officers, or employees of District. State, by virtue of this Agreement, has no authority to bind or incur any obligation on behalf of District. Except as expressly provided in Attachment A, State has no authority or responsibility to exercise any rights or power vested in the District. No agent, officer, or employee of the District is to be considered an employee of State. It is understood by both State and District that this Agreement shall not under any circumstances be construed or considered to create an employer-employee relationship. As an independent contractor:

A. State shall determine the method, details, and means of performing the work and services to be provided by State under this Agreement.

B. State shall be responsible to District only for the requirements and results specified in this Agreement, and except as expressly provided in this Agreement, shall not be subjected to District's control with respect to the physical action or activities of State in fulfillment of this Agreement.

C. State, its agents, officers, and employees are, and at all times during the term of this Agreement shall, represent

and conduct themselves as independent contractors, and not as employees of District.

11. **DEFENSE AND INDEMNIFICATION:**

State shall defend, indemnify, and hold harmless District, its agents, officers, and employees from and against all claims, damages, losses, judgments, liabilities, expenses, and other costs, including litigation costs and attorney's fees, arising out of, resulting from, or in connection with, the performance of this Agreement by State, or State's agents, officers, or employees. State's obligation to defend, indemnify, and hold the District, its agents, officers, and employees harmless applies to any actual or alleged personal injury, death, or damage or destruction to tangible or intangible property, including the loss of use. State's obligation under this paragraph extends to any claim, damage, loss, liability, expense, or other costs which is caused in whole or in part by any act or omission of the State, its agents, employees, supplier, or any one directly or indirectly employed by any of them, or anyone for whose acts or omissions any of them may be liable.

State's obligation to defend, indemnify, and hold the District, its agents, officers, and employees harmless under the provisions of this paragraph is not limited to, or restricted by, any requirement in this Agreement for State to procure and maintain a self insurance program or a policy of insurance.

To the extent permitted by law, District shall defend, indemnify, and hold harmless State, its agents, officers, and employees from and against all claims, damages, losses, judgments, liabilities, expenses, and other costs, including litigation costs and attorney's fees, arising out of, or resulting from, the active negligence, or wrongful acts of District, its officers, or employees.

12. **RECORDS AND AUDIT:**

A. Records.

State shall prepare and maintain all records required by the various provisions of this Agreement, federal, state, and municipal law, ordinances, regulations, and directions. State shall maintain these records for a minimum of four (4) years from the termination or completion of this Agreement. State may fulfill its obligation to maintain records as required by this paragraph by substitute photographs, microphotographs, or other authentic reproduction of such records.

B. Inspections and Audits.

Any authorized representative of District shall have access to any books, documents, papers, records, including, but not limited to, financial records of State, which District determines to be pertinent to this Agreement, for the purposes of making audit, evaluation, examination, ~~excerpts~~ and

transcripts during the period such records are to be maintained by State. Further, District has the right, at all reasonable times, to audit, inspect, or otherwise evaluate the work performed or being performed under this Agreement.

13. **NONDISCRIMINATION:**

During the performance of this Agreement, State, its agents, officers, and employees shall not unlawfully discriminate in violation of any federal, state, or local law, against any employee, or applicant for employment, or person receiving services under this Agreement, because of race, religion, color, national origin, ancestry, physical handicap, medication condition, marital status, age, or sex. State and its agents, officers, and employees shall comply with the provisions of the Fair Employment and Housing Act (Government Code section 12900, et seq.), and the applicable regulations promulgated thereunder in the California Code of Regulations. State shall also abide by the Federal Civil Rights Act of 1964 (P.L. 88-352) and all amendments thereto, and all administrative rules and regulations issued pursuant to said act.

14. **CANCELLATION:**

This Agreement may be canceled by District without cause, and at will, for any reason by giving to State thirty (30) days written notice of such intent to cancel. State may cancel this Agreement without cause, and at will, for any reason whatsoever by giving thirty (30) days written notice of such intent to cancel to District.

15. **ASSIGNMENT:**

State may subcontract this Agreement, or any part of it, with the express written consent of District. State shall not assign any monies due or to become due under this Agreement without the prior written consent of District.

16. **DEFAULT:**

If the State abandons the work, or fails to proceed with the work and services requested by District in a timely manner, or fails in any way as required to conduct the work and services as required by District, District may declare the State in default and terminate this Agreement upon five (5) days written notice to State. Upon such termination by default, District will pay to State all amounts owing to State for services and work satisfactorily performed to the date of termination.

17. **WAIVER OF DEFAULT:**

Waiver of any default by either party to this Agreement shall not be deemed to be waiver of any subsequent default. Waiver or breach of any provision of this Agreement shall not be deemed to be a waiver of any other or subsequent breach, and shall not be

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construed to be a modification of the terms of this Agreement unless this Agreement is modified as provided in paragraph twenty-four (24) below.

18. **CONFIDENTIALITY:**

State agrees to comply with the various provisions of the federal, state, and county laws, regulations, and ordinances providing that information and records kept, maintained, or accessible by State in the course of providing services and work under this Agreement, shall be privileged, restricted, or confidential. State agrees to keep confidential all such information and records. Disclosure of such confidential, privileged, or protected information shall be made by State only with the express written consent of the District.

19. **CONFLICTS:**

State agrees that it has no interest, and shall not acquire any interest, direct or indirect, which would conflict in any manner or degree with the performance of the work and services under this Agreement.

20. **SEVERABILITY:**

If any portion of this Agreement or application thereof to any person or circumstance shall be declared invalid by a court of competent jurisdiction, or if it is found in contravention of any federal, state, or county statute, ordinance, or regulation, the remaining provisions of this Agreement, or the application thereof, shall not be invalidated thereby, and shall remain in full force and effect to the extent that the provisions of this Agreement are severable.

21. **FUNDING LIMITATION:**

A. The ability of District to enter this Agreement is based upon available funding from various sources. In the event that such funding fails, is reduced, or is modified, from one or more sources, District has the option to cancel, reduce, or modify this Agreement, or any of its terms within ten (10) days of its notifying State of the cancellation, reduction, or modification of available funding. Any reduction or modification of this Agreement made pursuant to this provision must comply with the requirements of paragraph twenty-three (23) (Amendment).

B. This agreement shall not be effective until it has been approved by the Department of General Services.

22. **ATTORNEY'S FEES:**

If either of the parties hereto brings an action or proceeding against the other, including, but not limited to, an action to enforce or declare the cancellation, termination, or revision of the Agreement, the prevailing party in such action or proceeding

shall be entitled to receive from the other party all reasonable attorney's fees and costs incurred in connection therewith.

23. **AMENDMENT:**

This Agreement may be modified, amended, changed, added to, or subtracted from, by the mutual consent of the parties hereto, if such amendment or change is in written form and executed with the same formalities as this Agreement, and attached to the original Agreement to maintain continuity.

24. **NOTICE:**

Any notice, communication, amendments, additions, or deletions to this Agreement, including change of address of either party during the terms of this Agreement, which State or District shall be required, or may desire, to make, shall be in writing and may be personally served, or sent by prepaid first class mail to, the respective parties as follows:

Great Basin Unified Air Pollution Control District
157 Short Street, Suite 6
Bishop, California 93514

State Lands Commission
1807 13th Street
Sacramento, California 95814

25. **DESIGNATION OF AGREEMENT REPRESENTATIVE:**

The Commission and District hereby name a representative who shall represent his or her agency regarding this Agreement. Each agency may change its representative by notifying the other agency as provided for in Paragraph 24.

COMMISSION'S REPRESENTATIVE SHALL BE:
Steve Sekelsky

DISTRICT'S REPRESENTATIVE SHALL BE:
Ted Schade

26. **ENTIRE AGREEMENT:**

This Agreement contains the entire agreement of the parties, and no representations, inducements, promises, or agreements otherwise between the parties not embodied herein or incorporated herein by reference, shall be of any force or effect. Further, no term or provision hereof may be changed, waived, discharged, or terminated, unless the same be in writing executed by the parties hereto.

//// ////
//// ////

AGREEMENT BETWEEN
GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT
AND STATE OF CALIFORNIA, STATE LANDS COMMISSION
FOR THE PROVISION OF
RESEARCH AND DEVELOPMENT SERVICES

IN WITNESS THEREOF, THE PARTIES HERETO HAVE SET THEIR HANDS AND SEALS THIS ____________ DAY OF ______________, 19 ___.

DISTRICT	State
By:___________________________	By:___________________________
Dated:_________________________	Dated:_________________________

APPROVED AS TO FORM AND
LEGALITY:

____
District Counsel

APPROVED AS TO ACCOUNTING
FORM:

____
County Auditor

ATTACHMENT A

AGREEMENT BETWEEN
GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT
AND STATE OF CALIFORNIA, STATE LANDS COMMISSION
FOR THE PROVISION
RESEARCH AND DEVELOPMENT SERVICES

TERM:

FROM: May 1, 1992 TO: April 30, 1995

SCOPE OF WORK:

PARTIAL MITIGATION OF PM-10 DUST EPISODES
THROUGH CONTROL OF SALTATING PARTICLES AND REDUCTION OF WIND
SHEAR, 1992-1993

April 28, 1992

TASK 1 - SAND DUNE ARRAY FIELD TESTS

1. Construction

a. 1992 Small-Scale Array

In the summer of 1992, the State Lands Commission (SLC) shall cause to be designed and constructed a small-scale sand dune test array to test the effectiveness of sand dunes and sand fences in controlling sand migration and PM-10 emissions from Owens Lake. The small-scale test array shall be located on the southern portion of the lake near the 1981-82 WESTEC sites (see Map, Pg. 10) and shall contain at least 3900 feet of sand fence arranged in a staggered array covering an area at least 820 feet by 1300 feet (Diagram pg.9). All material purchased and labor contracted shall conform to standard State Lands Commission contracting and bid procedures. SLC or its subcontractor shall establish a construction and data collection field office in the south end of the Owens Valley. The final configuration and location of the small-scale test array and the fence design shall be presented to GBUAPCD for their review and comments prior to any construction.

b. 1993 Large-Scale Arrays

In the summer of 1993, the SLC or its contractor shall cause to be designed and constructed large-scale sand dune test arrays to test the effectiveness of sand dunes and sand fences in controlling sand migration and PM-10 emissions from Owens Lake. The specific design and location of the large-scale array shall be based on the results of the small-scale test. The array will be designed to reduce sand migration on the southern sand sheet from the Dirty Socks Well wash to the western stream courses. The large-scale test shall contain at least 12,000 feet of sand fence in staggered lines arranged in an array at least 1 mile long (see Map pg. 10). However, if the small-scale test shows that it is necessary, much larger amounts of fencing may be emplaced. There may also be smaller lines of fences consisting of roughly parallel lines of staggered fences approximately in the same area.

Four linear, staggered arrays will be constructed at locations upwind and downwind of the block array. The purpose of these arrays is to start to set the parameters for spacing arrays at Owens Lake to optimize sand capture per dollar. Each array will be approximately 4,000 feet long with adequate randomization in length and placement to present a quasi-natural dune field when filled. Spacing between arrays will be roughly 2,600 feet, depending on terrain and earlier tests. All material purchased and labor contracted shall conform to SLC contracting and bid procedures. The final configuration and exact location of the large-scale test arrays shall be presented for review and comment to the GBUAPCD prior to any construction.

2. Instrumentation

All test arrays shall contain the types and amounts of data collection devices necessary to determine the effectiveness of sand dune arrays at controlling PM-10 emissions. Data to be collected shall include, but shall not necessarily be limited to wind speed, wind direction, air temperature, relative humidity, precipitation, sand movement, air quality (PM-10 levels), surface crust conditions, groundwater levels, groundwater chemistry, soil chemistry, soil surface erosion/deposition, sand dune stratigraphy, sand dune growth rates, and sand dune stability. Instrumentation types, amounts, and locations shall be presented for review and comments to GBUAPCD prior to any equipment purchases.

3. Data Collection

Sufficient manpower resources shall be provided to collect the data necessary to determine the effectiveness of sand dune arrays at reducing PM-10 emissions. In addition to PM-10 related data, data shall also be collected to determine the effect of sand dune arrays on the shallow groundwater table using piezometers within the dune array. A data collection protocol shall be provided that addresses, in detail, the procedures for collecting the data discussed above. This protocol shall be presented for review and comments to GBUAPCD prior to any construction. GBUAPCD may request raw data for review at any time.

4. Data Analysis

The proper type and amount of data analysis necessary to determine the effectiveness of sand dune arrays at reducing PM-10 emissions shall be conducted. Data analysis shall be conducted as per a data analysis protocol to be developed by SLC or its Contractor and presented for review and comment to GBUAPCD prior to any data collection. Drafts of all data analyses shall be submitted to GBUAPCD for review and comment.

5. Maintenance

All approved sand fence materials and data collection equipment shall be maintained in working order. All materials and equipment shall be adequately anchored and secured. Upon completion of the test all equipment and material shall be removed from the lake bed and properly disposed of. This includes all sand fence materials if required by SLC.

6. Environmental Mitigation

A Negative Declaration (ND) under the provisions of the California Environmental Quality Act (CEQA) has been issued for this project by SLC. The mitigation measures called for in the approved ND that affect the sand dune project shall be implemented by SLC. Mitigation measure monitoring shall occur as per a monitoring plan to be adopted by SLC. The agency responsible for monitoring shall be decided at a later date.

7. Schedule

The small-scale array fences shall be in place by October 31, 1992. All monitoring equipment for the small-scale test shall be in place and operational by October 31, 1992. Data collection on the small-scale array will continue at least until January 1, 1994. The large-scale array fences and monitoring equipment shall be in place and operational by October 1, 1993. Data collection on the large-scale arrays

will continue at least until April 30, 1994. For the small-scale array, the quarterly project status reports will be prepared and submitted to GBUAPCD on October 1, 1992; January 1, 1993; April 1, 1993; July 1, 1993; and October 1, 1993. A draft data analysis report will be submitted on November 1, 1993 and draft final report will be submitted on January 1, 1994. For the large-scale array, the quarterly reports will be submitted on the same schedule, but in 1993 and 1994. A draft data analysis report for the large-scale arrays will be submitted on November 1, 1994, and the final report will be submitted on January 1, 1995.

TASK 2 - OPTIMIZED AND ENGINEERING OF SAND FENCE MATERIALS AND DESIGN

1. Analysis of Field Acquired Meteorological Data

   All field acquired meteorological data shall be properly reduced and estimates of surface friction speed and surface roughness shall be provided.

2. Sand Fence Design - Conceptual

   All previous field installations of sand fences on Owens Lake will be examined and reported on. Wind tunnel tests to be conducted per a separate contract will be used to develop the optimum parameters for the sand fence manufacturers, and other sand fence investigators will be conducted.

3. Sand Fence Design - Engineering

   Field and laboratory tests necessary to establish the principle sand fence engineering parameters will be conducted and a sand fence design will be generated. The design parameters to be developed will include: fence height, distance between support posts, post embedment depth, fence porosity, fence post, guy and anchor materials, fence orientation, and fence shape. The location of any field testing to be performed shall be submitted for review and comment to GBUAPCD prior to any field work.

4. Lake Bed Access

   Preliminary investigations regarding provision of all-weather access to all mitigation areas on the lake will be conducted. This will include collection of representative samples of the native soils found on Owens Lake and laboratory stabilization testing.

5. <u>Schedule</u>

The work described in this task shall be completed by October 15, 1993. All raw data collected can be requested by GBUAPCD at any time. Drafts of all data analysis shall be submitted to GBUAPCD for review and comment.

TASK 3 - NATIVE VEGETATION, SOIL AND WATER SURVEY

1. <u>Study Site Selection</u>

Study areas will be selected and will include natural dune areas and artificial dune areas. These sites will be submitted to GBUAPCD for review and comment prior to initiation of any field work.

2. <u>Species Inventory</u>

A species list will be made for each dune or dune system according to micro habitants present (dune top, dune margin, and interdune depressions). Quantitative data on species present will be developed. This will include, but is not limited to, cross section profiles, percentage cover, and species frequency.

3. <u>Dune Morphology and Composition</u>

Dune height, length, width, and shape will be recorded for each study area. Core samples of selected dunes will be collected and analyzed. Analyses will include, but are not limited to, particle size, pH, electrical conductivity, moisture content, organic matter and sulfate, carbonate, and nitrate levels.

4. <u>Vegetation Composition Analysis</u>

Representative plant samples will be collected and analyzed. Analyses will include, but are not limited to, ions of sodium, calcium, magnesium, chloride, boron, sulfate, and carbonate.

5. <u>Seed Dispersal Study</u>

Seasonal variability of seeds between the barren playa and dune sites and between open areas and beneath vegetation canopies will be compared. Random soil samples will be collected from each type of area of interest. Seeds present in the samples will be germinated and identified.

6. Report Preparation

A report will be prepared that addresses the study's main objectives. These include, but are not limited to, qualitative and quantitative descriptions of dune vegetation on and around the playa, and comparisons of these species compositions with the surrounding non-dune salt bush communities. The report will also describe the physical and chemical characteristics of sand dunes as they bear upon vegetation, and determine any correlation between species composition and dune characteristics. The report will also investigate the seeds and seed dispersal on and around the playa.

7. Schedule

The work described in this task shall be completed by October 15, 1993. All raw data collection may be requested at any time by the GBUAPCD. Drafts of all data analyses shall be submitted to GBUAPCD for review and comment.

COST BY TASK

Large and Small Scale

Task 1 - Sand Dune Array Field Test

1. Personnel	$34,315
2. Equipment**	$ 5,200
3. Subcontractors	
a. Fencing materials	$46,000
b. Construction labor	$27,000
4. Travel	$11,315
5. Supplies, Dust analysis	$ 8,332
Total	$132,252

Task 2 - Optimization and Engineering

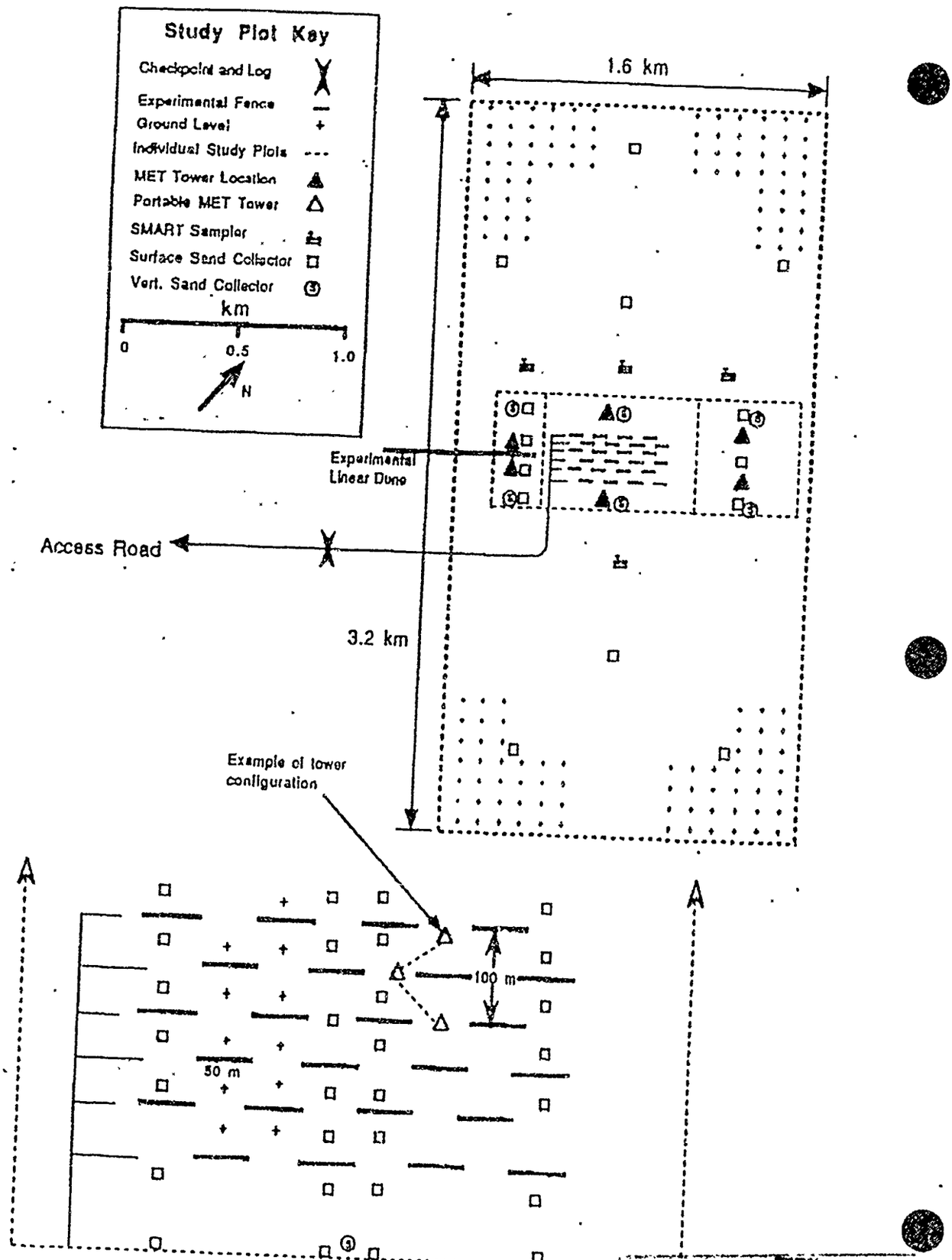
1. Personnel	$20,986
2. Equipment	-0-
3. Subcontractors	
a. Fencing materials	$ 3,000
b. Construction labor	$ 2,910
4. Travel	$ 3,182
5. Supplies	$ 3,288
Total, Task 2	$33,366

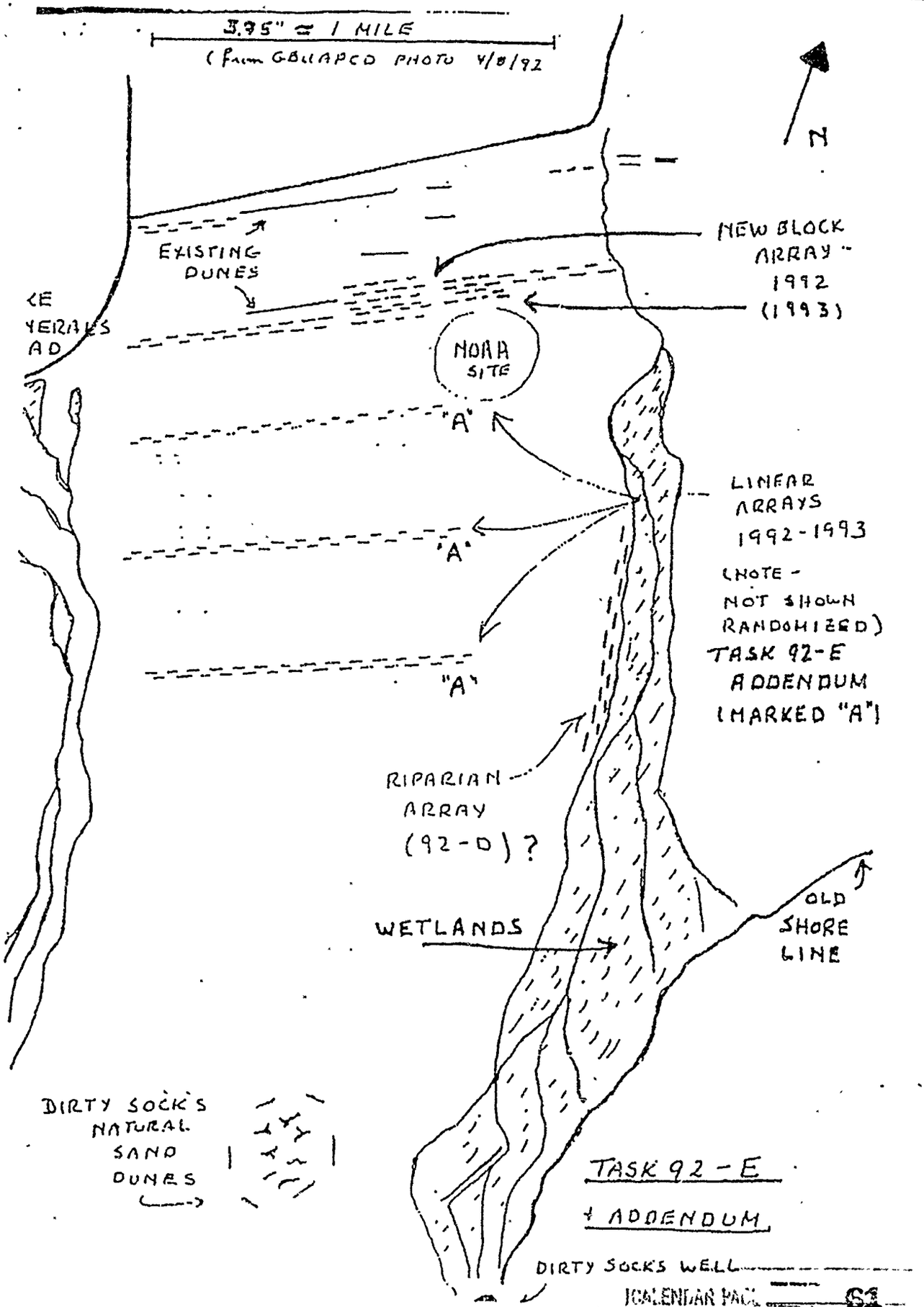
Task 3 - Nature Vegetation

1. Personnel	$ 5734
2. Travel	$ 3182
3. Supplies	$ 2,652
Total, Task 3	$11,568

Indirect Costs
(Items ** not subject to Indirect Costs)

10% of $163,138 =	16,314
PROJECT TOTAL	$193,500





BUDGET SUMMARY

DIRECT COSTS:

1.	Labor	$40,389
2.	Subcontractors/Consultants	30,000
3.	Equipment	5,200
4.	Travel & Subsistence	17,680
5.	Electronic Data Processing	
6.	Reproduction & Publication	1,500
7.	Mail & Telephone	1,000
8.	Materials & Supplies	58,501
9.	Analyses	2,300
10.	Micscellaneous	8,848
	Total Direct Cost	$175,018

INDIRECT COSTS:

11.	Employee Fringe Benefits	2,168
12.	Other Indirect Costs	16,314
	Total Indirect Cost	$15,482

TOTAL PROJECT COST $193,500

BUDGET DETAIL

Direct Costs:

1. Labor Charges Direct Labor		Monthly Salary	No. Months	Total Salary
A.	T.A. Cahill	$2,175./wk	1 week	$ 2,175
B.	M. Taylor	1,950./wk	6 weeks	11,700
C.	T.E. Gill	2,185./mo	6 months	6,555
D.	J.S. Reid	2,185./mo	6 months	6,555
E.	M.L. Yau	2,185./mo	6 months	6,555
F.	Research Asst.	2,072./mo	7 months	9,324
G.	Student Asts.	4.75./hr	1500 hours	7,125
			SUBTOTAL	$49,989

2. Subcontractors & Consultants — Estimated Cost

A. Contractor - Fence Construction — $30,000

1. Local Contractor must have California Contractor's License.

   a. Maintain secure area(s) for storage of fences, etc.

   b. Supply vehicle suitable for:

      (1). Work on lake bed
      (2). Capable of carrying fence, tools and personnel.

   c. Supply operator for vehicle:

      (1). Estimated days: 180 days
      (2). Work hours: 1,440 hours

   d. Supply safety equipment, communications equipment, etc.

   e. Superisor of operator - 20% time

      (1). Estimated days: 180 days
      (2). Work hours: 288 hours

SUBTOTAL — $30,000

3. Equipment — Estimated Cost

A.	All Terrain Vehicle - 4 wheel	$ 1,300
B.	Trailer For ATV	600
C.	Electric Winch, etc. - On Lake	400
D.	Meterorological Equipment (add-on to equipment on loan to project. See also ARB contract #132-105)	2,400
	SUBTOTAL	$ 5,200

4.	Travel & Subsistence	Estimated Cost
A.	Air Transportation (none)	
B.	Ground Transportation	
	1. Round trips to Owens Lake 600 miles @ 0.24/mi -$144 x 15 trips	$ 2,160
	2. Transportation at Owens Lake UC car rental for 6 months.	2,600
C.	Per Diem or Subsistence 160 days @ $26/day	5,920
D.	Other - Rental of housing (replaces housing)	7,000
	SUBTOTAL	$17,680

5.	Electronic Data Processing	Estimated Cost
A.	Computer Usage	$ 0
	SUBTOTAL	$ 0

6.	Reproduction & Publication	Estimated Cost
A.	Progress Reports/Final Report	$ 1,500
	SUBTOTAL	$ 1,500

7.	Mail & Telephone	Estimated Cost
A.	Telephone At Lone Pine	$ 800
B.	Mail Costs	200
	SUBTOTAL	$ 1,000

8.	Materials & Supplies	Estimated Cost
A.	Sand Fencing, Posts, Cable, etc.	$50,000
B.	Film, Optical Support	800
C.	Hardware, etc.	900

D.	Materials For Sand Traps, Vehicle Tow	2,105
E.	Safety Equipment (Helmets, etc.)	200
F.	Miscellaneous Supplies	4,496
	SUBTOTAL	$58,501

9.	Analyses	Estimated Cost
A.	Compositional Analysis - Aerosols	$ 1,700
B.	Compositional Analysis - Water, etc.	600
	SUBTOTAL	$ 2,300

10.	Miscellaneous	Estimated Cost
A.	Graduate Student Fee Remission	$ 8,848
	SUBTOTAL	$ 8,848
	TOTAL DIRECT COSTS	$175,018

Indirect Costs:

11.	Employee Fringe Benefits	Estimated Cost
A.	Employee Benefits	$ 2,168
	SUBTOTAL	$ 2,168

12. Indirect Costs

(Based on modified total direct costs [MTDC] basis where MTDC = direct cost less equipment and Graduate Student Fees.

Rate 0.10 x MTDC 163,138.* = $16,314

*Overhead does not apply to items 3 (Equipment) and 10 (Graduate Student Fee Remission).

SUBTOTAL	$16,314
TOTAL INDIRECT COST	$18,482
TOTAL PROJECT COST	$193,500

ATTACHMENT b

AGREEMENT BETWEEN
GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT
AND STATE OF CALIFORNIA, STATE LANDS COMMISSION
FOR THE PROVISION OF
RESEARCH AND DEVELOPMENT SERVICES

TERM:

FROM: May 1, 1992 TO: April 30, 1995

SCHEDULE OF FEES AND PAYMENT:

Great Basin Unified Air Pollution Control District shall pay the State of California, State Lands Commission the sum of fifty thousand dollars ($50,000) for the final data analysis reports resulting from the work described in Attachment A. Payment shall be made in a lump sum and will be paid within thirty (30) days of receipt of the funds from the City of Los Angeles Department of Water and Power

EXHIBIT C

MITIGATION OF WINDBLOWN DUSTS AND RECLAMATION OF PUBLIC TRUST VALUES, OWENS LAKE, CALIFORNIA, 1992-1993

Owens Lake Task Group
University of California, Davis

Partial Mitigation of PM-10 Dust Episodes Through Control of Saltating Particles and Reduction of Wind Shear, 1992-1993

Thomas A. Cahill: Principal Investigator
Robert G. Flocchini: Meteorology and Aerosols
Bruce White: Wind Field Diagnostics
Mike Taylor: Civil Engineering
Don Nielsen: Hydrology
Cathy Toft, Susan Ustin: Ecology
Tom Gill, Jeff Reid, Mee-Ling Yau: Air Quality Group

April 28, 1992

WORK PLAN: 1992-1993

The central thrust of this program is to test the hypothesis that control of saltating coarse particles is an effective and efficient way to control PM-10 dusts on the Owens Lake playas and surrounding countryside.

It will not be possible in this first phase to test this hypothesis completely, since the scale of the pilot scale mitigation is too small to give more than a few percent reduction of PM-10 dusts over a relatively small area. But it will be possible to test our second hypothesis: that a critical and effective way to control saltating coarse particles is through carefully-designed, properly-tested sand fences (which work by interacting directly with the saltation process) placed in "corridors" that cut the major wind fetches and areas of high sand movement.

Further, such sand fences can be placed in an array that, while it appears random and natural, provides effective control as it leads to a quasi-natural dune structure that is consistent with the public trust values of the Owens Lake area. In some cases, when water is available, these "dune corridors' could eventually become "riparian corridors" with native vegetation supported by naturally occurring and pumped water sources.

In addition, geophysical monitoring of the saltation process itself and its associated processes - upwind of, downwind of, on and around the sand fences - must be done if a mitigation effort is to be made successful. By better understanding the saltation phenomenon, as well as the physicochemical properties and processes characterizing the saltating particles (with respect to momentum transfer, fine particulate generation, etc.) we can optimize our mitigation strategy. Even a small improvement in our knowledge of the saltation process and how saltating particles create Pm-10 dusts at Owens Lake could lead to great reductions in the ultimate cost of mitigation.

After consultation with the State Land Commission (SLC) and the GBUAPCD, the original proposal of January 1992 (derived from the proposal of August 1991) has been focussed into tasks: a dry dune field, array sand fence dunes associated with either the array or the GBUAPCD wetlands tests, and a small riparian corridor vegetation test, and fence engineering and design. The wind tunnel testing is being prepared in a separate proposal.

It is important to realize that, although some mitigation will be accomplished by this summer's work, the essence of this proposal is a test of all aspects of field emplacement of dune arrays, aiming to optimize designs and engineering, reduce costs of future work, and get the greatest benefit per dollar spent. As such, it must be considered a research project on a pilot scale.

Nevertheless, the emplacement of more extensive fence arrays in summer 1993, pending satisfactory results of the test array of 1992-1993 and the detailed model/wind-tunnel/test fence studies, could be the initiation of mitigation efforts on the Owens Lake Bed.

CB

SUMMARY OF TASKS

NOTE: Task numbers derived from January 1992 Proposal. Listed in order of present priority.

1) TASK 92-E: Task 92-E instrumented dry dune field on the south Owens Lake area, has been expanded to incorporate some of the objectives from Task 92-A and Task 92-C from the January 1992 proposal. Appended.

2) TASK 92-F: Optimization for costs and materials, mechanical design and civil engineering of sand fence array placement. This will involve test fences at Davis and the existing south Owens Lake test area near the WESTEC fences. Implementation of this task will be submitted in a separate proposal. Appended.

3) TASK 92-A: Task 92-A from the January 1992 proposal for the emplacement of dry dune fields in the sand-dominated corridor north and west of Keeler has been deleted due to conflict with the GBUAPCD wetlands tests. Significant aspects have been incorporated into Task 92-E on the southern sand sheet near Olanch.

4) TASK 92-A: Alternate: Sand Fence array in corporation with the GBUAPCD wetlands tests. (New to this proposal). Appended.

5) TASK 92-B: Task 92-B from the January 1992 proposal for the initial tests of the Swansea Riparian Corridor has been deleted due to conflict with the GBUAPCD wetlands tests. Some of the information desired from Task 92-B can be obtained from Task 92-A: Alternate.

6) TASK 92-C: Task 92-C from the January 1992 proposal for the widening and extension of the One Mile Dune to the salt plan north and west of Keeler (an area heavily involved in the dust storms of November 1992), has been deleted due to conflicts with the GBUAPCD wetlands tests. Significant aspects of Task 92-C have been incorporated into Task 92-A: Alternate and Task 92-E.

7) TASK 92-D: Task 92-D has been retained as a small-scale test riparian corridor vegetation focussed on the Sulfate Well and Dirty Socks Well wetlands. Appended.

TASK 92-G: Design and optimization of sand fences and sand fence arrays for sand capture using computer models, wind tunnel tests and the experience of other projects around the world. This task will include the analysis of wind field of individual fences and fence arrays. Implementation of this task will be submitted in a separate proposal and part of which is covered by the companion ARB contract.

C9

I) TASK 92-E

Description:

Project 92-E involves construction of a test block array on the south area sand-dominated area near the 1981-1982 WESTEC sites. Access is via Lake Minerals Road. this area was significantly involved in the November 1992 dust storm.

Project 92-E has as its main purposes:

1. The measurement of transportal sand and saltating particles through a series of fences and to find the removal rate factor per staggered fence array. (Also see Plot 92-A.1). Such an array is one aspect of the riparian corridors or dry fence/dune arrays.

2. To measure the rate of entrainment of sand and saltating particles.

3. To measure the rate of dune buildup in the array.

4. To make measurements of wind speed in, around, and above the extended array (also data for wind tunnel model verification.)

5. To measure changes in surface, water levels, etc., in the array.

Project 92-E shall involve:*

1. Construction of 24 sand fences of the preliminary optimum design (Figure 1) in a block array of 3 staggered rows (Figure 2) placed across the prevailing direction of sand migration on the south sand sheet (Figure 3), ideally next to an existing filled linear dune. These are scheduled for completion in October 1992. Estimated fence - 4,000 feet.

2. Continuation of the array across the sand sheet, with the intent of blocking all N/S migration of sand, by Summer 1993. Estimated fence - 12,000 feet.

* All figures are present "best estimates" depending on local conditions and advances in design and materials.

3. Test arrays will have detailed meteorological and physical measurements designed to evaluate the effectiveness of the array. These are shown in Figure 2 and detailed in the protocols, but include:

   a. Sand Level Monitors (~600)
   b. Surface Sand Collectors (~50)
   c. Permanent Instrumented Meteorological Tower
   d. Portable 5-Tower Meteorological Array
   e. Vertical Sand Collectors (6)
   f. PM-10 Aerosol Collectors (4 to 6)
   g. Several Surface Moisture Level Sensors [not shown]

4. All data will be collected and reduced as a component of this contract and in collaboration with the companion Air Resources Board contract #A-132-105.

5. Further detail and operational protocols are found below in "General Protocols for Tasks.

92-E (addendum)
(If 92-A: Alternate is not chosen)

The purpose of these arrays is to start to set the parameters for spacing arrays at Owens Lake to optimize sand capture per dollar.

1. Four linear, staggered arrays will be constructed at locations upwind, downwind, and beside the block array. Each array will be approximately 4,000 feet long with adequate randomization in length and placement to present a quasi-natural dune field when filled. The spacing between arrays will be ~2,600 feet. Estimated fence - 16,000 feet.

2. Test arrays will have detailed instrumentation on ground level and sand migration, with occasional surveys of meteorology and aerosols and other parameters of 92-E.

FIGURE 2

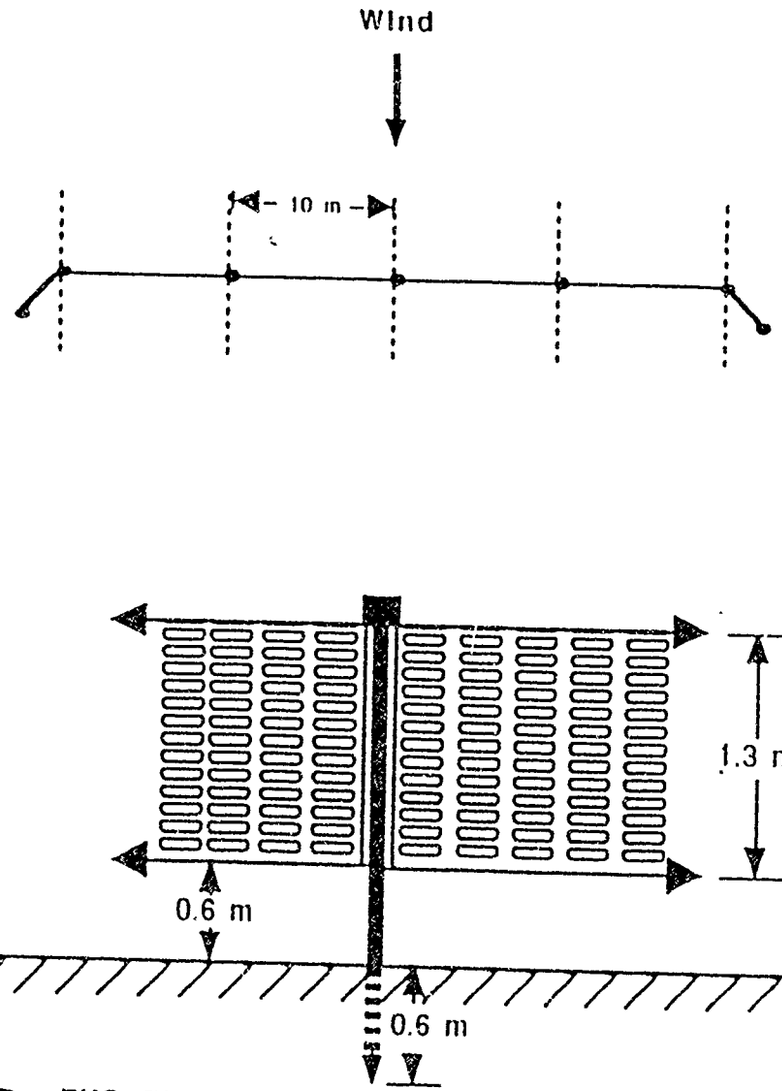
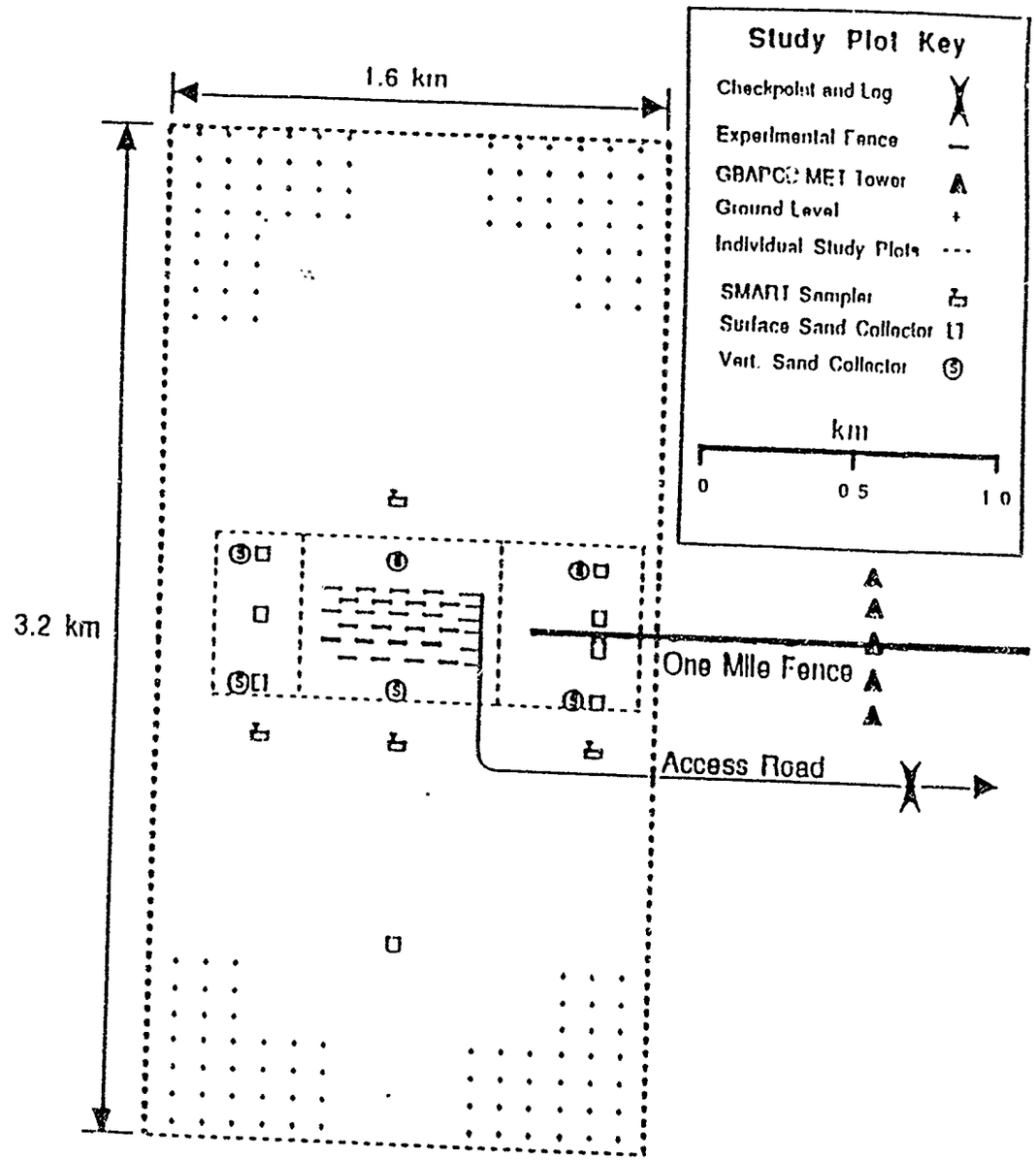
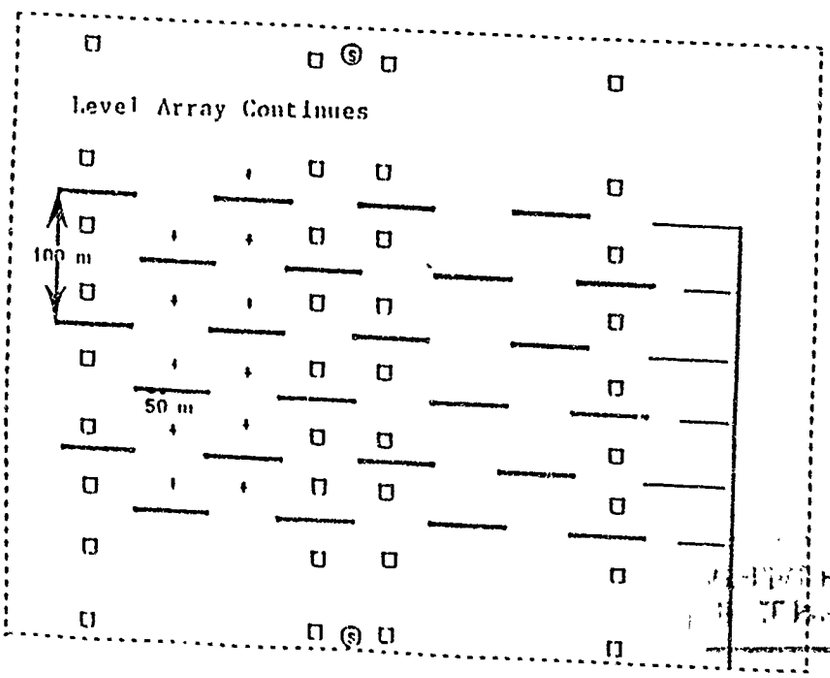
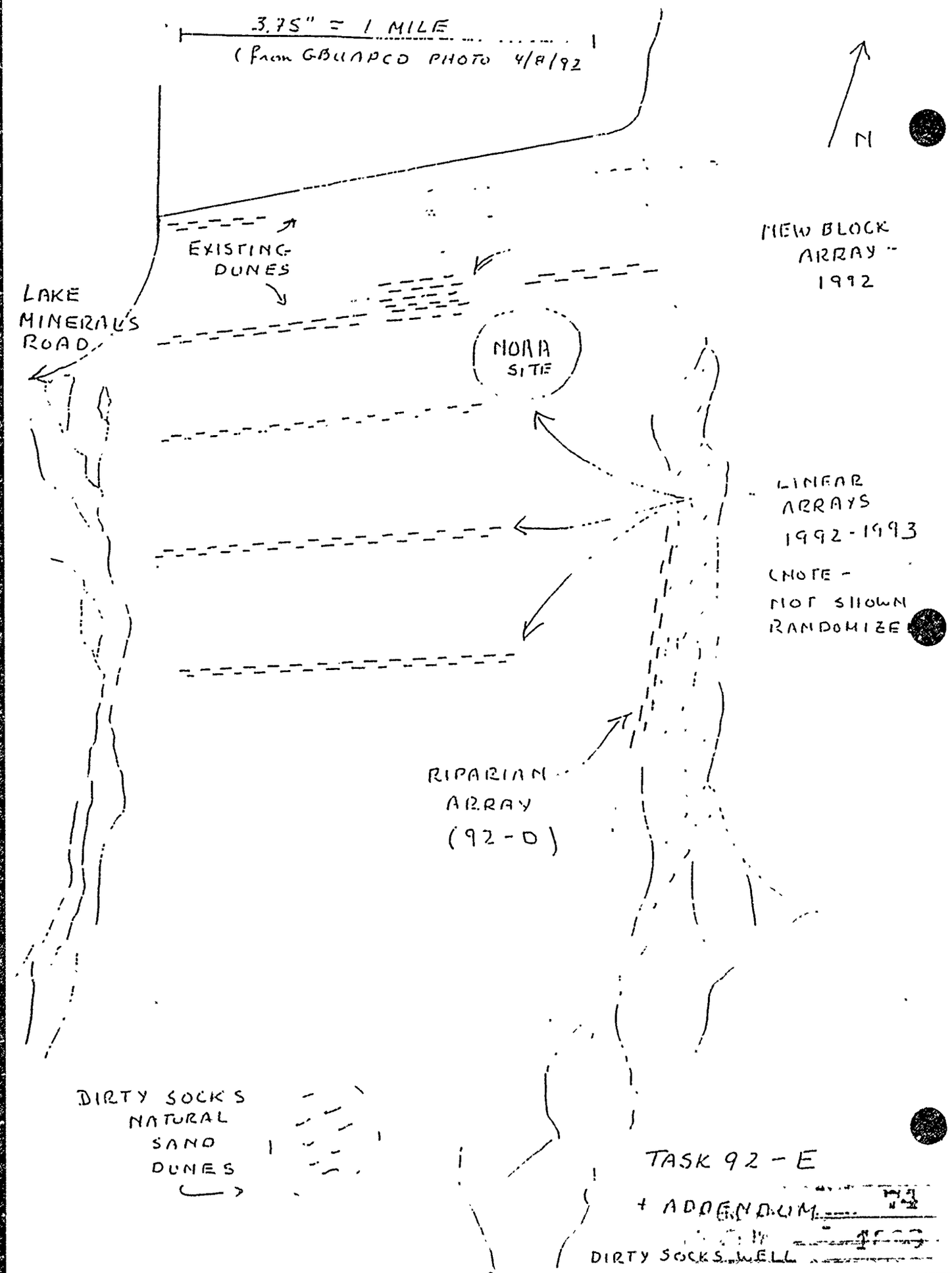

Wind
10 m
1.3 m
0.6 m
0.6 m
PVC Pipe
Plastic Fence
Manila Rope
PVC Pipes

FIGURE 1.


Study Plot Key
Checkpoint and Log
Experimental Fence
GBAPCS MET Tower
Ground Level
Individual Study Plots
SMART Sampler
Surface Sand Collector
Vert. Sand Collector
km
0
0.5
1.0
1.6 km
3.2 km
One Mile Fence
Access Road


Level Array Continues
100 m
50 m


3.75" = 1 MILE
(From GBUAPCD PHOTO 4/8/92
N
EXISTING DUNES
NEW BLOCK ARRAY - 1992
LAKE MINERALS ROAD
NOAA SITE
LINEAR ARRAYS 1992-1993
(NOTE - NOT SHOWN RANDOMIZED
RIPARIAN ARRAY (92-D)
DIRTY SOCKS NATURAL SAND DUNES
TASK 92-E
+ ADDENDUM
DIRTY SOCKS WELL

2) Task 92-F. Mike Taylor, Investigator

Optimization of costs and materials, mechanical design, and civil engineering of sand fence array placement. This will involve test fences at both Davis and the existing south test area.

This work is greatly aided by the simultaneous efforts of ARB contract of Tom Cahill that focusses on the nature and origins of the saltating particles, their motions across the lake bed, the connection between saltating particles and PM-10 dusts, the origins and transport of PM-10 dusts, and their detection through high altitude and satellite photography.

As the project is presently envisaged, this particular sub-project involves the following tasks which are listed in approximate chronological order.

(a) Fence Design - Conceptual
(b) Fence Design - Engineering
(c) Installation Methods for Fences
(d) Economies of Fence Design and Installation
(e) Logistics of Accessing the Lake Bed

(a) Fence Design - Conceptual

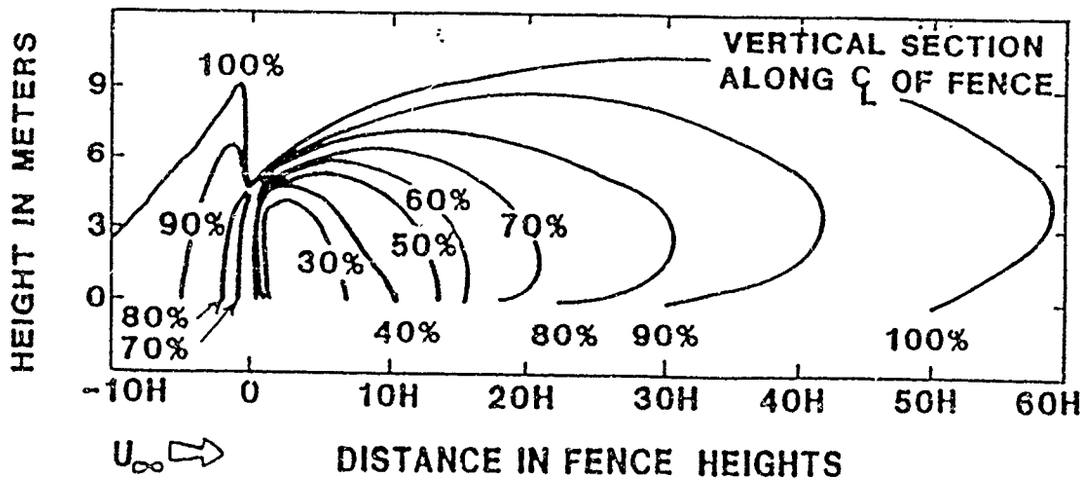
The detailed design of the fence(s) will be based upon the results of the following research.

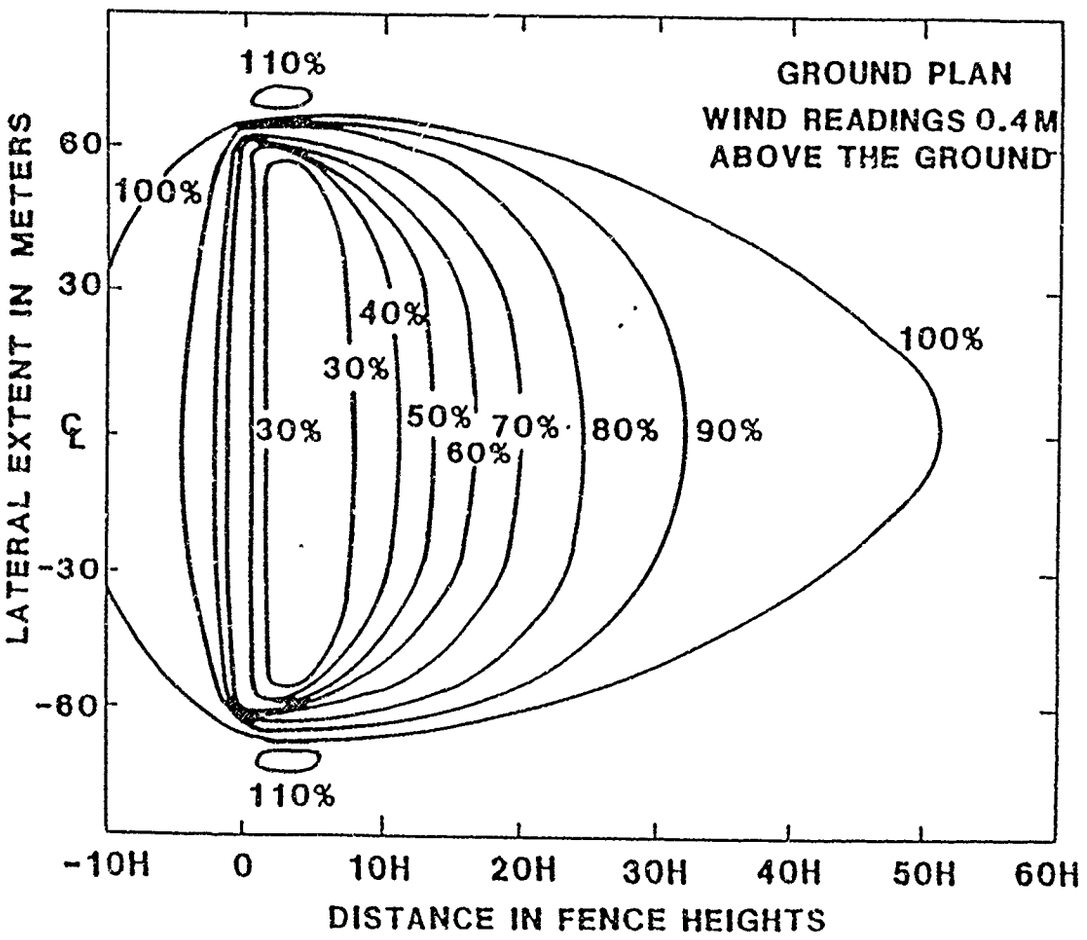
First, the experiences of all previous field installations of fences will be examined. A compilation of the successful and unsuccessful features of these prior installations will be made and, wherever possible, interviews with participants will be conducted to obtain first-hand accounts of both problems and successes. Considerable field experience has already been acquired by members of the Great Basin Unified Air Pollution Control District for fences subjected to the conditions at Owens Lake. Some sources of problems have also been identified - these include the effects of ultraviolet radiation and some failures initiated by the interaction of dissimilar materials in the fence components.

Second, the wind tunnel tests conducted by Dr. Bruce White will be used to predict the optimum parameters of each fence. Note that there may well be different design objectives for different fences, e.g. (i) maximization of storage capacity for sand, (ii) maximum life (stability) of created dune (iii) reduction of windshear (iv) suitability for (chosen) vegetation, etc. The detailed parameters are discussed hereinafter.

Third, a survey of the literature will be made to obtain the experiences of other investigators with fence designs, materials, and installation.

Fourth, UCD has personal communications with some of the worlds foremost experts on topic closely related to the Owens Project. Wherever possible the advice of these experts will be incorporated in the design process (Figure 4).





NOTE: VELOCITIES ARE % OF UPSTREAM VELOCITY AT THE SAME HEIGHT

Fifth, the manufacturers of fence materials will be a valuable source of experience and advice.

(b) Fence Design - Engineering

The principal engineering parameters which define a fence are

1. Height of Fence, H
2. Length between posts, S
3. Embedment depth of posts E
4. Permeability of curtain P
5. Material to be used in curtain, in posts, in anchors and in guys.
6. Orientation of Fence relative to wind (if fence is straight)
7. Shape of fence if not straight.

Parameters through 7 must await the results of research to be conducted in the first phase of the Owens project, although experience and preliminary investigations have already been conducted into item 5 and indicate that an all plastic fence system is probably the best.

Parameters 1 through 3, while also based partly on the results of previous research, will be determined by calculations based upon well established principles of mechanics. This will require information on the materials properties of both the fence materials and the soil at the selected fence locations. This information will be determined by laboratory testing at UCD of samples of fence making materials and of soil from Owens Lake. These tests will be augmented by tests on full scale fences installed at UCD followed, if necessary, by tests on full scale fences on the Owens lake bed. Professor White is investigating the possibility of using a transportable wind machine to expedite such tests.

In view of the extensive amount of fence which are envisaged it is anticipated that the design process will involve an iterative process in which calculations based upon wind tunnel tests will be used to produce prototype designs which will then be evaluated and, if necessary, modified prior to installation.

(c) Installation Methods for Fences

The first phase of the fence investigations will involve relatively small lengths of fences designed primarily to verify the results of the wind tunnel tests and previous experience on the lake bed. Such lengths of fence may be installed by hand and with a relatively inexperienced crew with little need for exceptional efficiency or speed. However when full scale fence placement is undertaken, this will clearly change. It will then be possible to save much money and time by designing a highly coordinated procedure for transport and installation of the fences. While the detailed investigation of this aspect of fence installation will not be undertaken until the next phase of the project, preliminary ideas and prototype equipment will be developed and filed for future reference and use.

(d) Economics of Fence Installation

The full scale remediation effort which is planned will require many miles of fences which will represent one of the major costs of the remediation program. Even small savings per unit length in the cost of the fence or of its installation will return enormous savings over the long range effort required at Owens.

It is anticipated that the most economical method of installation of fencing will involve an automated process utilizing a specially designed piece of moveable equipment which works in conjunction with a trained team of human workers. The design of this equipment will be initiated during later stages of the project.

(e) Logistics

The installation of what may be hundreds of miles of fencing in a remote desert site creates many special problems, among which may be mentioned:

1. access to the construction sites,
2. storage and protection of equipment and supplies,
3. production of special equipment to facilitate fence installation,
4. surveying to establish fence locations and to locate personnel and equipment on the lake bed, and
5. provision of human needs for personnel installing fence.

Each of these items will present a problem to be solved. Some individual problems are discussed below. Undoubtedly others will arise as the project continues.

Access to Lake Bed

The conditions on the lake bed can vary from "a crust which is rock hard," through "sticky mud" to "standing water." Obviously it will be a difficult task to move equipment around under such a variety of conditions. Three approaches may be adopted. In one method, a series of roads could be created which will remain accessible (for chosen equipment) through most weather conditions. In the second, a variety of transportation devices could be designed and constructed, each device being designed to be usable under one set of surface conditions. In the third approach, a combination of the previous two is used. The optimum solution may be arrived at my discussions with those who have the most experience of traveling on the lake bed and with the designers of equipment for such conditions. Some possible devices range from simple balloon tires to ground-effect machines, helicopters and airships.

4) TASK 92-A: Alternate

Project 92-A: Alternate replaced 92-E (Addendum) with all parameters identical, including cost. (See above, 92-E Addendum)

Description:

A series of four fence/dune arrays, roughly in a linear direction down the playa slope, each up to 3/4 mile long, but curving to match terrain and possessing some randomization in length and placement, be used between the GBUAPCD wetlands plots on the north sand sheet (see plan). Estimated total fence available (after returning the UCD/SLC fence fund to $50,000) - about three miles.

Work Plan:

Project 92-A (Alternate) replaces 92-E (Addendum) with all parameters identical, including cost (see above, 92-E Addendum).

Purposed Work Plan:

1. A series of fences/dune arrays, up to 3/4 mile in length, could provide significant modification of saltation and dusts. This would allow us to make sand migration measurements, PM-10 measurements, and photographic observations of dust both before and after the wetlands are emplaced. This would greatly aid our design of future arrays, as well as assisting the GBUAPCD's evaluation of the effectiveness of their program.

2. Any mechanical disturbance of the surface by berming, etc., of the GBUAPCD wetlands tests is a potential source of salting coarse particles that could generate PM-10 dusts, increasing downwind PM-10 and confusing the results of the tests, especially the later dust suppression component. The fences would replace much of the need for berming and suppress dusts from any berming necessary.

3. Upwind saltating particles brought into the array from the northwest will make the first fence, on the northwest edge, different from downwind fences.

4. The resulting dunes, even if very low, could be used for road access to the test plots even when water is present in the plots themselves.

5. Any accidental generation of fluffy crust in the wetting/drying cycle would be protected from abrasion even when water is not present.

6. The resulting dunes would provide some topography in direct contact with water, with potential for the vegetation tests in future years.

7. The fence/dune arrays would be "proof in place" that a serious pilot scale pre-mitigation tests is in progress during 1992, while the pumps and piping are being designed and built.

8. A series of 4 fence/dune arrays, approximately 3/4 miles in length, could provide significant modification of saltation and PM-10 dust. This would allow us to make sand migration measurements, PM-10 measurements, and photographic observations of dust both before and after the wetlands are emplaced. This would greatly aid our design of future arrays, as well as assisting the GBUAPCD's evaluation of the effectiveness of their program.

9. The emplacement of the arrays in the north area was presented on January 10, 1992. Task 92-A: Alternate meets some of the stated goals of the original proposal, Tasks 92-A and 92-B (Figure 6).

10. I could honestly say that, in my opinion, there is nothing that one could do as quickly or cheaply to reduce Keeler violations of PM-10 than place these fences.

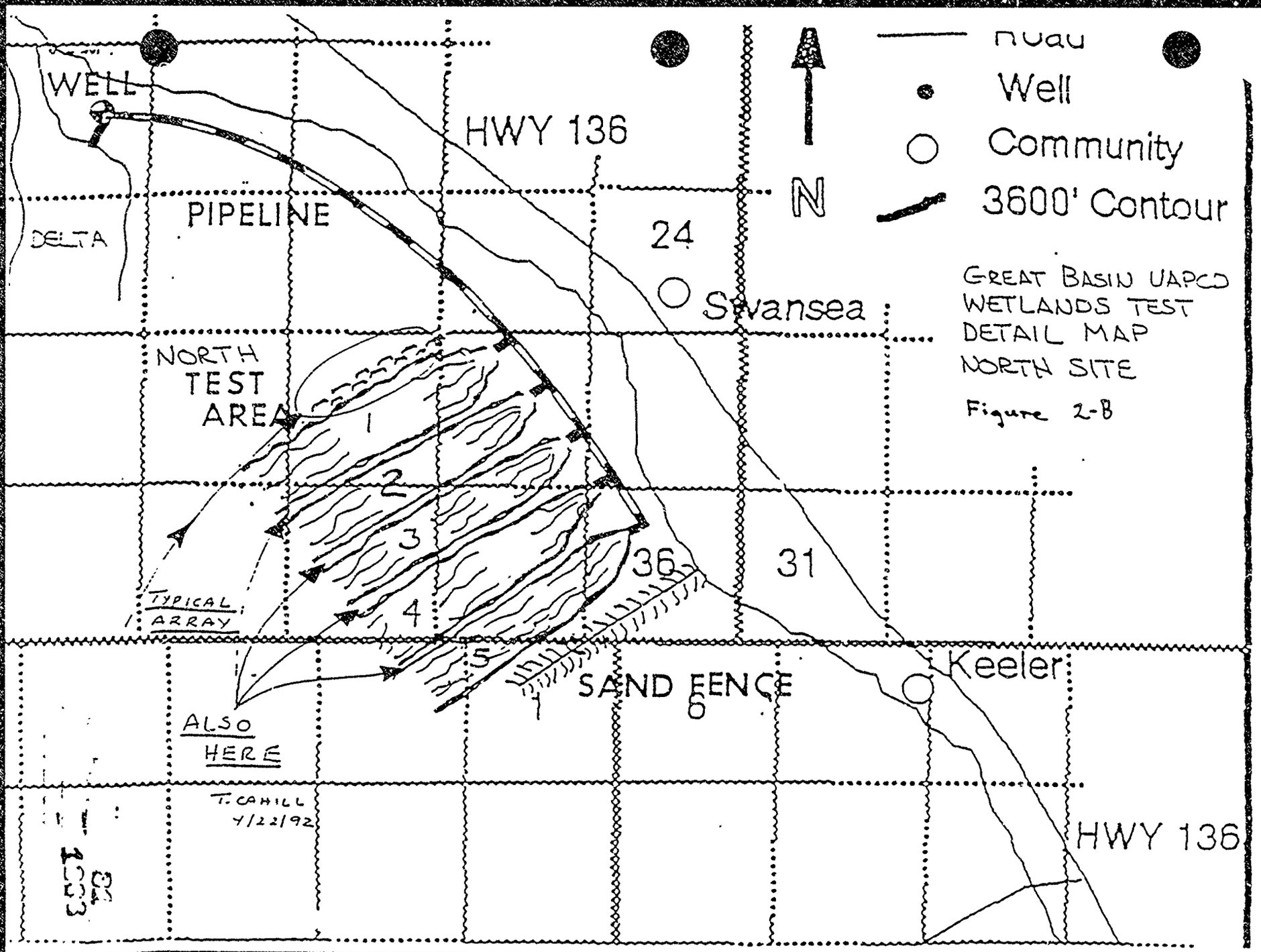
However:

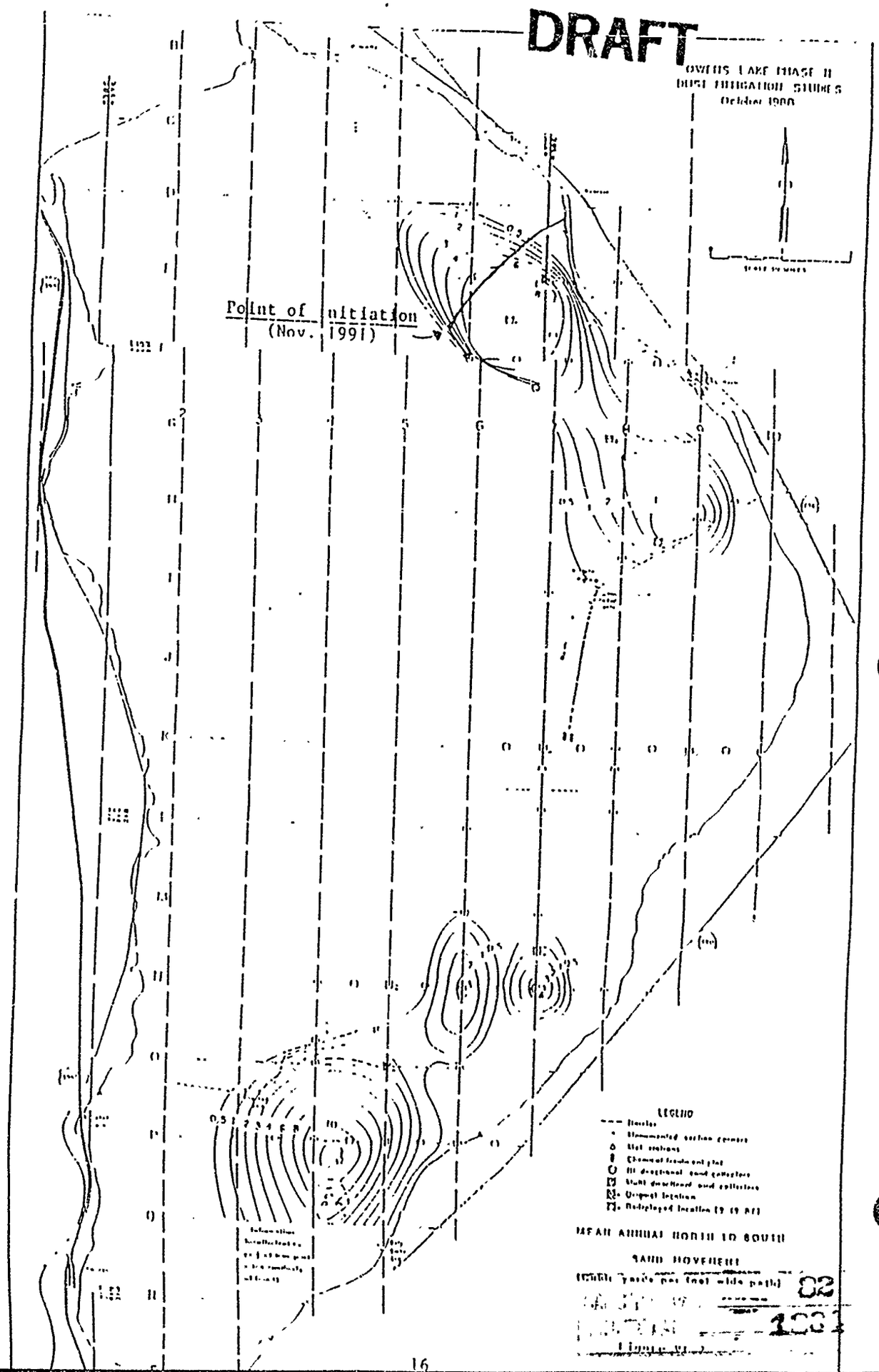
1. The diversion of so much fence north will make the south arrays less extensive and thus decrease the value of the array tests.

2. We are not sure that we can get that much construction done in Fall 1992. Some of the benefits of the fence/dune barriers would be reduced if they could only be built in Spring 1993.

3. We could not provide as detailed evaluation of these fence barriers as we had planned for the arrays (now in the south) without diverting efforts from that area.

4. The wetlands plots would be fixed in location by the dunes, and some future plans could be thwarted by the artificial relief.


Road
Well
Community
3600' Contour
N
WELL
HWY 136
PIPELINE
DELTA
24
Savansea
NORTH TEST AREA
1
2
3
4
5
6
36
31
TYPICAL ARRAY
SAND FENCE
Keeler
ALSO HERE
T. CAHILL 4/22/92
HWY 136
GREAT BASIN UAPCD WETLANDS TEST DETAIL MAP NORTH SITE
Figure 2-B


DRAFT
OWENS LAKE PHASE II
DUST MITIGATION STUDIES
October 1990
Point of initiation
(Nov. 1991)
LEGEND
MEAN ANNUAL NORTH TO SOUTH
SAND MOVEMENT
02
1991

7) TASK 92-D

Description:

Enhancing the sulfate well riparian corridor by emplacement of sand fences, redirection of water, and test planting of locally derived vegetation.

Purpose:

1. Extensive survey of existing vegetation on or near the Owens Lake playa in its full ecological setting, including:

    a. Vegetation
    b. Physical environment
    c. Chemical environment

        i. Soil
        ii. Water
        iii. Wind Protection

2. Collection of test samples for cultivation at UCD and in the playa.

3. Evaluation of the sulfate well area, which has been mitigating dusts for decades, generating a riparian corridor, and serving as a home to wildlife. It is our model for the future of the Owens Lake bed. We wish to evaluate how much additional effort is needed to enhance its effectiveness.

4. The sulfate well corridor lies upwind of Keeler on the southern dust storms more common in spring. Any mitigation in this area will reduce PM-10 dusts in such events, but the scale is too small for any serious effect 1992-1993.

5. We need data on revegetation efforts on the lake bed and the waters of the sulfate well may be a good model for future well-supported riparian corridors.

6. A good production well is available to provide the additional water for a future enhances riparian corridor.

7. Should be far enough from Task 92-A:Alternate and the GBUAPCD wetlands tests to not affect those tasks.

Oversight: Tom Cahill, Don Nielsen, Jim Richards, Cathy Toft, Susan Ustin; Mei Ling Yau

Work Schedule:

1. Survey of vegetation 7/1/92 - 7/1/93.

2. Detailed mapping of existing water flow patterns, barriers, etc. 7/1/92-7/30/92.

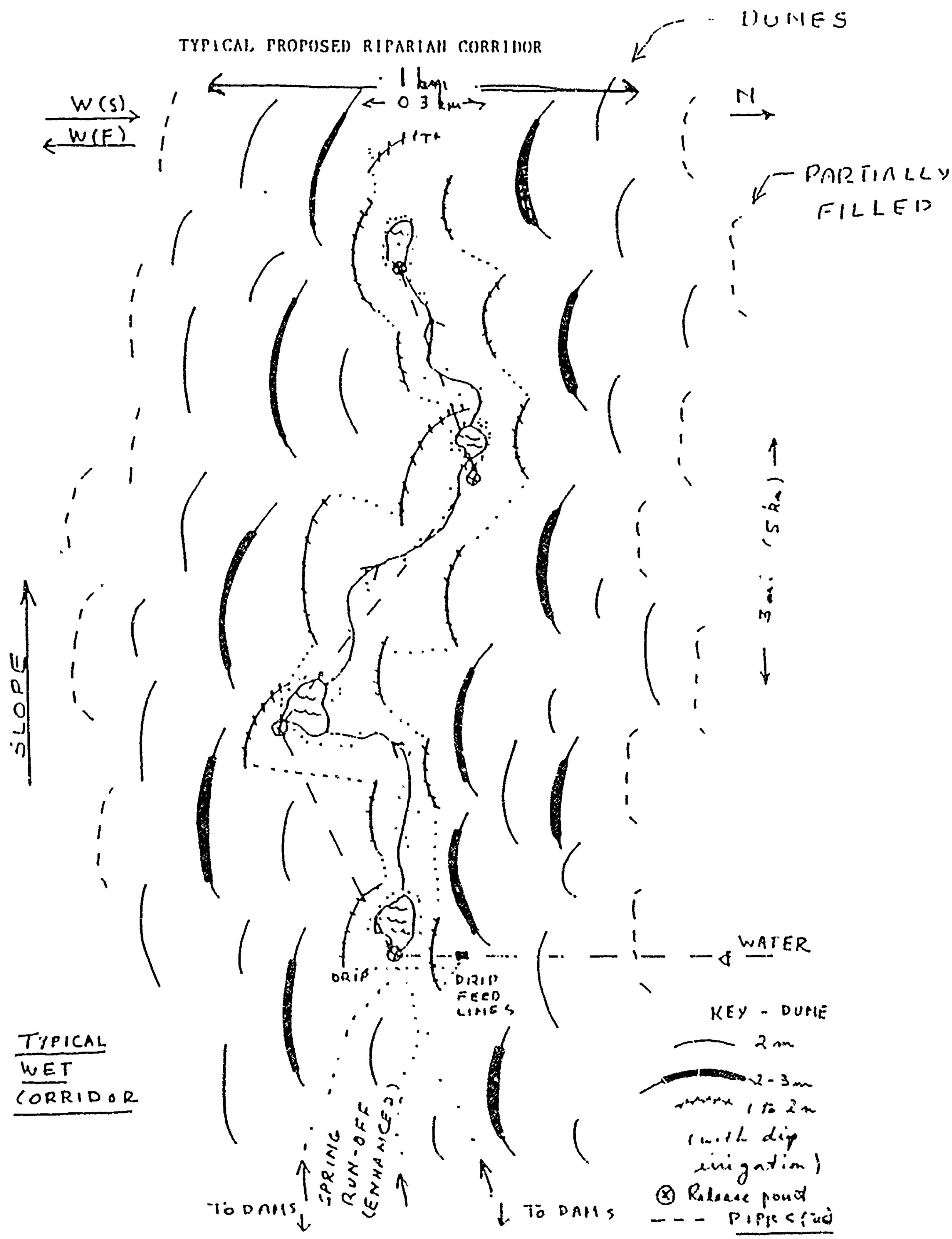
3. Placement of sand fences west to the sulfate well to form a protective barrier for plantings 8/1/92-10/1/92 (note: may draw resources from the western team, based at Olancha, for this task).

3. Engineering evaluation of water course changes along historical channels (8/1/92-10/1/92).

4. Establishment of vegetated test plots along the corridor using locally-derived vegetation (9/1/92-9/1/93).

5. Evaluation of Dirty Socks Well wetlands as the basis for a dune-stabilized riparian corridor (9/1/92-7/1/93) (Figure 7).

TYPICAL PROPOSED RIPARIAN CORRIDOR



GENERAL PROTOCOLS FOR TASKS

PROTOCOL 1: All requirements and deliverables of the California State Standard agreement ARB A-132-105 Owens Lake, California Air Resource Board, 2/10/92 - 8/9/93 are hereby incorporated by reference.

PROTOCOL 2: All of the requirements in the SLC Mitigation Plan are hereby adopted in full, and will be part of any sub-contracts.

PROTOCOL 3: Before deployment of any sampling or test procedures, a complete literature review will be performed in order to ensure that the optimal techniques will be utilized. It may be necessary to modify previously-suggested techniques if review indicates that a different technique may be more effective.

PROTOCOL 4: On-Site Sand Fence Construction: Stewardship.

We are keenly aware that any operations on the lake bed have the potential to increase dust generation through destruction of the existing surface crusts, enhanced erosion/ degradation of the lake bed, etc. Therefore, all access and construction activities at the north site must be strictly controlled, as any disturbance of the crust of the lake bed can influence subsequent measurements. For this reason:

4.1 All construction activities shall do minimal damage to existing crusts. In particular, access trails to sites shall be clearly mapped out and followed.

4.2 Fence emplacement shall always commence at the edge closest to the salt pan and work up-slope. The fences shall be built directly upon the access road itself, which will then be blocked by the fence and its guy ropes.

4.3 Whenever possible, only a single trip shall be required for each fence emplacement, after which no visits shall be made by heavy equipment to the fence unless required by fence failure.

4.4 Only a severely limited number of access points shall be allowed giving access to the test array area of the playa, and each shall be barred by a locked gate and explanatory signs. Only a single access road will be used for all activities if possible. Every trip along this road by any vehicle will be logged, and signs will be posted at the control point. A log will be kept at this location and in the central control office (see Figure 1).

4.5 Within the test site, an attempt will be made to make all roads lie along future fence lines, so that wherever there is broken crust, there will also be a future dune (see Figure 1).

4.6 An absolute minimum of vehicular activity will be allowed beyond the test section further southwest of the fence array. We will cooperate with the GBUAPCD and all other activities to ensure that the area roughly 1 mile on each side of the fence has no other activity during this period. This conforms to the written protocols.

4.7 Any fence material that is not beige in color will be removed once the tests are concluded, if this is mechanically possible. If not, a second beige portion will be used to hide the offending portion, so that the future dunes will eventually cover it.

PROTOCOL 5: Day-To-Day Task Operations, Sequential Plan.

5.1 UCD will establish a central operations/laboratory site and supply center in Inyo County, to enhance communications with all active groups on the lake, especially the GBUAPCD.

5.2 Weekly meetings will be held beginning in summer 1992, with attendance (in person or by telephone) of:

a. State Lands Commission personnel.

b. Great Basin personnel.

c. LA Department of Water and Power personnel, or their contractors.

d. UCD sub-contractors.

e. Cooperating agencies such as the Air Resources Board, US Navy, Department of Fish and Game, Lake Minerals Corporation, etc.

We also invite specific attendance by members assigned to monitor the project by the Owens lake Task Force.

5.3 Layout of the dune array, with regard to environmental considerations, plans for future studies, obstacles, etc. Mark locations, establish access point and trails, following protocols described in Task 92-E.

5.4 Construct dune array, following the protocols described in Task 92-E, using the results of 92-F (See Figure 2).

5.5 Deploy instrumentation and equipment for monitoring saltating particles, san migration, sand depth, wind field, PM-10 generation, and related parameters upwind of, downwind of, and around the dune array, as described in Task 92-A, Category 5.

5.6 At completion of the construction phase, the monitoring and evaluation phase will begin and continue through the 1992-1993 dust "seasons" to 1/1/94.

5.7 Quarterly reports will be prepared (10/1/92; 1/1/93; 4/1/93; 7/1/93), and a final report be 10/1/93.

PROTOCOL 6: Data Gathering for Evaluation of Mitigation Effectiveness via Instrumentation.

6.1. Observation of Test Fence Area. A detailed written and photographic log will be maintained and updated for each sand fence on a regular basis (suggested term: bi-weekly upon completion of sand fence array, lake bed and weather conditions permitting. During winter months [Dec.-Feb.] of difficult conditions on the lake bed, suggest monthly visits). Information on the fence's physical condition, captured sand depth, and weather history will be recorded. Additionally, as part of the ARB study, the test area will be targeted by an automatic camera site during dust events.

6.2. Sand Level/ Dune Growth Measurement. A series of land level measuring posts to determine minor variations of sand levels will be placed throughout the entire sand fence array test plot at 100-meter intervals, soon after the test plot is established. The grid point spacing will be decreased to 50 meters forming a total database of approximately 592 points. Posts inside the experimental dune area as well as the sand fences themselves will be measured for dune growth after each moderate to large dust episode. Readings from posts in other areas will be measured monthly. Data will be analyzed, mapped and correlated to the mean wind velocity and time lapse photography (see ARB proposal) of the associated dust storms.

6.3 Windflow/Turbulence Measurement and Assessment of Test Fence Area. Three portable and two semi-portable meteorological (met) towers will be available to determine the mean and turbulent flows in and around the fence arrays. The air flow over each of the three individual study areas will be determined and compared under similar meteorological conditions. Because the flow in fence regions is extremely turbulent, severe nonlinearities exist. These nonlinearities increase dramatically at closer distances to the fences and thus surface variables such as u_* and shear stress near the array cannot be determined directly. However, the mean and turbulent flows can be correlated to data derived from the Davis wind tunnel (Task 92-B), allowing a better approximation of these variables.

The met towers will be deployed in various configurations in each individual study area. Data from the different configurations will be evaluated and used as appropriate for optimization of future fence designs. Deployment of equipment and field measurements for this project will begin upon the completion of the test fence array and continue through December 1992. Data analysis will continue at least through February.

6.4. Soil and Sediment Sampling.

Surface samples of free and crusted sediments from the lake bed will be taken from sites upwind, downwind, and around the test array, and from additional sites on the Owens Lake playa. Sand collection with BSNE sand collectors and isokinetic dust collectors will be done on playa as part of the existing contract with the Air Resources Board.

Additional saltating sands will be collected with additional collectors located at the and near test fence array. Thirty-five multidirectional surface sand collectors will be installed throughout the study area, with the majority located close to the fence array: 27 throughout the experimental array, 4 located in series normal to the GBUAPCD 1-mile fence, 3 in the control area, and the remaining one in further reaches downwind of the study plot. Six additional vertical sand collectors will also be deployed along the outer boundary of the experimental dune area, two for each section of the study plot. These will have North and South oriented collectors at seven heights: 0.2, 1.0, 2.0, 3.0, 4.0, 5.0, and 6.0 meters above the ground surface. Total volume will be measured and physical samples obtained.

In addition, core samples of the dunes building up under each sand fence will be taken.

Collection of sand from the devices described above will be measured on the same schedule as the sand level measuring posts described in Protocol 5.2.

Soil and sediment sampling procedures will be followed pursuant to generally-recognized procedures described in detail in several documents including the guidebooks "Methods of Soil Analysis" by the Soil Science Society of America: "Soil Survey Manual" of the U.S. Department of Agriculture, Soil Conservation Service: the U.S. EPA document "Control of Open Fugitive Dust Sources": and soil sampling procedures taken from the document "Quality Assurance/ Project Plan for Determination of Particie Size Distribution and Chemical Composition of Particulate Matter from Selected Sources in California," prepared for the California ARB by Desert Research Institute.

Sample collection will be performed in conjunction with the other fieldwork described in this project, continuing through the Fall 1992 and Spring 1993 dust seasons. Samples will be archived at OLTG field headquarters in Lone Pine and at UCD.

6.5. Soil and Sediment Analysis. A selection of the sand and sediment samples will be analyzed for bulk chemistry by standard chemical techniques. Some samples may be analyzed by PIXE (Proton-Induced X-ray Emission) for trace element content, which can be related to other physico-chemical parameters of the sample. The particle size distribution will be determined by sieving with ASTM-approved test sieves, aqueous extraction and/or resuspension (as appropriate), and their mineralogy will be determined by optical (petrographic) microscopic examination, scanning electron microscope (SEM), transmission electron microscope (TEM) and/or X-ray diffraction, as appropriate. Other physical characteristics, including angularity, will also be measured for selected samples as appropriate

The core samples from the dune, including individual depositional layers from each dust event when discernible, will also be analyzed by a selection of the above techniques.

Analyses will be performed at UCD in laboratories of the Department of Land, Air and Water Resources, Civil Engineering, Facility for Advanced Instrumentation, and Crocker Nuclear Laboratory. Analyses will be performed as facilities are available, and can be done during the winter season when access to the lake bed is limited.

6.6. Aerosol Monitoring. Although the Mono-Owens Davis Dust Model suggests that the individual study areas on the test plot will have little effect on the total PM-10 generation on the Owens Lake bed, under microscale conditions it is theoretically possible that at moderate distances downwind there could be a slight decrease in PM-10 concentrations. If the sand fence array prevents saltation of large particles, PM-10 generation downwind will be suppressed. However, the relatively large amount of fine (PM-10) aerosols generated upwind of the individual study areas on the test plot will have time to be diluted by turbulent diffusion and their areal density will be reduced. Thus, there may be a slight dip in PM-10 concentrations just downwind of the fences. To test this theory, four UCD-designed Solar Monitoring for Aerosols in Remote Terrain (SMART) samplers (see ARB proposal) will be deployed in various configurations throughout the experimental dune area. The SMART units will be operated, and their resultant data analyzed, using standard methods described in the Air Resources Board proposal. The SMART units will allow for the optimization of aerosol collecting on the lake bed before the evaluation of the larger array to be built in Summer 1993 begins.

The exception to this premise occurs for 92-A Alternate and MODDM predicts significant PM-10 reductions should this option be chosen.

PROTOCOL 7: Analysis of environmental impacts.

The areas and activities of the proposed work represent such a modest change in prior and present activities as to justify a "Negative Declaration" under CEQA. In fact, all activities are designed to mitigate a serious environmental problem, and any minor impacts caused by construction will be more than offset by reduction of PM-10 dusts.

Please refer to the attached State Lands Commission document (included as an Appendix), "Proposed Negative Declaration... Proposed Dust Remediation Pilot Program-- Owens Lake," which addresses these concerns comprehensively.

PLEASE NOTE: Other protocols may be generated during the tests at Davis and Owens Lake, and these will be ready prior to the commencement of large scale lake bed operations, in summer 1992.

REQUEST FOR BID

Sand fence materials.

Not to exceed $50,000.

The University of California, Davis, Crocker Nuclear Laboratory Owens Lake Task Group wishes to solicit bids for sand (snow) fence for a major sand mitigation project at Owens Lake (near Lone Pine, California). The fence will be used to form dune arrays, each dune 6 ft high, 150 TO 300 ft in length, on the saline dry lake bed of Owens Lake.

The material proposed must have the following characteristics:

a. Height - initially 4 ft, but 5 ft, and 6 ft high fences can be considered. However, they pose problems in installation. Please make suggestions. All other things being equal, we prefer 4 ft fencing, which will be placed 2 ft above the playa.

b. Length - up to 240 foot on a spool (80 yard or 72 meter lengths, pre-cut). Can be in smaller lengths and joined on-site.

We also wish to obtain 100 pieces of your fencing, 60 feet in length, promptly.

You may propose that we cut to length on-site, if there is a significant savings in cost. Nevertheless, on-site equipment is not designed for over 2,000 lb per roll.

c. Porosity - initially 50%, but please feel free to propose other values based upon your experience

d. Material - we propose a lifetime on the lake bed of at least 30 years, in conditions of high salt content, high winds (to 65 mph), abrading sand, high temperature, and high sun and ultraviolet levels. Please document experience with your proposed materials in similar conditions.

e. Color - beige to light gray; sample of lake surface color provided with bid package; please submit sample of your color.

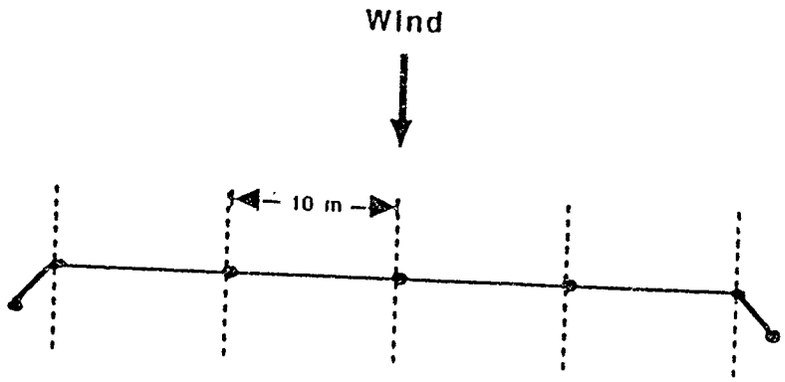
f. If the fence comes in smaller lengths and needs to be joined, detail the types of joint and their survival in such conditions.

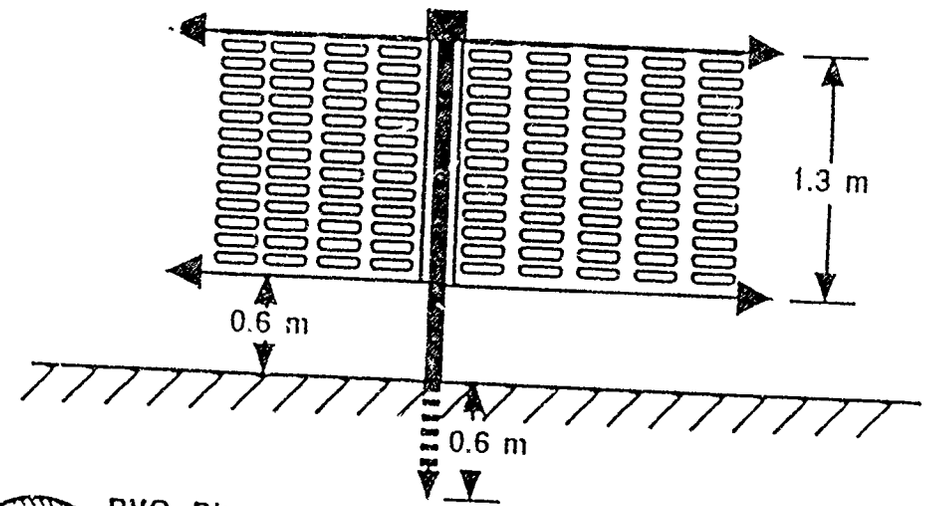
g. If you have suggestions for fence designs, and/or additional hardware, please propose a package with these items.

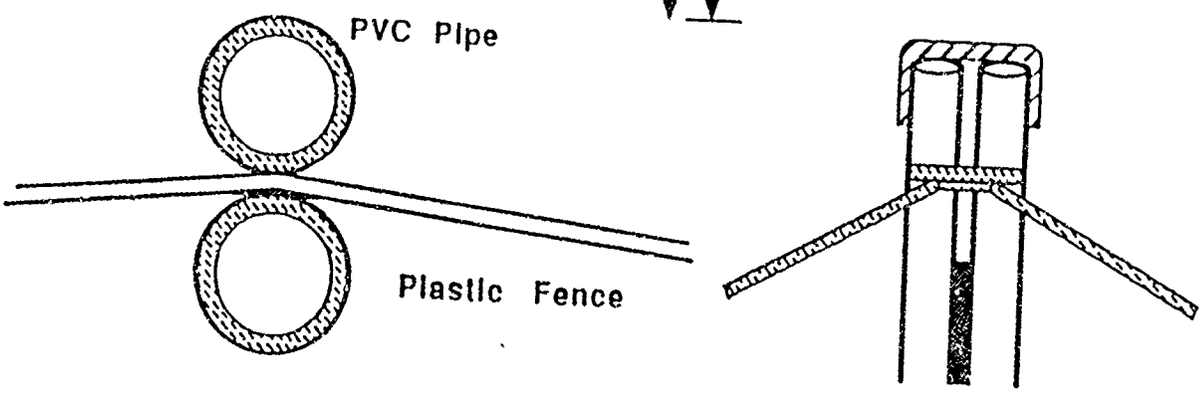
Delivery: Small scale samples, to UC Davis by 8/1/92. Later materials, to a location near Ca, on or before 9/1/92. Note: we are willing to consider phased deliveries, as long as at least 30% of the order on hand by 9/1/92, and all the rest of the order by 4/1/93.

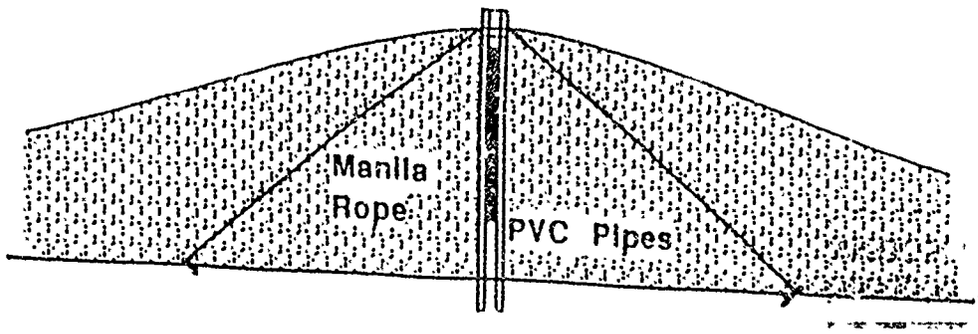
Payment terms: TBA

FIGURE 2


Wind
10 m


1.3 m
0.6 m
0.6 m


PVC Pipe
Plastic Fence


Manila
Rope
PVC Pipes

REQUEST FOR QUOTE

Support of sand fence construction, 7/15/92 - 10/15/92.

Support from West Side Owens Lake, not to exceed $15,000
Support from East Side Owens Lake, not to exceed $15,000

You may bid on either or both contracts.

The Owens Lake Task Group, Crocker Nuclear Laboratory, University of California, Davis, requests quotes on support of construction efforts of sand fence-sand dune arrays and minor excavation on the Owens lake Bed.

This support will include providing:

1. Equipment for unloading from delivery trucks all materials used in the project. The weight could be as high as 2,000 lbs for a spool of fencing.

2. Mechanical equipment capable of travelling over the lake bed carrying up to 1,000 pounds of (nominal) 6 ft. fencing material, spooling the material off the vehicle onto the lake bed in a control fashion so as to lay out a series of 240 foot fence arrays. The equipment should do minimal damage to the lake bed surface crust.

3. Provision of trained operators (one/team, up to 2 teams) to operate the equipment and assist untrained laborers, (4/crew, under the direction of a UCD supervisor), emplace the fence, guy it, and do whatever is necessary to secure it and the associated diagnostic equipment. Also support safety of the work party(s). Nominally, this will involve 40 hrs/week, estimate 180 days duration.

4. Repair and maintenance of all equipment.

5. Provision of a base areas on the east side (Keeler-Swansea) and west side (Cartago-Olancha) of the lake to receive fencing equipment, supplies, etc., and keep them available in a secured work area.

6. Provision of contractor's supervisor, 20% time, 180 days, with oversight and consultations on design and implementation.

7. The duration of the contract is 15 months.

8. Bidders may bid on either or both teams, one on the west side, one on the east side of Owens Lake.

9. All bidders must have a California Contractor's License.

10. Payment Provisions TBA.

Budget Submittal Form 102

This form is supplied for presenting budget detail to the Air Resources Board.
In addition to this form, alternate forms or computer printouts may be submitted.

Name of Institution: The Regents of the University of California

Address: Crocker Nuclear Laboratory
Air Quality Group
University of California
Davis, CA 95616

Title of Proposal: A Proposal For Partial Mitigation of Owens Lake PM-10 Episodes Through Control Of Saltating Particles and Reduction of Wind Sheer, 1992-1993.

Total Budget Requested: $200,000.

Period Covered(months): 15 months

(1) Statement of Binding

This proposal is firm for 120 days after the submittal date of _____.

The following official binds
to this technical and cost proposal _____

_____ _____ _____
Name Title Telephone No.

_____ _____
Signature Date

(2) CONTACT PERSON

Please provide the name, title, and telephone number of the contact person authorized to modify/ clarify technical or financial aspects of this proposal.

Thomas A. Cahill, Professor of Physics, (916) 752-1120
Name Title Telephone No.

Budget Summary*

Direct Costs

1.	Labor	$ 56,544.	
2.	Subcontractor(s)/Consultant(s)	$ 30,000. 6,500 *	
3.	Equipment	$ 5,200. *	
4.	Travel & Subsistence	$ 13,920.	
5.	Electronic Data Processing	$	
6.	Reproduction & Publication	$ 1,500.	
7.	Mail & Telephone	$ 1,000.	
8.	Materials & Supplies	$ 54,595.	
9.	Analyses	$ 2,300.	
10.	Miscellaneous	$ 4,500. *	
	Total Direct Cost	176,059.	$ 176,059.

Indirect Costs

11.	Employee Fringe Benefits	$ 7,228.	
12.	Other Indirect Costs	$ 15,986.	
	Total Indirect Cost	23,937.	$ 23,937.

Total Project Cost		$ 199,996.

*Please provide budget details on pages 3 5. Definitions of terms used are provided on pages 6-8.

*Overhead does not apply

4. TRAVEL & SUBSISTENCE

1.	Round trips to Owens Lake 600 miles @ 0.24/mi = $144. x 15 trips	$ 2,160.
2.	Transportation at Owens Lake UC Car Rental for 6 months	2,600.
3.	Per Diem 160 days @ $26./day	4,160.
4.	Rental of housing (replaces housing)	5,000.
	TOTAL TRAVEL & SUBSISTENCE	$13,920.

PROTOCOL: TASK 92-D

BACKGROUND

A study by Kusko and Cahill of aerosols found that there are 5 major requirements for PM-10 violations at Owens Lake and, corresponding to each requirement, there are certain control mechanisms (Appendix, Table 1). First studies of experimental test plots based on these control mechanisms was done by WESTEC (1984) on the lake bed, including sand fence construction, vegetation studies on dune and unaltered lake bed, application of surface stabilizing agent, and leaching. Results of some tests performed will be discussed later. Similar studies plus flooding and sprinkling tests were performed by the Great Basin Unified Air Pollution Control District. However, most of the tests show disappointing results.

The idea of establishing vegetated dunes has been reconsidered by the UCD Owens Lake Task Group and proposed again despite the failure of prior studies. This is because of the following reasons.

First, although the fundamental goal of mitigation is to reduce the dust burden within minimum amount of water and money, a "stable, attractive, and ecologically diverse Owens Lake playa", if possible, is the ultimate goal of dust mitigation and management plan. Although restoration usually means to bring back an ecosystem to its original condition, it is redefined to be "activities which seek to upgrade damaged land or to recreate land that has been destroyed and bring it back to beneficial use, in a form in which biological potential is restored". This has similar meaning as an "alternative ecosystem", which is a management option of a disturbed ecosystem. Sand dunes with vegetation is a mitigation alternative much more ecologically sound and resembling the natural ecosystem around the playa than the other proposed methods, which are basically pure engineering work.

Second, although previous vegetation studies were not successful, vegetation does thrive naturally on some parts of the playa, for example, the Owens delta with plant species of various communities from riparian to desert scrub, the Sulfate Well region with an artesian well supporting abut 0.01 square mile of *Juncus balticus* and *Distichilis spicata*, vegetated natural and artificial dunes on and around the playa and so forth. This convincing evidence supports the possibility of vegetation establishing under the harsh conditions on the lake bed, provided that the plant communities, as well as ecology and physiology of the species within the communities, are well studied. Besides that, vegetation is still the primary means of improving air quality and an essential element in control mechanisms of dust problems (Table 1). In addition, vegetation can interfere with wind and lessen saltation. Vegetation of certain height can increase the frictional velocity and therefore increase the resistance of laminar flow. Vegetation of certain canopy structure can have significant protection against wind erosion.

On the other hand, dunes provide mesic habitats for vegetation in the desert environment. Despite the lower water holding capacity than silt and clay, the moisture in sand is more available to plants because of the less negative matrix potential. Dune vegetation, in return, can stabilize the dunes, accumulate organic matter, and finer silt and clay and can facilitate the

growth of other plant species, leading to succession. Such a process from bare dune to stabilized vegetated dunes can be as fast as 10 years.

Before any implementation of the mitigation plan, however, the vegetation and dune system naturally occurred on the playa has to be studied. Plant-water-substrate relationship as well as the successional pattern, if any, of the dunes on the playa must be known so as to select the right species, plant them at the right place and right time. Proper plant selection is the key to successful dune afforestation program. Therefore, successional species (e.g. pioneer, mid-stage and climax species), their microhabitats (e.g. dune top, margin, windward, or leeward side of slope), and their niche must be identified. Besides that, physical factors such as wind direction and magnitude determine erosion rate, dune shape and ultimately the microhabitats of vegetation. Dune shape, together with other dune characteristics like dune size, particle size distribution, organic matter, carbonate content and pH, might have correlation with vegetation type and abundance if succession does exist. A study of chronosequence can shed light on succession over time.

Besides harsh physical environment, failure of natural shrub establishment on the playa might also be due to such biological factors as lack of seed bank and seed dispersal. Shrubs and other perennials have life history strategies of being long-lived, producing few but large seeds and often having a transient seed bank. That might be the reason why there are non-vegetated dunes along with the vegetated ones on the Owens Lake playa. In addition, clumped distribution of seeds indicate that seeds tend to accumulate in microhabitats such as under canopys and depressions. Lack of vegetation or such topographic features on the barren playa could also aggravate the effect. The observation that experimental plots growing barley, oats, and other crops on the playa were never invaded by seedlings of native species of the surrounding communities might also support this hypothesis, which needed to be tested with seed bank studies.

There are few studies on inland dunes or playa succession, perhaps because of the perception of lack of succession in the desert environment. Flowers' long-term study at the Great Salt Lake, Utah and the study of Vasek and Lund at Rabbit Dry Lake in Mojave Desert are among those few both supporting the idea of succession in due or mound ecosystems. Bowers also agreed that there is succession on dunes, which is the "process by which dune plants communities become increasingly similar to those of adjacent non-dune habitats" under favorable climatic conditions and limited supplies of sand. However, Pavlik believed that, under this strict definition of dunes, which are wind deposited sand, and unless the dune systems have been destroyed, succession of dune vegetation would not include those from surrounding habitats.

REVIEW OF PREVIOUS VEGETATION ANALYSIS AT OWENS LAKE

Basically, there is no vegetation analysis performed on the playa itself because it is the property of the Lands Commission and no funding has been allocated on vegetation survey so far. WESTEC conducted an examination of vegetation growing along the margin of the lake bed for species selection in its revegetation study. Four native species were selected based on the observation of their distribution (*Atriplex parryi*, which grew farthest out to the lake bed) and the literature review on their limit tolerance to salt, such as *Distichilis spicata*, tolerance to

carbonate such as *Sporobulus airoides*, and tolerance to wind erosion such as *Sarcobatus vermiculatus*. The seedlings of those were planted on artificial dunes, on unaltered lake bed and sands surrounded by tires and drip irrigation with 1 gallon of water per plant per day. Although salinity of the substrate (except unaltered lake bed) and the irrigated water were within the tolerance limit of the plants, most of the plants died, probably due to a poor planting technique - sand blasting. In fact, the plants might have been over irrigated, as indicated by stem rot. Drip irrigation also might not be a good irrigation method for establishing native vegetation, as the root system of those will otherwise develop mainly on the surface but not extending downward to reach more permanent ground water. The problem of sand blasting, together with the water source problem, brings out the question of how the seedlings of those native species establish and develop naturally on such a harsh environment. Desert shrub seedling establishment might, in fact, be a rare event.

The lands surrounding Owens Lake and along the Owens Valley are owned mainly by the Bureau of Land Management (BLM) and the Los Angeles Department of Water and Power (LADWP), who have conducted vegetation surveys on their property. Because of the nature of BLM/s data (grazing management oriented), only findings of LADWP will be discussed and used here.

VEGETATION INVENTORY DONE BY LADWP

Beginning from the mid-80's, LADWP has been performing a vegetation inventory on its property along the Owens Valley including those areas around the Owens Lake playa.

Eightysix vegetation mapping units around the playa and the delta region were selected for the purpose of this study. A total of 43 species were found. Among those, istichilis spicata, *Sarcobatus vermiculatus*, *Atriplex parryi*, and *Suaeda torreyana* were the dominant species in many of the mapping units (Table 2). Except *Suaeda torreyana*, the other three were selected for revegetation studies. All of them occupy wide ranges of habitats with different soil mapping units (Table 2). *D. spicata* and *S. vermiculatus* are well known for their wide range of tolerance to various soil factors (Table 3). *D. spicata*, in particular, is one of the most salt tolerant graminoids in inland dunes and saline wetland. It is always the pioneer plant habituating the most saline area or can be a co-dominant species with other shrubs as well. In general, it is agreed that *D. spicata* has a reduced photosynthetic rate and even showed dwarfism with increased salinity. Its shallow roots indicate the presence of a high water table. However, at Owens Lake playa normal or even taller *D. spicata* (30-50cm) was observed to grow directly on the crusted playa with high salinity and even as pioneer on dunes where the water table is usually very deep. These findings seem contradictory to the previous studies. *S. vermiculatus*, on the other hand, seems to co-dominate with *S. torreyana* on dunes along the NE shore, where *A. parryi* seems able to tolerate harsh physical environments by growing farthest out on the playa surface. As one moves landward where there is an increase in sand accumulation, *A. parryi* drops outland instead *S. vermiculatus* and *S. torreyana* occupy the dunes, which are probably still active and moving. However, there is virtually no literature on the ecology of either *A. parryi* or *S. torreyana*, so their niches are not well known.

OBJECTIVES

In order to have successful bioremediation, at least problems related to inland dune succession mentioned above have to be solved. Owing to the limit of time and resources, the following objectives are set up to investigate spatial succession patterns, which would shed light on understanding of the temporal succession of dunes on and around the playa.

1. To qualitatively and quantitatively descrivbe dune vegetation on and around the playa; and to compare species composition of those and the surrounding non-dune salt bush communities.

2. To describe physical and chemical characteristics of sand dunes, and to determine correlation, if any, between species composition and various dune characteristics, including dune size, shape, etc.

3. To investigate seasonal variability of seed bank and seed dispersal of shrub species, if any, on and around the playa.

HYPOTHESES

Based on the above objectives, the null hypothesis corresponding to each objective will be as follows:

1. There is no difference between species composition occupying the dunes and those in surrounding communities.

2. There is no correlation between various dune characteristics and species composition.

3. Seed availability and seedling establishment are not limiting factors for propagation of dune vegetation.

STUDY SITE AND METHODS

Natural dunes along the northeast short of Owens Lake, at the delta region and artificial dunes formed by sand fence construction, and sprinkler plot on the northeast of the playa, are selected as study sites. The natural dunes are formed after the desiccation of the lake (ca. 60 years) and probably are still moving. Artificial dunes are formed within 10 years as mitigation test plots were set up on the playa for sand trapping and sprinkling in various studies.

A species list will be made for each dune or dune system according to the microhabitats: dune top, dune margin and interdune depression. Quantitative data will be obtained by releve on each microhabitat and line-intercept methods across the microhibitats. A cross section profile, percent cover and frequency data, can be generated. Within site and between site comparisons will be made.

Dune height, length, width and shape will be recorded. Dune size and volume of sand can be derived using these data. A layer of pebbles (5cm x 5 cm) will be placed on each side of selected dunes to monitor movement of the dunes. Core samples of selected dunes, representing different size ranges and species composition, will be collected by soil augers. Plant samples on these dunes will be collected and analyzed for various ions including Na, Ca, Mg, CO, Cl, SO and B.

Each soil core will be divided into depth intervals with playa surface as reference level. Particle size, pH, EC, CO, organic matter, NO, Na, moisture content will be determined. Both soil and plant samples will be analyzed in the Soil Laboratory at UC Davis.

Seasonal variability of seeds between the barren playa and dune site and between open areas and beneath canopy on the vegetated sites will be compared. Eight random line transects, each 100m, will be set up approximately perpendicular to the contour line, 4 at the vegetated dune site at NE shore and 4 at the barren playa adjacent to the vegetated site. Ten sample points will be selected randomly along each transect and soil samples of 5cm x 5cm x 2cm deep (80%-90% shrub seeds is at the top 2cm of soil surface) will be collected with a knife at each sample point. The total volume of soil sample will be 400 cm, the soil volume recommended for detection of species in a climax forest based on seed-soil volume curves.

Sample size will therefore be great enough for a desert ecosystem. Soil samples collected at dune sites will be divided into samples beneath canopy and at open areas, so there will be 3 bulk samples, including the one from the playa. The bulk samples will be spread thoroughly to a depth of 2cm in shallow pots, which will be interdispersed at random with pots containing sterile soil for monitoring potential contamination in a greenhouse. The pots will be watered as desired for germination. Each seedling will be pulled out after identification. Emphasis will be put on shrub species for the purpose of this study, so annual and other species will be counted and grouped only according to their life form. Group comparison T-test will be performed for comparing the mean seed number found at various sites. Phenology, volume of canopy and number of seed production of *Atriplex parryi* and *Suaeda torreyana* will be estimated as well.

Appendix

Factor	Control mechanism
1. wind velocity	uncontrollable
2. fetch length	sand fences, water traps, vegetation
3. surface roughness	sand fences, vegetation, dunes, mechanical obstructions
4. coarse saltating particles	dunes, vegetation, flooding
5. efflorescent crust	sprinkling, coating covering, flooding, drying (?)

Table 1. Rrequirements for PM-10 violations from Owens Lake (After Kusko and Cahill, 1984)

species	no. of units dominant (>50% relative cover)	soil units involved
DISPS2	25	419, 423*,602,612, 620, 625,640, 801
ATPA3	12	410,422,423,429,600,601,602, 623,620,623,625,640,801,802
SUTO	10	420,423*,429,601,602,620,525, 626,630
SAVE4	8	419, 422,423,429,601,602,603, 620,627,625,626,630

Table 2. Dominant species on the playa margin. Note their wide range of tolerance showed by the diverse soil units involved.

range of tolerance	Distichilis spicata	Sarcobatus vermiculatus
pH	6.8-9.2	8.0-9.6
conductivity (mmhos/cm)	6-49	37.5-49
% moisture	22-46	20-45
% Na	0.1-0.4	0.091-0.43
% Cl	0-0.2	0.788 (ave)
% SO	0.1-0.7	0.14 (ave)
% total salt	0.03-5.6	0.29(ave)
partricle size	and-clay	sand-clay (prefer medium to heavy texture)
roots	shallow	deep tap root (to >10m)
water table	high	low, ground water
reproduction	vegetative	seedlings
mechanism	excrete salt	accumulate salt under canopy

Table 3. Range of tolerance of D. spicata and S. vermiculatus (Ref: Gates et al. 1956; Flowers and Evans 1966; Ungar 1974; Romo and Eddleman 1985; WESTEC 1984)

EXHIBIT "D"

JOINT POWERS AGREEMENT BETWEEN GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT AND STATE OF CALIFORNIA, STATE LANDS COMMISSION FOR THE PROVISION OF VEGETATION RESEARCH AND DEVELOPMENT SERVICES

INTRODUCTION

WHEREAS, the Great Basin Unified Air Pollution Control District (hereinafter referred to as "District") has the need for the Research and Development services of the State of California State Lands Commission (hereinafter referred to as "State"), and in consideration of the mutual promises, covenants, terms, and conditions hereinafter contained, the parties hereby agree as follows:

TERMS AND CONDITIONS

1. SCOPE OF WORK:

The State shall furnish to the District, those services and work set forth in Attachment A, attached hereto and by reference incorporated herein.

Services and work provided by the State under this Agreement will be performed in a manner consistent with the requirements and standards established by applicable federal, state, and County laws, ordinances, regulations, and resolutions. Such laws, ordinances, regulations, and resolutions include, but are not limited to, those which are referred to in this Agreement.

2. TERM:

The term of this Agreement shall be from July 1, 1992 to June 30, 1993 unless sooner terminated as provided below.

3. CONSIDERATION:

A. Compensation.

District shall pay State in accordance with the Schedule of Fees (set forth as Attachment B) for the services and work described in Attachment A which are performed by State.

B. Travel and per diem.

Costs of all travel and per diem which State incurs in providing services and work under this agreement are included in the compensation to be paid to State in the Schedule of Fees (Attachment B). State will not be entitled to any additional compensation for travel expenses or per diem incurred by State in performing this Agreement.

C. No additional consideration.

Except as expressly provided in this Agreement, State shall not be entitled to, nor receive, from District, any additional consideration, compensation, salary, wages, or other type of remuneration for services rendered under this Agreement. Specifically, State shall not be entitled, by virtue of this Agreement, to consideration in the form of overtime, health insurance benefits, retirement benefits, disability retirement benefits, sick leave, vacation time, paid holidays, or other paid leaves of absence of any type or kind whatsoever.

D. Limit upon amount payable under Agreement.

The total sum of all payments made by the District to State for services and work performed under this Agreement, shall not exceed **$150,737.00** (hereinafter referred to as "contract limit"). District expressly reserves the right to deny any payment or reimbursement requested by State for services or work performed which is in excess of the contract limit.

E. Billing and payment.

Billing and Payment will be in accordance with the Schedule of Fees (set forth as Attachment B).

F. Federal and State taxes.

(1) District will not withhold any federal or state income taxes or social security from any payments made by District to State under the terms and conditions of this Agreement.

(2) District has no obligation to withhold any taxes or payments from sums paid by District to State under this Agreement. Payment of all taxes and other assessments on such sums is the sole responsibility of State. District has no responsibility or liability for payment of State's taxes or assessments.

4. WORK SCHEDULE:

State's obligation is to perform, in a timely manner, those services and work identified in Attachment A. State will coordinate with District to insure that all services and work will be performed within the time frame set forth by District.

5. REQUIRED LICENSES, CERTIFICATES, AND PERMITS:

State will be responsible for ensuring that any licenses, certificates, or permits required by the federal, state, county, or municipal governments for the services and work described in attachment A, are procured and valid at the time State begins performance of this Agreement. Further, during the term of this Agreement, State must ensure that such licenses, certificates, and permits remain in full force and effect. Licenses, certificates, and permits may include, but are not limited to, driver's licenses, professional licenses or certificates, and business licenses. Such licenses, certificates, and permits will be procured and maintained in force at no expense to the District. State will provide District, upon beginning performance of this Agreement, with evidence of current and valid licenses, certificates and permits which are required to perform the services identified in attachment A. Where there is a dispute between State and District as to what licenses, certificates, and permits are required to perform the services and work identified in attachment A, District reserves the right to make such determinations for purposes of this Agreement.

6. OFFICE SPACE, SUPPLIES, EQUIPMENT, ETC:

State shall provide such office space, supplies, equipment, vehicles, reference materials, and telephone service as is necessary for State to provide the services identified in Attachment A to this Agreement. District is not obligated to reimburse or pay State, for any expense or cost incurred by State in procuring or maintaining such items. Responsibility for the costs and expenses incurred by State in providing and maintaining such items is the sole responsibility and obligation of State.

7. DISTRICT PROPERTY:

A. Personal Property of District.

Any personal property such as, but not limited to, protective or safety devices, badges, identification cards, keys, etc. provided to State by District pursuant to this Agreement are, and at the termination of this Agreement remain, the sole and exclusive property of District. State will use reasonable care to protect, safeguard and maintain such items while they are in State's possession. State will be financially responsible for any loss or damage to such items, partial or total, which is the result of State's negligence.

B. Products of State's Work and Services.

Any and all compositions, publications, plans, designs, specifications, blueprints, maps, formulas, processes, photographs, slides, video tapes, computer programs, computer disks, computer tapes, memory chips, soundtracks, audio recordings, films, audio-visual presentations, exhibits, reports, studies, works of art, inventions, patents, trademarks, copyrights, or intellectual properties of any kind which are created, produced, assembled, compiled by, or are the result, product, or manifestation of, State's services or work under this Agreement are, and at the termination of this Agreement remain, the sole and exclusive property of the State. However, State hereby grants to District an irrevocable non exclusive right to use any such products for any District purpose without payment of any further compensation or requirement of prior State approval.

8. WORKERS' COMPENSATION:

State shall provide worker's compensation coverage, in the legally required amount, for all State's employees utilized in providing work and services pursuant to this Agreement. By executing a copy of this Agreement, State acknowledges its obligations and responsibilities to its employees under the California Labor Code, and warrants that State has complied and will comply during the term of this Agreement with all provisions of the California Labor Code with regard to its employees. Further, State will ensure that any contractor whom it engages to perform work or services under this Agreement will provide workers' compensation coverage for its employees.

9. INSURANCE:

A. General Liability.

State shall procure, and maintain during the entire term of this Agreement, a policy of general liability insurance or a self insurance program which covers all the work and services to be performed by State under this Agreement. Such insurance policy or a self insurance program will have a per occurrence combined single limit coverage of not less than $6,000,000.00. Such policy or a self insurance program will not exclude or except from coverage any of the services and work required to be performed by State under this Agreement. Any policy of insurance will be issued by an insurer authorized to sell such insurance by the State of California, and having at least a "Best's" policyholder's rating of "A" or "A+." District will be named as "an additional named insured" on this policy. State will provide the District with evidence of a self insurance program or a copy of the policy and a certificate of insurance showing the District as "an additional named insured" and indicating that the policy will not be terminated, canceled, or modified without thirty (30) days written notice to the District.

B. Business Auto.

If State utilizes a motor vehicle in performing any of the work or services identified in Attachment A (Scope of Work), State shall cover such vehicle operations by a self insurance program or procure and maintain in force throughout the duration of this Agreement, a business auto liability insurance policy with minimum coverage levels of $300,000.00 per occurrence, combined single limit for bodily injury liability and property damage liability. The coverage shall include all State owned vehicles and all hired and non-owned vehicles used in performing under this Agreement.

Evidence of a self insurance program or a certificate of insurance shall be provided to the District at least ten (10) days prior to the start of work under this Agreement. Any policy shall contain a provision prohibiting the cancellation or modification of said policy except upon thirty (30) days prior written notice to the District.

C. Professional Liability.

If State or any of its employees is required to be professionally licensed or certified by any agency of the State of California in order to perform any of the work or services identified in Attachment A (Scope of Work), State shall cover such professional liability with a self insurance program or shall procure and maintain in force throughout the duration of this Agreement, a professional liability insurance policy with a minimum coverage level of $1,000,000.00. Evidence of the self insurance program or proof of such insurance shall be provided to District at least ten (10) days prior to the start of any work by State.

10. STATUS OF STATE:

All acts of State, its agents, officers, and employees, relating to the performance of this Agreement, shall be performed as independent contractors, and not as agents, officers, or employees of District. State, by virtue of this Agreement, has no authority to bind or incur any obligation on behalf of District. Except as expressly provided in Attachment A, State has no authority or responsibility to exercise any rights or power vested in the District. No agent, officer, or employee of the District is to be considered an employee of State. It is understood by both State and District that this Agreement shall not under any circumstances be construed or considered to create an employer-employee relationship. As an independent contractor:

a. State shall determine the method, details, and means of performing the work and services to be provided by State under this Agreement.

b. State shall be responsible to District only for the requirements and results specified in this Agreement, and except as expressly provided in this Agreement, shall not be subjected to District's control with respect to the physical action or activities of State in fulfillment of this Agreement.

c. State, its agents, officers, and employees are, and at all times during the term of this Agreement shall, represent and conduct themselves as independent contractors, and not as employees of District.

11. **DEFENSE AND INDEMNIFICATION:**

State shall defend, indemnify, and hold harmless District, its agents, officers, and employees from and against all claims, damages, losses, judgments, liabilities, expenses, and other costs, including litigation costs and attorney's fees, arising out of, resulting from, or in connection with, the performance of this Agreement by State, or State's agents, officers, or employees. State's obligation to defend, indemnify, and hold the District, its agents, officers, and employees harmless applies to any actual or alleged personal injury, death, or damage or destruction to tangible or intangible property, including the loss of use. State's obligation under this paragraph extends to any claim, damage, loss, liability, expense, or other costs which is caused in whole or in part by any act or omission of the State, its agents, employees, supplier, or any one directly or indirectly employed by any of them, or anyone for whose acts or omissions any of them may be liable.

State's obligation to defend, indemnify, and hold the District, its agents, officers, and employees harmless under the provisions of this paragraph is not limited to, or restricted by, any requirement in this Agreement for State to procure and maintain a self insurance program or a policy of insurance.

To the extent permitted by law, District shall defend, indemnify, and hold harmless State, its agents, officers, and employees from and against all claims, damages, losses, judgments, liabilities, expenses, and other costs, including litigation costs and attorney's fees, arising out of, or resulting from, the active negligence, or wrongful acts of District, its officers, or employees.

To the extent that State has subcontracted with the University of California, Davis all or part of the work to be performed under this Agreement and by such subcontract the University has expressly assumed the State's obligation to indemnify, defend and hold harmless the District, State shall be relieved of its duty to defend and indemnify District as described in Paragraph 11 of this Agreement.

12. RECORDS AND AUDIT:

A. Records.

State shall prepare and maintain all records required by the various provisions of this Agreement, federal, state, and municipal law, ordinances, regulations, and directions. State shall maintain these records for a minimum of four (4) years from the termination or completion of this Agreement. State may fulfill its obligation to maintain records as required by this paragraph by substitute photographs, microphotographs, or other authentic reproduction of such records.

B. Inspections and Audits.

Any authorized representative of District shall have access to any books, documents, papers, records, including, but not limited to, financial records of State, which District determines to be pertinent to this Agreement, for the purposes of making audit, evaluation, examination, excerpts, and transcripts during the period such records are to be maintained by State. Further, District has the right, at all reasonable times, to audit, inspect, or otherwise evaluate the work performed or being performed under this Agreement.

13. NONDISCRIMINATION:

During the performance of this Agreement, State, its agents, officers, and employees shall not unlawfully discriminate in violation of any federal, state, or local law, against any employee, or applicant for employment, or person receiving services under this Agreement, because of race, religion, color, national origin, ancestry, physical handicap, medication condition, marital status, age, or sex. State and its agents, officers, and employees shall comply with the provisions of the Fair Employment and Housing Act (Government Code section 12900, et seq.), and the applicable regulations promulgated thereunder in the California Code of Regulations. State shall also abide by the Federal Civil Rights Act of 1964 (P.L. 88-352) and all amendments thereto, and all administrative rules and regulations issued pursuant to said act.

14. CANCELLATION:

This Agreement may be canceled by District without cause, and at will, for any reason by giving to State thirty (30) days written notice of such intent to cancel. In the event of such cancellation District shall compensate State for work completed on the date of cancellation. State may cancel this Agreement without cause, and at will, for any reason whatsoever by giving thirty (30) days written notice of such intent to cancel to District.

15. ASSIGNMENT:

A. State may subcontract this Agreement, or any part of it, and assign any monies due or to become due under this Agreement to the University of California, Davis without the express written consent of District. State shall not make other subcontracts or assignments of any monies due or to become due under this Agreement without the prior written consent of District.

B. Without the written consent of State, District shall not assign this Agreement either in whole or in part.

16. DEFAULT:

If the State abandons the work, or fails to proceed with the work and services requested by District in a timely manner, or fails in any way as required to conduct the work and services as required by District, District may declare the State in default and terminate this Agreement upon five (5) days written notice to State. Upon such termination by default, District will pay to State all amounts owing to State for services and work satisfactorily performed to the date of termination.

17. WAIVER OF DEFAULT:

Waiver of any default by either party to this Agreement shall not be deemed to be waiver of any subsequent default. Waiver or breach of any provision of this Agreement shall not be deemed to be a waiver of any other or subsequent breach, and shall not be construed to be a modification of the terms of this Agreement unless this Agreement is modified as provided in paragraph twenty-four (24) below.

18. CONFIDENTIALITY:

State agrees to comply with the various provisions of the federal, state, and county laws, regulations, and ordinances providing that information and records kept, maintained, or accessible by State in the course of providing services and work under this Agreement, shall be privileged, restricted, or confidential. State agrees to keep confidential all such information and records. Disclosure of such confidential, privileged, or protected information shall be made by State only with the express written consent of the District.

19. CONFLICTS:

State agrees that it has no interest, and shall not acquire any interest, direct or indirect, which would conflict in any manner or degree with the performance of the work and services under this Agreement.

20. SEVERABILITY:

If any portion of this Agreement or application thereof to any person or circumstance shall be declared invalid by a court of competent jurisdiction, or if it is found in contravention of any federal, state, or county statute, ordinance, or regulation, the remaining provisions of this Agreement, or the application thereof, shall not be invalidated thereby, and shall remain in full force and effect to the extent that the provisions of this Agreement are severable.

21. FUNDING LIMITATION:

A. The ability of District to enter this Agreement is based upon available funding from various sources. In the event that such funding fails, is reduced, or is modified, from one or more sources, District has the option to cancel, reduce, or modify this Agreement, or any of its terms within ten (10) days of its notifying State of the cancellation, reduction, or modification of available funding. Any reduction or modification of this Agreement made pursuant to this provision must comply with the requirements of paragraph twenty-three (23) (Amendment).

B. This agreement shall not be effective until it has been approved by the Department of General Services.

22. ATTORNEY'S FEES:

If either of the parties hereto brings an action or proceeding against the other, including, but not limited to, an action to enforce or declare the cancellation, termination, or revision of the Agreement, the prevailing party in such action or proceeding shall be entitled to receive from the other party all reasonable attorney's fees and costs incurred in connection therewith.

23. AMENDMENT:

This Agreement may be modified, amended, changed, added to, or subtracted from, by the mutual consent of the parties hereto, if such amendment or change is in written form and executed with the same formalities as this Agreement, and attached to the original Agreement to maintain continuity.

24. NOTICE:

Any notice, communication, amendments, additions, or deletions to this Agreement, including change of address of either party during the terms of this Agreement, which State or District shall be required, or may desire, to make, shall be in writing and may be personally served, or sent by prepaid first class mail to, the respective parties as follows:

Great Basin Unified Air Pollution Control District
157 Short Street
Bishop, California 93514

State Lands Commission
1807 13th Street
Sacramento, California 95814

25. DESIGNATION OF AGREEMENT REPRESENTATIVE:

The Commission and District hereby name a representative who shall represent his or her agency regarding this Agreement. Each agency may change its representative by notifying the other agency as provided for in Paragraph 24.

COMMISSION'S REPRESENTATIVE SHALL BE:

Steve Sekelsky

DISTRICT'S REPRESENTATIVE SHALL BE:

Ted Schade

26. FORM OF STANDARD AGREEMENT:

Paragraphs 1 through 7 on the reverse side of the first page of this Agreement are not intended to be a part of this Agreement and are hereby deleted. These paragraphs have been modified and restated in other paragraphs of this Agreement.

27. ENTIRE AGREEMENT:

This Agreement contains the entire agreement of the parties, and no representations, inducements, promises, or agreements otherwise between the parties not embodied herein or incorporated herein by reference, shall be of any force or effect. Further, no term or provision hereof may be changed, waived, discharged, or terminated, unless the same be in writing executed by the parties hereto.

AGREEMENT BETWEEN
GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT
AND STATE OF CALIFORNIA, STATE LANDS COMMISSION
FOR THE PROVISION OF
VEGETATION RESEARCH AND DEVELOPMENT SERVICES

IN WITNESS THEREOF, THE PARTIES HERETO HAVE SET THEIR HANDS AND SEALS THIS _____ DAY OF _____, 19__.

DISTRICT	STATE
By:_____	By:_____
Dated:_____	Dated:_____

APPROVED AS TO FORM AND LEGALITY:

_____
District Counsel

APPROVED AS TO ACCOUNTING FORM:

_____
County Auditor

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ATTACHMENT A

JOINT POWERS AGREEMENT BETWEEN
GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT
AND STATE OF CALIFORNIA, STATE LANDS COMMISSION
FOR THE PROVISION OF
VEGETATION RESEARCH AND DEVELOPMENT SERVICES

TERM: From: July 1, 1992 To: June 30, 1993

SCOPE OF WORK

PROJECT I - SALT AND NUTRIENT DYNAMICS IN VEGETATION, SOIL AND GROUNDWATER OF THE OWENS PLAYA SYSTEM

The state shall perform the following tasks relating to an investigation of the salt and nutrient dynamics of the vegetation, soil and groundwater found on and around the Owens Dry Lake in Inyo County, California.

OBJECTIVES

1. Characterize i) salt composition and distribution and ii) nutrient pools on the bare playa and in natural and man-made dunes with and without vegetation.

2. Relate salt concentrations and composition to root and folia, elemental concentrations. Evaluate potential toxicities and deficiencies in conjunction with Project II.

3. Determine elemental concentrations in shallow groundwater and evaluate this water as a potential source of irrigation water.

TASKS

The following tasks set forth the basic work effort necessary to complete the project. Prior to the actual start of any field or laboratory work, task protocols shall be developed that describe in detail the data collection and data analysis to be performed.

1. Perform a Literature Search

A literature search to collect existing data on soil, vegetation and groundwater chemistry/hydrology of Owens Lake and other similar sites will be conducted prior to the experiments. This effort will take place in conjunction with the literature search performed in Project II.

2. Identify Intensive Study Sites

Working with Great Basin staff and consultants, and with the Project II vegetation investigators, a series of sites will be selected as intensive study locations. These locations will include stable dunes, both man-made and naturally occurring, bare playa, and transitional gradients from vegetated to non-vegetated surfaces. Preliminary selections for the study locations include the Phase II Keeler/Swansea dune, the old pipeline dune, the Dirty Socks dunes, the vegetated dunes north of Keeler and representative bare playa sites in sand, clay and mixed soils.

3. Survey Soil Salt Distribution

An electromagnetic detection device capable of measuring salinity profiles down to 4 to 5 feet deep (EM Model 38 electromagnetic detector) will be used to survey salt distribution in the upper 4 to 5 feet at each location. This preliminary study will be used to develop a salinity map showing spatial variability at each location.

4. Trench Study Sites

Based on the preliminary study of salt spatial variability, representative sites will be trenched and samples collected as a function of depth and horizontal distance along the trench. Where possible, this trenching will be performed to characterize gradients from vegetated to non-vegetated, or from wet to dry sites. Trenching will be performed with a backhoe and will generally be perpendicular to and as deep as the dunes. No backhoe trenching will be performed in areas designated by the project negative declaration as sensitive. All trenches will be backfilled and restored to their original condition.

5. Analyze Water Chemistry

Water extracts will be made for each sample and the following chemical parameters measured: pH, EC (electrical conductivity), Li, Sr, Ca, Mg, Na, K, NH_4, F, Cl, Br, NO_3, PO_4, SO_4, B, Se, As, and Mo. Representative samples will also be screened using an inductively coupled plasma mass spectrometer (ICP-MS) to determine if other elements are present in detectable quantities. Only those elements that exceed detection limits and are important from a plant or toxicological perspective will be analyzed on all the samples. laboratory quality assurance/quality control protocols will follow EPA approved methods including spikes, blind samples, reference materials, setting of control limits, criteria for rejection, and data validation methods.

6. Correlate Soil and Water Chemistry to Plant Uptake

In collaboration with the Project II vegetation subgroup, foliage and roots will be collected along the trench in vegetated dunes to determine chemical concentrations. The vegetation subgroup will map root distribution and the relationship between soil chemistry and plant nutrient/toxic element distribution will be evaluated (see Project II Tasks). Plant samples will be digested using nitric acid. Both nutrient and potentially toxic element concentrations will be measured. The elemental concentrations in the plant materials will be correlated with the nutrient and salt concentrations in the soil solution to determine plant uptake mechanisms and toxicity avoidance mechanisms.

7. Monitor Shallow Groundwater Chemistry

At each study location, shallow groundwater monitoring stations will be installed in conjunction with the network being installed by Great Basin. Shallow groundwater will be collected and chemically analyzed to permit comparison of the chemistry of the plant and soil material to the water that supplies it. This work will be coordinated with hydrologic experts working with the Great Basin APCD in order to derive estimates of groundwater discharge and an estimation of the degree of concentration of salts and toxic ions that occur through evaporation and transpiration. The relationship of shallow groundwater to interstitial pore water in the unsaturated zone will be developed to determine the influence of shallow ground water on dune salt composition. Shallow groundwater samples will be collected throughout the year in order to observe seasonal changes that may occur. Sufficient data will be collected to evaluate the feasibility of a regression model for predicting water chemistry as a function of electrical conductivity values for a given source area. Water chemistry analysis will be performed for those parameters indicated under #5 above (pH, EC, Li, Sr, Ca, Mg, Na, K, NH_4, F, Cl, Br, NO_3, PO_4, SO_4, B, Se, As, and Mo).

8. Evaluation of Results for Study Sites

The state will synthesize and interpret results of vegetation, soil and groundwater analyses in an effort to identify the microsite environmental conditions associated with bare playa and man-made, natural, vegetated and non-vegetated dunes. Results and their interpretation will be given to Great Basin for review and comment. A final project report will be prepared and submitted to Great Basin no later than June 30, 1993.

SCHEDULE	Start	Finish
1. Perform a Literature Search	7/92	9/92
2. Identify Intensive Study Sites	7/92	8/92
3. Survey Soil Salt Distribution	7/92	10/92
4. Trench Study Sites	7/92	10/92
5. Analyze Water Chemistry	10/92	3/93
6. Correlate Chemistry to Plant Uptake	3/93	6/93
7. Monitor Shallow Groundwater Chemistry	7/92	6/93
8. Evaluation of Results For Study Sites	10/92	6/93

PROJECT II - PHYSIOLOGICAL LIMITS OF PLANTS IN DESERT PLAYA ENVIRONMENTS

The state shall perform the following tasks relating to an investigation of the physiological limits of plants found on and around the Owens Dry Lake in Inyo County, California.

OBJECTIVES

1.To determine the tolerance limits to NaCl, $NaSO_4$, and borate individually for a suite of species that occur naturally on dune or playa habitats at Owens Lake.

2.To determine how much the levels of tolerance of the most tolerant Owens Lake species, selected based on the results of objective 1, above, and field observations, are reduced when sodium, chloride, sulfate and borate are provided in combination.

3. To determine the influence of increased Ca/Na activity ratio on the levels of tolerance to sodium, chloride, sulfate, and borate.

4. To relate the results of the greenhouse studies of objectives 1, 2 and 3 to the actual chemical environment of roots of plants growing naturally in playa and dune habitats at Owens Lake.

TASKS

The following tasks set forth the basic work effort necessary to complete the project. Prior to the actual start of any field or laboratory work, task protocols shall be developed that describe in detail the data collection or data analysis to be performed.

1. Perform a Literature Search

A literature search regarding the tolerances of species native to Owens Lake will be conducted prior to the experiments, which may result in modification of the solution concentration ranges selected.

2. Collect Plants

Plant materials to be used will be collected at Owens Lake. When possible, both seedlings and more mature plants derived from transplants, cuttings or rhizome segments, as appropriate, would be utilized and evaluated. Potential species to be evaluated include *Distichlis spicata*, *Sarcobatus vermiculites*, and *Atriplex parryii*. Final decisions on the species to be tested will be based on field observations of species abundance and distribution in the most stressful habitats, literature review, and suitability of species for use in ecosystem development efforts. The number of species that can be evaluated is constrained by the number of test containers in the greenhouse sand-culture system. Five replicates, the minimum number acceptable, of each species in each treatment will limit the list to six species.

3. Collect and Map Soil, Roots and Shoots

Soil samples, root and shoot materials will be collected at Owens Lake and will be coordinated with the work to be performed in Project I. Root profiles will be mapped and correlated with vegetation at the soil/vegetation sampling sites. Roots will be mapped along the trench profile walls excavated for the soil chemistry study. Mapping will include counting fine roots crossing the plane of the profile wall in 5-10 10x10-cm quadrats in each 10-cm soil layer to obtain a semi-quantitative measure of the vertical distribution of fine root density. Root and soil samples will be taken at representative depths through the rooted zone. This work will be coordinated with the work to be performed in Project I.

4. Analyze Soil and Plant Tissue

Chemically analyze field-collected soil and plant tissue samples. Coordinate with work performed in Project I.

5. Compile and Analyze Root Profile Wall Maps

6. Set-up Greenhouse Experiments

The plants for all experiments will be propagated in a greenhouse adjacent to the sand-culture greenhouse. Plants will be adequately supplied with water and nutrients, both during propagation and experimental periods. If possible, seed germination and initial growth (3-4 weeks) will be evaluated simultaneously with longer treatment of more mature plants planted in the same container. The containers' size (30 cm diameter) will be large enough for these evaluations to be done simultaneously without plant-plant interference. The greenhouse experiments will utilize a sand-culture system with programmable control of the root solution composition. This system is currently available in a greenhouse in the Orchard Park facility at the UC Davis campus but will require some refurbishment before it can be used for the Owens Lake experiments. Refurbishment will consist of valve replacements, replumbing and replacing pots. After refurbishment, the system will consist of 180 35-liter pots and a nutrient solution supply system that can be programmed to provide 6 different treatments (nutrient/salt solutions). Environmental conditions and operation of the solution supply system will be monitored with a CR-10 data logger system (Campbell Scientific, Inc. Logan, UT) that is included in the budget.

7. Test Tolerance Limits of Plants

Greenhouse experiments with species and solution concentration as main factors will be conducted to determine the tolerance limits to NaCl, $NaSO_4$, and borate individually for the selected species. Include six NaCl levels ranging from 0.5 mM (milli Moles) to 1000 mM and six boron levels ranging from 0.05 mM to 10 mM. Higher maximum concentrations of both salt and boron may be necessary to define the upper limits of tolerance of the most tolerant species at Owens Lake. Concentrations to be used in these experiments, and for the sulfate experiment, will be adjusted as necessary to span the range of soil solution concentrations found in the substrates adjacent to the roots of plants growing in playa and dune habitats at Owens Lake.

Based on the results of the individual concentration tests, a factorial set of treatments including salt and borate in combination will be conducted to address how much the levels of tolerance of the most tolerant species are reduced. The concentrations to be used will depend on the results of the first two experiments and the soil solution concentrations in Owens Lake habitats. Additional interactions will be studied as time permits.

To determine the influence of increased Ca/Na activity ratio on the levels of tolerance to sodium, chloride, sulfate and borate, interactions of the toxic elements with calcium activity will then be investigated. A factorial set of treatments with stressful levels of salt or borate combined with three Ca/Na activity ratios will be conducted. The Ca/Na activity ratios used will range upward from the very low values in the soil solutions at Owens Lake. An appropriate computer model will be used to develop the specific nutrient/salt solution concentrations for this factorial experiment.

8. Evaluation of Experimental Treatments and Field Data

All experiments will utilize a randomized block design to account for gradients in the environmental conditions in the greenhouse. In all experiments the concentrations of toxic ions will be increased slowly over several weeks to the target levels to prevent osmotic shock and allow time for acclimation to the stress. Plant performance in all experiments will be measured both during the growth period and with a final harvest of the experimental plants. The measurements proposed will be used to make preliminary assessments of some of the key mechanisms of salinity tolerance. Measurements will include: survival; rate of leaf production and growth; biweekly predawn and midday plant water potentials; sodium, chloride and borate content of the xylem sap at biweekly midday and predawn measurements; total shoot and root production; total root length produced; nutrient, salt and boron content of leaves and roots. During the growth period and at the end of the experiments evidence of salt excretion (e.g. by *Distichlis spicata*) or accumulation in epidermal trichomes will also be determined. The nutrient, salt and boron content measurements taken for the greenhouse plants will be compared with the same measurements taken for the field collected plants. The growth period of each experiment will be limited to approximately two months.

An analysis and synthesis of field and lab results will be performed. Analysis of the results of the greenhouse experiments will be conducted using the SAS statistical analysis computer program (Statistical Analysis Systems) and all data will be transformed as necessary to obtain homogeneity of variances and adequate approximation to normality. Field results will be summarized with descriptive statistics for comparison to the treatment solutions used in the greenhouse.

Results and their interpretation will be given to Great Basin for review and comment. A final project report will be prepared and submitted to Great Basin no later than June 30, 1993.

SCHEDULE

		Start	Finish
1.	Perform a Literature Search	7/92	9/92
2.	Collect Plants	7/92	8/92
3.	Collect and Map Soil Roots and Shoots	7/92	10/92
4.	Analyze Soil and Plant Tissue	9/92	1/93
5.	Compile and Analyze Root Profile Wall Maps	9/92	1/93
6.	Set-up Greenhouse Experiments	7/92	4/93
7.	Test Tolerance Limits of Plants	8/92	5/93
8.	Evaluation of Treatments and Field Data	1/93	6/93

ATTACHMENT B

AGREEMENT BETWEEN
GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT
AND STATE OF CALIFORNIA, STATE LANDS COMMISSION
FOR THE PROVISION OF
VEGETATION RESEARCH AND DEVELOPMENT SERVICES

TERM: From: July 1, 1992 To: June 30, 1993

SCHEDULE OF FEES, TRAVEL AND PER DIEM

Billing and Payment:
State shall submit to the District, no more than once a month, an itemized statement of all hours spent by State and its subcontractors in performing services and work described in Attachment A. This statement will identify the date on which the hours were worked and an itemization of any materials, travel or per diem expenses. Upon timely receipt of the statement by the fifth day of the month, District shall make payment to the State by the last day of the month. Payments shall be made according to the following schedule:

PROJECT I - SALT AND NUTRIENT DYNAMICS IN VEGETATION, SOIL AND GROUNDWATER OF THE OWENS PLAYA SYSTEM

Personnel

Post-graduate research associate -2081 hrs. @ $15.00 /hr.	$31,215
Benefits (30%)	9,365
Undergraduate laboratory assistant - 545 hrs. @ $5.50/hr.	2998
Subtotal Personnel	$43,578

Supplies and Services

Miscellaneous field equipment	250
Excavation (backhoe time) 20 hrs. @ $50/hr.	1,000
Reagents and laboratory supplies	2,500
Filters	1,775
Chemical analyses	
Ion chromatography	2,500
ICP-MS	4,000
AA-graphite furnace	2,000
Plant digestions	2,500
Subtotal Supplies and Services	$16,525

Travel (mileage and per diem)	
Vehicle rental - 16 days @ $45/day	$720.00
Per diem - 37 days @ $75/day	2,775
Subtotal Travel	$3495
Overhead (10%)	$6,360
Total for Project I	$69,958

PROJECT II - PHYSIOLOGICAL LIMITS OF PLANTS IN DESERT PLAYA ENVIRONMENTS

Personnel	
Post-graduate research associate -2081 hrs. @ $15.00/hr.	$31,215
Benefits (30%)	9,365
Undergraduate laboratory assistant - 1181 hrs. @ $5.50/hr.	6,496
Subtotal Personnel	$47,076
Supplies and Services	
Refurbish sand culture system	$6,000
Chemicals for solutions	2,500
Sampling supplies, greenhouse supplies, plant propagation, and sample extraction	2,300
Chemical analyses (digests, ICP-MS, AA,)	6,000
Secretarial, publication charges, computing charges	3,000
Subtotal Supplies and Services	$19,800
Travel (mileage, per-diem)	
Vehicle rental - 15 days @ $45/day	$675
Per diem - 15 days @ $75/day	1,125
Subtotal Travel	$1,800
Overhead (10% of Personnel, Supplies, Services & Travel)	$6,868

Equipment

CR-10 data logger, storage module, power supply and sensors to monitor sand culture greenhouse	$3,985*
Pressure chamber for plant water extraction (for ionic analyses and water potential measurements)	1,250**
Subtotal Equipment	$5,235

*Note: Data logger will be purchased for use in this contract but will be turned over to Great Basin for use on future Owens Lake projects upon completion of this contract.

**Note: This figure represents 50% of the cost of the chamber. The Contractor will be responsible for funding the remaining 50% as this equipment will remain with the Contractor upon completion of the work.

Total for Project II	$80,779
GRAND TOTAL FOR PROJECTS I and II	$150,737

STATE OF CALIFORNIA

INTERAGENCY AGREEMENT

STD. 13 (REV. 9-89)

NUMBER
C 9176

EXHIBIT "E"

THIS AGREEMENT is entered into this ______________ day of ______________, 19____,
by and between the undersigned State Agencies:

Set forth services, materials, or equipment to be furnished, or work to be performed, and by whom, time for performance including the terms, date of commencement and date of completion, and provision for payment per (1225 and 8752-8752.1 SAM.)

Distribution:
- ☐ Agency providing services
- ☐ Agency receiving services
- ☐ Department of General Services (unless exempt from DGS approval)
- ☐ Controller

I. The University agrees to provide all personnel, labor, materials and equipment necessary to perform the work described in a document entitled "Provision For Vegetation Research And Development Services" which is attached hereto and incorporated herein as Exhibit B to this Agreement.

II. The State agrees to compensate the University a total amount not to exceed $150,737.00 as consideration for the work performed and in accordance with the cost estimates contained in Exhibit C - Cost Proposal For Provision of Vegetation Research And Development Services hereto.

III. For purposes of this Agreement the direct and indirect costs (with the indirect cost expressed as a percentage of direct costs) allowable for payment shall be as identified in this Agreement.

IV. The following documents are hereby incorporated and made a part of this Agreement by reference:

a. Exhibit A - Special Provisions.

b. Exhibit B - Provision For Vegetation Research And Development Services.

(Continued on ______ sheets which are hereby attached and made a part hereof)

NAME OF STATE AGENCY RECEIVING SERVICES	NAME OF STATE AGENCY PROVIDING SERVICES
State Lands Commission	University of California, Davis
CALLED ABOVE (SHORT NAME)	CALLED ABOVE (SHORT NAME)
AUTHORIZED SIGNATURE ▷	AUTHORIZED SIGNATURE ▷
PRINTED NAME AND TITLE OF PERSON SIGNING	PRINTED NAME AND TITLE OF PERSON SIGNING
FUND NUMBER AND NAME	FUND NUMBER AND NAME

AMOUNT ENCUMBERED BY THIS DOCUMENT $	PROGRAM/CATEGORY (CODE AND TITLE)		FUND TITLE		Department of General Services Use Only
	(OPTIONAL USE)				
PRIOR AMOUNT ENCUMBERED FOR THIS CONTRACT $	ITEM	CHAPTER	STATUTE	FISCAL YEAR	
TOTAL AMOUNT ENCUMBERED TO DATE $	OBJECT OF EXPENDITURE (CODE AND TITLE)				
I hereby certify upon my own personal knowledge that budgeted funds are available for the period and purpose of the expenditure stated above.	T.B.A. NO.		B.R. NO.		
SIGNATURE OF ACCOUNTING OFFICER X			DATE		

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c. Exhibit C - Cost Proposal For Provision of Vegetation Research And Development Services

V. In the event of an inconsistency in this Agreement, the inconsistency shall be resolved by giving precedence in the following order:

a. Interagency Agreement/Form 13.

b. Exhibit A.

c. Exhibit B.

d. Exhibit C.

Exhibit A

Special Provisions
State Lands Commission - University Of California
Interagency Agreement

1. **Cost:** Upon completion of the work described in Exhibit B the SLC shall pay the University an amount equal to the University's cost of performance as computed in accordance with Section 8752 of the State Administrative Manual and in accordance with cost estimates as presented in Exhibit C, and in an amount not to exceed $157,737.00.

2. **Payments & Invoices:**

   a. Payment shall be made monthly upon receipt of an invoice and progress report in triplicate. With respect to the payment period completed, the invoice shall set forth in detail, in accordance with the contract budget, charges for direct costs and overhead costs, including employee fringe benefits; and an itemization of time expended, the classification of personnel involved in such time expenditure, and the salaries and wages for such personnel by monthly, weekly or hourly rates, as appropriate. The invoice shall also contain an itemization cf all travel and all equipment purchased from any source with SLC funds, or procured from the State, including the type of equipment, serial number and cost. Any reimbursement for travel expenses incurred under this agreement shall not exceed the rates established by the State Department of Personnel Administration regulations for civil service employees. Nothing herein contained shall preclude advance payments pursuant to Article 1, Chapter 3, Part 1, Division 3, Title 2 of the Government Code.

   b. Copies of all invoices shall be sent to Great Basin Unified Air Pollution Control District as follows:

      Mr. Ted Schade
      Great Basin APCD
      157 Short St., Suite 6
      Bishop, CA 93514

CALENDAR PAGE [illegible]
MINUTE PAGE [illegible]

3. **Audits:**

a. The University shall maintain books, records, documents, and other evidence pertaining to the reimbursable costs, and any matching costs and expenses, and hold them available for audit and inspection by the Auditor General for a minimum of four (4) years from the termination or completion of this Agreement.

b. The University grants the SLC, upon reasonable prior notice and identification of materials to be examined, permission to examine University records pertinent to direct costs payable under this Agreement solely for the purpose of determining that the direct costs are consistent with those identified in this Agreement.

4. **Retentions:** The SLC may withhold final payment of an amount not to exceed ten (10) percent of the total agreement cost until completion of all work and submission to the SLC of all reports required by the Agreement.

5. **Term & Time Of Performance:** Performance shall not commence until final approval of this Agreement by all necessary State agencies. This Agreement shall be effective from the last of the approval dates and shall remain in effect until June 30, 1993 unless it is terminated sooner under the provisions of this Agreement.

6. **Termination:** Each party shall have the right to terminate this Agreement at its sole discretion upon thirty (30) days written notice to the other party. In case of early termination by the SLC, a final payment shall be made to the University upon receipt of an invoice in triplicate and report in triplicate covering services to the termination date. Such payment shall be for all incurred costs including time expended, equipment purchased or utilized to termination at the actual rates incurred including proration of indirect costs. However, the total amount shall not exceed the total contract amount.

7. **Information & Research Data:**

a. The University prepare and submit to the SLC the reports described in Attachment A to the Joint Powers Agreement at the times designated in said Attachment A. Copies of such reports

shall be submitted to the Great Basin Unified Air Pollution Control District at the same time as those to the SLC.

b. The SLC shall have the right at reasonable times during the term of this Agreement to inspect and reproduce any written or printed matter developed under this Agreement by the University.

c. Any information or research data generated under this Agreement shall become the joint property of the University and the SLC.

d. The University shall be entitled to release or make available reports, information or other data prepared or assembled by it pursuant to this Agreement in scientific journals and other publications and at scientific meetings, provided however, that a copy of the publication shall be submitted to the SLC for review and comment forth-five (45) days prior to such publication. Further, the University shall place a disclaimer statement in a conspicuous place in all such reports or publications. Nothing in this provision shall be construed to limit the right of the SLC to release information obtained from the University or to publish reports, information or data in SLC publications.

8. **Designation of Representatives:** The SLC and the University each hereby name a representative who shall represent it during the term of this Agreement. The SLC or the University may change its representative by notifying the other as provided for in Paragraph 10.

The SLC's representative for technical matters shall be:

Mr. Steve Sekelsky.
State Lands Commission
1807 13th Street
Sacramento, CA 95814

The SLC's representative for contractual matters shall be:

Mr. David Brown.
State Lands Commission
1807 13th Street
Sacramento, CA 95814

The University's representative for technical matters shall be:

Mr. Randy Dahlgren
University of California, Davis
Department of Land Air Water Resources
Davis, CA 95616

The University's representative for contractual matters shall be:

Ms. Louise Ivey.
Office of Research
410 Mrak Hall
University of California, Davis
Davis, CA 95616

9. **Notice:** Any notice, communication, amendments, additions, or deletions to this Agreement, including change of address of either party during the term of this Agreement, which the SLC or the University shall be required or may desire to make shall be in writing and may be personally served or sent by prepaid first class mail to the respective parties as follows:

SLC: Owens Lake Project Coordinator
State Lands Commission
1807 13th Street
Sacramento, CA 95814

University: University of California, Davis
Department of Land Air Water Resources
Davis, CA 95616

11. **Disputes:** Except as otherwise provided in this Agreement, any dispute concerning a question of fact arising under or relating to the performance of this Agreement which is not disposed of by agreement shall be decided by the SLC's representative, who shall reduce his decision to writing and shall transmit a copy thereof to the University. The decision of the SLC's representative shall be deemed final and conclusive unless, within thirty (30) days from the date of receipt of such copy, the University transmits to the SLC a written appeal. Said appeal shall be supported with specificity. In connection with any appeal proceeding under this clause, the University shall be afforded an opportunity to be heard before the State Lands Commission and to offer evidence in support of its appeal. Pending the final resolution of any such dispute, the University shall proceed diligently with the performance of this Agreement and in accordance with the written decision of the SLC's

representative which is the subject of the University's appeal.

12. **Defense And Indemnification:** University shall defend, indemnify and hold the SLC, its officers, employees and agents harmless from and against any and all liability, loss, expense (including reasonable attorneys' fees), or claims for injury or damagaes arising out of the performance of this Agreement but only in proportion to and to the extent such liability, loss, expense, attorneys' or claims for injury or damages are caused by or result from the negligent or intentional acts or omissions of University, its officers, agents, or employees.

SLC shall defend, indemnify and hold University, its officers, employees and agents harmless from and against any and liability, loss, expense (including reasonable attorney7s' fees), or claims for injury or damages arising out of the performance of this Agreement but only in proportion to and to the extent such liability, loss, expense, attorneys' fees, or claims for injury or damages are caused by or result from the negligent or intentional acts or omissions of SLC, its officers, agents, or employees.

EXHIBIT B

PROVISION OF VEGETATION
RESEARCH AND DEVELOPMENT SERVICES

SCOPE OF WORK

PROJECT I - SALT AND NUTRIENT DYNAMICS IN VEGETATION, SOIL AND GROUNDWATER OF THE OWENS PLAYA SYSTEM

The state shall perform the following tasks relating to an investigation of the salt and nutrient dynamics of the vegetation, soil and groundwater found on and around the Owens Dry Lake in Inyo County, California.

OBJECTIVES

1. Characterize i) salt composition and distribution and ii) nutrient pools on the bare playa and in natural and man-made dunes with and without vegetation.

2. Relate salt concentrations and composition to root and foliage elemental concentrations. Evaluate potential toxicities and deficiencies in conjunction with Project II.

3. Determine elemental concentrations in shallow groundwater and evaluate this water as a potential source of irrigation water.

TASKS

The following tasks set forth the basic work effort necessary to complete the project. Prior to the actual start of any field or laboratory work, task protocols shall be developed that describe in detail the data collection and data analysis to be performed.

1. Perform a Literature Search

A literature search to collect existing data on soil, vegetation and groundwater chemistry/hydrology of Owens Lake and other similar sites will be conducted prior to the experiments. This effort will take place in conjunction with the literature search performed in Project II.

2. Identify Intensive Study Sites

Working with Great Basin staff and consultants, and with the Project II vegetation investigators, a series of sites will be selected as intensive study locations. These locations will include stable dunes, both man-made and naturally occurring, bare playa, and transitional gradients from vegetated to non-vegetated surfaces. Preliminary selections for the study locations include the Phase II Keeler/Swansea dune, the old pipeline dune, the Dirty Socks dunes, the vegetated dunes north of Keeler and representative bare playa sites in sand, clay and mixed soils.

3. Survey Soil Salt Distribution

An electromagnetic detection device capable of measuring salinity profiles down to 4 to 5 feet deep (EM Model 38 electromagnetic detector) will be used to survey salt distribution in the upper 4 to 5 feet at each location. This preliminary study will be used to develop a salinity map showing spatial variability at each location.

4. Trench Study Sites

Based on the preliminary study of salt spatial variability, representative sites will be trenched and samples collected as a function of depth and horizontal distance along the trench. Where possible, this trenching will be performed to characterize gradients from vegetated to non-vegetated, or from wet to dry sites. Trenching will be performed with a backhoe and will generally be perpendicular to and as deep as the dunes. No backhoe trenching will be performed in areas designated by the project negative declaration as sensitive. All trenches will be backfilled and restored to their original condition.

5. Analyze Water Chemistry

Water extracts will be made for each sample and the following chemical parameters measured: pH, EC (electrical conductivity), Li, Sr, Ca, Mg, Na, K, NH_4, F, Cl, Br, NO_3, PO_4, SO_4, B, Se, As, and Mo. Representative samples will also be screened using an inductively coupled plasma mass spectrometer (ICP-MS) to determine if other elements are present in detectable quantities. Only those elements that exceed detection limits and are important from a plant or toxicological perspective will be analyzed on all the samples. laboratory quality assurance/quality control

protocols will follow EPA approved methods including spikes, blind samples, reference materials, setting of control limits, criteria for rejection, and data validation methods.

6. Correlate Soil and Water Chemistry to Plant Uptake

In collaboration with the Project II vegetation subgroup, foliage and roots will be collected along the trench in vegetated dunes to determine chemical concentrations. The vegetation subgroup will map root distribution and the relationship between soil chemistry and plant nutrient/toxic element distribution will be evaluated (see Project II Tasks). Plant samples will be digested using nitric acid. Both nutrient and potentially toxic element concentrations will be measured. The elemental concentrations in the plant materials will be correlated with the nutrient and salt concentrations in the soil solution to determine plant uptake mechanisms and toxicity avoidance mechanisms.

7. Monitor Shallow Groundwater Chemistry

At each study location, shallow groundwater monitoring stations will be installed in conjunction with the network being installed by Great Basin. Shallow groundwater will be collected and chemically analyzed to permit comparison of the chemistry of the plant and soil material to the water that supplies it. This work will be coordinated with hydrologic experts working with the Great Basin APCD in order to derive estimates of groundwater discharge and an estimation of the degree of concentration of salts and toxic ions that occur through evaporation and transpiration. The relationship of shallow groundwater to interstitial pore water in the unsaturated zone will be developed to determine the influence of shallow ground water on dune salt composition. Shallow groundwater samples will be collected throughout the year in order to observe seasonal changes that may occur. Sufficient data will be collected to evaluate the feasibility of a regression model for predicting water chemistry as a function of electrical conductivity values for a given source area. Water chemistry analysis will be performed for those parameters indicated under #5 above (pH, EC, Li, Sr, Ca, Mg, Na, K, NH_4, F, Cl, Br, NO_3, PO_4, SO_4, B, Se, As, and Mo).

8. Evaluation of Results for Study Sites

The state will synthesize and interpret results of vegetation, soil and groundwater analyses in an effort to identify the microsite environmental conditions associated

with bare playa and man-made, natural, vegetated and non-vegetated dunes. Results and their interpretation will be given to Great Basin for review and comment. A final project report will be prepared and submitted to Great Basin no later than June 30, 1993.

SCHEDULE	Start	Finish
1. Perform a Literature Search	7/92	9/92
2. Identify Intensive Study Sites	7/92	8/92
3. Survey Soil Salt Distribution	7/92	10/92
4. Trench Study Sites	7/92	10/92
5. Analyze Water Chemistry	10/92	3/93
6. Correlate Chemistry to Plant Uptake	3/93	6/93
7. Monitor Shallow Groundwater Chemistry	7/92	6/93
8. Evaluation of Results For Study Sites	10/92	6/93

PROJECT II - PHYSIOLOGICAL LIMITS OF PLANTS IN DESERT PLAYA ENVIRONMENTS

The state shall perform the following tasks relating to an investigation of the physiological limits of plants found on and around the Owens Dry Lake in Inyo County, California.

OBJECTIVES

1. To determine the tolerance limits to NaCl, $NaSO_4$, and borate individually for a suite of species that occur naturally on dune or playa habitats at Owens Lake.

2. To determine how much the levels of tolerance of the most tolerant Owens Lake species, selected based on the results of objective 1, above, and field observations, are reduced when sodium, chloride, sulfate and borate are provided in combination.

3. To determine the influence of increased Ca/Na activity ratio on the levels of tolerance to sodium, chloride, sulfate, and borate.

4. To relate the results of the greenhouse studies of objectives 1, 2 and 3 to the actual chemical environment of roots of plants

growing naturally in playa and dune habitats at Owens Lake.

TASKS

The following tasks set forth the basic work effort necessary to complete the project. Prior to the actual start of any field or laboratory work, task protocols shall be developed that describe in detail the data collection or data analysis to be performed.

1. Perform a Literature Search

A literature search regarding the tolerances of species native to Owens Lake will be conducted prior to the experiments, which may result in modification of the solution concentration ranges selected.

2. Collect Plants

Plant materials to be used will be collected at Owens Lake. When possible, both seedlings and more mature plants derived from transplants, cuttings or rhizome segments, as appropriate, would be utilized and evaluated. Potential species to be evaluated include *Distichlis spicata*, *Sarcobatus vermiculites*, and *Atriplex parryii*. Final decisions on the species to be tested will be based on field observations of species abundance and distribution in the most stressful habitats, literature review, and suitability of species for use in ecosystem development efforts. The number of species that can be evaluated is constrained by the number of test containers in the greenhouse sand-culture system. Five replicates, the minimum number acceptable, of each species in each treatment will limit the list to six species.

3. Collect and Map Soil, Roots and Shoots

Soil samples, root and shoot materials will be collected at Owens Lake and will be coordinated with the work to be performed in Project I. Root profiles will be mapped and correlated with vegetation at the soil/vegetation sampling sites. Roots will be mapped along the trench profile walls excavated for the soil chemistry study. Mapping will include counting fine roots crossing the plane of the profile wall in 5-10 10x10-cm quadrats in each 10-cm soil layer to obtain a semi-quantitative measure of the vertical distribution of fine root density. Root and soil samples will be taken at representative depths through the rooted zone. This work will be coordinated with the work to be performed in Project I.

4. Analyze Soil and Plant Tissue

Chemically analyze field-collected soil and plant tissue samples. Coordinate with work performed in Project I.

5. Compile and Analyze Root Profile Wall Maps

6. Set-up Greenhouse Experiments

The plants for all experiments will be propagated in a greenhouse adjacent to the sand-culture greenhouse. Plants will be adequately supplied with water and nutrients, both during propagation and experimental periods. If possible, seed germination and initial growth (3-4 weeks) will be evaluated simultaneously with longer treatment of more mature plants planted in the same container. The containers' size (30 cm diameter) will be large enough for these evaluations to be done simultaneously without plant-plant interference. The greenhouse experiments will utilize a sand-culture system with programmable control of the root solution composition. This system is currently available in a greenhouse in the Orchard Park facility at the UC Davis campus but will require some refurbishment before it can be used for the Owens Lake experiments. Refurbishment will consist of valve replacements, replumbing and replacing pots. After refurbishment, the system will consist of 180 35-liter pots and a nutrient solution supply system that can be programmed to provide 6 different treatments (nutrient/salt solutions). Environmental conditions and operation of the solution supply system will be monitored with a CR-10 data logger system (Campbell Scientific, Inc. Logan, UT) that is included in the budget.

7. Test Tolerance Limits of Plants

Greenhouse experiments with species and solution concentration as main factors will be conducted to determine the tolerance limits to NaCl, $NaSO_4$, and borate individually for the selected species. Include six NaCl levels ranging from 0.5 mM (milli Moles) to 1000 mM and six boron levels ranging from 0.05 mM to 10 mM. Higher maximum concentrations of both salt and boron may be necessary to define the upper limits of tolerance of the most tolerant species at Owens Lake. Concentrations to be used in these experiments, and for the sulfate experiment, will be adjusted as necessary to span the range of soil solution concentrations found in the substrates adjacent to the roots of plants growing in playa and dune habitats at Owens Lake.

Based on the results of the individual concentration tests, a factorial set of treatments including salt and borate in combination will be conducted to address how much the levels of tolerance of the most tolerant species are reduced. The concentrations to be used will depend on the results of the first two experiments and the soil solution concentrations in Owens Lake habitats. Additional interactions will be studied as time permits.

To determine the influence of increased Ca/Na activity ratio on the levels of tolerance to sodium, chloride, sulfate and borate, interactions of the toxic elements with calcium activity will then be investigated. A factorial set of treatments with stressful levels of salt or borate combined with three Ca/Na activity ratios will be conducted. The Ca/Na

activity ratios used will range upward from the very low values in the soil solutions at Owens Lake. An appropriate computer model will be used to develop the specific nutrient/salt solution concentrations for this factorial experiment.

8. Evaluation of Experimental Treatments and Field Data

All experiments will utilize a randomized block design to account for gradients in the environmental conditions in the greenhouse. In all experiments the concentrations of toxic ions will be increased slowly over several weeks to the target levels to prevent osmotic shock and allow time for acclimation to the stress. Plant performance in all experiments will be measured both during the growth period and with a final harvest of the experimental plants. The measurements proposed will be used to make preliminary assessments of some of the key mechanisms of salinity tolerance. Measurements will include: survival; rate of leaf production and growth; biweekly predawn and midday plant water potentials; sodium, chloride and borate content of the xylem sap at biweekly midday and predawn measurements; total shoot and root production; total root length produced; nutrient, salt and boron content of leaves and roots. During the growth period and at the end of the experiments evidence of salt excretion (e.g. by *Distichlis spicata*) or accumulation in epidermal trichomes will also be determined. The nutrient, salt and boron content measurements taken for the greenhouse plants will be compared with the same measurements taken for the field collected plants. The growth period of each experiment will be limited to approximately two months.

An analysis and synthesis of field and lab results will be performed. Analysis of the results of the greenhouse experiments will be conducted using the SAS statistical analysis computer program (Statistical Analysis Systems) and all data will be transformed as necessary to obtain homogeneity of variances and adequate approximation to normality. Field results will be summarized with descriptive statistics for comparison to the treatment solutions used in the greenhouse.

Results and their interpretation will be given to Great Basin for review and comment. A final project report will be prepared and submitted to Great Basin no later than June 30, 1993.

SCHEDULE

		Start	Finish
1.	Perform a Literature Search	7/92	9/92
2.	Collect Plants	7/92	8/92
3.	Collect and Map Soil, Roots and Shoots	7/92	10/92
4.	Analyze Soil and Plant Tissue	9/92	1/93
5.	Compile and Analyze Root Profile Wall Maps	9/92	1/93
6.	Set-up Greenhouse Experiments	7/92	4/93
7.	Test Tolerance Limits of Plants	8/92	5/93
8.	Evaluation of Treatments and Field Data	1/93	6/93

EXHIBIT C

COST PROPOSAL FOR THE PROVISION OF
VEGETATION RESEARCH AND DEVELOPMENT SERVICES

SCHEDULE OF FEES, TRAVEL AND PER DIEM

PROJECT I - SALT AND NUTRIENT DYNAMICS IN VEGETATION, SOIL AND GROUNDWATER OF THE OWENS PLAYA SYSTEM

Personnel

Post-graduate research associate -2081 hrs. @ $15.00 /hr.	$31,215
Benefits (30%)	9,365
Undergraduate laboratory assistant - 545 hrs. @ $5.50/hr.	2998
Subtotal Personnel	$43,578

Supplies and Services

Miscellaneous field equipment	250
Excavation (backhoe time) 20 hrs. @ $50/hr.	1,000
Reagents and laboratory supplies	2,500
Filters	1,775
Chemical analyses	
Ion chromatography	2,500
ICP-MS	4,000
AA-graphite furnace	2,000
Plant digestions	2,500
Subtotal Supplies and Services	$16,525

Travel (mileage and per diem)

Vehicle rental - 16 days @ $45/day	$720.00
Per diem - 37 days @ $75/day	2,775
Subtotal Travel	$3495

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Overhead (10%)	$6,360
Total for Project I	**$69,958**

PROJECT II - PHYSIOLOGICAL LIMITS OF PLANTS IN DESERT PLAYA ENVIRONMENTS

Personnel

Post-graduate research associate -2081 hrs. @ $15.00/hr.	$31,215
Benefits (30%)	9,365
Undergraduate laboratory assistant - 1181 hrs. @ $5.50/hr.	6,496
Subtotal Personnel	$47,076

Supplies and Services

Refurbish sand culture system	$6,000
Chemicals for solutions	2,500
Sampling supplies, greenhouse supplies, plant propagation, and sample extraction	2,300
Chemical analyses (digests, ICP-MS, AA,)	6,000
Secretarial, publication charges, computing charges	3,000
Subtotal Supplies and Services	$19,800

Travel (mileage, per-diem)

Vehicle rental - 15 days @ $45/day	$675
Per diem - 15 days @ $75/day	1,125
Subtotal Travel	$1,800

Overhead (10% of Personnel, Supplies, Services & Travel)	$6,868

Equipment

CR-10 data logger, storage module, power supply and sensors to monitor sand culture greenhouse	$3,985*
Pressure chamber for plant water extraction (for ionic analyses and water potential measurements)	1,250**
Subtotal Equipment	$5,235

*Note: Data logger will be purchased for use in this contract but will be turned over to Great Basin for use on future Owens Lake projects upon completion of this contract.

**Note: This figure represents 50% of the cost of the chamber. The Subcontractor will be responsible for funding the remaining 50% as this equipment will remain with the subcontractor upon completion of the work.

Total for Project II	$80,779
GRAND TOTAL FOR PROJECTS I and II	$150,737