Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan

Appendices C through K

Prepared by:

Great Basin Unified Air Pollution Control District

November 16, 1998

Owens Valley PM_{10} Planning Area
Demonstration of Attainment
State Implementation Plan

Appendices C through K

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Appendix C

Example Permit to Operate for an Industrial Facility

PERMIT TO OPERATE

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

157 Short St. Suite #6 - Bishop, CA 93514
(619) 872-8211

PERMIT NUMBER 632

Pursuant to the authority granted under the Rules and Regulations for the Great Basin Unified Air Pollution Control District, the

Federal White Aggregates
870-789 West Pender Street
Vancouver, B.C., Canada V6C1AZ

operations and associated equipment and buildings located at:
Dolomite Ghost Town, on Dolomite Loop Road, off Hwy 138, 7 miles southeast of Lone Pine, Inyo County.

is hereby granted a permit to operate as of July 22, 1991.

This Permit to Operate is granted for one year and may be renewed upon payment of the renewal fee on or before the anniversary date above.

EQUIPMENT DESCRIPTION FOR PERMIT: Dolomite Crushing & Screening Plant.

1 - 10 ton ore hopper	n/a	hp
1 - vibrating feeder	n/a	hp
1 - Cedar Rapids jaw crusher	50	hp
2 - conveyors (jaw to screen) 3 hp ea.	6	hp
1 - Overstrom triple deck screen	7 1/2	hp
1 - conveyor (screen to rolls)	3	hp
1 - Columbia rolls crusher	70	hp
1 - conveyor (rolls to jaw)	3	hp
2 - belt conveyors @ 5 hp ea.	10	hp
2 - coarse ore storage bins	n/a	hp
2 - Union Special sewing machines	1	hp
1 - sacking bin & sacker	n/a	hp
2 - conveyors (Overstrom to Sweco) 3 hp ea	6	hp
1 - Sweco triple deck screen	3	hp
2 - valve packers 3 hp ea	6	hp

CONTROL SYSTEM:

1 - Water truck controls pit and haul road fugitive dust emissions.

PERMIT CONDITIONS: See the attached conditional approval.

Ellen Hardebeck
AIR POLLUTION CONTROL OFFICER

Date July 22, 1991

This Permit does not authorize the above permittee to violate any of the Rules and Regulations of the Great Basin Unified Air Pollution Control District or Division 20, Chapter 2, Article 3, of the Health and Safety Code of the State of California.

Conditional Approval for Permit to Operate No. 632

Federal White Aggregates
870-789 West Pender Street
Vancouver, B.C., Canada V6C1AZ

Located at:
Dolomite Ghost Town, on Dolomite Loop Road,
off Hwy 138, 7 miles southeast of Lone Pine

PERMIT CONDITIONS:

1. The District will be notified 48 hours prior to equipment start up and 48 hours prior to commencing seasonal start up by calling (619) 872-8211.
2. Federal White Aggregates is responsible for dust control from commencement of this project to final completion and is also responsible for insuring that subcontractor(s), employees, and all other persons connected with the project abide by the conditions of this permit.
3. The hourly input feed rate shall be limited to 10 tons per hour and is restricted to processing no more than 240 tons of dolomite aggregate per day. Daily production records shall be kept on site and made available to the District staff upon request.
4. Within 90 days after placing the crushing plant into operation, the applicant shall offset all increased emissions by dismantling the equipment covered under former Permits to Operate No. 521 (crushing plant # 2), and No. 487 (aggregate wash plant).
5. To prevent violations of District Rule(s) 400, 401 and 402, Federal White Aggregates shall have at a minimum one (1) watering truck available full time to apply water to areas in and around the plant. The applicant will give particular attention to controlling dust from:
   a. unimproved access roads used for entrances to or exit from the material pit.
   b. areas in and around the open quarry, and aggregate crushing plant.
   c. dirt and mud carried on and deposited on adjacent improved streets and roads, and these streets are maintained in a clean manner.
   d. the materials pit, and ore storage pile fugitive emissions when needed to maintain fugitive dust emissions below a Ringelmann 1 (20% opacity).
   e. all dust emissions, and that any dust emission is kept below a Ringelmann 1 (20% opacity).
6. Federal White Aggregates shall post and observe a 15 mph speed limit at the project. During normal daily activity, Federal White Aggregates, their contractor(s), and employees will observe this speed limit. The speed limit will be strictly enforced by the applicant. (Authority cited rules 402 & 210).
7. If wind conditions are such that the applicant cannot control dust, Federal White Aggregates shall shut down all operations (except for equipment used for dust control). Under no circumstance will wind generated dust be allowed to blow across a property boundary.
8. The height of all aggregate storage piles and its conveyor drop distance shall be kept to a minimum. Aggregate storage pile height shall not be allowed to exceed a 20 foot maximum height. If District Rule(s) 400, 401 or 402 are violated, water shall be applied to the storage piles as necessary to minimize fugitive dust emissions cause by high winds.

9. Federal White Aggregates shall pursue and explore potential buyers for the reject waste collected by the baghouse. Any progress towards finding a market for this waste material shall be reported to the District. Until a market is established, the applicant shall take every reasonable precaution necessary to prevent this waste material from becoming airborne and prevent the transport of dust or dirt beyond the property boundary by continuously stabilizing and controlling the material. Reasonable available dust control measures may include, but need not be limited to: covering the waste material with 4 inches of overburden material, or rocks, sealing, re-vegetation, or by paving. On a temporary basis, the fine waste dust may be controlled by use of a resinous or petroleum based dust suppression agent, or otherwise stabilizing the spoils with a chemical surfactant, or latex binder. This control operation shall be performed before the close of business each operating day or at least once a day when the plant is in continual operation. Since waste crankcase oil is a hazardous waste it will not be considered or used as a dust suppression agent.

10. In the quarry, core and blast holes shall be properly drilled, using water injection, cyclone collection, or other approved methods to decrease the amount of dust created to below a Ringelmann 1 (20% opacity). During blasting, the generation of fugitive dust shall be reduced by minimizing the amount of explosives used and by preventing overshot. No blasting shall take place during periods of high winds where the wind velocity is high enough to carry dust or dirt cross a property boundary.

11. Federal White Aggregates shall keep the active quarry as small as possible. Once any portion of the quarry is exhausted of useful material, the applicant shall immediately begin reclamation of the disturbed surface. Federal White Aggregates shall not allow any abandoned portion of the quarry to remain subject to wind erosion for a period in excess of six (6) months without applying all reasonably available dust control measures necessary to prevent the transport of dust or dirt beyond the property boundary. Reasonable available control measures may include, but need not be limited to: sealing, re-vegetation, paving, or otherwise stabilizing the soil surfaces with chemical surfactants, or latex binders.

12. At the termination of mining, and prior to abandoning the site, Federal White Aggregates shall apply reasonable available control measures to prevent fugitive dust emissions from being emitted after the quarry is closed. The applicant shall comply with the mitigation measures specified by the Inyo County Planning Commission's Conditional Use Permit #88-3 dated November 17, 1988 and by the mitigation measures outlined in Reclamation Plan #88-1.

13. The provisions of this permit may be modified by the District if it determines the stipulated controls are inadequate, or if District Rule(s) 400, 401, or 402 are violated. If requested by the Air Pollution Control Officer, Federal White Aggregates shall within thirty (30) days submit a written plan to the District describing how the dust emissions will be controlled and maintained below a Ringelmann I (20% opacity). The Air Pollution Control Officer will approve or modify the plan. Federal White Aggregates shall implement the plan immediately following the APCO's approval.

14. Federal White Aggregates shall promptly notify the District in writing should they learn of or encounter conditions where toxic air emissions of concern are emitted and allowed to disperse into the ambient air. Toxic air emissions are those listed on the AB2588 list of substances as required by the California Health & Safety Code Section 44321.

Appendix D

Feasibility and Cost-Effectiveness of Flood Irrigation for the Reduction of Sand Motion and PM_{10} on Owens Dry Lake

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

FEASIBILITY AND COST-EFFECTIVENESS OF FLOOD IRRIGATION FOR THE REDUCTION OF SAND MOTION AND PM_{10} ON OWENS DRY LAKE

Ellen Hardebeck, Ph.D., Grace Holder, Ph.D., Duane Ono, Jim Parker, Theodore D. Schade, P.E., and Carla Scheidlinger

NOVEMBER 1996

APPENDIX D

Ellen Hardebeck, Air Pollution Control Officer
157 Short Street, Bishop, California 93514
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FEASIBILITY AND COST-EFFECTIVENESS OF FLOOD IRRIGATION FOR THE REDUCTION OF SAND MOTION AND PM-10 ON OWENS DRY LAKE

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1.0 INTRODUCTION

In 1988 and 1991 Great Basin staff prepared feasibility reports that addressed the use of shallow flood irrigation to control PM-10 emissions from Owens Lake (Appendices A and B). In 1990 an unplanned test of shallow flood irrigation was conducted when water used for the District's sprinkler project was allowed to run out the end of the sprinkler supply main during cold weather to prevent the main from freezing. This water spread into a broad shallow sheet that controlled dust emissions.

In 1992, as a result of the feasibility reports and the small-scale test of shallow flooding, the District decided to pursue the testing of shallow flood irrigation on a moderately large scale. In November 1992 the District finalized the project design and test protocols (Appendix C) and began baseline monitoring of the test site. In October 1993 the District finalized the flooding operation and maintenance procedures (Appendix D) and began flooding the site in January 1994.

The purpose of the flood irrigation project (FIP) was to determine the effectiveness and the technical and economic feasibility of using flood irrigation on a large scale as a dust control measure for Owens Lake. By flood irrigation, we mean the mimicking of physical and chemical processes that occur at and around naturally irrigated and vegetated springs and wetlands located on Owens Lake. Flooding has the direct benefit of wetting the soil to prevent PM-10 emissions, as well as incidental benefits, such as leaching salts to accelerate natural rates of plant establishment, trapping saltating particles from outside the test area and providing water directly for vegetation use.

The project used locally developed water resources to flood low relief areas of the lake bed and test the ability of the flooded area to prevent dust emissions. The project tested the ability to deliver and spread water in a uniform manner and the effect that wind had on the flooded area. The project determined the techniques that maximize water use efficiency given available water resources. It tested the ability to use flood irrigation to accelerate natural leaching processes to allow establishment of vegetation directly on the lake bed. It also determined wildlife enhancement values associated with the flood irrigated area. Finally, the test investigated the effect that surface flooding has on the near surface soils and groundwaters of Owens Lake and, in conjunction with the District's water resource investigations, determined whether sufficient water resources are available to implement the measure on a larger scale.

2.0 EXPERIMENTAL DESIGN

A detailed discussion of the project design and test methodologies can be found in Appendix C: "Northern Area Project Design and Test Protocols," Great Basin Staff Report, November 1992. This section addresses test location, site layout, infrastructure, instrumentation, operation, data collection and data analysis.

2.1 Choice and Description of Study Area

The north study area was chosen to be representative of those areas of the lake bed that are dominated by sandy soil at the surface. The site was located near the north end of the largest continuous sand sheet on the lake bed. Figure 2.1-1 shows the location of the study area.

The FIP study area was approximately 10,000 feet long and varied from 3000 to 6000 feet wide. The site area components and dimensions are shown in Figure 2.1-2. There were two major investigation objectives that dictated the layout of the test area and gave it two distinct axes: a downhill axis and a downwind axis.

The plot needed to have a long dimension perpendicular to lake bed elevation contours, or downhill, in order to maximize the distance that the water traveled over the lake bed. Maximizing the downhill distance allowed monitoring of the changes in soil chemistry, surface water chemistry, shallow groundwater levels and groundwater chemistry that were anticipated as the water moved from the shoreline toward the evaporite deposit at the center of the lake. The distance from the water outlets to the beginning of the salt crust near the center of the lake was approximately 6000 feet. Air quality monitoring did not take place on the upper (east) portion of the wetted area between the "A" and "B" outlets.

In addition to maximizing the downhill dimension, the test area needed to have a long dimension in the downwind direction in order to test soil particle saltation across control and wetted areas. The downwind dimension needed to be long enough in the upwind control area to allow saltation to develop, long enough across the wetted area to observe anticipated reductions in saltation, and long enough across the downwind control for saltation to reestablish. In addition, this section of the study area needed to be free of topographic relief. The portion of the study area chosen to measure the air quality effects of surface flooding was approximately 10,000 feet long and was located on an area of the lake bed with extremely low relief that experienced high levels of saltation.

The main wetted area (test site) occupied the central portion of the study area. Its shape was dictated by the need to have two test axes. The downhill axis was parallel to the Keeler/Swansea sand fence, was 1500 feet wide by 6000 feet long and was between the sand fence and an existing elliptical shaped sand dune to the north. The downwind axis in the test area was nearly perpendicular to the downhill axis and was located in one of the largest dust source areas on the lake bed. It was 3000 feet wide and 5500 feet long. Water was discharged onto the site from two 1500-foot long outlet lines. The "A Outlets" were located nearest the

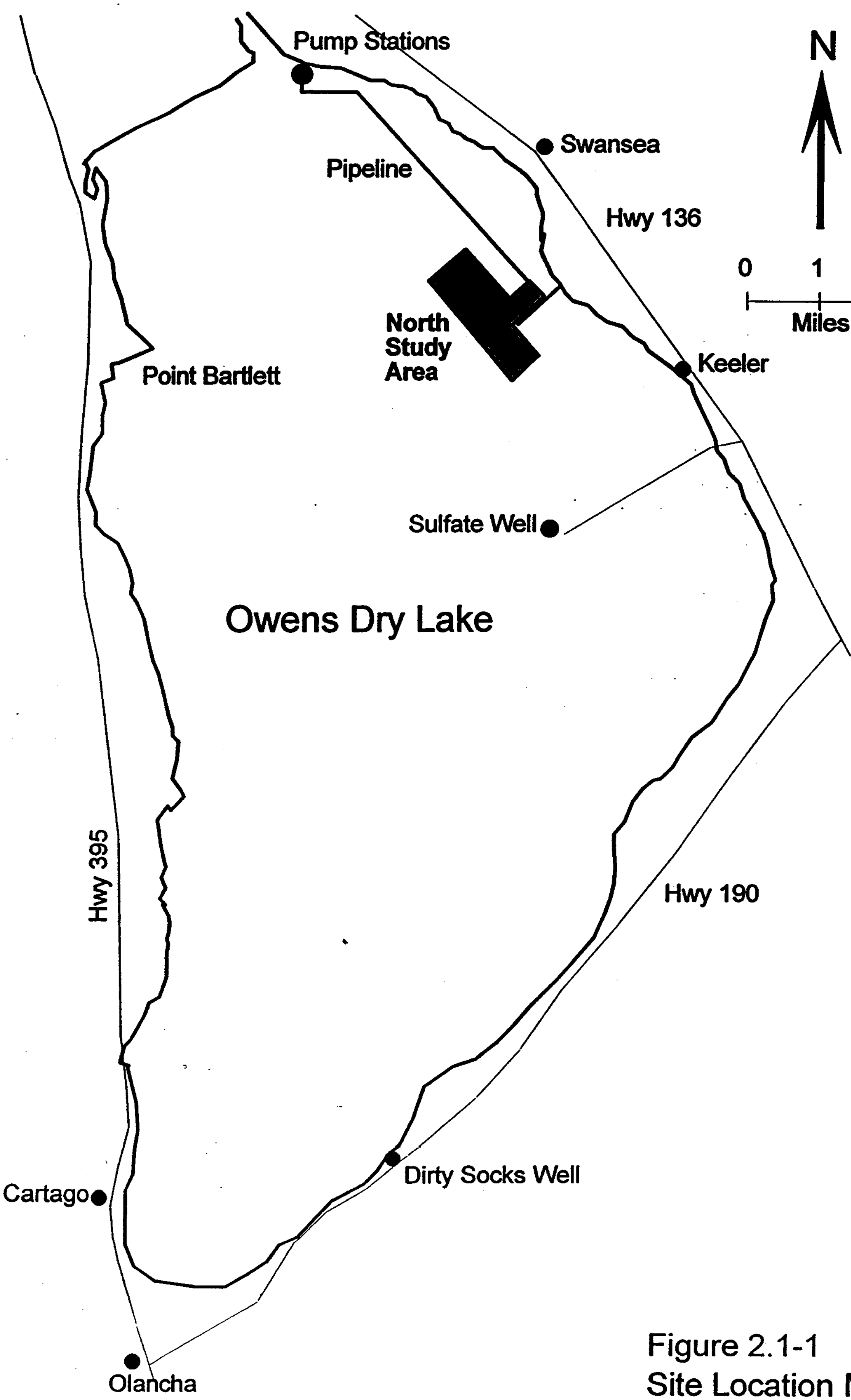
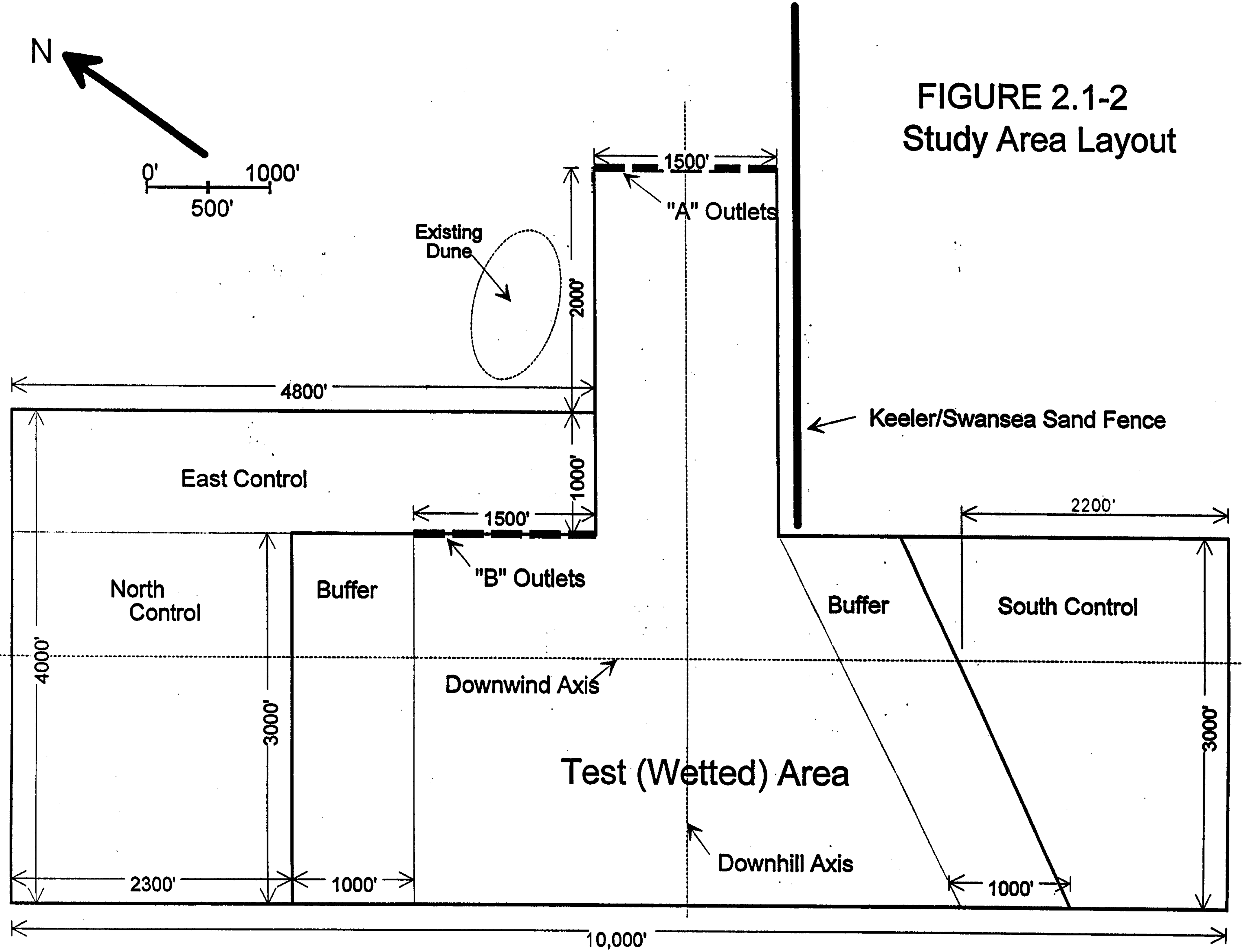


Figure 2.1-1
Site Location Map

FIGURE 2.1-2
Study Area Layout



historic shoreline and the "B Outlets" were located west of the existing sand dune. This two-outlet arrangement allowed a backwards "L" shaped flooded area to be created which gave the test site its two (downhill and downwind) axes.

There were two 1000 foot wide "buffer" areas on each side of the wetted area. These were areas that, at times, were either wet or dry depending on how the water spread and the direction the winds blew. Strong winds caused the water on the surface to shift due to the shallow water depths, large water surface areas and shallow gradients with little topographic relief. The buffer zones prevented the adjacent dry control areas from being inundated.

In addition to the wetted and buffer areas, control areas are also shown in Figure 2.1-2. There were three control areas: north, south and east. The north and south control plots were located to insure there was a dry upwind saltation initiation area in front of the wetted area and a dry downwind recovery area, whether the wind blew from the northwest or the southeast. The east control plot was a parallel control area placed to the east of and in the same type of soil as the adjacent wetted area.

2.2 Instrumentation

Previous work (Gillette et al., 1995 and White, 1996) has shown that for sandy areas it is reasonable to assume that the vertical flux of PM-10 is proportional to the horizontal flux of sand. The study area was instrumented to measure sand motion and PM-10.

2.2.1 Sand Transport Samplers, Sensits™ and Meteorological Stations

Figure 2.2-1 shows the layout of instrumentation on the main study area that was to be flooded (test area) and the three control areas. There were three meteorological stations (5010 at site 326A-3, 5011 at site 326A-9, and 5012 at site 326A-15) that recorded hourly averages of wind speed at 1, 2 and 4 meters, wind direction at 4 meters, and temperature and relative humidity at 1 and 4 meters. In addition to these parameters, which were collected on a continuous basis, dataloggers were programmed to record Sensit™ responses and maximum wind speed (gusts) at 2 meters when triggered by high winds or Sensit™ activity. See Appendix E for a description of Sensits™.

The sand transport samplers (STS) were bi-directional, with the inlets oriented to sample parallel to the transects from wind directions 180° apart (e.g. northwest (326°) and southeast (146°)). See Appendix C for a description of STS. The original configuration deployed twenty-three STS on two transects oriented to 326°/146°, fifteen STS on two transects oriented to 281°/101°, and twenty-seven STS on four transects oriented to 191°/11°. This configuration was changed on October 14, 1993 to a new arrangement that provided a wider two-dimensional coverage of the North Sand Sheet for the 326°/146° direction. This new configuration deployed forty-one STS oriented to 326°/146° and twenty-eight STS oriented to 191°/11°. Figure 2.2-1 shows the new configuration. Sensits™, which record particle flux from all directions, were installed adjacent to twelve of the 17 STS along the 326A/146A transect and all of the STS along the 326B/146B transect.

Great Basin Flood Irrigation Project
(Sand Transport, PM10, and MET layout)

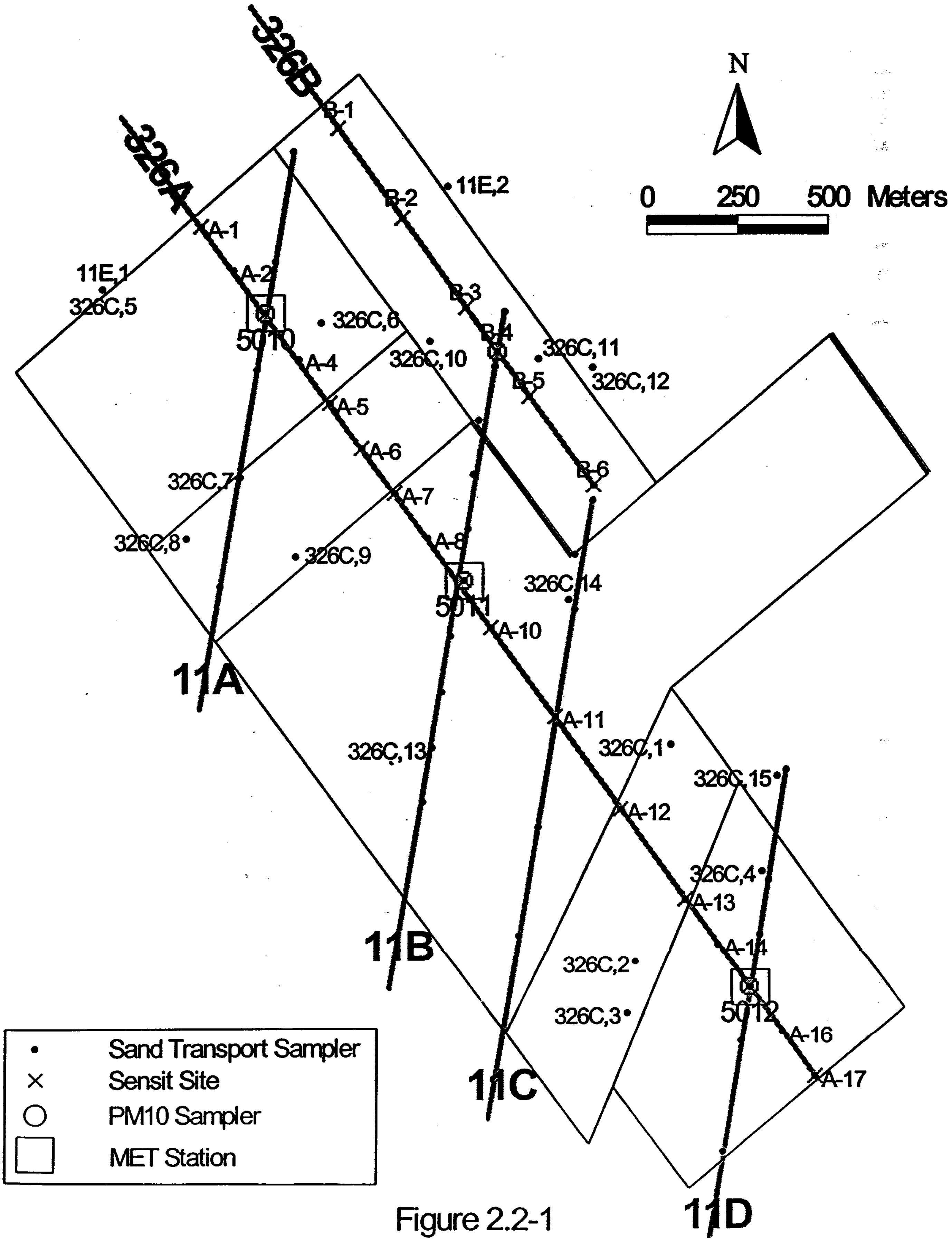


Figure 2.2-1

2.2.2 PM-10 Monitors
Four low-volume (16.7 liters per minute) battery-powered PM-10 samplers were installed at the three FIP meteorological stations located adjacent to sites 326A-3, 326A-9, and 326A-15, and at site 326B-4. The samplers were a modification of an AeroVironment design, utilizing the well-characterized Sierra 246b PM-10 inlet. This inlet is designed to produce a 50% particle-size cutpoint for particles 10μm aerodynamic diameter and less when operated at a volumetric flow rate of 16.7 liters per minute (lpm). The samplers were powered by a battery system, recharged by solar panels. The direct-current (DC) powered pump was governed by a vacuum regulator to maintain the flow rate at 16.7 lpm. The sampler inlet height was set at approximately three meters above the playa surface.

2.2.3 Portable Wind Tunnel
The District used a portable wind tunnel to measure sand flux, PM-10, and threshold wind speed to characterize surfaces on the study area at Owens Lake. The tunnel is described in detail in Cowherd and Ono, 1990.

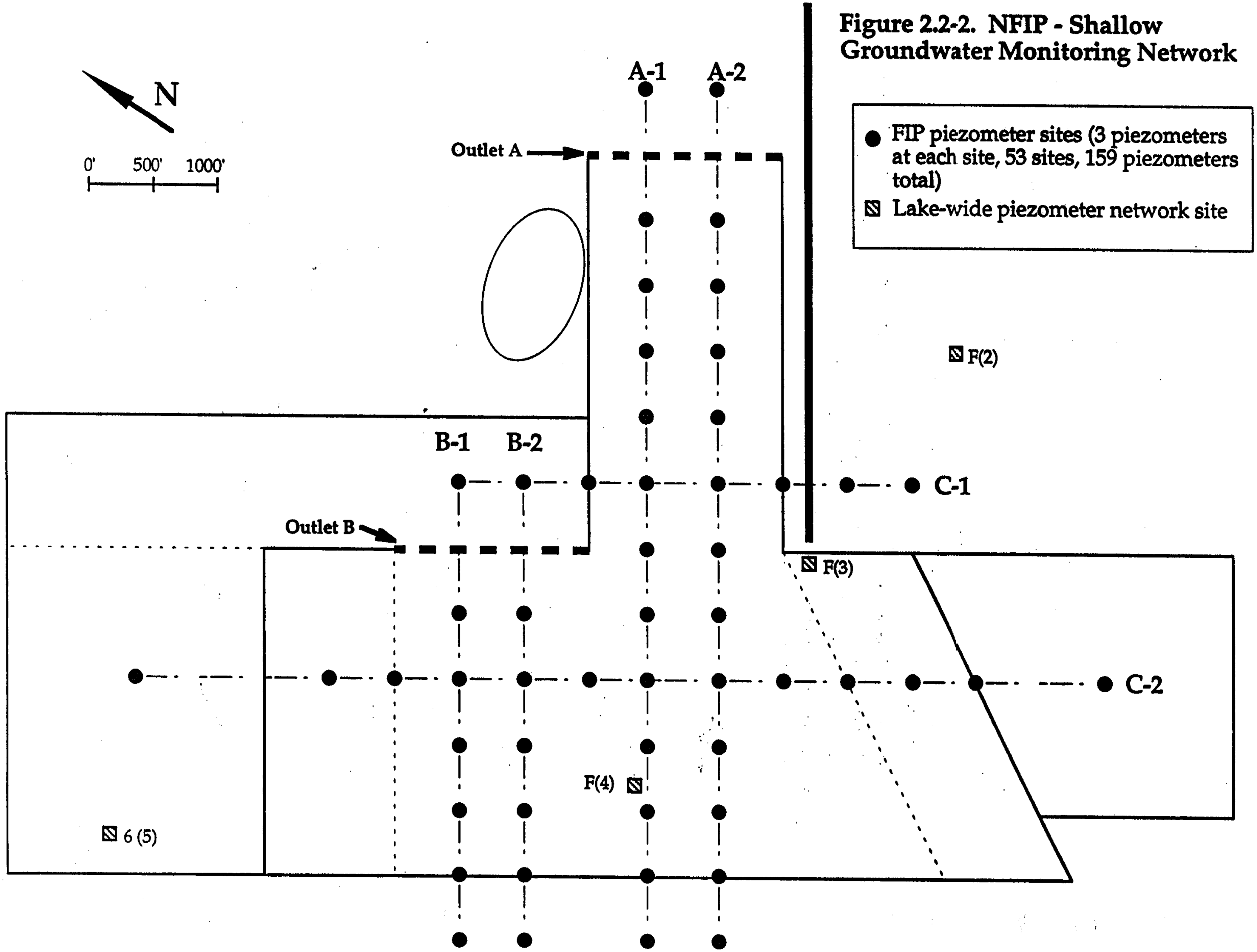
2.2.4 Shallow Groundwater, Soil, and Surface Water Instrumentation
The instrumentation and protocol for monitoring the shallow groundwater, soil, and surface water during the FIP test is described in Holder, 1993 and Holder, 1996. A summary of the sites is described below; however, the reader is referred to these documents for more details.

A network of 53 piezometer sites was installed on the FIP study area in the Spring of 1993 to monitor water levels and water chemistry of the shallow groundwater (Fig. 2.2-2). The network was arranged into six transects. Four transects extend down-slope through the "A"- and "B"-outlets (A1, A2, B1 and B2 transects) and two transects cross the test area roughly parallel to surface contours (C1 and C2 transects). The sites on the A and B transects were designed to monitor changes down-slope along the path of water movement while the C-transects were installed across-slope to monitor the lateral effects due to flooding. Piezometer sites were installed in control areas that were expected to remain dry during the test in order to monitor conditions outside of the wetted area. Each groundwater monitoring site consisted of three piezometers installed to standard depths of 1.5, 2.5 and 5.0 feet below surface. Surface flood water sample locations and soil sampling sites were collocated with the piezometer sites in order to provide a profile of water level and salinity from the surface down to a depth of five feet.

2.3 Data Collection and Analysis Methodology.

2.3.1 Sand
Sand was collected from sand transport samplers as soon as possible after each significant wind event on the North Sand Sheet during the period of the experiment according to procedures described in the District Staff Document "Sand Transport Sampler Collection Procedures, Flood Irrigation Project", November 1993 by Grace Holder. (Appendix F) Sand storm events thus represent time periods from a few days to a few months in

Figure 2.2-2. NFIP - Shallow Groundwater Monitoring Network



duration, depending on the frequency of dust storms and the ability of the data collection crew to get out to the sites and change out the sample bags.

Sensits™ were used to continuously collect sand motion data, which were stored on a datalogger for periodic retrieval. The dataloggers stored 5-minute averages of wind speed, wind direction and sand motion data whenever Sensits™ responded to sand motion or winds exceeded a predetermined threshold. (The protocol determining which of the preceding "triggers" for collection of 5-minute data would be used changed during the course of the experiment.)

For each sand collection event, there would thus be a series of corresponding 5-minute records of wind and Sensit™ data covering the same period. A number of storms could be distinguished within each sand collection. These records were divided into two groups; for example, "north winds" and "south winds," based on whether each record's wind direction fell within 90° of the 326° sand transport sampler inlet or the 146° sand transport sampler inlet. A weighted average wind direction was calculated for each sand collection event, for each inlet direction, using the formula

$$\text{Weighted avg. wind} = \frac{\Sigma[\text{(wind direction)} * \text{(sensit value)}]}{\Sigma\text{(sensit value)}}$$

where data were summed over all records for each inlet direction that fell within a particular sand collection period. A sand catch from either inlet direction with a weighted average wind direction that diverged by more than 45° was considered invalid, since previous tests (Ono, *et al.*, 1994) established that this design of sand transport sampler does not accurately sample sand blowing at such widely oblique angles.

Collection Events - Full Array. Maps of sand flux across the North Sand Sheet area were generated from the full array of sand transport samplers. Sand catch weights from inlets with a variety of orientations were adjusted to the same weighted average wind direction described above, by dividing each sand catch by the cosine of the angle the inlet direction diverged from the weighted average wind direction. Data for each sand storm event were divided by the duration of each storm to allow comparison of intensity at any location from one storm to the next. These corrected sand flux rates were then moved 250 feet NW (326 °) for north wind events and 250 feet SW (146°) for south wind events to more accurately represent the source area locations. Grid squares that overlaid wetted areas and that had no associated sand flux value were given default values of zero. These values were then used as "elevations" to create a three-dimensional sand flux surface. This surface was then resampled with a 500 foot grid to produce the two-dimensional maps. Some examples for pre-flooding and flooded periods are shown in Section 3, Figures 3.1-6 through 3.1-9.

The sand flux analysis protocol that was written for this project included correcting the measured sand flux at each monitoring site to avoid double counting suspended material that was carried over, or transported, from the upwind monitoring site (Ono *et al* 1994). This correction would yield the amount of material that was newly entrained between the sampling sites. The corrected value could be used to determine if the sand flux measured at a site, such as a wet site, was due to erosion from the adjacent area or if it was transported from an area further upwind. The protocol stated that this correction factor would be modified if new information showed the sand flux deposition rate to be different from previous estimates. Careful analysis of the Sensit™ and sand transport sampler data near water-covered areas showed that the deposition rate was higher than previously estimated. It was found that negligible amounts (less than the sampler accuracy) of saltation size particles were transported across the entire 500 foot separation between the samplers near wet areas. Had the samplers been closer together, compensation for transport may have been required. The conclusion of this analysis is that the sand flux measurement at each site represents material that was locally entrained within 500 feet of the samplers. This greatly simplifies analyses of the sand flux data in the wet areas. It can be assumed that if sand flux was measured near the wet test area it was due to particles entrained within 500 feet of the sampler site.

Collection Events - 326°/146° Transect. Sand Flux was also mapped along the main transect. Averages of the valid sand catches from both inlet directions along the 326°/146° transect and from both pre-flooding, flooded, and post-flooding periods are depicted in Section 3, Figures 3.1-1 through 3.1-3.

Individual Storms. Sensit™ data allowed a closer look at individual sand storms than the coarser view of the sand catches permitted. The 326° and 146° inlets at each sampler were aligned parallel to a 9500-foot transect of sites that included both sand transport samplers and Sensits™. Dates with significant Sensit™ activity were selected in which discrete sand storms had weighted average wind directions within 15° of either inlet direction. The flux of sand blowing past any particular Sensit™ site was calculated using the following procedure. Sensit™ counts for records with wind direction within 90° of the sand transport sampler inlet direction, within the period of a particular sand catch, were multiplied by a correction factor for wind direction equal to the cosine of the angle the sand transport sampler inlet direction diverged from the wind direction for each 5-minute period. This adjustment was done to account for the reduced effective sand catcher inlet size for winds that did not hit the inlet straight on. The sum of these corrected Sensit™ values at each Sensit™ site was then calibrated with the sand catch at that site to produce a sand/Sensit™ ratio for that Sensit™ for that event. Then, for any given storm of shorter duration, within a particular sand catch event, Sensit™ values could be multiplied by their respective sand/Sensit™ ratios to produce an estimate of sand flux calculated from Sensit™ values at each Sensit™ site. In Section 3, Tables 3.1-2 and 3.1-3 contain values calculated with this method and Figures 3.1-11 and 3.1-13 depict averages of pre-flooding and flooded sand storms for winds from the north that were within 15° of the 326° inlet direction.

2.3.2 PM-10

PM-10 Monitors These samplers were operated on an episode or wind event basis. Forecasting of the appropriate weather conditions determined when the samplers were operated. When these conditions were predicted, a technician was dispatched to program the start time into the datalogger at each of the sites to ensure all four samplers were triggered simultaneously. At the beginning of the project, the samplers operated for 12-hour periods during episodes; however, later in the program the samplers were operated for 24-hour periods to allow a more accurate comparison with samples collected by off-lake particulate monitors.

Filter samples were collected as soon as possible after each wind event according to the procedure described in the District Staff Document, "Procedures for Operating the Flood Irrigation Project Portable PM-10 Samplers", Appendix G. A technician visited each of the four monitoring sites, triggered the sampler to take a final flow measurement, then removed the filter holder from the sampler. The PM-10 inlet was inspected and cleaned as necessary. A new filter holder was installed in the sampler, the flow rate adjusted to the appropriate setting, the information recorded on a sample form, and the sampler turned off, ready for the next episode.

Exposed filters were returned to the filter processing lab in Bishop where they were removed from the filter holders and put into petri slides marked with the filter number, for storage until they were shipped to the contract laboratory. Filters were provided and processed by Chester Lab Net of Tigard, Oregon. Chester handled the procurement, inspection, equilibration, and gravimetric analysis of the filters.

The gravimetry data from Chester were put into a spreadsheet by the District. Information in the spreadsheet included: filter number, filter initial weight, filter final weight, net weight of deposit, site number, sample date, sample start and end times, hours sampled, average sampler flow rate during the run, total sample volume, and the calculated PM-10 concentration.

Wind Tunnel. Procedures for the collection and reduction of the portable wind tunnel data are described in detail in Satterfield and Associates, 1994.

2.3.3 Water Coverage

Low level aerial photographs were used during the project to calculate the areal extent of the various types of surface conditions present on the test area (flooded, dry and transition). Ground control points visible from the air were set within the test area and accurately located with global positioning system (GPS) equipment. High resolution 35 mm aerial photos were taken regularly during the test. The areas of standing water and wet areas visible on the photos were digitized into the District's geographic information system (GIS) and rectified with the known locations of the ground control points. This allowed the acreage of the standing water and wet areas to be calculated. This information was then used to determine which portions of the test site were flooded during wind events and to allow a calculation of water use efficiency (acres controlled per acre-ft of water) to be performed.

2.3.4 Shallow Groundwater and Surface Water

Water level and conductivity data from the shallow piezometers were collected during 42 monitoring episodes over a period extending from May 1993 through September 1995. The procedures for field measurements and sample collection from the groundwater and surface water are provided in Holder, G., 1993. A summary of monitoring episodes is presented in Table 2.3 -1. Data collection from the shallow groundwater monitoring piezometers can be divided into three time periods.

1. Pre-flooding: monitoring was conducted on a monthly to bi-monthly basis from 5/93 through 12/93.
2. Early-time flooding: monitoring was conducted on a weekly to bi-weekly basis from 1/12/94 through 3/31/94.
3. Late-time flooding: monitoring was conducted on an monthly to tri-monthly basis from 4/94 through 9/95.

Data collected during each period include water level (depth to water, DTW) and electrical conductivity (EC). Electrical conductivity is the ability of a substance to conduct an electrical current. EC measurements provide a good indication of the total salinity of a sample since higher EC values indicate a higher concentration of dissolved charged ionic species. In order to provide specific information on the salt and ionic chemistry of the groundwater, water samples were collected during selected monitoring episodes for laboratory analysis of general ionic chemistry, salt compounds, and Chloride.

The EC, water depth, and the areal extent of surface water coverage were monitored at the same time as measurements from the shallow groundwater piezometer sites. Samples for EC analysis were collected from water that was visibly flowing as close as possible to the piezometer sites but within a maximum radius of 75 feet from the site. A sketch map of the lateral extent of surface flood water was made during monitoring episodes using the instrumented sites as references. Further mapping of the surface water extent was conducted through periodic aerial photographs. This is discussed in Section 2.3.3.

The data collected from the piezometers and surface water were entered into a database. Data from each separate monitoring depth were treated as a separate layer within which spatial variations on the test area during each discrete monitoring event could be analyzed as well as temporal changes at individual sites. The data from all of the monitored depths were also combined for individual monitoring events in order to analyze the vertical profiles at specific sites.

2.3.5 Water Use

Water was delivered to the test site from the District's two River Well Pump Stations via approximately 5 miles of buried pipeline. Generally, one pump station was run at a time. Each station was equipped with a totalizing water meter, which was read weekly or

Table 2.3-1

FIP Water and Soil Monitoring Episodes

FIP Soil and Water Sample Collection Periods				
(GW = groundwater, SW = surface water, C = 1993, D = 1994, E = 1995)				
Pre-Flooding				
Date		**month**	**Comments**	**type of soil data collected**
Apr-89		5C	GW only	n/a
May-89		6C	GW only	n/a
Jul-89		8C	GW only	n/a
Aug-89		9C	GW only	n/a
Sep-89		10C	GW only	n/a
Oct-89		11C	basic soil and GW plus chemical analyses	2,6,12,18,30" augered
Nov-89		12C	soil and GW	2,6,12,18,30" augered
Post-Flooding				
Date	**moni-toring week**	**month-Julian week**	**Comments**	**type of soil data collected**
1/12-1/14/94	1D	1-2D	GW, SW and soil	2,6,12,18,30" augered at dry soil sites only
1/17/90	2D	1-3D	GW, SW and soil	2,6,12,18,30" augered at dry soil sites only
1/25 - 1/26/94	3D	1-4D	GW, SW and soil	2,6,12,18,30" augered at dry soil sites only
2/1 - 2/2/94	4D	2-5D	GW, SW and soil	2,6,12,18,30" augered at dry soil sites only
2/8 - 2/10/94	5D	2-6D	GW, SW and soil	2,6,12,18,30" augered at dry soil sites only
2/15 - 2/16/94	6D	2-7D	GW, SW and soil	2,6,12,18,30" augered at dry soil sites only
3/1 - 3/2/94	8D	3-9D	GW, SW and soil	2,6,12,18,30" augered at dry sites, 0-12" core from wet soil sites
3/14/90	10D	3-11D	partial GW, SW and soil	2,6,12,18,30" augered at dry sites, 0-12" core from wet soil sites
3/30 - 3/31/94	12D	3-13D	GW, SW and soil	2,6,12,18,30" augered at dry sites, 0-12" core from wet soil sites
4/26 - 4/27/94	16D	4-17D	asic GW, SW and soil plus chemical analyses	2,6,12,18,30" augered at dry sites, 0-12" core from wet soil sites
5/23 - 5/ 24/94	20D	5-21D	GW, SW and soil	0-12" core tube sample from wet and dry soil sites
6/27 - 6/30/94	25D	6-26D	GW, SW and soil	0-12" core tube sample from wet and dry soil sites
7/20 -7/21/94		7-29D	A-outlet test - wk 1	25-30 cm core tube sample from A-outlet neck sites only
7/27/90		7-30D	A-outlet test - wk 2	25-30 cm core tube sample from A-outlet neck sites only
8/1 - 8/3/94	30D	8-31D	A-outlet test-3, complete GW,SW and soil	25-30 cm core from A-outlet neck sites, 0-30 cm core from all soil sites
8/9/90		8-32D	A-outlet test - wk 4	25-30 cm core tube sample from A-outlet neck sites only
8/16/90		8-33D	A-outlet test - wk 5	25-30 cm core tube sample from A-outlet neck sites only
8/22 - 8/23/94		8-34D	A-outlet test - wk 6	25-30 cm core tube sample from A-outlet neck sites only
8/29 - 8/31/94	34D	8-35D	A-outlet test-7, complete GW, SW and soil	25-30 cm core from A-outlet neck sites, 0-30 cm core from all soil sites
9/8 - 9/9/94		9-36D	A-outlet test - wk 8	25-30 cm core tube sample from A-outlet neck sites only
9/14/90		9-37D	A-outlet test - wk 9	25-30 cm core tube sample from A-outlet neck sites only
9/21 - 9/22/94		9-38D	A-outlet test - wk 10	25-30 cm core tube sample from A-outlet neck sites only
9/27 - 9/30/94	38D	9-39D	A-outlet test-11, complete GW, SW and soil	25-30 cm core from A-outlet neck sites, 0-30 cm core from all soil sites
10/6 - 10/7/94		10-40D	A-outlet test - wk 12	25-30 cm core tube sample from A-outlet neck sites only
10/11/90		10-41D	A-outlet test - wk 13	25-30 cm core tube sample from A-outlet neck sites only
10/20 - 10/22/94		10-42D	A-outlet test - wk 14	25-30 cm core tube sample from A-outlet neck sites only
10/26 - 10/28/94	42D	10-43D	A-outlet test-15, complete GW, SW and soil	25-30 cm core from A-outlet neck sites, 0-30 cm core from all soil sites
11/28 - 11/30/94	47D	11-48D	complete GW,SW and soil	0-30 cm core from all soil sites
1/20 - 1/26/95	4E	1-4E	complete GW,SW and soil	0-30 cm core tube samples from select sites
3/8 -3/16/95	11E	3-11E	complete GW monitoring only	no soil samples taken
7/3-7/7/95	27E	7-27E	complete GW and soil monitoring	0-30 cm core tube samples from all soil sites
9/12-9/14/95	37E	9-37E	GW only	no soil samples taken

whenever there was a change in operating conditions. Each pump station was also equipped with an LADWP installed and operated electric meter. District personnel read these meters at the same time they read the water meters.

The water delivered to the test site was also metered. The "A" and "B" outlets were each separately metered which allowed for adjustment of the flows to each of the outlet areas. These meters were also read weekly or whenever there was a change in operating conditions.

Water and electric meter readings were entered onto forms developed for each meter site. These forms were delivered to the data processing group on a monthly basis. The data from the forms were then entered onto spreadsheets along with the acreage flooded, derived from the aerial photographs, to allow water delivery costs and water use efficiencies to be calculated.

2.3.6 Soil

Soil samples were collected on the FIP at the same time as the monitoring of the piezometer network. A summary of monitoring episodes is presented in Table 2.3 -1. Prior to flooding, soil samples were collected with a 2-inch diameter soil auger from discrete intervals below the surface (2, 6, 12, 18, and 30 inch depths). Since soil sampling was difficult once flooding began, due to saturated conditions in the wetted area, a soil core tube was used during flooding to collect bulk soil samples from 0-12 inches (0-30 cm) below the surface. Soil samples from dry sites were still collected with a 2-inch auger until April 1994 after which samples from all sites were collected with a soil core tube.

The EC of the soils was measured in the laboratory using the extract from a saturated soil paste. The EC measurements were used to compare vertical salinity differences from site to site as well as lateral changes during the course of the test.

2.3.7 Vegetation

This portion of the project was initially intended to sample soil characteristics on the continuously flooded area to determine its suitability for vegetation, to conduct similar sampling methods on subplots flooded intermittently, and to develop a plan and protocol for establishment of saltgrass (*Distichlis spicata*) on both sites. In practice, the soil sampling was done on the continuously flooded areas and saltgrass plants were actually established on the continuously flooded area using several methods and configurations. In addition, a number of plants established spontaneously on the FIP in the immediate vicinity of the water outlets. These stands were monitored for expansion of live plants using the District's Global Positioning System (GPS). Finally, three subplots were developed for the exclusive purpose of saltgrass planting, using three different methods of introduction. The subplots as actually developed were not part of the flooding project, as water was delivered to them exclusively for the purposes of leaching and plant irrigation, without regard to the function of the water itself as a surface stabilizing measure.

2.4 Pre-construction Monitoring

One of the most difficult aspects of a measurement of effectiveness is the prediction of how much PM-10 would have been produced from the test area if the control measure had not been implemented. Emission factors can change by orders of magnitude in a matter of hours (if there is a precipitation event or a strong wind that breaks down a crust) and at a particular time can vary significantly over the lake bed. In order to have the best chance to determine what changes in emissions were due to the dust control measure, and what changes were just the natural variability of the surface, the District monitored the three control areas and the area to be wetted (test area) during an entire year before the test area was flooded. The same monitoring was then done during an entire year with the test area flooded to determine the effects of the flooding.

2.4.1 Sand

For nearly one year before flooding began (2/22/93 - 1/10/94) the District took measurements both on the area to be flooded (test area) and on three surrounding areas that were not to be flooded (control areas), of meteorology and sand transport according to the same protocols that were to be used after flooding to measure effectiveness. The purpose of these measurements was to determine if there was a consistent relationship between sand transport on the test area and on the control areas. If so, then that relationship could be used to predict, for each event after flooding began, what the sand motion would have been on the test area if it had not been flooded. If there was not a consistent relationship, then statistical methods would be used to estimate the effectiveness over the whole year. Flooding was postponed until both the District and the City of Los Angeles were satisfied that sufficient pre-flooding data had been accumulated. (Appendix H: Letter from Henry Venegas on Baseline Monitoring)

2.4.2 PM-10.

PM-10 Monitors. The low-volume PM-10 monitors were installed on the test area and the three control areas prior to flooding. A total of eleven network-wide measurements were made before flooding began. Five of these measurements were of significant (PM-10 concentrations greater than 150 µg/m3) wind/dust events.

Since, unlike sand, PM-10 particles travel long distances before settling out, a localized decrease in production of PM-10 can be masked by the large amount of still-suspended particles generated upwind. The District did not expect to find a clear and repeatable relationship between PM-10 measurements in the four areas. The intent was to see if a significant reduction in sand motion produced a measurable reduction in observed PM-10.

Wind Tunnel - A portable wind tunnel was run at sites on the North Flood Irrigation Project (FIP) to determine the PM-10 and saltation emission rates before and after the test site was flooded. Pre-flooding runs were done in the spring, fall and early winter in 1993. Post-flooding runs were performed first in June of 1994 when the test area was fully flooded, next in October 1994 when water flow had been drastically cut back, and finally in December 1994 when water again covered large portions of the test area.

2.4.3 Groundwater and Soil

The piezometer network was monitored seven times prior to the beginning of surface flooding. Water level (DTW) and EC data were collected to establish baseline conditions for the shallow groundwater under the test area. Soil samples were collected from nineteen piezometer sites to establish pre-flooding soil EC.

2.4.4 Wildlife

Observations of the North Flood Irrigation Project area prior to flooding revealed very little wildlife activity. Common ravens were usually observed, but were not plentiful. The general aspect of the pre-flood Owens Lake playa could easily be summed up as "lifeless." A very few snowy plovers and their nests were observed in Spring of 1991 in the general area of the FIP.

3.0 RESULTS

3.1 Air Quality

In order to determine through air quality modeling if implementation of a measure will achieve the National Ambient Air Quality Standard (NAAQS), the District must have an accurate measurement of the reduction in the PM-10 emission factor to be expected from the measure. The District has used a variety of techniques to estimate the PM-10 emission reduction effectiveness of flood irrigation. The techniques include inferred PM-10 from sand motion measurements (three methods), and direct PM-10 measurements from monitors and a portable wind tunnel.

3.1.1 Sand Motion.

The sand motion data from sand transport samplers (STS) and Sensits™ were graphed along linear transects for those storms aligned within 15 degrees of those transects, and over the entire study area for all storms.

During the pre-construction monitoring period (2/22/93 through 1/10/94, henceforth referred to as the DRY period) there were 25 collections from the sand transport samplers. The Sensit™ data showed 71 distinct storms; 32 from the north and 39 from the south. All of these data are summarized in Appendix I. Although there were fewer storms from the north, the total Sensit™ count (proportional to sand mass) at 326A-15 during north winds was 2.5 times that for south winds (N winds = 8722, S winds = 3799).

Pumping began for the Flood Irrigation Project on January 10, 1994. First only the "A" Outlets were opened - then on January 20, 1994 the "B" outlets were opened. It took until the beginning of March for the entire area to be flooded fairly uniformly. Sand transport samples were taken during this transition period, but those data were not used for the effectiveness calculation.

During the period from 3/15/94 to 3/8/95 (henceforth referred to as the WET period), there were 14 collections of the Sand Transport Samplers and 77 distinct storms measured on the Sensits™. Thirty-six of these storms were from the North, and 41 from the South. The total Sensit™ count from the North was nearly twice that from the South (N winds = 3560, S winds = 1878). Total Sensit™ counts from the WET period were less than half those of the DRY period, indicating less sand movement.

The "A" outlets were turned off on July 14, 1994 and turned on again on October 17, 1994 to test the theory that water does not need to be applied to the lakebed during the high-evaporation summer months. Data were collected during this time, but there were no events large enough to qualify as Sensit™ storms from 7/19/94 to 9/13/94 across the study area. Some sand was collected in the sand transport samplers.

After March of 1995, flooding was turned on and off to test various flooding schedules and to facilitate planting of saltgrass. No more aerial photographs were taken to document coverage during this time. After January of 1996, the test area was generally allowed to return to its dry condition. The post-flooding period is defined as 1/30/96 through 4/12/96.

Sand Transport Sampler Data for the 326/146 Transect
Each of the 25 collections of the sand transport samplers during the pre-flooding (DRY) period and the 14 collections during the flooded (WET) period yielded two sand weights for each of the 17 locations along the 326/146 transect: that collected during the period for storms from the NW (326°) and that collected from the SE (146°) quadrants. The collectors are fairly efficient for winds at angles up to 45 degrees from the orientation of the inlet, and the collection at a height of 10 cm has been shown to be representative of the total sand motion for flat surfaces. (Ono et al, 1994)

For the DRY period, 10 of the 25 North (326°) and 9 of the 25 South (146°) collections were eliminated because either many of the samplers were empty (the storm was from the other direction) or were overloaded. For the WET period, 3 of the 14 North and 4 of the 14 South collections were eliminated for the same reasons. All of the remaining data, regardless of wind direction, were included in the following analysis.

Only six collections occurred during the post-flooding (DRIED) period, and none were omitted. Appendix J includes all of the data analyzed, and the profiles for each storm. Note the consistent shape of the DRY profiles. The effect of flooding can be seen in each WET profile. In the DRIED period, the profiles returned to shapes similar to those observed in the DRY period.

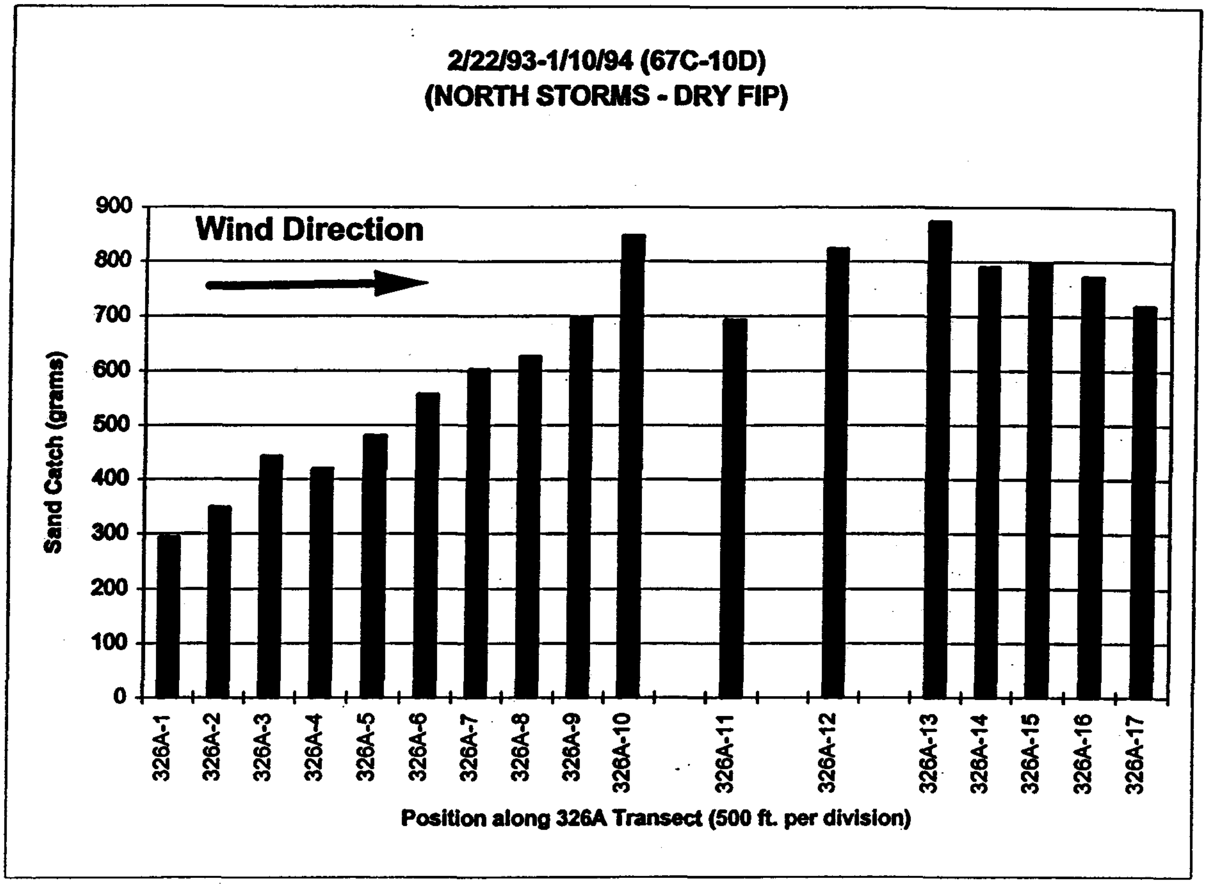
Figure 3.1 - 1 shows the average sand collection from the collectors pointed in the 326 (North) and 146 (South) direction during the DRY period. The surface at the north end of the transect yields less sand than the surface at the south end, with the maximum catch at A-10 through 13. This might indicate a "fetch length" effect except for the fact that the profile for south winds is similar. The maximum catch appears to be further north for south winds.

Figure 3.1 - 2 shows the average sand collections for the north and south winds during the WET period. The effect of the flooding the test area (A-8 through 11 for North winds and A-6 through 10 for South winds) is clear. For a few of the storms the easternmost outlets ("A") were turned off.

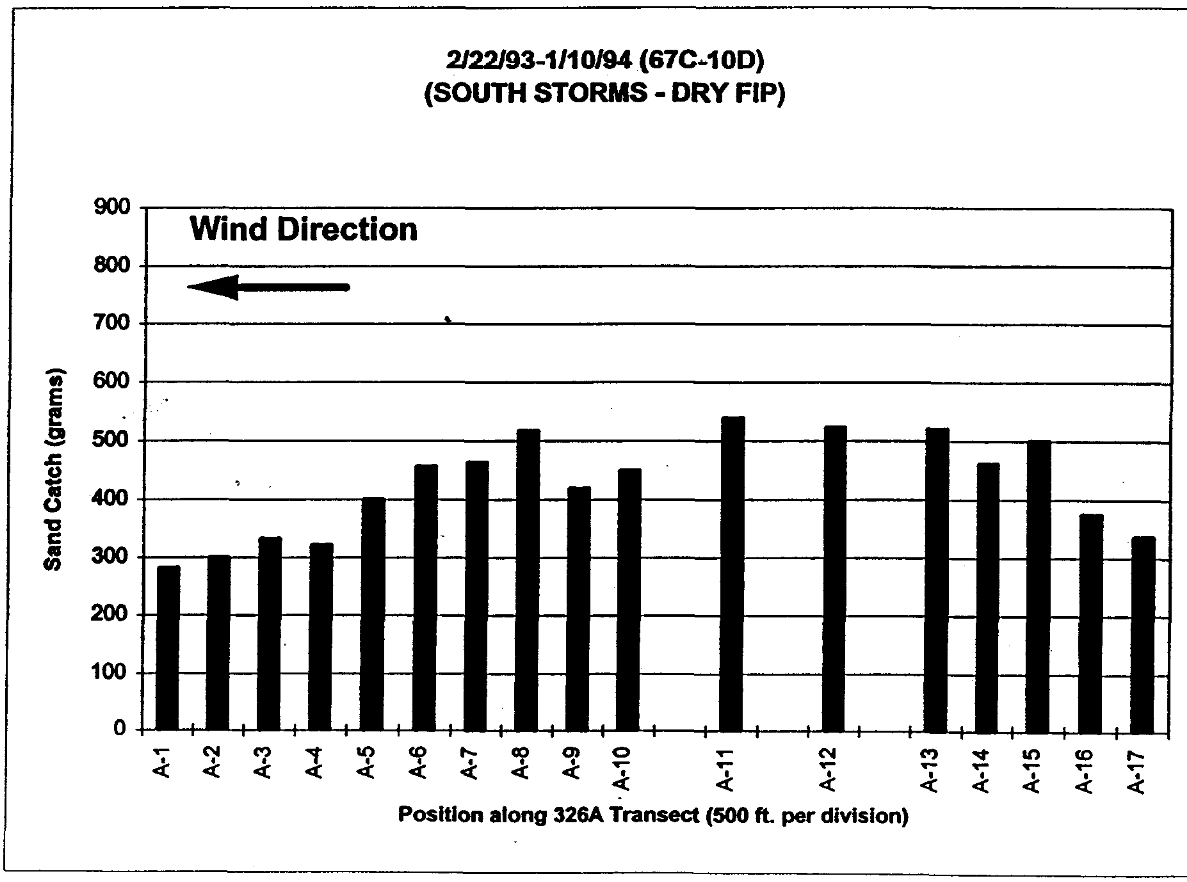
Figure 3.1 - 3 shows the average sand collections for the north and south winds after the test area had recovered from flooding in 1996.

An average effectiveness number can be calculated for each collector from the formula

$$\frac{\text{DRY} - \text{WET}}{\text{DRY}}$$

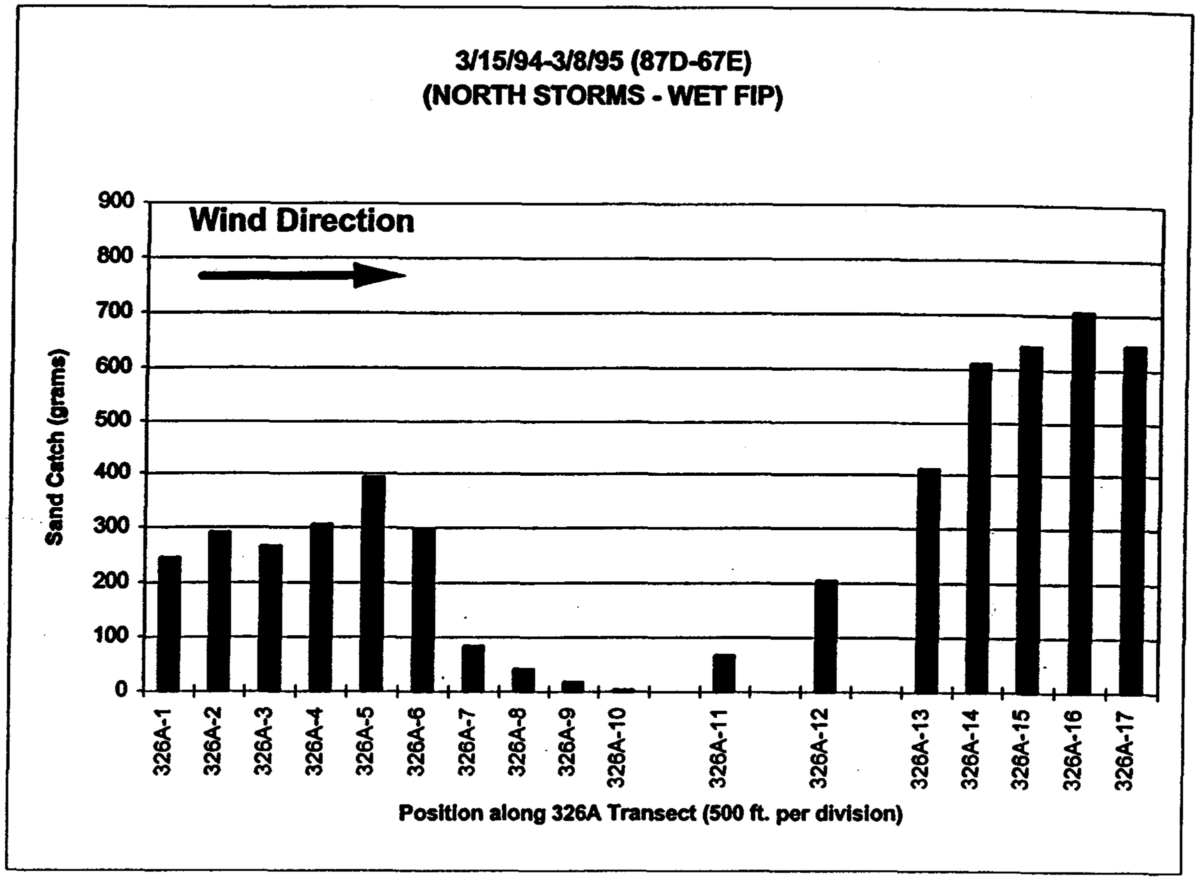


2/22/93-1/10/94 (67C-10D)
(NORTH STORMS - DRY FIP)
Wind Direction
Sand Catch (grams)
900
800
700
600
500
400
300
200
100
0
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft. per division)



2/22/93-1/10/94 (67C-10D)
(SOUTH STORMS - DRY FIP)
Wind Direction
Sand Catch (grams)
900
800
700
600
500
400
300
200
100
0
A-1
A-2
A-3
A-4
A-5
A-6
A-7
A-8
A-9
A-10
A-11
A-12
A-13
A-14
A-15
A-16
A-17
Position along 326A Transect (500 ft. per division)

Figure 3.1-1


3/15/94-3/8/95 (87D-67E)
(NORTH STORMS - WET FIP)
Wind Direction
Sand Catch (grams)
0
100
200
300
400
500
600
700
800
900
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft. per division)

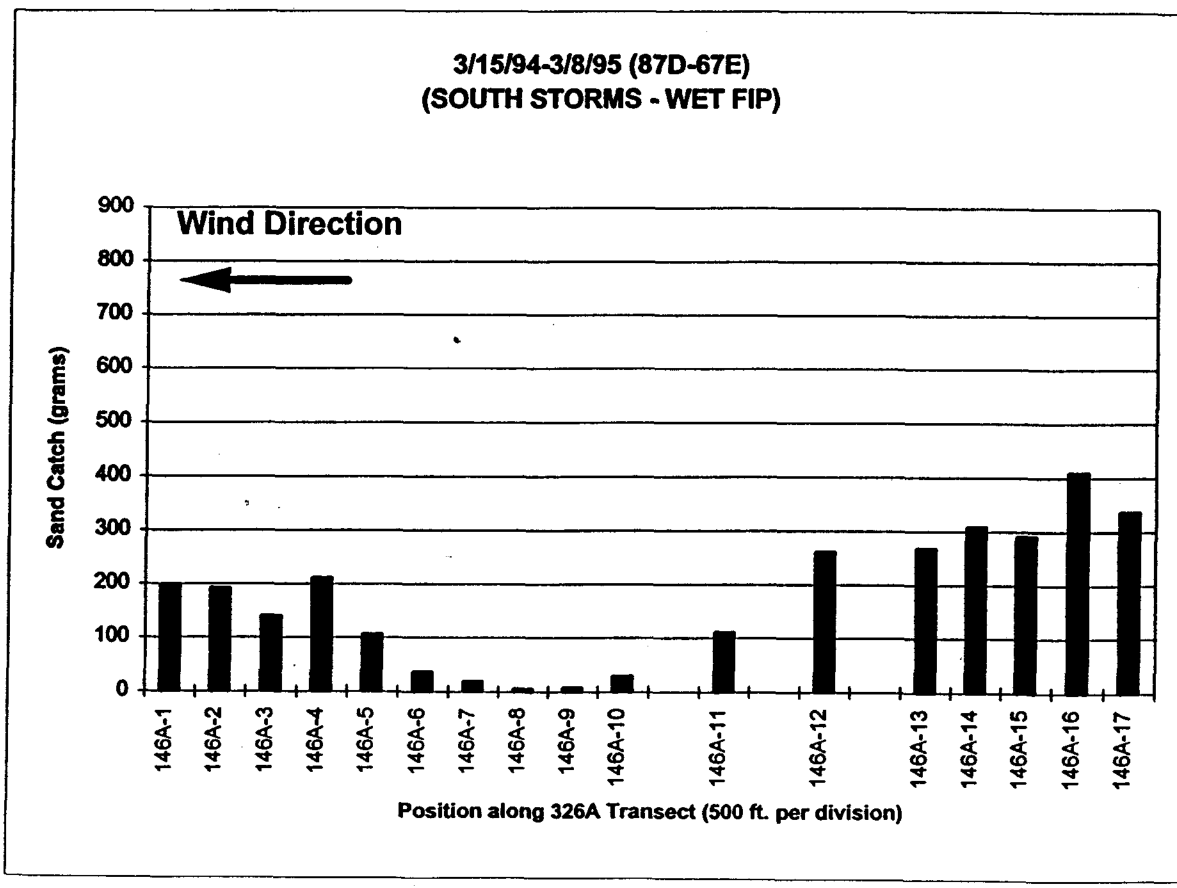
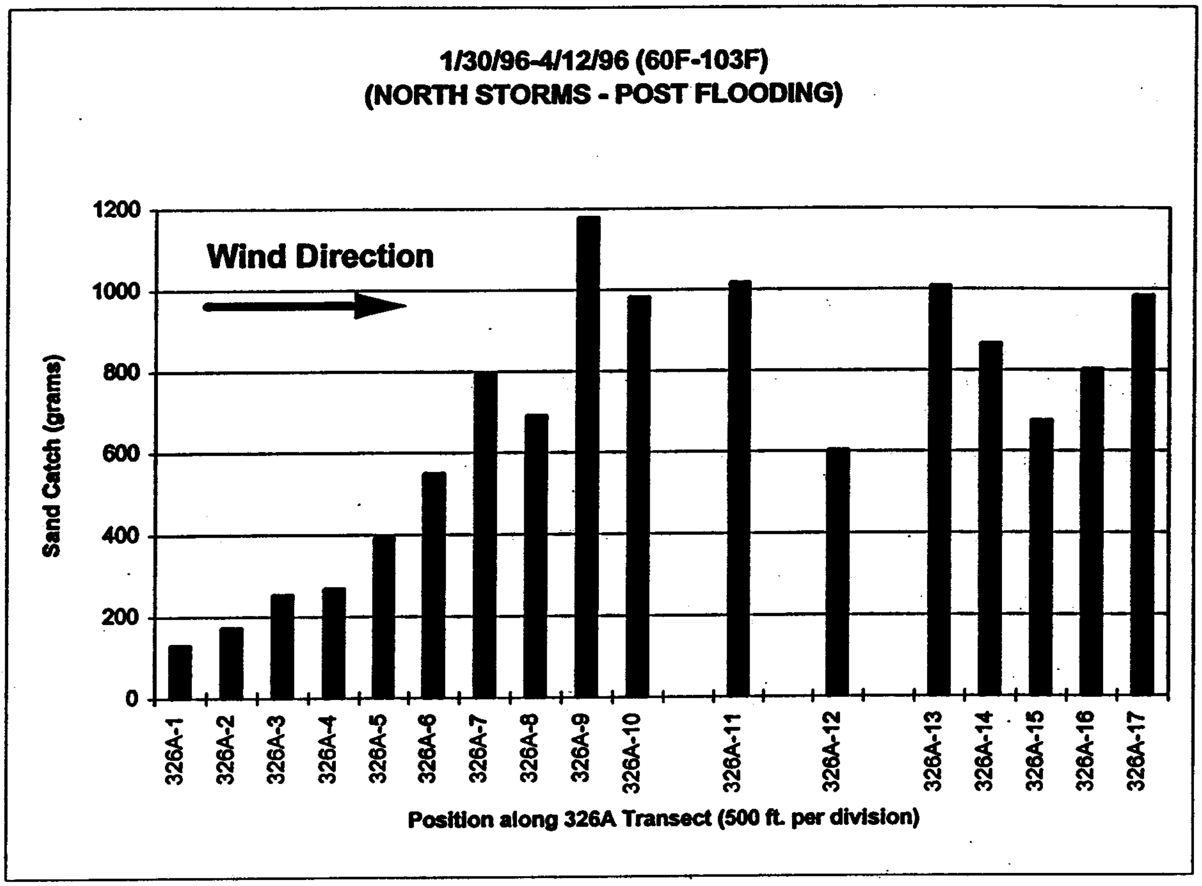

3/15/94-3/8/95 (87D-67E)
(SOUTH STORMS - WET FIP)
Wind Direction
Sand Catch (grams)
0
100
200
300
400
500
600
700
800
900
146A-1
146A-2
146A-3
146A-4
146A-5
146A-6
146A-7
146A-8
146A-9
146A-10
146A-11
146A-12
146A-13
146A-14
146A-15
146A-16
146A-17
Position along 326A Transect (500 ft. per division)

Figure 3.1-2


1/30/96-4/12/96 (60F-103F)
(NORTH STORMS - POST FLOODING)
Wind Direction
Sand Catch (grams)
0
200
400
600
800
1000
1200
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft. per division)

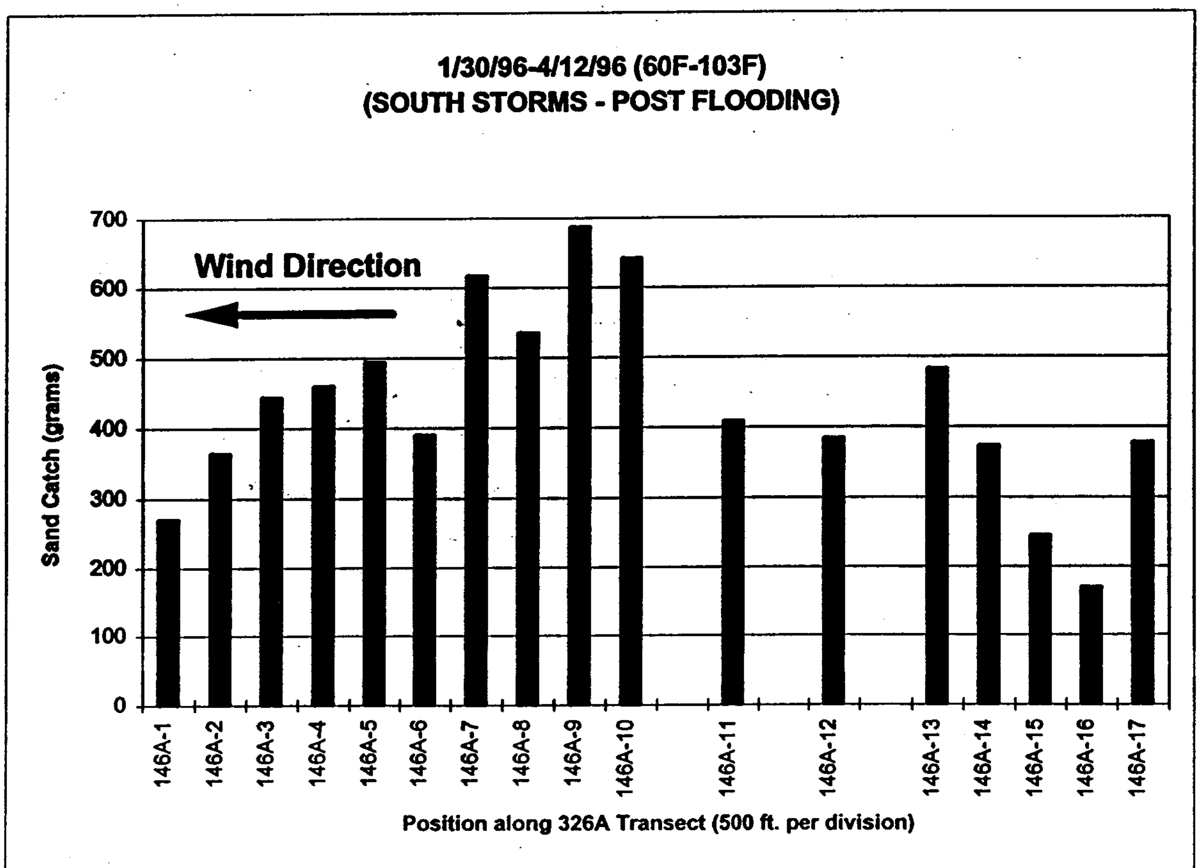

1/30/96-4/12/96 (60F-103F)
(SOUTH STORMS - POST FLOODING)
Wind Direction
Sand Catch (grams)
0
100
200
300
400
500
600
700
146A-1
146A-2
146A-3
146A-4
146A-5
146A-6
146A-7
146A-8
146A-9
146A-10
146A-11
146A-12
146A-13
146A-14
146A-15
146A-16
146A-17
Position along 326A Transect (500 ft. per division)

Figure 3.1-3

once the profiles are adjusted to account for the difference in the amount of sand moving across the study area in the two years. As discussed above, there was more sand movement on the study area in the DRY period than in the WET period. Figure 3.1 - 4 shows the DRY and WET profiles for North and South winds, shown as lines rather than bars in order to get more than one graph on a page. More sand motion was observed in the DRY period, so those profiles were decreased by a factor that made the average value for the control areas coincide (normalized).

Figure 3.1 - 5 shows the average effectiveness of flooding for North and South winds. The North Control, Test and South Control areas are identified, and an average effectiveness for each of those areas is calculated. A-5 and 11 for South winds and 7, 12 and 13 for North winds were considered transitional, since sometime they were affected by flooding, and sometimes they were not. (See Appendix M for the maps of the flooded areas during the WET period.) During storms the wind moved the water downwind, accounting for some of the transitional designations.

The flooding of the test area averaged over 90% effectiveness along the 326/146 transect. The error on this can be estimated from the average effectiveness on the controls (which should be zero) at about 10%.

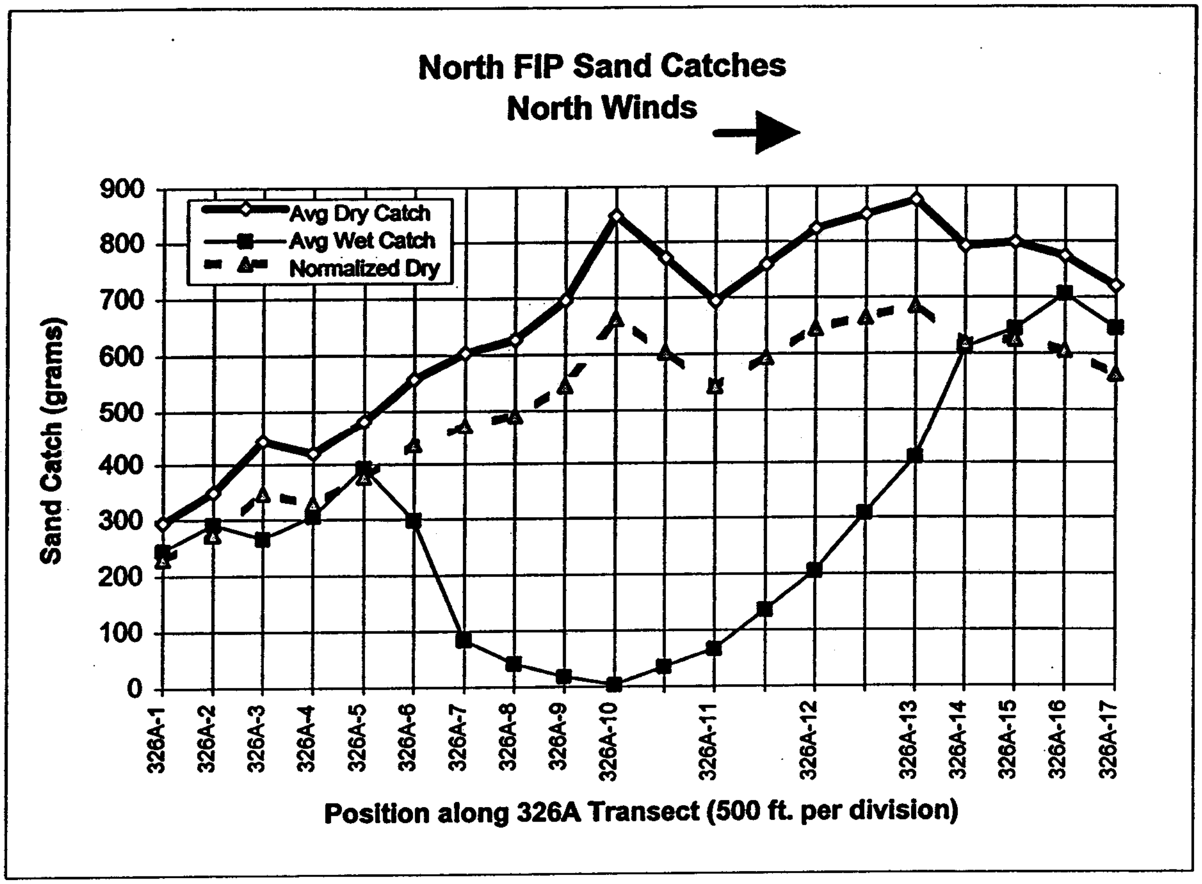
Sand Transport Sampler Data On the Entire Study Area

As shown in Figure 2.2-1, area-wide sampling was performed with a two-dimensional STS network that provided sand flux information for the entire test area. Valid sand flux data for the area-wide network could be obtained whenever sand motion was within 45 degrees of the sampler inlet directions. As described in Section 2.3.1, these data were used to generate two-dimensional sand flux maps for the test area. This information was then used to determine the control efficiency for the wet areas based on the changes in the sand flux in each region during a storm.

Figure 3.1- 6 through 3.1-9 show examples of gridded sand flux maps for north and south storms before and after flooding the test area. The effectiveness of the wet area to control dust was estimated by comparing the average sand flux from the wet area to the average sand flux in two control areas during the same storm. Three regions common to each of the four examples shown in the figures were used for the effectiveness estimate. These are labeled A, B and C, with B being the wet test section. Although the sand flux in region A often differs strongly from that in region C, the average of these two areas will generally result in under-estimates for the uncontrolled emissions and the control efficiency for region B. The simplified equation for the control efficiency, E, is;

$$E = 1 - 2B/(A+C)$$

where A, B, and C are equal to the average sand flux ($g/cm^2/hr$) per grid square in each of the respective regions.


North FIP Sand Catches
North Winds
Avg Dry Catch
Avg Wet Catch
Normalized Dry
Sand Catch (grams)
900
800
700
600
500
400
300
200
100
0
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft. per division)

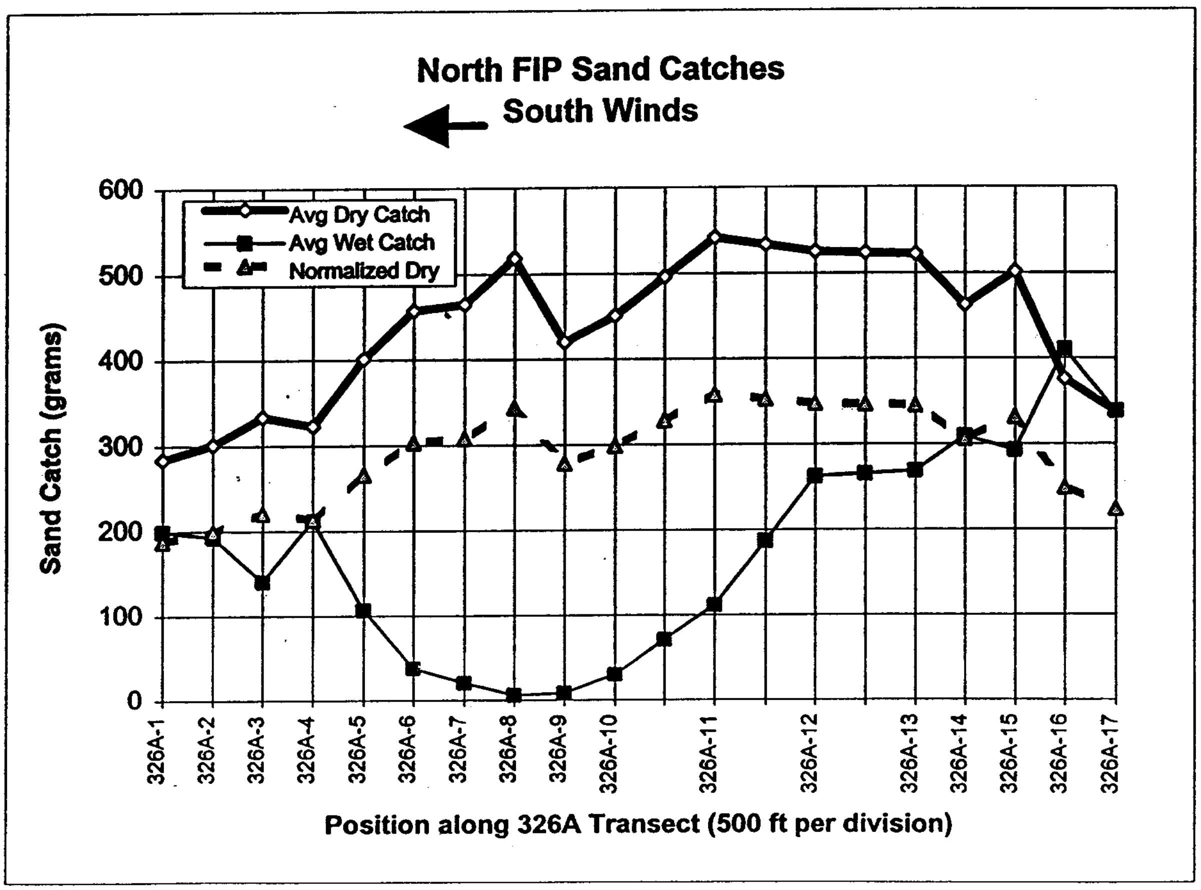
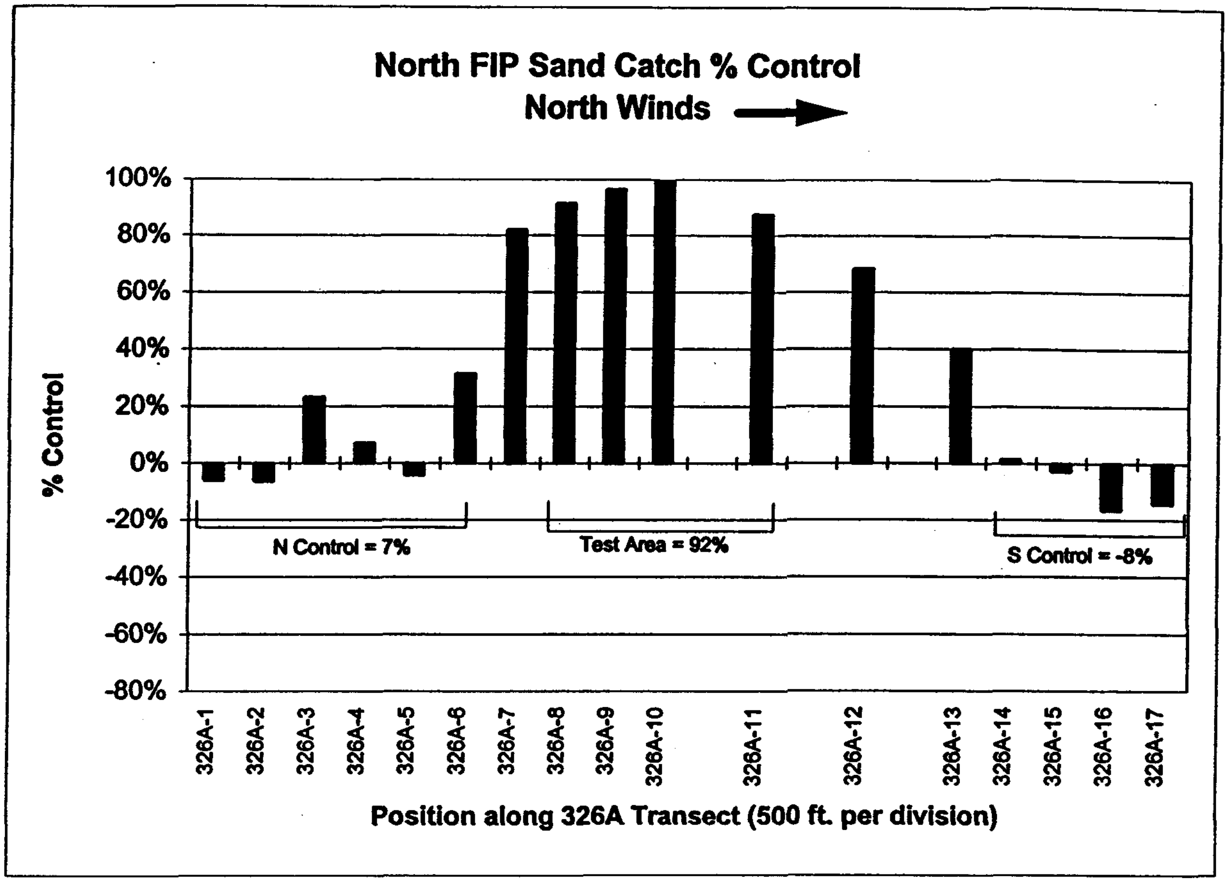

North FIP Sand Catches
South Winds
Avg Dry Catch
Avg Wet Catch
Normalized Dry
Sand Catch (grams)
600
500
400
300
200
100
0
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft per division)

Figure 3.1-4


North FIP Sand Catch % Control
North Winds
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
-80%
% Control
N Control = 7%
Test Area = 92%
S Control = -8%
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft. per division)

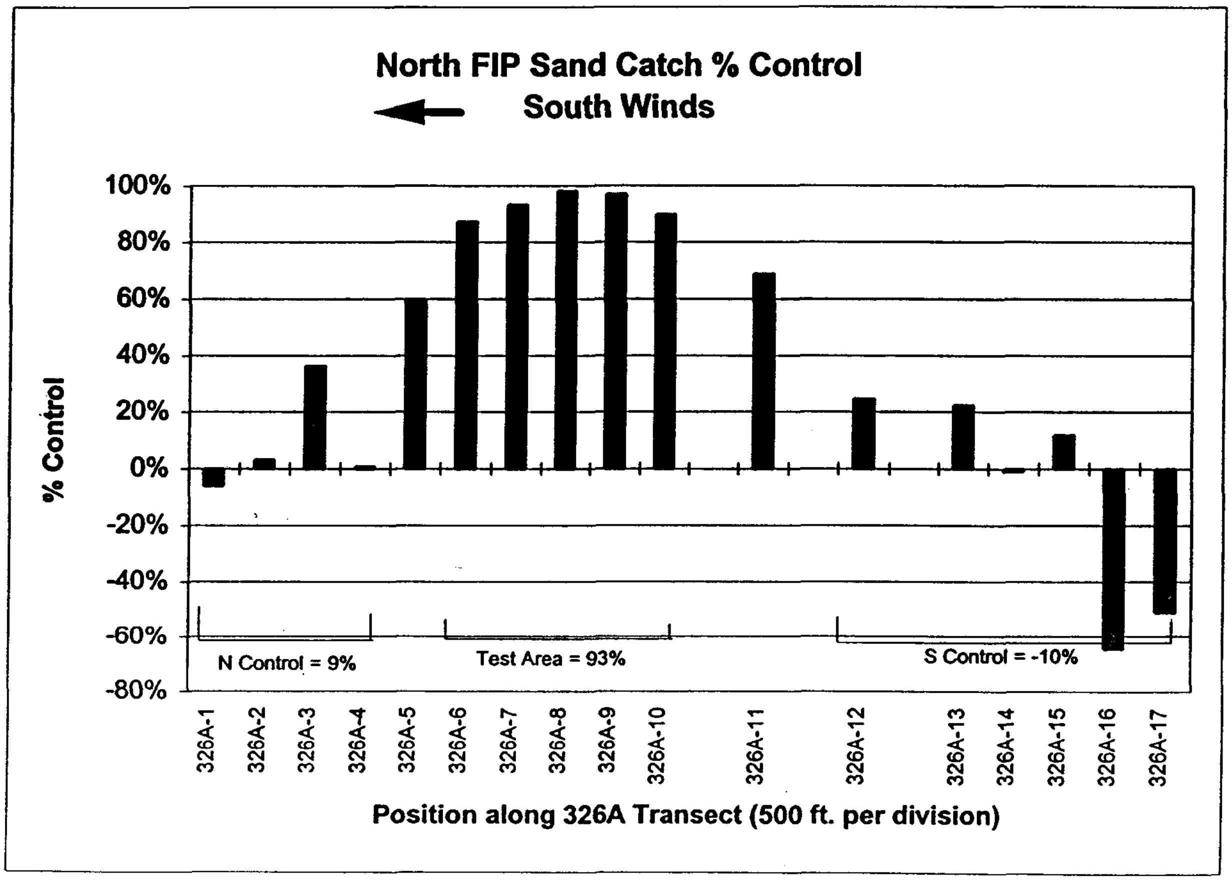

North FIP Sand Catch % Control
South Winds
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
-80%
% Control
N Control = 9%
Test Area = 93%
S Control = -10%
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft. per division)

Figure 3.1-5

Gridded Sand Flux (gm/cm2/hr)
North Storm (10/26/93)

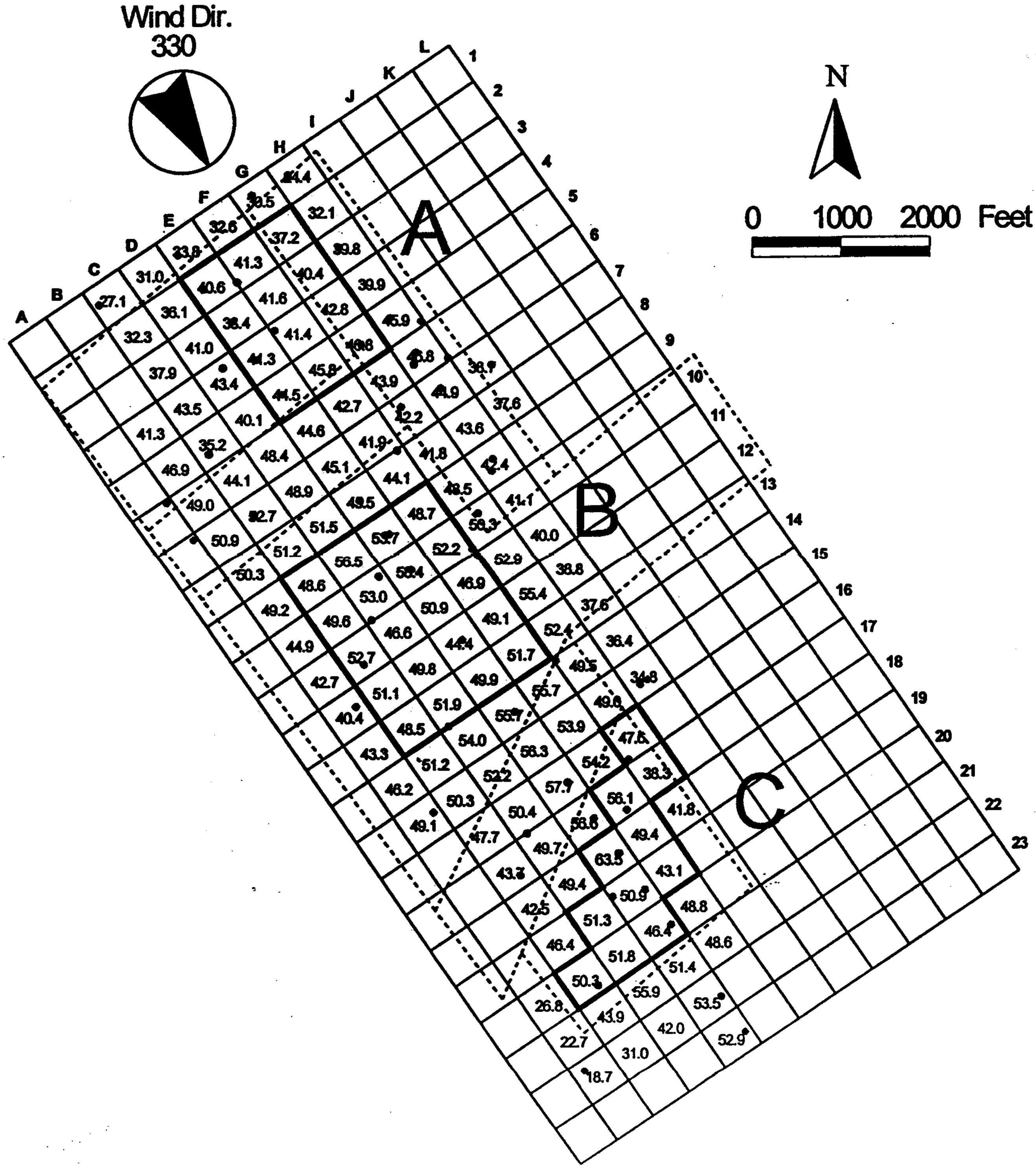


Figure 3.1-6

Gridded Sand Flux (gm/cm2/hr)
North Storm (11/26/94 - 12/8/94)
Aerial Photo (11/30/94)

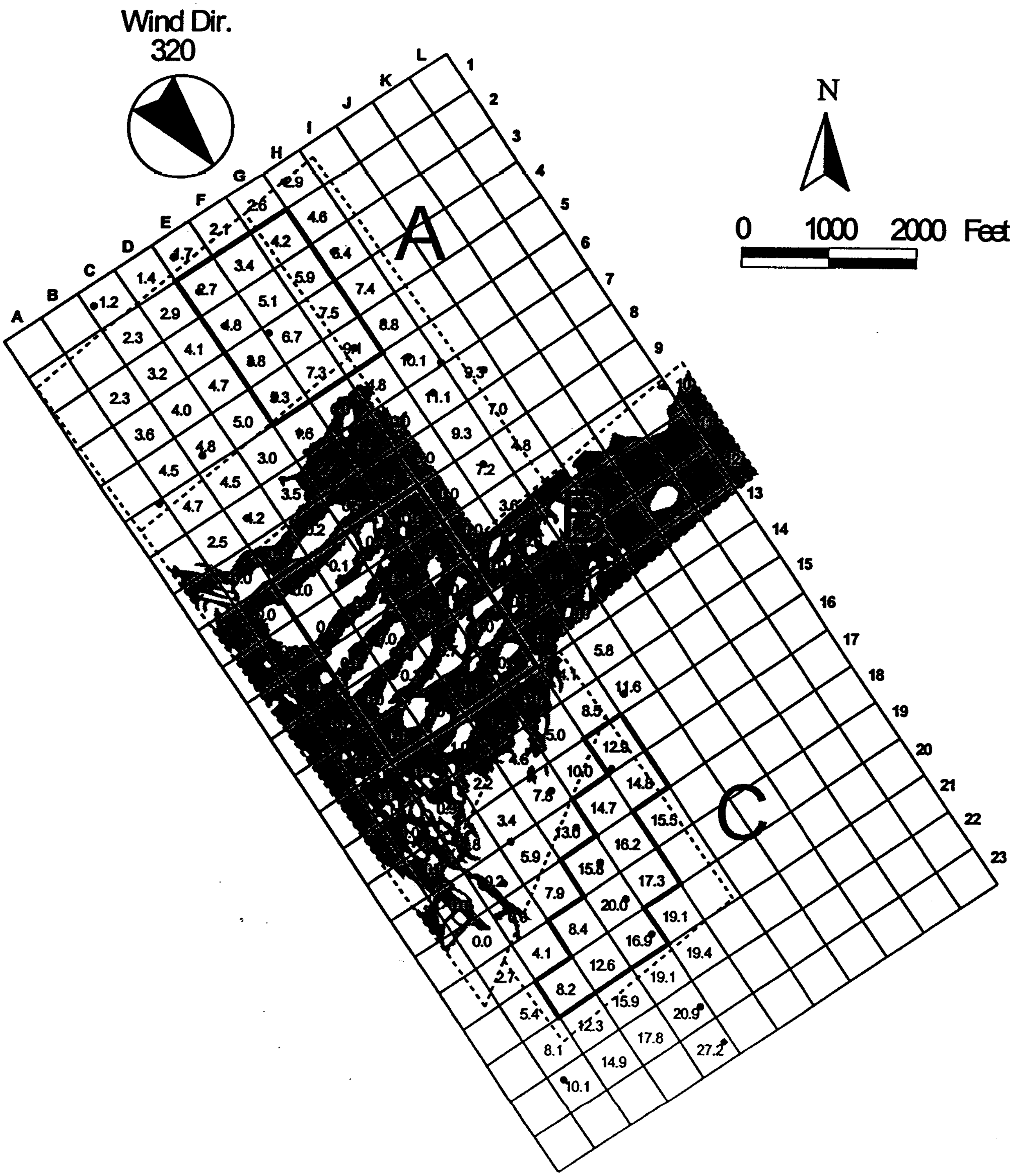


Figure 3.1-7

Gridded Sand Flux (gm/cm2/hr)
South Storm (5/10/93 - 5/15/93)

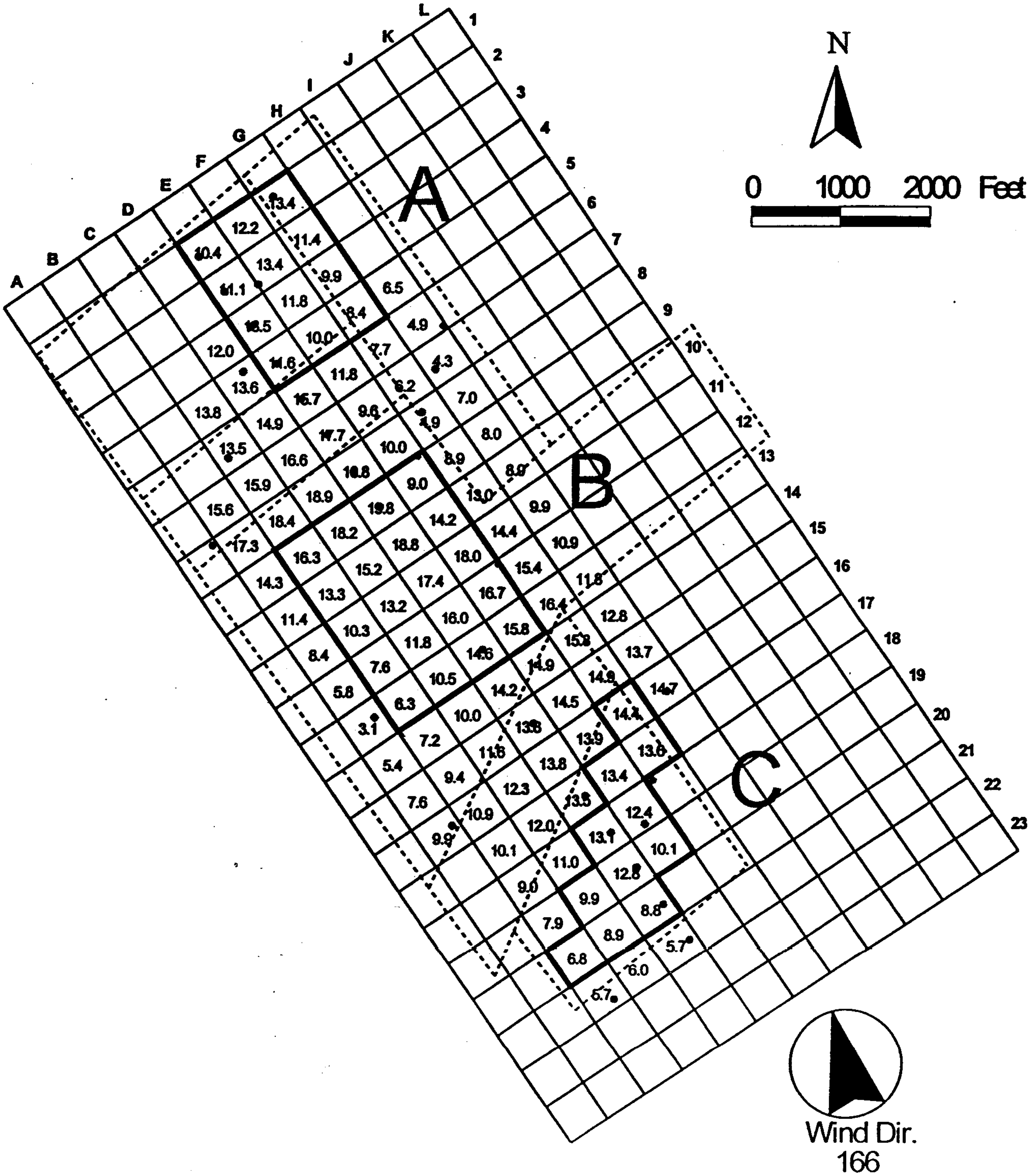


Figure 3.1-8

Gridded Sand Flux (gm/cm2/hr)
South Storm (2/16/94)
Aerial Photo (10/27/94)

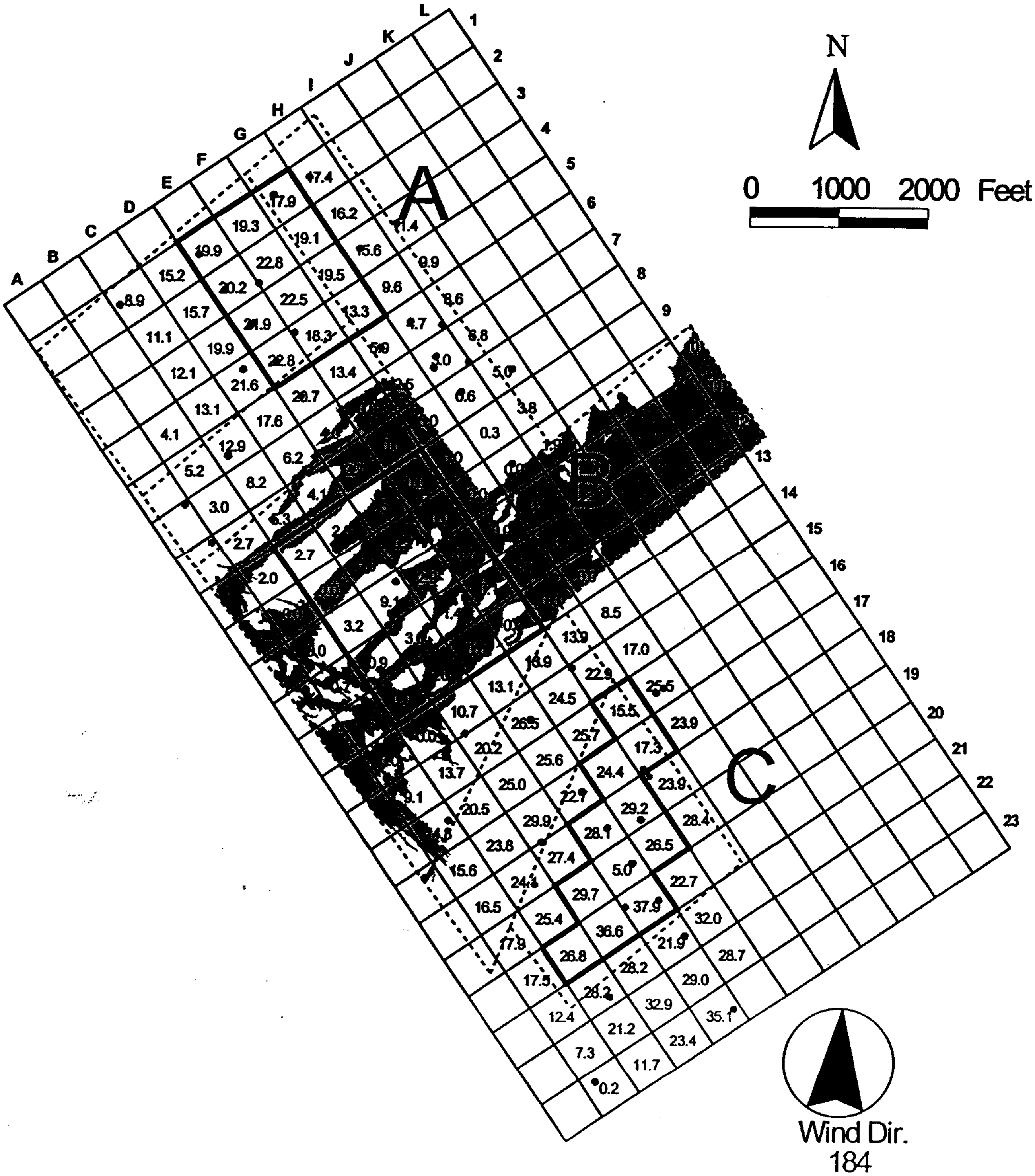


Figure 3.1-9

The control efficiencies for the four example storm periods are shown in Table 3.1- 1. The control efficiencies for these examples show no effect for the dry period, and 94% and 99% during the wet periods, with water coverages of 64% and 71% respectively. The negative efficiencies for the dry FIP runs result from underestimating the uncontrolled emissions for region B.

Table 3.1-1. Example FIP Control Efficiencies Using Two-Dimensional Sand Flux Data.

Storm Dates	Storm Dir.	Regional Sand Flux ($g/cm^2/hr$) A	B	C	Percent Efficiency	Water Cover
Dry Runs						
5/10/93 - 5/15/93	South	11.4	14.2	11.0	- 26%	0%
10/26/93	North	41.8	50.3	49.6	- 10%	0%
Wet Runs						
2/16/94	South	19.8	1.4	25.2	94%	64%
11/26/94 - 12/8/94	North	5.5	0.1	13.5	99%	71%

Appendix K includes two dimensional sand flux maps for the dry and wet FIP runs in 1993 and 1994. A summary table of the control effectiveness calculations is also included for each sample period. These effectiveness calculations are not reliable for episodes when region A has little or no sand movement, because it is possible that sand flux in region B would also have been low in an uncontrolled condition. Figure 3.1 - 10 shows all the reliable effectiveness measurements plotted against the percent of area B covered with water during that measurement.

Sensit™ Data for the 326/146 Transects

Pre-flooding (DRY Period) Eighteen of the 32 north storms and two of the 39 south storms collected from 2/22/93 - 1/10/94 had average weighted wind directions within 15 degrees of the direction of the Sensit™ transect, which was oriented at 326/146 degrees (the prevailing wind direction from the north). The Sensit™ data for these 20 storms are shown in Appendix L. The profiles appear to fall into two classes. Five of the profiles are approximately flat (Flat). Fifteen of the profiles (Standard) show low values at the north end of the transect (Sensit™ 1), rising to a peak at about Sensit™ 11 or 12, and a slow decrease to the south end (Sensit™ 17). This is true whether the wind came from the north or the south, although the peak for south winds is slightly further north (See profiles for July 15 and October 4, 1993). The Standard profiles, although similar in shape, are not all the same. For the north storms, the ratio of the north to the south control areas varies from .07 to .58.

We were unable to discover a meteorological difference between the storms with Flat and Standard profiles. Since in the Spring of 1993 for instance, the Flat profiles occurred in a group over two months, we suspect a change in crust conditions. The dominant Standard profile was restored in June and continued throughout the summer.

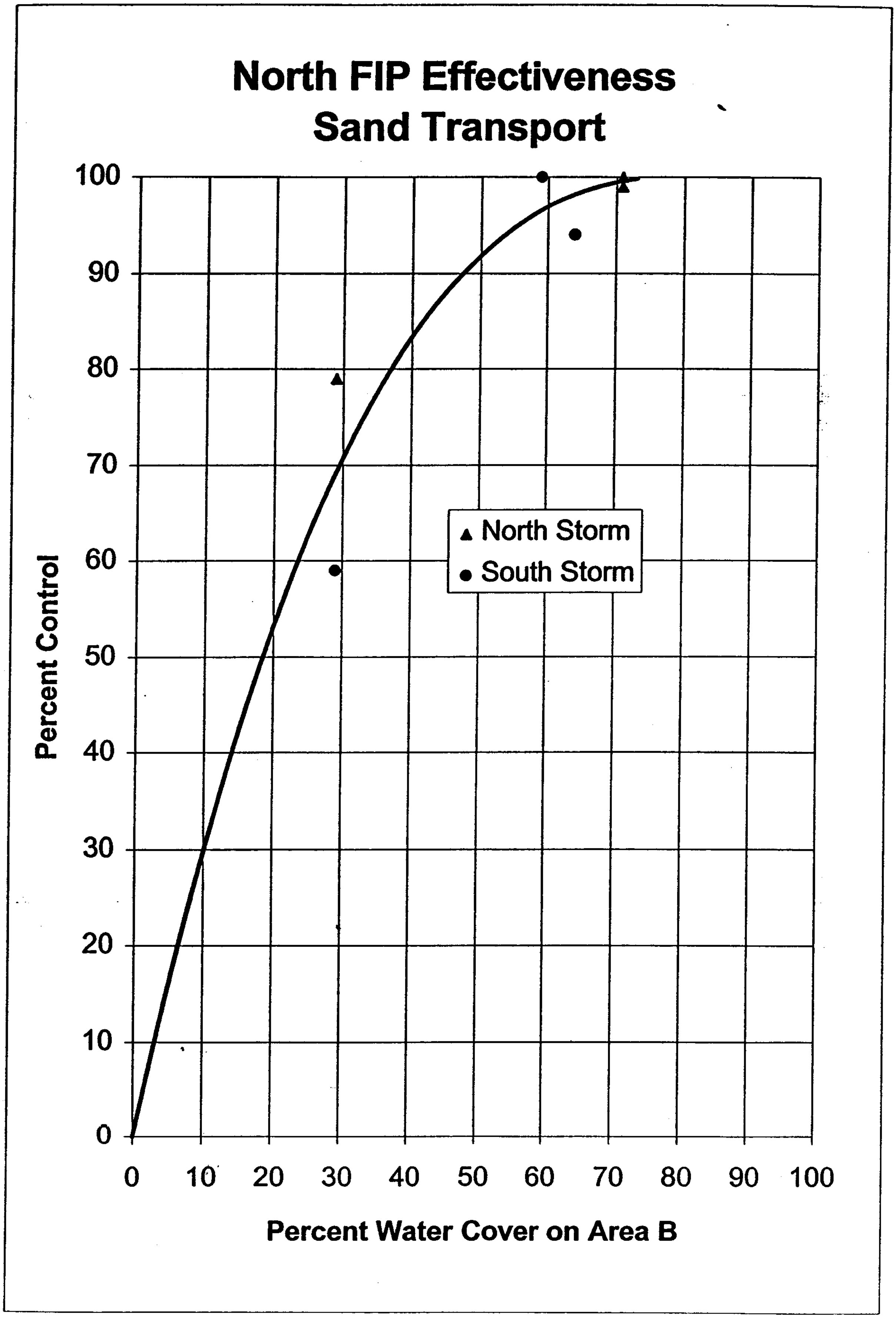

North FIP Effectiveness
Sand Transport
Percent Control
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Percent Water Cover on Area B
North Storm
South Storm

Figure 3.1-10

Post-flooding (WET Period). During the period from 3/15/94 to 3/8/95, of the 77 distinct storms measured on the Sensits, 14 storms were aligned within 15 degrees of the transect, all from the north. Four were Flat, and 10 were Standard. These profiles are also shown in Appendix L. The ratios of the north to the south control area for the Standard profiles varied from .01 to .40. The four storms with ratios of less than .04 were removed from the data set because there was so little sand motion on the north control that it was not possible to be sure that movement would have occurred on the flooded area if it had not been flooded.

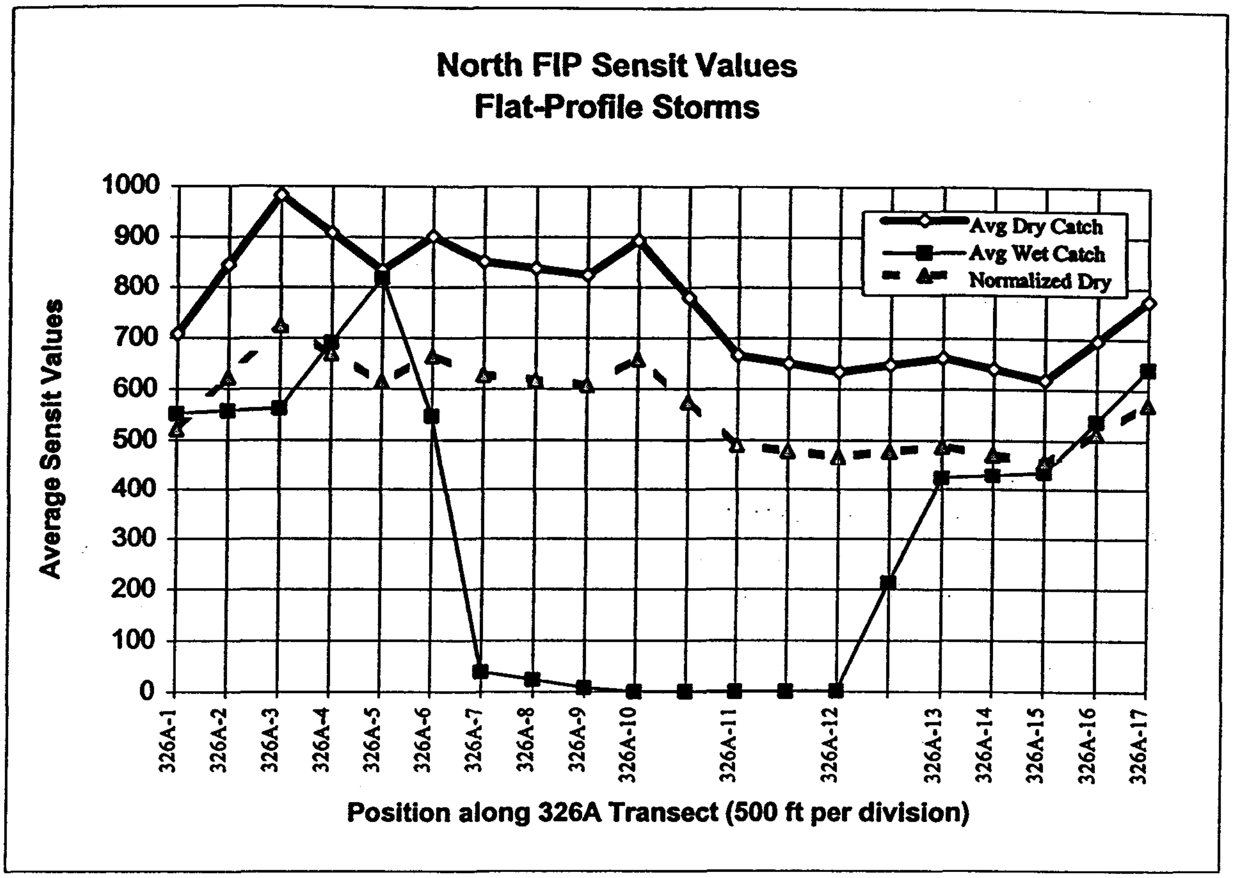
Effectiveness The assumption underlying this analysis is that when the control areas in the WET period are similar to the control areas in the DRY period, the test areas also would have been similar. When the North and South control areas have roughly equal sand motion, it is assumed that the study area profile would have been flat in the absence of flooding. When the North control area sand motion is significantly less than that of the South control area, it is assumed that there would have been a standard profile across the study area in the absence of flooding.

Flat Profiles: Of the five flat DRY period profiles, one had overloaded sand catches and another had two Sensit malfunctions. These were eliminated from further analysis. The remaining three profiles were averaged as shown in Figure 3.1-11. The average of all four WET flat profiles is also shown in Figure 3.1-11.

Since we could not expect that exactly the same amount of sand would move across the site in the DRY and WET periods, the DRY profile was multiplied by .74 so that the profiles in the control areas coincided. Then the percent effectiveness of flooding was calculated in the test area by the formula (DRY - WET)/DRY. The results are presented in Table 3.1-2 and Figure 3.1-11 for the flat profiles. These data show approximately 100% control of sand motion in the flooded area. The time period over which these WET profiles were taken coincided with very good coverage of water on the test area (See Figure 3.1-12 - from aerial photo taken January 3, 1995 showing 89% coverage) and very low evaporation. The error, estimated from the average effectiveness on the control areas (which should be zero) is 5%.

Standard Profiles In order to compare similar situations, a set of 10 DRY storms with standard profiles was chosen that had a similar ratio of north to south control areas (0.19) as the set of 7 WET storms (0.18). The data appear in Table 3.1-3 and the average profiles are shown in Figure 3.1-13.

Effectiveness was calculated the same way as for the flat profiles. Figure 3.1-13 shows about 95% control for the standard profiles in the consistently flooded areas (Sensit locations A-9 through 12). The error on this is estimated at about 5 to 10 %. The difference in effectiveness between the flat and standard profiles is probably explained by the variation in amount of area wetted during the period the standard profile data were taken. Standard profile storms occurred from 4/3/94 though 3/6/95, and water coverage varied from 30 to 80%. (See Appendix M.)


North FIP Sensit Values
Flat-Profile Storms
Avg Dry Catch
Avg Wet Catch
Normalized Dry
Average Sensit Values
1000
900
800
700
600
500
400
300
200
100
0
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft per division)

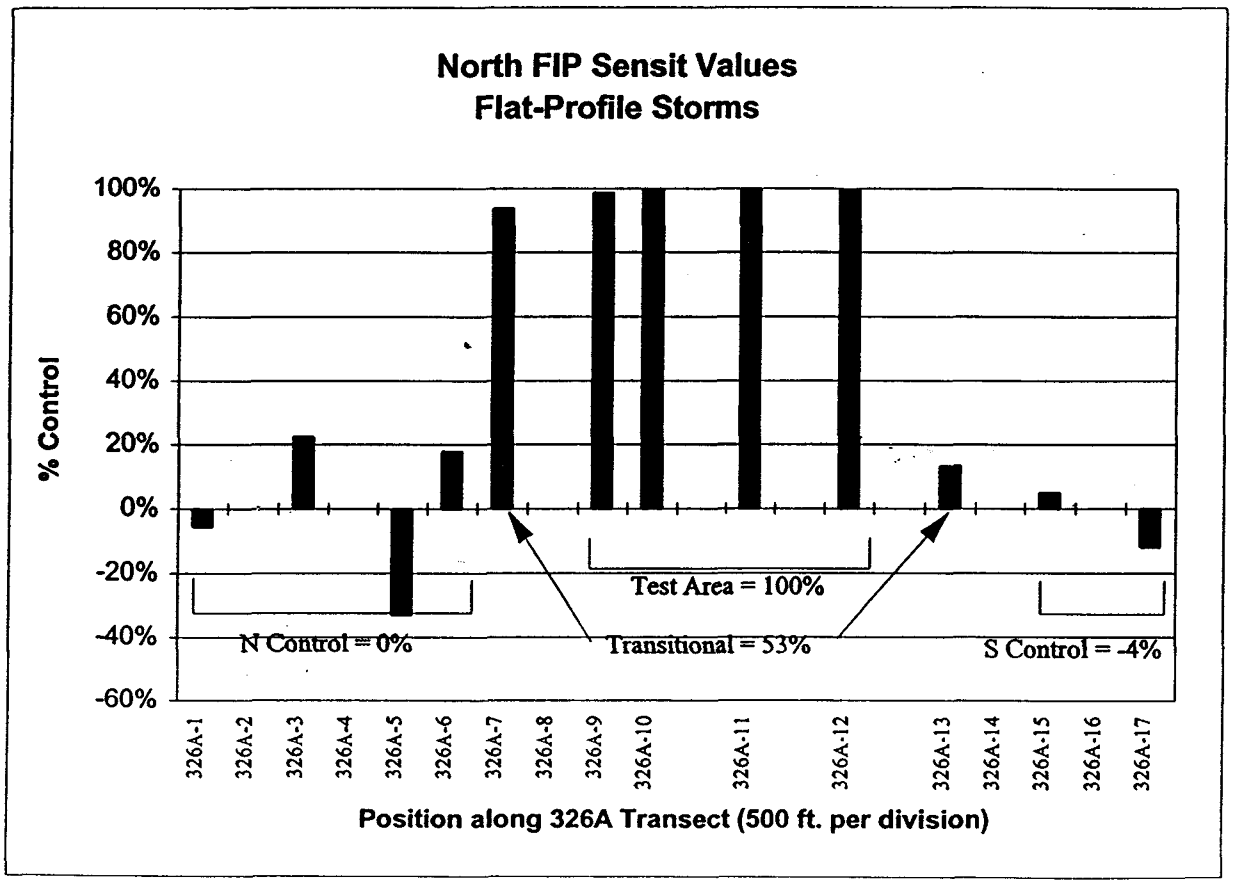

North FIP Sensit Values
Flat-Profile Storms
% Control
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
Test Area = 100%
N Control = 0%
Transitional = 53%
S Control = -4%
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft. per division)

Figure 3.1-11

Table 3.1-2

North FIP Sensit Values
Flat-Profile Storms

	WET					DRY			
	11/16/94	11/18/94	12/25/94	2/14/95	Average	4/12/93	4/22/93	4/23/93	Average
326A-1	14	913	1018	262	552	1163	328	633	708
326A-3	14	1103	823	312	563	1688	437	823	983
326A-5	212	1347	1268	448	819	1285	457	761	834
326A-6	21	949	890	327	547	1362	664	679	902
326A-7	0	2	142	14	40	1190	682	681	851
326A-9	0	1	0	31	8	1124	538	812	824
326A-10	0	0	0	2	0	1302	622	756	893
326A-11	0	1	0	0	0	996	441	562	666
326A-12	1	7	0	0	2	969	349	585	634
326A-13	7	429	1258	0	424	1028	344	614	662
326A-15	76	1355	255	51	434	1069	312	475	619
326A-17	117	915	1148	379	640	1414	429	480	774

Wet "Control" Average = 592

Dry "Control" Average = 803

FIP Surface Coverage
1/3/95

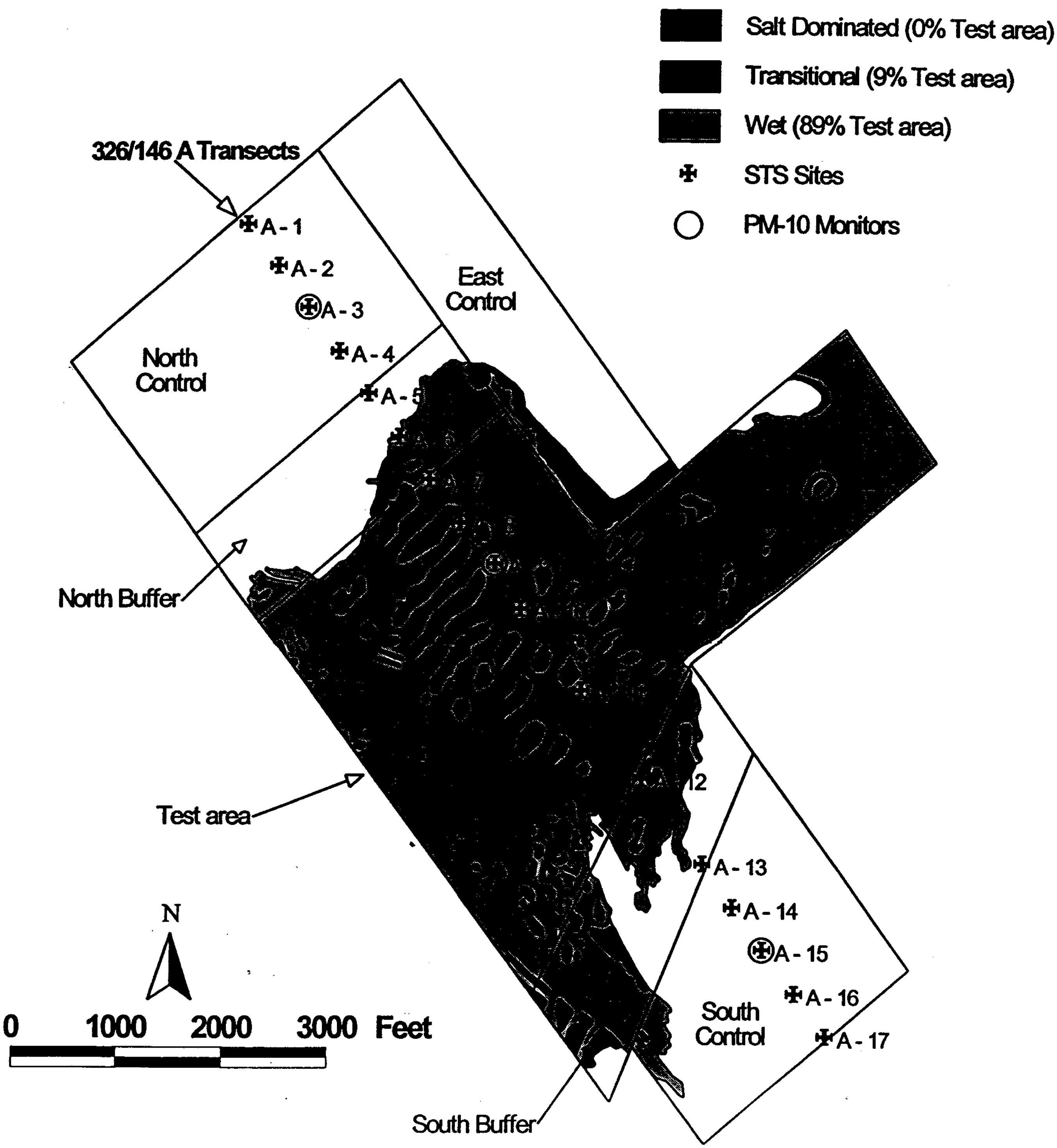


Figure 3.1-12

Table 3.1-3

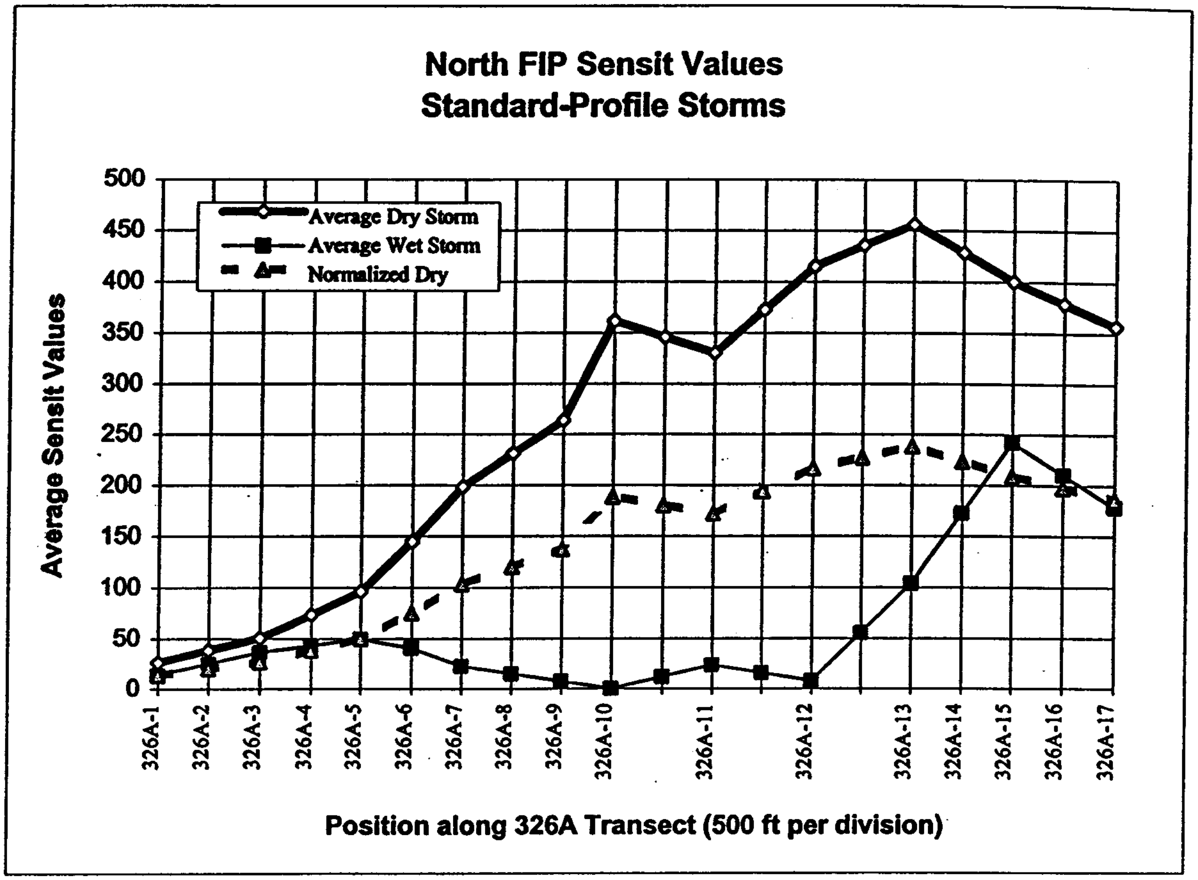
North FIP Sensit Values
Standard-Profile Storms

Dry	2/27/93	3/3/93	3/11/93	4/5/93	6/2/93	6/10/93	7/15/93	9/12/93	11/30/93	12/1/93	Average
326A-1	6.3	7.0	50.8	71.7	33.8	0.0	0.6	12.1	52.2	29.0	26.4
326A-2											
326A-3	19.0	15.3	135.0	53.4	63.6	0.1	11.8	61.0	92.3	55.6	50.7
326A-4											
326A-5	86.0	23.6	100.0	90.2	112.6	1.1	58.8	175.2	212.8	101.7	96.2
326A-6	102.1	22.3	120.3	114.0	215.0	5.6	145.1	285.1	285.8	151.4	144.7
326A-7	145.0	31.5	150.6	123.5	342.0	11.2	185.3	338.6	430.8	224.3	198.3
326A-8											
326A-9	240.0	57.3	278.4	184.2	511.9	23.7	261.3		535.5	278.7	263.4
326A-10	276.0	79.6	340.2	187.0	554.6	29.3	298.1	545.7	852.4	452.8	361.6
326A-11	320.1	154.8	390.5	235.7	503.9	48.6	256.3	488.1	507.0	400.2	330.5
326A-12	374.8	178.5	506.1	339.0	536.7	62.7	318.9	661.2	692.8	478.1	414.9
326A-13	408.1	183.0	512.0	352.3	556.1	53.4	381.7	740.1	895.4	480.8	456.3
326A-14											
326A-15	420.7	256.1	445.5	404.3	503.1	46.7	408.5	867.4	423.0	228.0	400.3
326A-16											
326A-17	416.6	202.0	225.6	422.6	338.0	29.3	191.4	626.8	678.7	440.2	357.1

Dry "Control" Average= 153.6

WET	4/3/94	9/19/94	9/28/94	11/3/94	11/26/94	12/8/94	3/6/95	Average
326A-1	3.5	7.8	24.1	11.3	44.0	5.9	0.0	13.8
326A-2								
326A-3	9.3	15.2	63.5	19.5	120.0	28.0	0.0	36.5
326A-4								
326A-5	26.7	33.5	91.7	31.9	132.3	29.0	1.8	49.6
326A-6	54.3	18.1	129.7	28.6	43.3	9.6	0.3	40.6
326A-7	53.7	0.0	6.9	7.2	45.5	44.8	0.5	22.7
326A-8								
326A-9	44.9	0.1	0.1	0.0	0.0	7.8	0.1	7.6
326A-10	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.4
326A-11	0.0	36.6	106.3	0.6	0.0	21.2	0.0	23.5
326A-12	0.4	0.0	0.2	0.0	0.0	53.2	0.0	7.7
326A-13	99.2	98.7	233.7	13.8	160.6	110.4	10.0	103.8
326A-14								
326A-15	291.1	313.0	498.8	20.0	288.9	260.2	21.6	241.9
326A-16								
326A-17	213.6	60.5	326.3	84.4	209.1	350.2	6.8	178.7

Wet "Control" Average= 80.2


North FIP Sensit Values
Standard-Profile Storms
Average Dry Storm
Average Wet Storm
Normalized Dry
Average Sensit Values
500
450
400
350
300
250
200
150
100
50
0
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft per division)

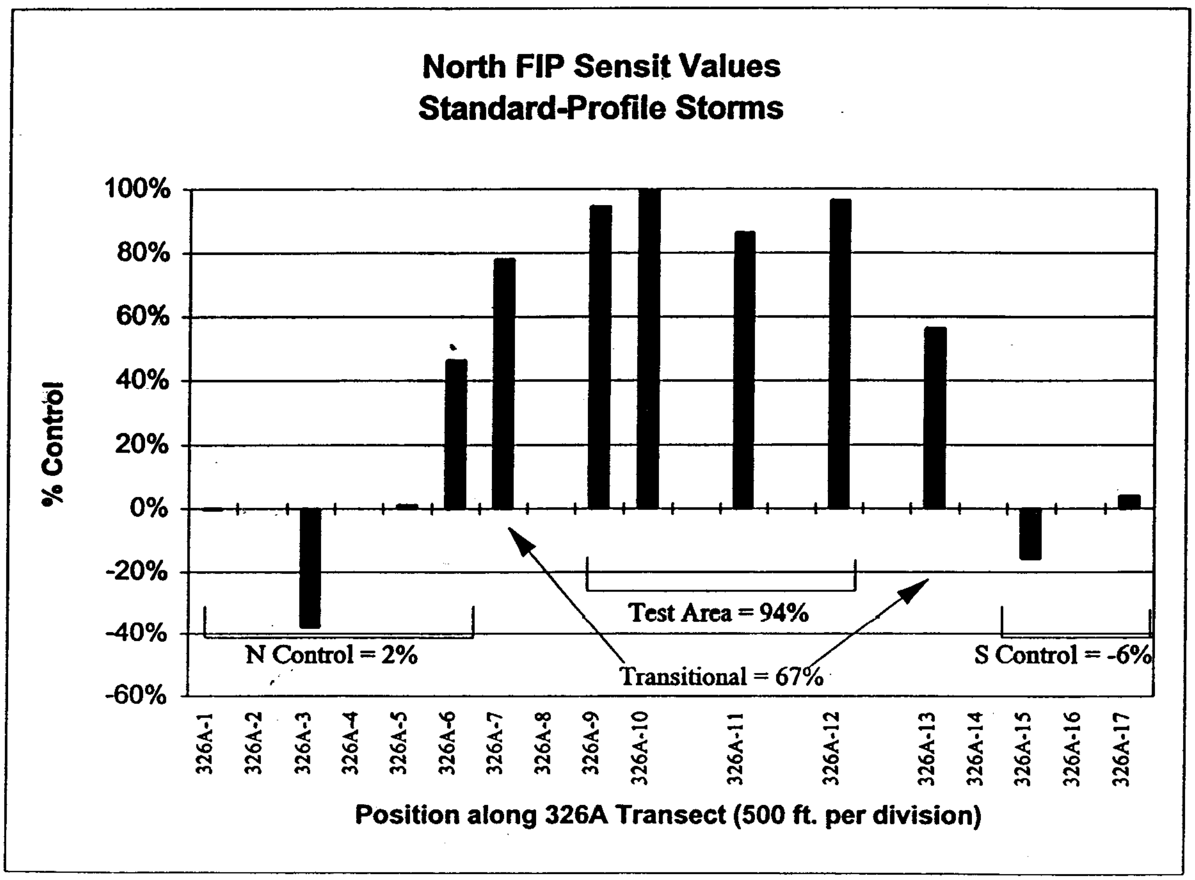

North FIP Sensit Values
Standard-Profile Storms
% Control
100%
80%
60%
40%
20%
0%
-20%
-40%
-60%
Test Area = 94%
N Control = 2%
Transitional = 67%
S Control = -6%
326A-1
326A-2
326A-3
326A-4
326A-5
326A-6
326A-7
326A-8
326A-9
326A-10
326A-11
326A-12
326A-13
326A-14
326A-15
326A-16
326A-17
Position along 326A Transect (500 ft. per division)

Figure 3.1-13

Relation of Sand Motion to PM-10 Production
Gillette, et al., 1995 have shown that the ratio of vertical flux of PM-10 to horizontal mass sand flux for sandy soils at Owens Lake is similar to values measured elsewhere. Those previous measurements show that the ratio is relatively constant with friction velocity for sandy soils. Assuming that for any wind event the ratio of vertical PM-10 flux to horizontal sand flux is constant along the transect, the PM-10 effectiveness would be the same as the sand motion effectiveness. Portable wind tunnel measurements on the areas within the test area that were not flooded (islands) but where the groundwater levels were raised (See Figure 3.2-3) show that the ratio of PM-10 to sand motion is reduced by about 20% from the ratio for the control areas (See Section 3.1.2, Table 3.1-4). Therefore, assuming that the reduction of PM-10 is the same as the reduction of sand would tend to underestimate the effectiveness of the flooding. Measurements in the U.C. Davis Wind Tunnel with Owens Lake sand showed that PM-10 reduction was proportional to sand motion reduction measured by Sensit™ (White, 1996).

3.1.2 PM-10. PM-10 effectiveness was measured directly with PM-10 monitors and with the portable wind tunnel described above.

Wind Tunnel.

PM-10 Emitting Areas
Flooding of the North FIP started in January 1994. By the end of March 1994 the water covered 294 acres of formerly dry lake playa. Figure 3.1-14 shows the water coverage on March 29, 1994. Within the wet FIP test area were dry islands and salt crust surfaces that comprised about 96 acres of surface within the boundaries of the wet area. About 72% of the area is covered with water and does not emit PM-10. The other 20% is considered to be transitional between wet and dry and includes salt crust areas. These transitional areas are considered potential sources of wind blown PM-10 emissions.

Average PM-10 Emission Rates
Seasonal average emission rates from the FIP test area were measured before and after flooding. Spring PM-10 emissions prior to flooding were an order of magnitude higher than the Fall PM-10 emissions rate for surfaces that had measurable PM-10. The average PM-10 emission rates are shown in Table 3.1-4 for the pre and post-flooding surface conditions in the spring and fall.

Figures 3.1-15 through 17 show scatter plots of the data used for Table 3.1-4. These plots show that the PM-10 emission rates are not strongly related to wind speed for any of the data sets. The clusters of points for each data set, however, do show that there are order of magnitude differences between the DRY Spring, DRY Fall, and the WET Spring and Fall emission rates (see Figure 3.1-17). The lack of a wind speed trend may be due to differences in the threshold wind speed for each of the surfaces that were tested in within each group. This may be especially true for the flooded (wet) tests. Two-thirds of the surfaces tested in the wet FIP group had PM-10 thresholds above 45 miles per hour -- the limit for the portable wind tunnel. Since measurable PM-10 emissions only occur when

FIP Surface Coverage
3/29/94

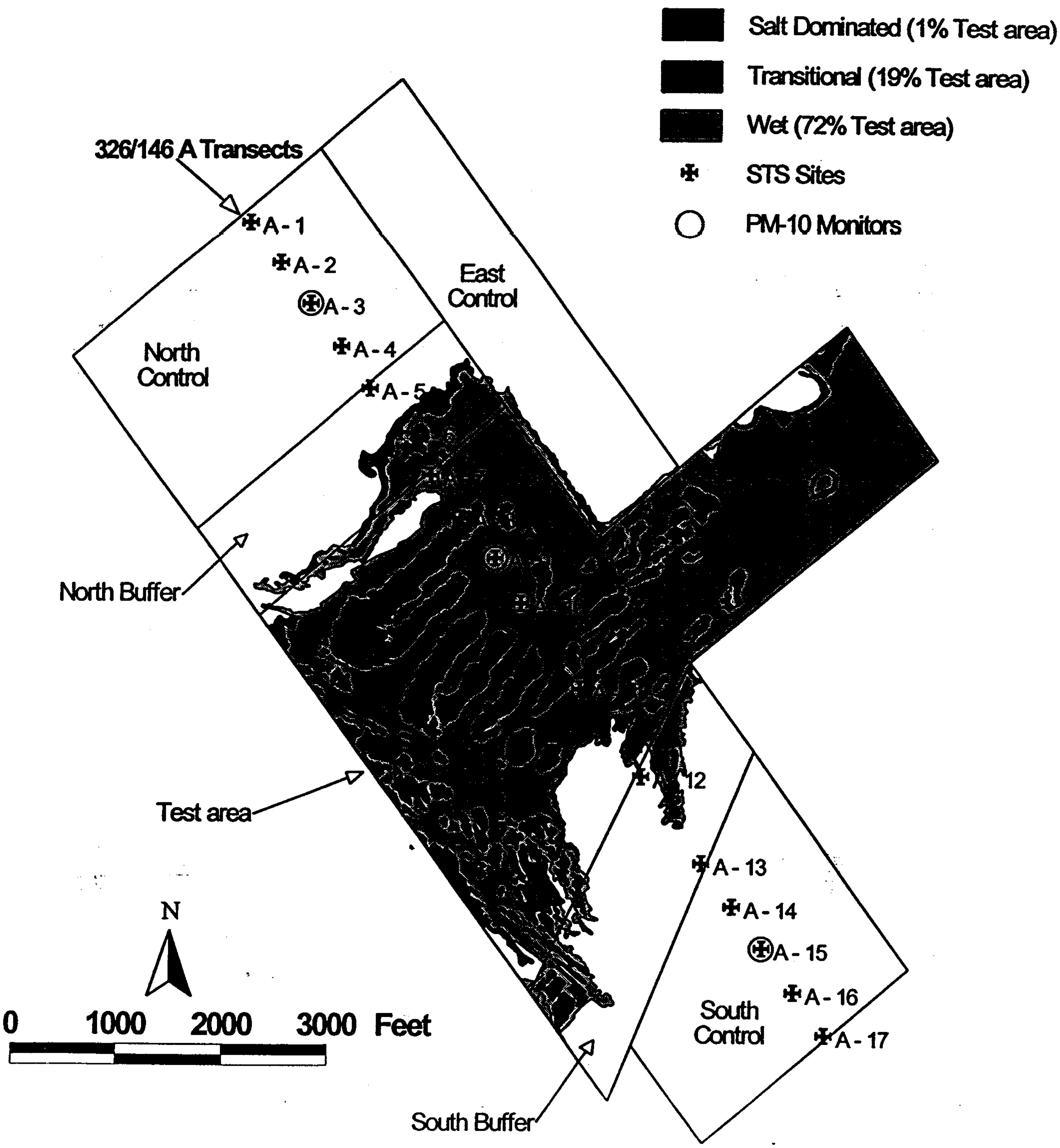
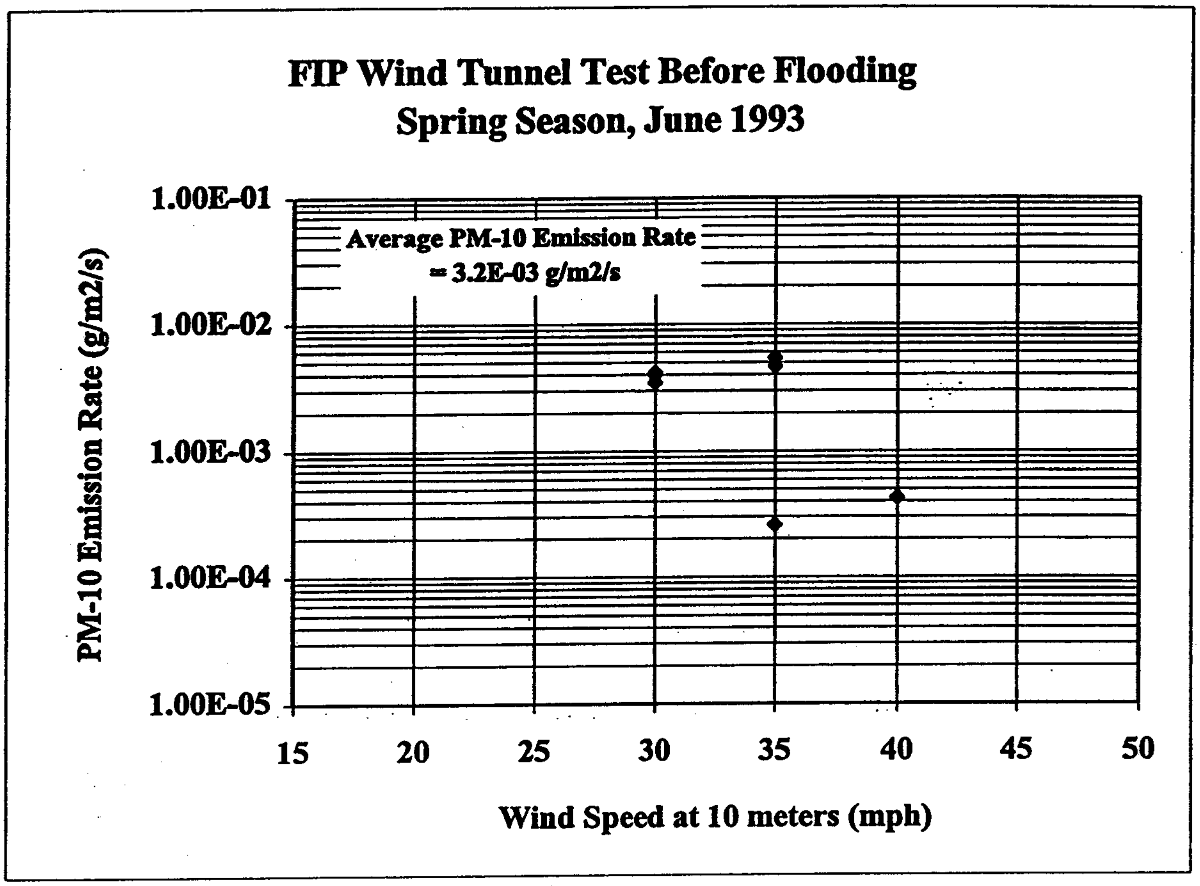


Figure 3.1-14


FIP Wind Tunnel Test Before Flooding
Spring Season, June 1993
Average PM-10 Emission Rate
= 3.2E-03 g/m2/s
PM-10 Emission Rate (g/m2/s)
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
15
20
25
30
35
40
45
50
Wind Speed at 10 meters (mph)

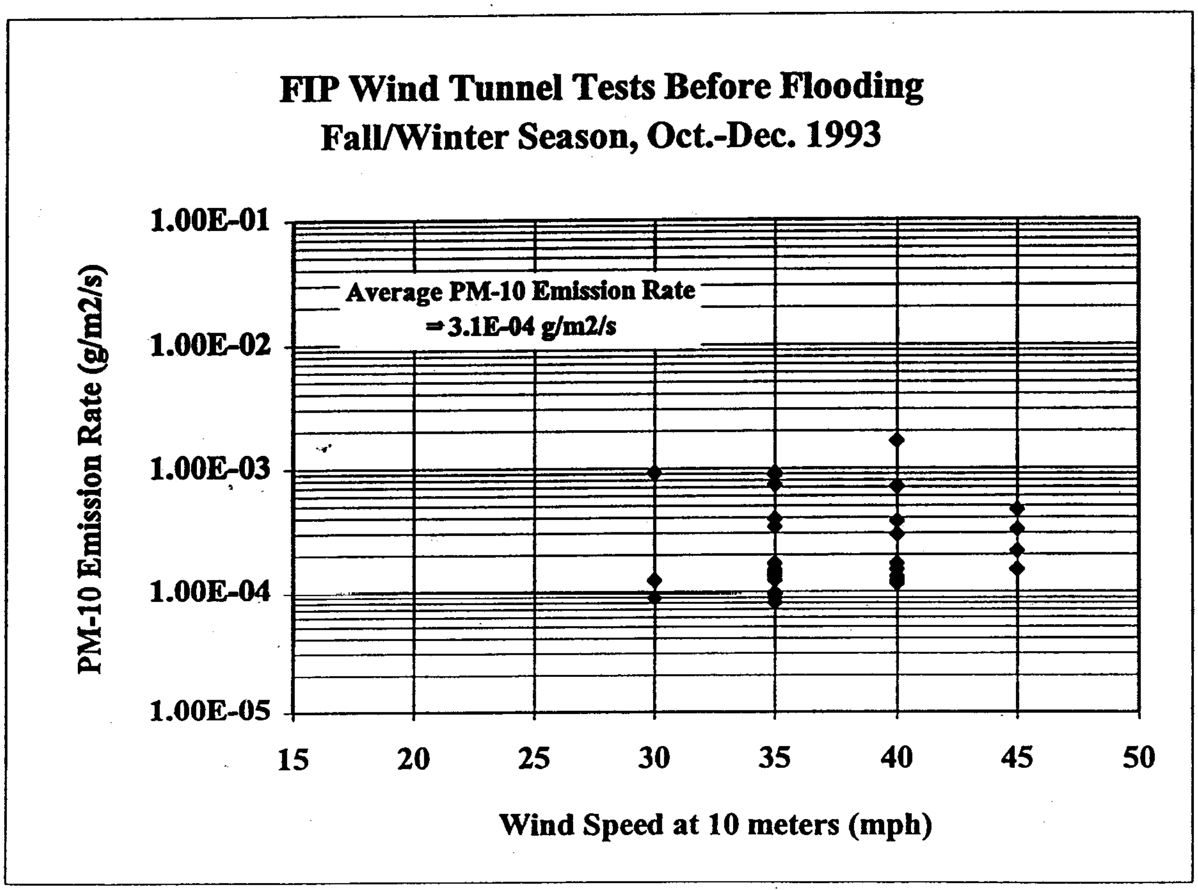

FIP Wind Tunnel Tests Before Flooding
Fall/Winter Season, Oct.-Dec. 1993
Average PM-10 Emission Rate
= 3.1E-04 g/m2/s
PM-10 Emission Rate (g/m2/s)
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
15
20
25
30
35
40
45
50
Wind Speed at 10 meters (mph)

Figure 3.1-15

the threshold wind speed is exceeded, the large variability of threshold wind speeds -- 25 to 45+ mph -- causes the emission rates to be scattered relative to the wind speed.

Table 3.1-4. Average PM-10 emission rates for the FIP as measured by a portable wind tunnel.

<u>Pre-Flooding (DRY) Emissions</u>	
Spring 1993	3.2×10^{-3} g/m²/s
Fall 1993	3.1×10^{-4} g/m²/s
<u>Flooded (WET) Emissions</u>	
Spring/Late Fall 1994 - near water [a]	4.1×10^{-6} g/m²/s
<u>Post-Flooding Emissions</u>	
Fall 1994 - formerly wet playa [b]	2.5×10^{-4} g/m²/s

[a] The average is adjusted to yield an overall FIP emission rate considering that 21 of 31 runs had PM-10 emissions below the detection limit and 75% of the FIP surface was covered by water with no PM-10 emissions. This emission rate is used for every hour when the wind speed is greater than a threshold wind speed of 25 mph at 10 meters.

[b] The water flow rate was significantly reduced during this period to expose silts, sand, and algae fragments on this formerly wet playa.

Wet FIP PM-10 Emission Rate

As previously stated and shown in Figure 3.1-16 , there is no apparent trend between wind speed and PM-10 emissions in the wet FIP areas, so an arithmetic average is a simple method to estimate an overall wet FIP emission rate. This arithmetic average uses one data point for each site and includes non-detectable emissions as zero. Including zero emission surfaces incorporates a portion of the dry areas into the average that were non-emissive in the wind tunnel. The overall PM-10 emission rate for the FIP is 4.1×10^{-6} $g/m^2/s$. This emission rate does not increase with wind speed, but is held as a constant emission rate whenever the hourly average wind speed is greater than 25 mph at 10 meters. The threshold wind speed was taken from one test that showed PM-10 emitted at 25 mph. There is no distinction between wet FIP emissions in the Spring and the Fall because there were so few PM-10 detectable runs in this group.

Wet FIP Control Efficiency

The control efficiency for the wet FIP can be calculated using the averages from Table 3.1-4. The PM-10 control efficiency in the spring is 99.9%, and in the fall it is 98.7%. This assumes that the FIP will have 75% water coverage during the windy period and that the PM-10 emissions are generated from the dry surface areas of the FIP.

Formerly Wet FIP PM-10 Emission Rate
The PM-10 emission rate from the post-flooding measurements taken on formerly wet playa areas was generated from playa areas that were covered with water from January through June 1994, but later dried. From July through mid-October the flow rate was reduced at the 'A' Outlets to evaluate the effect of exposing the surface during hot summer months when evaporation was high and dust events were infrequent. The exposed surface was composed of silts, sands, and algae fragments. Wind tunnel measurements taken in October 1994 on areas that had been without water for about three months showed that the exposed surface was about 80% as emissive as the FIP surface in Fall 1993 before flooding began. Although a 20% reduction in Fall PM-10 emissions was achieved, the dried North FIP surface may be too emissive to achieve compliance with the PM-10 standard if high winds occur during the exposed period.

In contrast to the dried FIP, other surfaces in the North FIP area that were unaffected by the FIP test had formed hard summer crusts during July through October and were judged to be stable. It should be noted that the portable wind tunnel cannot be run on hard crusted surfaces, because the wind tunnel blades that are used to seal the bottom cannot penetrate the surface.

Wind Tunnel Saltation Measurements
Table 3.1-5 summarizes the average saltation rate and PM-10 to saltation ratio measured by the wind tunnel.

Table 3.1-5. Average saltation emission rates and PM-10 to saltation ratios for the North FIP as measured by a portable wind tunnel.

	Saltation Rate ($g/m^2/s$)	PM-10/ Saltation
Pre-Flooding (DRY)		
Spring 1993	9.0×10^{-2}	9.5×10^{-2}
Fall 1993	1.8×10^{-1}	9.1×10^{-2}
Flooded (WET)		
Spring/Late Fall 1994 - near water [a]	1.3×10^{-3}	7.3×10^{-2}
Post-Flooding		
Fall 1994 - formerly wet playa [b]	6.9×10^{-3}	5.6×10^{-2}

[a] The average PM-10 to saltation ratio includes 21 of 31 runs that had PM-10 emissions below the detection limit. Saltation was measured on all but 2 runs.

[b] The water flow rate was significantly reduced during this period to expose silts, sand, and algae fragments on this formerly wet playa. Four test surfaces showed very little or no saltation, but had measurable PM-10 emissions. These runs are not included in the average ratio because a value cannot be divided by zero.

Saltation data can be used to roughly estimate the relative amount of PM-10 that was emitted during a storm. This information can be gathered by sand transport samplers and

Sensits™ that directly collect and monitor saltation during the dust storms on the playa. Wind tunnel tests from the formerly flooded areas showed that some PM-10 may be emitted from the playa without significant saltation occurring. However, the PM-10 emission rates in these cases were found to be low, about 1 x 10^{-4} $g/m^2/s$.

Data Sets
The data that were used to generate this report are included as Appendix N.

PM-10 Monitors

Thirty-eight successful runs were captured with the three PM-10 monitors aligned with the 326 transect. These were sorted into 5 categories: North winds, DRY period; North winds, WET period; South winds, DRY period; South winds, WET period; and all winds, Transition period. The Transition period data were not used in the following analysis.

Sensit™ data for the same period were compared with the PM-10 data for each dust storm captured. If the Sensit™ showed that no sand was moving on the test area during that storm, it was assumed that the PM-10 was generated elsewhere and the data were not used.

There were 6 valid North wind and 11 valid South wind storms remaining. These data are shown in Appendix O, and are listed in Table 3.1-6. Figure 3.1-18 shows the average South wind DRY and WET storms and the average North wind DRY and WET storms. The location of the flooded area for the WET storms relative to the PM-10 monitors is shown in Figure 3.1-14.

It is interesting that PM-10, as well as sand motion, increases from North to South whatever the wind direction during the DRY period. It is clear for both wind directions that there is less PM-10 at the monitor in the flooded area during the WET period, so the flooding did reduce PM-10 emissions significantly. Unlike sand, PM-10 travels long distances making it difficult to determine how much of the collected sample has been generated on the test area. These samples are consistent with our assumption that a significant reduction in sand motion will be accompanied by a significant reduction in PM-10 emissions.

3.2 Groundwater and Surface Water Results

3.2.1 Pre-Flooding Groundwater Conditions:

The sites in the piezometer network were monitored seven times prior to the beginning of surface flooding (see Table 2.3-1). Water level and EC monitoring was conducted on a monthly to bi-monthly basis from May 1993 through December 1993 in order to establish the baseline conditions of the shallow groundwater system under the test area. Other pre-flooding data collected from the piezometers include: 1) general ionic and salt chemistry from November 1993, 2) Chloride (Cl^-) concentrations on samples from the November

Table 3.1-6

Owens Lake North FIP
PM-10 Monitoring Data ($\mu g/m^3$)
11/24/9 - 12/21/94

South Winds

DRY	5010	5011	5012
11/29/93	420	605	655
12/14/93	2242	2914	3639
Average	1331	1759	2147

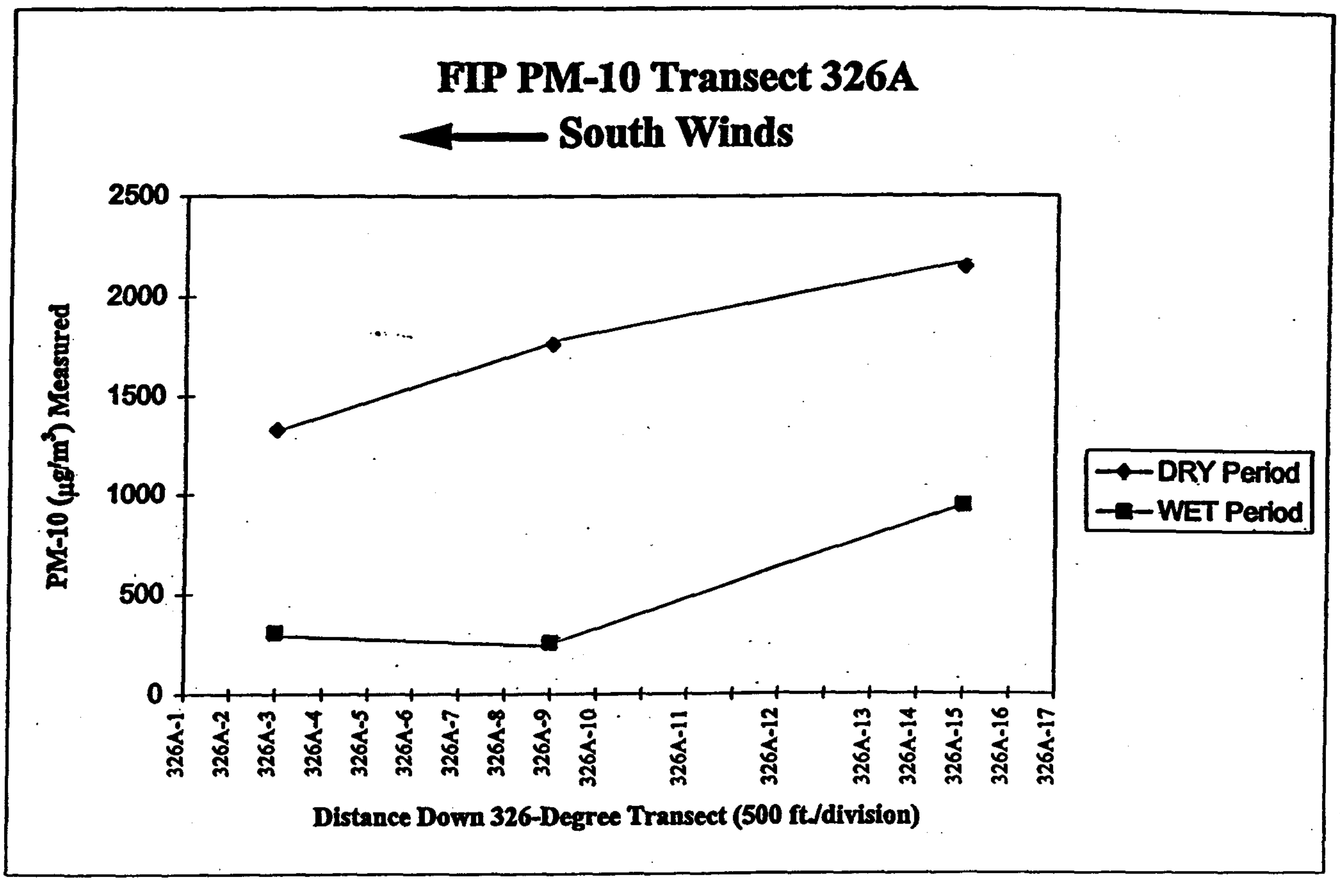
WET	5010	5011	5012
3/15/94	113	145	241
3/18/94	734	1073	2763
4/23/94	314	271	922
10/3/94	47	107	189
11/6/94	92	70	77
11/9/94	962	272	856
11/25/94	259	100	772
12/3/94	53	68	496
12/12/94	189	197	2173
Average	307	256	943

North Winds

DRY	5010	5011	5012
11/30/93	83	694	1467
12/2/93	2242	2914	3639
12/15/93	140	318	1518
1/5/94	696	2696	4407
Average	790	1655	2757

WET	5010	5011	5012
3/10/94	387	368	1527
11/17/94	416	657	1385
Average	401	513	1456

Owens Lake North FIP PM-10 Monitoring
(11/29/93 - 12/12/94)



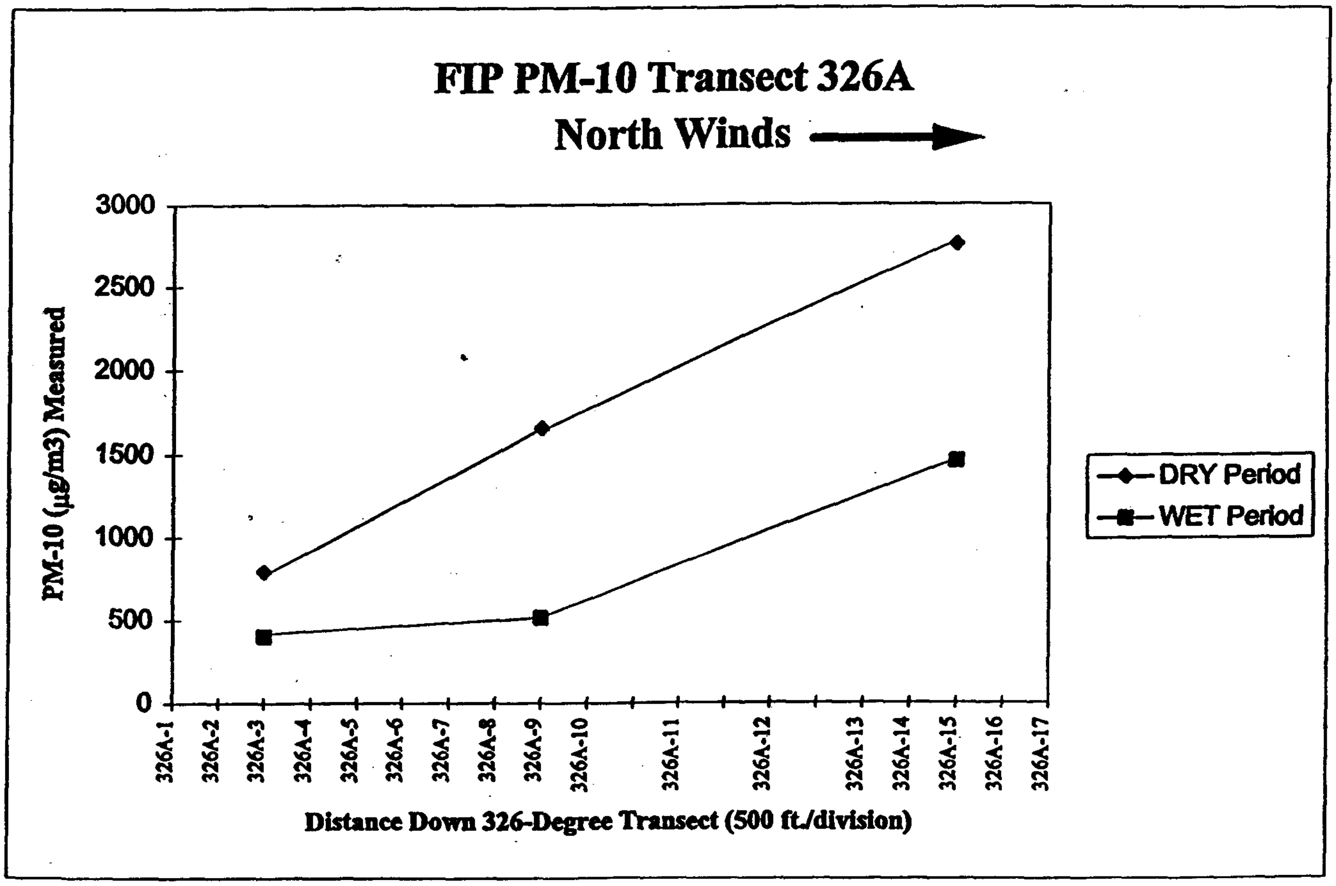


Figure 3.1-18

and December 1993 monitoring events, and 3) elevations of the top of the piezometer well heads. The results of the chemical analyses are presented in Holder, 1996.

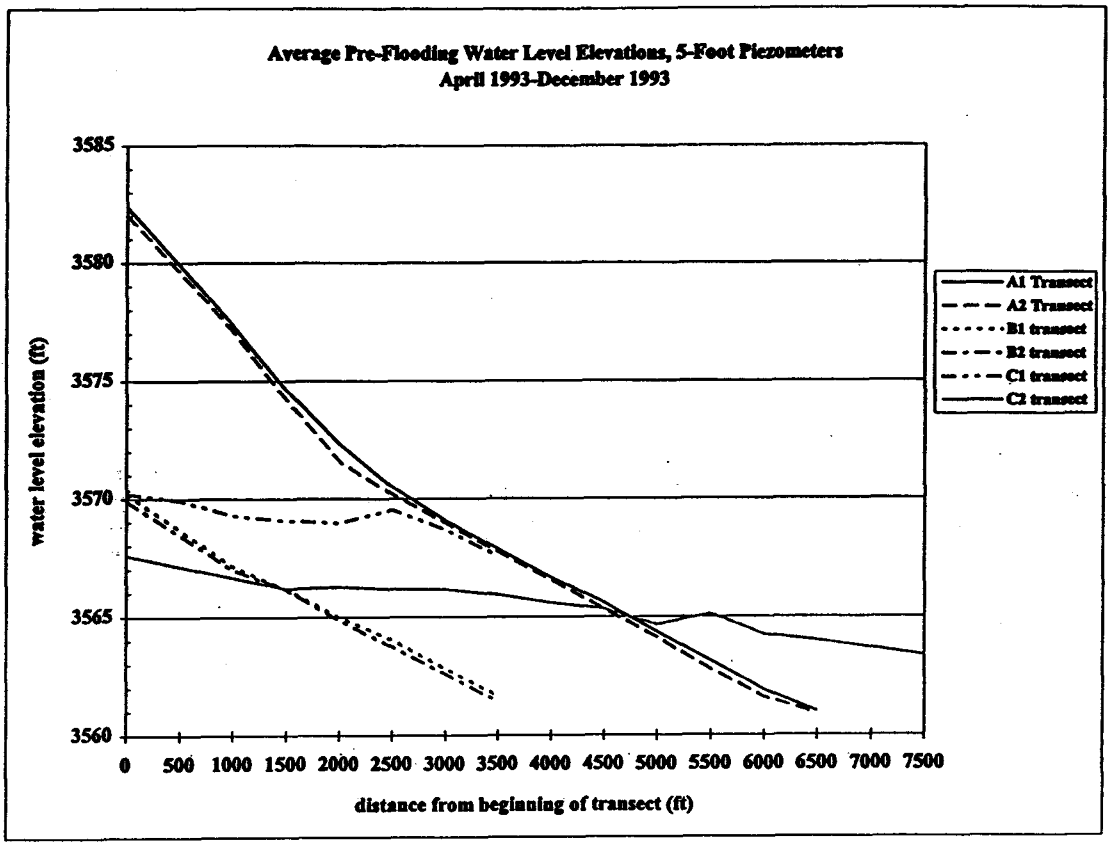
Soil samples were collected from nineteen select piezometer sites during the November 1993 and December 1993 monitoring events. Samples were collected with a 2-inch auger from five intervals between the surface and 30 inches (0-2, 4-6, 10-12, 16-18, and 28-30 inches). EC measurements were completed on extracts from saturated soil pastes.

Review of the DTW and EC data from the pre-flooding monitoring episodes shows little temporal variation at each piezometer site prior to the beginning of flooding in January 1994. The average pre-flooding EC and water level data for each of the six piezometer transects are shown on Figure 3.2-1 and summarized on Table 3.2-1. The data from the 1.5-foot piezometer depth are not shown since the water levels were generally below this depth and there were not enough data to show trends. Comparison of the data from the 2.5 foot (2.5') and 5 foot (5') depths shows that the water levels between the two are generally similar, typically varying by less that 0.10 feet. The EC data between the 2.5' and 5' are also similar, typically varying up to about 10% with the water from the 2.5' generally being more conductive. These data are presented in Holder, 1996.

Water Level Data:
The most noticeable feature of the pre-flooding water level data is the consistency of the water level elevations with time. Even though the monitoring episodes were spread over a 7 month period, extending from spring into winter, very little change in water elevations was observed (Table 3.2-1). Even though the absolute water level elevations in the piezometers changed down the length of a transect, the depth of the water levels below the ground surface remained relatively constant so that the piezometric surface mimicked the elevation of the ground surface (Holder, 1996).

Water level elevations on the two main down-slope transects (A-1 and A-2) were highest on the east end (beginning) of the transects adjacent to the shoreline and gradually fell to a low on the west end of the transects with a total drop along the transect of approximately 21-22 feet. The B-transects start 3,000 feet down-hill from the beginning of the A-transects and as expected, the water levels on the B-1 and B-2 transects mimic the water levels measured on the lower portion of the A-transects.

The two C-transects were designed to measure the conditions of the shallow groundwater across the test area approximately perpendicular to the slope. Water levels drop slightly down the length of both the C-transects (from north to south). The drop in water level elevation along the C-2 transect, which extends for 7,000 feet through the middle of the test area, is approximately 4 feet. The shorter C-1 transect displayed a drop in water level elevation of approximately 2-3 feet. The drop in water level along the C-transects indicates that these piezometer transects are not oriented parallel to the water level contours but instead cross them at a slight angle. The depth from the playa surface to the shallow groundwater along the C-transects was relatively consistent at approximately 3.5 feet.


Average Pre-Flooding Water Level Elevations, 5-Foot Piezometers
April 1993-December 1993
water level elevation (ft)
3585
3580
3575
3570
3565
3560
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
distance from beginning of transect (ft)
A1 Transect
A2 Transect
B1 transect
B2 transect
C1 transect
C2 transect

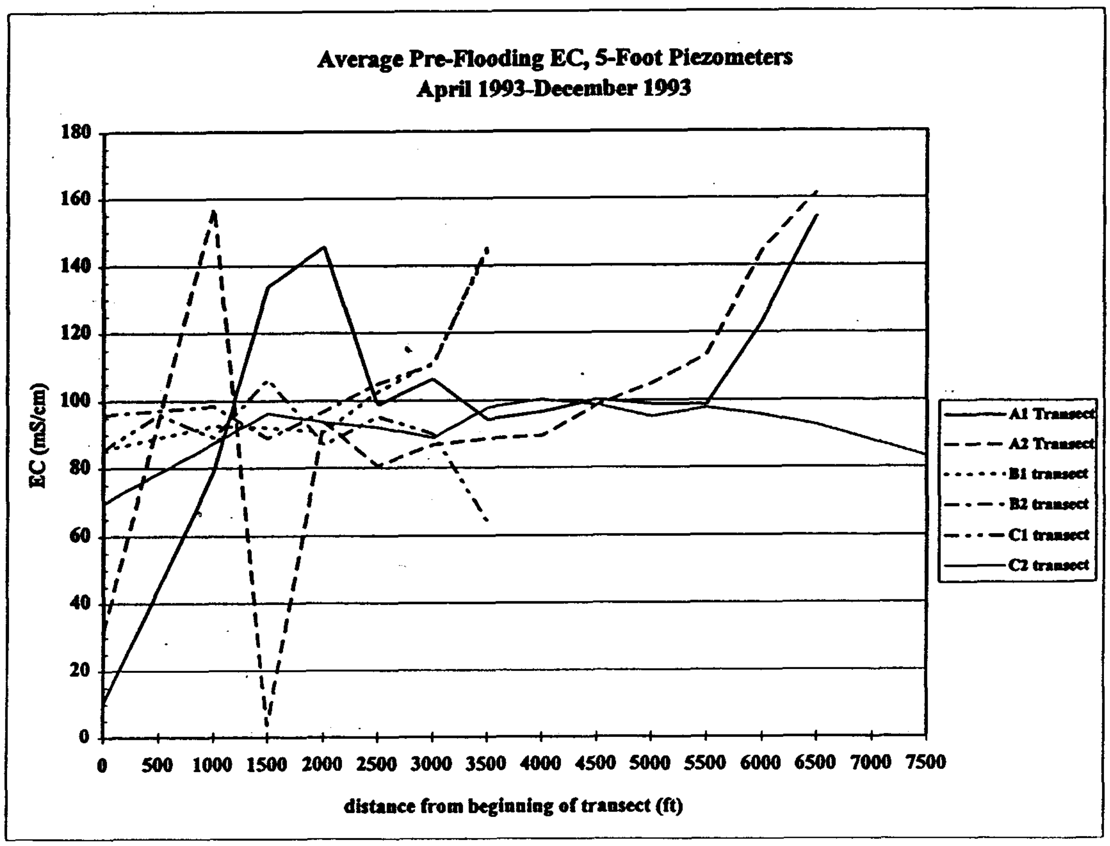

Average Pre-Flooding EC, 5-Foot Piezometers
April 1993-December 1993
EC (mS/cm)
180
160
140
120
100
80
60
40
20
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
distance from beginning of transect (ft)
A1 Transect
A2 Transect
B1 transect
B2 transect
C1 transect
C2 transect

Figure 3.2-1

Table 3.2-1. Summary of water level and EC data from seven pre-flooding monitoring events.

SITE	Average Water Elevation (ft)	Standard Deviation Water Elevation	Average EC (mS/cm)	Standard Deviation EC
A1-1	3582.40	0.23	10.3	0.81
A1-2	3577.34	0.13	78.7	5.79
A1-3	3574.59	0.19	133.9	8.06
A1-4	3572.32	0.19	145.7	9.41
A1-5	3570.50	0.26	98.7	8.89
A1-6	3569.06	0.29	106.3	9.33
A1-7	3567.86	0.37	94.3	9.75
A1-8	3566.67	0.33	96.5	9.59
A1-9	3565.60	0.33	100.2	8.51
A1-10	3564.35	0.28	98.8	7.99
A1-11	3563.14	0.28	98.6	6.14
A1-12	3561.90	0.23	123.3	8.82
A1-13	3561.00	0.20	154.5	12.07
A2-1	3582.04	0.18	31.5	3.02
A2-2	3577.09	0.17	157.3	14.20
A2-3	3574.18	0.31	3.4	0.42
A2-4	3571.58	0.27	93.7	8.05
A2-5	3570.20	0.30	80.6	7.56
A2-6	3568.95	0.30	86.7	10.11
A2-7	3567.75	0.36	88.5	10.60
A2-8	3566.55	0.32	89.4	10.17
A2-9	3565.35	0.30	98.6	12.16
A2-10	3564.14	0.32	104.9	14.28
A2-11	3562.80	0.21	113.3	10.62
A2-12	3561.60	0.19	144.5	14.68
A2-13	3560.90	0.20	161.4	15.66
B1-1	3570.21	0.36	85.4	5.60
B1-2	3567.16	0.46	92.5	7.59
B1-3	3566.18	0.42	91.9	7.89
B1-4	3565.01	0.39	90.6	7.23
B1-5	3564.05	0.40	102.6	8.49
B1-6	3562.84	0.23	111.1	10.26
B1-7	3561.68	0.20	144.4	11.52
B2-1	3569.92	0.31	95.8	7.03
B2-2	3567.00	0.39	98.4	6.48
B2-3	3566.16	0.51	88.8	4.36
B2-4	3564.87	0.33	96.8	4.94
B2-5	3563.76	0.32	104.9	8.80
B2-6	3562.60	0.27	110.6	9.48
B2-7	3561.44	0.20	145.8	13.48
C1-3	3569.28	0.28	89.0	7.58
C1-6	3569.53	0.29	95.2	8.56
C1-7	3568.68	0.27	89.9	8.79
C1-8	3567.56	0.38	63.8	6.43
C2-1	3567.59	0.46	69.6	7.88
C2-2	3566.20	0.51	96.2	8.96
C2-3	3566.27	0.44	93.6	8.98
C2-6	3565.94	0.32	97.8	9.31
C2-9	3564.66	0.32	95.1	9.36
C2-10	3565.12	0.29	97.6	8.63
C2-11	3564.23	0.29	95.6	9.54
C2-12	3564.00	0.32	92.5	9.42
C2-13	3563.37	0.47	83.2	5.73

Conductivity (EC) Data:
The conductivity measurements of the shallow groundwater along the A-transects display a distinct trend that increases rapidly down slope (down-transect) in the upper portions of the test area, falls to a relatively stable concentration in the middle of the plot and ultimately rises again at the end of the test area (see Figure 3.2-1). The peak in conductivity measurements at the beginning of the A-1 and A-2 transects occurs within a 1,000-2,000 foot distance from the beginning of the transect with EC values rising from 10-30 mS/cm at the first site on the transect to a high of 140-160 mS/cm. This rapid rise in EC concentrations may result from the beginning of the A-transects being on the western fringe of a large spring mound system. Water coming to the surface along this zone is relatively fresh with an EC of approximately 1-3 mS/cm. The trend of increasing EC away from the spring zone may result from a flushing of salt out of the spring area and subsequent transport and concentration of those salts down slope to the west. The A-1 and A-2 transects display elevated EC concentrations through the middle portions of the transects that range between approximately 80 to 100 mS/cm and remain relatively constant until the western end of the test area where a second rise in EC is observed (Figure 3.2-1).

The extremely low conductivity observed at the A2-3 site results from the presence of a single active spring mound on the transect in the vicinity of the site (Fig. 3.2-1). The A2-3 site was installed along the southwest flank of this mound approximately 100 feet from the active spring vent. Water flowing from this mound has a low conductance of approximately 2-3 mS/cm similar to the conductance measured at the A2-3 site.

The B-1 and B-2 transects show an EC pattern that is essentially the same as that found on the middle and end portions of A-1 and A-2 (Figure 3.2-1). The C-1 and C-2 transects show little change in EC concentrations across most of their length. The EC values range from approximately 80-100 mS/cm for most of the transect with a slight drop in EC observed on the south end of C1 and the north end of C2. The consistency in EC values along the C-transects suggests that the salinity of the shallow groundwater system is relatively uniform across the test area perpendicular to the surface slope.

3.2.2 Groundwater and Surface Water Results During Flooding:

Groundwater levels and EC concentrations were measured at piezometer sites during 21 monitoring episodes once flooding began. During the initial stages of flooding (January 1994 through March 1994) data were collected weekly to biweekly. Data collection episodes were changed to monthly periods from April 1994 through November 1994 and then to every two to three months from December 1994 through September 1995. During each of these monitoring episodes the EC and water depth of the surface flood water was also measured throughout the wetted area. Surface water measurements were conducted as close to an existing piezometer site as possible. Soil samples were collected from selected piezometer sites during each groundwater monitoring episode. The EC of each soil sample was analyzed in the lab by a District technician.

Analyses of the general ionic and salt chemistry were performed on water samples collected from all of the wet piezometers (those with water in them) during the 4/26/94-4/27/94 monitoring episode. Chloride (Cl-) analyses were completed on groundwater and surface water samples from all monitoring episodes from January 1994 through May 1994. These results are presented in Holder, 1996.

As part of the drying test conducted on the A-outlets during the summer of 1994, 16 of the piezometer sites on the A-1 and A-2 transects were included for intensive groundwater and soil sampling. Monitoring at these sites was conducted weekly from 7/20/94 until the flood water was restored on October 17, 1994, for a total of 15 monitoring events. Parameters monitored during this test include groundwater levels and EC of the soil and groundwater. These measurements were taken to complement surface observations and wind tunnel tests and to determine the change in the area as a result of drying. The groundwater and soil results of this test are not presented here but are described in the Holder, 1996.

Shallow Groundwater Level Changes

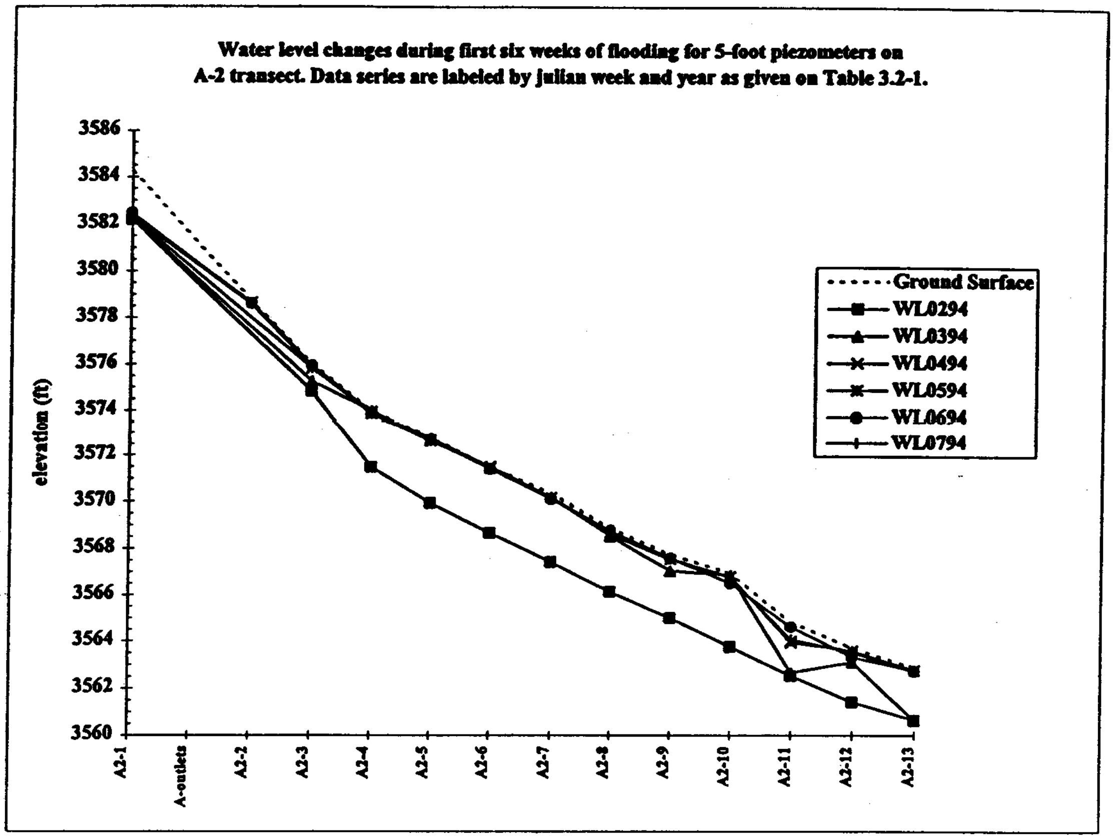
The water levels of the shallow groundwater changed dramatically as a result of flooding. Prior to flooding the shallow groundwater was approximately 2.5-3.5 feet below the surface in the 5-foot wells. Once flooding began in January 1994, water levels in all three of the monitored depths (1.5, 2.5, and 5 feet) at the inundated piezometer sites immediately rose to the ground surface. Figure 3.2-2 illustrates the progression of flood waters as they influence water levels in the five foot piezometers on the A2 transect. The inundated sites stand out as those where the water levels have come up to the surface. This can be seen most clearly on the DTW vs. site location at the bottom of Figure 3.2-2 and on Figure 3.2-3.

Water spreading was not uniform. As a result many of the piezometer sites within the test area did not become wet at the surface. These sites are visible on Figures 3.2-2 and 3.2-3 as those where water levels did not fully rise to the playa surface. Water spreading was more uniform along the A2 transect than on the A1 transect (Holder, 1996). The flood waters took between 2-3 weeks from the time the A-outlets were opened until the water reached the distal ends of the A2 transect 6,500 feet away (see section 3.5).

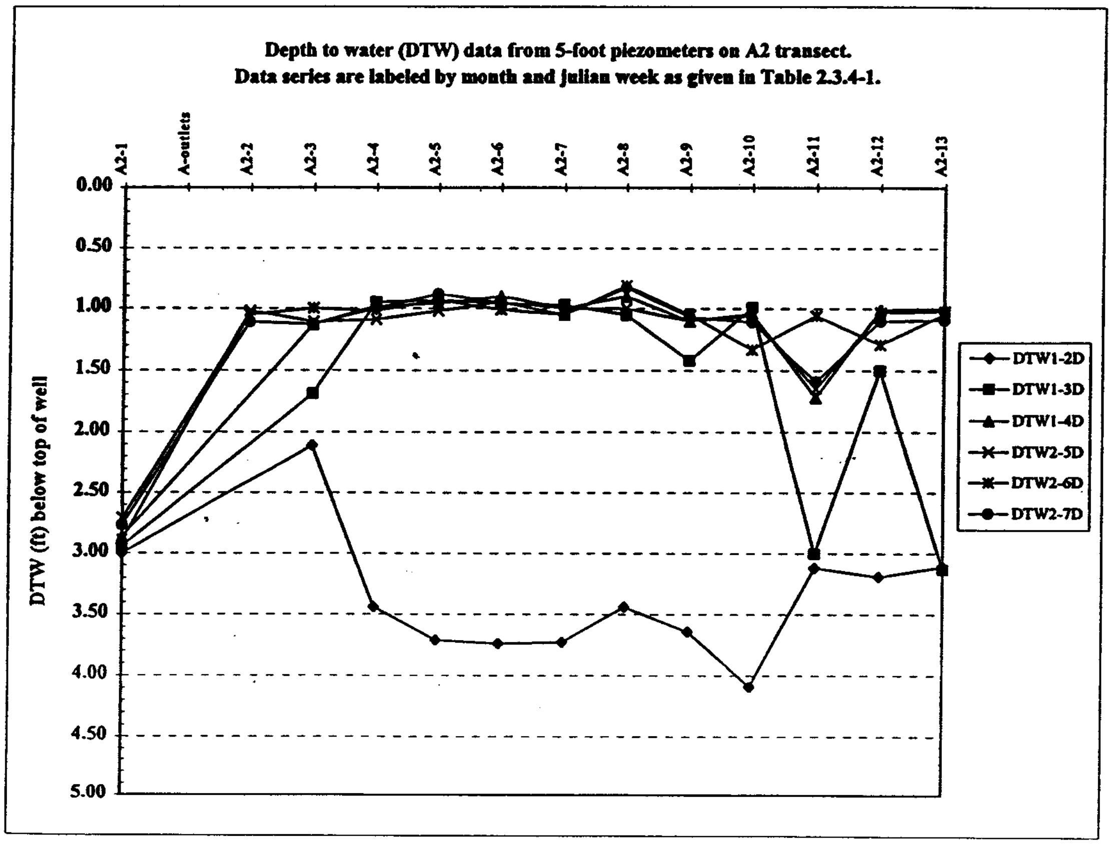
The effects on the shallow groundwater level across the test area can be seen on Figure 3.2-3. The distinct spikes in DTW across the wetted areas illustrate the channeled nature of water spreading across as well as the small area of lateral influence of the surface flood water. Within 500 feet laterally away from the outer edges of the surface water the water levels in the piezometers are unaffected.

Shallow Groundwater Conductivity (EC) Data

Analysis of the groundwater EC data collected during flooding indicates that the effect of flooding on the shallow groundwater salinity diminished with depth below the surface and that many of the 1.5' and 2.5' piezometers experienced a significant decrease in salinity. The sites showing the greatest decrease in EC were located in zones that were

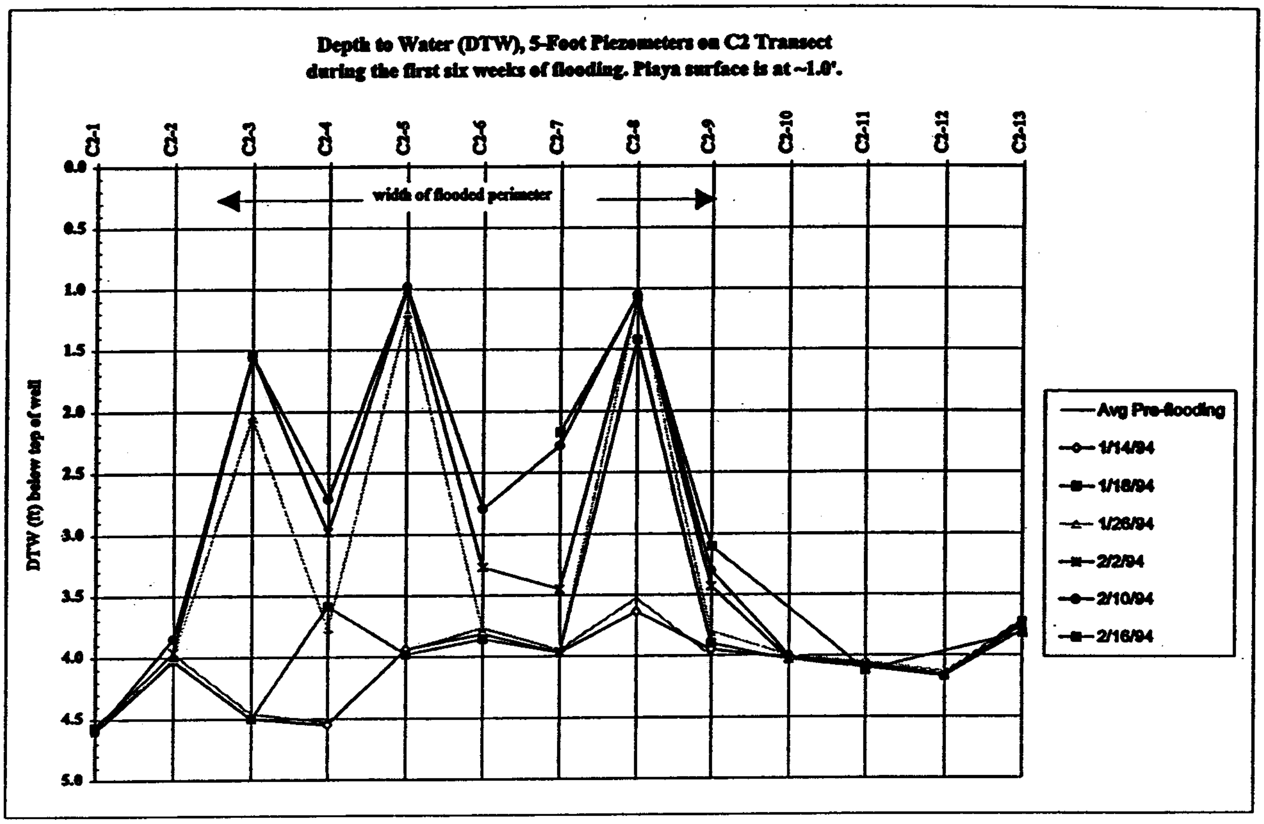


Water level changes during first six weeks of flooding for 5-foot piezometers on A-2 transect. Data series are labeled by julian week and year as given on Table 3.2-1.
elevation (ft)
3586
3584
3582
3580
3578
3576
3574
3572
3570
3568
3566
3564
3562
3560
Ground Surface
WL0294
WL0394
WL0494
WL0594
WL0694
WL0794
A2-1
A-outlets
A2-2
A2-3
A2-4
A2-5
A2-6
A2-7
A2-8
A2-9
A2-10
A2-11
A2-12
A2-13



Depth to water (DTW) data from 5-foot piezometers on A2 transect. Data series are labeled by month and julian week as given in Table 2.3.4-1.
A2-1
A-outlets
A2-2
A2-3
A2-4
A2-5
A2-6
A2-7
A2-8
A2-9
A2-10
A2-11
A2-12
A2-13
DTW (ft) below top of well
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
DTW1-2D
DTW1-3D
DTW1-4D
DTW2-5D
DTW2-6D
DTW2-7D

Figure 3.2-2



Depth to Water (DTW), 5-Foot Piezometers on C2 Transect
during the first six weeks of flooding. Playa surface is at ~1.0'.
C2-1
C2-2
C2-3
C2-4
C2-5
C2-6
C2-7
C2-8
C2-9
C2-10
C2-11
C2-12
C2-13
width of flooded perimeter
DTW (ft) below top of well
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Avg Pre-flooding
1/14/94
1/18/94
1/26/94
2/2/94
2/10/94
2/16/94

Figure 3.2-3

intermittently flooded due to wind-caused movement of surface water. Conversely, many of the 1.5' and 2.5' piezometers located on dry "islands" or in areas continually wetted generally display an increase in EC concentrations. None of the 5' piezometers display any significant decrease in EC during flooding, instead, the slight increase in EC concentration measured at several sites, through June 1994, suggests that much of the salt being removed from the higher zones was forced vertically downward into the groundwater system in the early stages of flooding. Data collected through 1995 show that this feature did not persist with extended surface flooding (Holder, 1996).

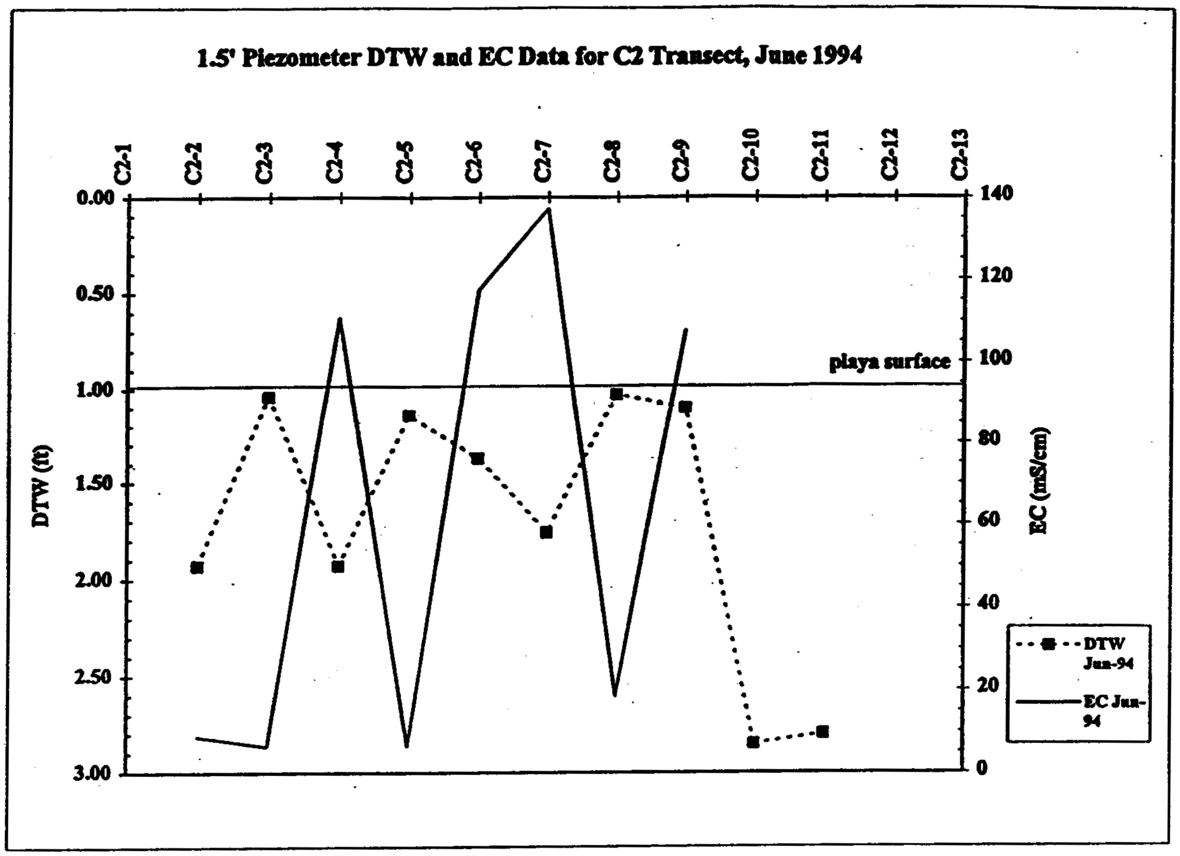
The response of the EC concentrations from the 1.5' piezometers during flooding was not uniform. With continued flooding into 1995 more of the 1.5' sites showed a significant reduction in EC (i.e. they were leached). The EC response of the 2.5' piezometers during flooding was similar to the response of the 1.5' sites. The main differences between the 1.5' and 2.5' EC data is that the number of 2.5' sites that were affected is less than the number of 1.5' sites affected, and that there were a significant number of 2.5' sites that displayed an increase in EC over time (Holder, 1996). This suggests that there was some vertical movement downward of salts during at least part of the test.

Most of the decrease in EC associated with flooding occurred at shallow depths near the center portion of the wetted area where the wind-associated movement of surface water is greatest. The surface water in the area between the A and B outlet (A-outlet neck) did not shift as much in response to wind events due the presence to topographic features (sand dunes) to the north and south that largely prevented significant lateral movement.

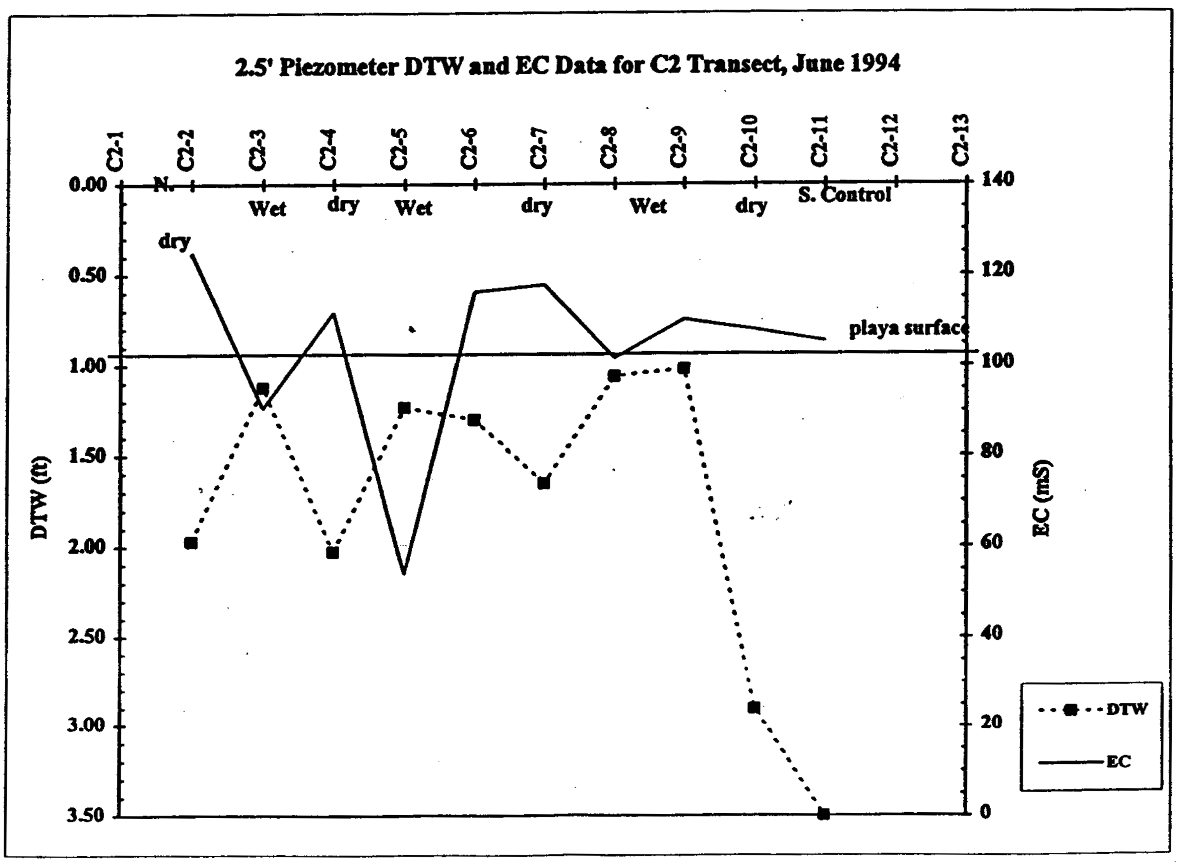
Figure 3.2-4 illustrates the relation of water level with EC laterally across the test area for the 1.5' and 2.5' piezometers on the C2 transect. The irregular spiked pattern visible on Figure 3.2-4 results from uneven spreading of surface water across the test area leaving large elongate "islands" within the wetted perimeter. The sites that are inundated have DTW measurements elevated up to or close to the surface while the dry sites have water levels that are below the surface. (Note DTW is measured from the top of the piezometer casing so that on Figure 3.2-4 the surface is approximately at the 1.0 foot depth not at zero). The sites within the wetted test area, but located on islands, display slightly elevated DTW measurements between 1.5 and 2.0 feet from the top of the piezometer tube. Water level patterns along the C2 transect are similar for both the 1.5' and 2.5' depths. The lowest EC concentrations in both the 1.5' and 2.5' depths are located at wetted sites however the magnitude of the EC change at these sites is greatest at the 1.5' depth with EC values dropping to a minimum of 5-15 mS/cm. The DTW and EC changes illustrated on Figure 3.2-4 die off rapidly away from the main wetted area. The lateral affects on C2 occur over a distance of about 500' to 1000' feet from the edge of the flooded area (Holder, 1996).

Surface Water Results

Water released onto the FIP from the two outlet sections is relatively fresh (but not potable) with an EC composition between 0.7 to 1.2 mS/cm. Water supplied to the FIP came from two wells located at the River Site. The waters from the two wells differed in



1.5' Piezometer DTW and EC Data for C2 Transect, June 1994
C2-1
C2-2
C2-3
C2-4
C2-5
C2-6
C2-7
C2-8
C2-9
C2-10
C2-11
C2-12
C2-13
playa surface
DTW (ft)
EC (mS/cm)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
140
120
100
80
60
40
20
0
DTW Jun-94
EC Jun-94



2.5' Piezometer DTW and EC Data for C2 Transect, June 1994
C2-1
C2-2
C2-3
C2-4
C2-5
C2-6
C2-7
C2-8
C2-9
C2-10
C2-11
C2-12
C2-13
N.
Wet
dry
Wet
dry
Wet
dry
S. Control
dry
playa surface
DTW (ft)
EC (mS)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
140
120
100
80
60
40
20
0
DTW
EC

Figure 3.2-4

salinity with the Lower River Well water having an EC of approximately 1.2 mS/cm while water from the Upper River Well had an EC of approximately 0.7 mS/cm. Surface water data were collected at sites collocated with the piezometer transect sites. The A-outlets were opened on January 10, 1994 and allowed to flow by themselves until January 20, 1994 when the B-outlets were turned on (see section 3.5)

The salinity of the surface water increased downhill through with wetted area. This indicates that the surface water was becoming enriched in salts as it flowed from the outlets across the test area. The EC enrichment of the surface water from the "A" and "B" outlets down the flow direction to the end of the piezometer transects ranged from 1.5 to 12 times that of the water discharged onto the test area from the outlets. Water flowing down the longer A2 transect displays a greater enrichment in EC than water flowing down the B1 transect. This is partly due to the longer flow path but can also be attributed to higher groundwater salinity and more extensive salt crust developed in the upper portion of the A-transects (Holder, 1996).

3.3 Salt Movement

The design protocol for the NFIP called for a detailed examination of the salt budget on the NFIP and how it changed as a result of flooding. The monitoring network was designed to provide the necessary data in order to perform this task. However, during the test it became apparent that even with 53 monitoring sites, the network on the NFIP was not extensive enough to collect the required data. The lateral coverage of the surface water extended well beyond the furthest down-slope piezometers so there was no measurement of the amount of salt leaving the area. The District tried to extend the sampling network to the west but was unable to access areas of concern due to soft soil conditions. After review of the data, it is also evident that most of the change in salt content occurred rapidly so that even our frequent monitoring schedule was unable to capture the detailed progression of the change. As a result of these factors, changes in salt concentrations were only determined qualitatively through trend analysis down-slope through the NFIP and through analysis of the temporal changes in EC (Holder, 1996).

From review of the EC changes to the shallow groundwater, surface water, and soil samples during the course of flooding, it is apparent that there were significant changes to the salt content of the upper portions of the soil column. The most drastic reduction in salt concentration was observed adjacent to wetted areas where the surface was periodically inundated from migration of surface water across the site. The lateral extent of these leached areas is not known in detail, but they were generally less than 500'. It is assumed that the leaching adjacent to the flooded areas was localized and occurred in bands parallel to the water. Leaching only reached a maximum depth of about 2.5 feet from the surface.

The areas on the test that were continually flooded showed much less leaching response than the intermittently flooded sites. This resulted from the low gradients present on the test area allowing little place for the leachate to migrate. Areas that were periodically flooded provided a mechanism for salt removal by allowing the salts to build up in the profile during drying only to be subsequently washed away by surface water during the next flooding event. It is apparent that salts were carried horizontally down slope by surface water since the EC of the flood water at the bottom of the test area showed a significant enrichment in EC over the EC of the water from the outlets.

3.4 Soil Leaching

3.4.1 Pre-Flooding Soil Conditions:

The majority of the EC profiles taken from pre-flooding soil samples display a classic evaporation-dominated shape characterized by values that are highest at the surface and drop rapidly with depth (Figure 3.4-1). The high EC values measured at the surface result from the presence of a salt crust at the surface. The crust develops through capillary rise of saline shallow groundwater upward through the profile and subsequent evaporation at the surface leaving the salts behind. EC values of close to 200 mS/cm at the surface are near saturation with respect to salts and reflect the development of the salt crust at the surface (Holder, 1996).

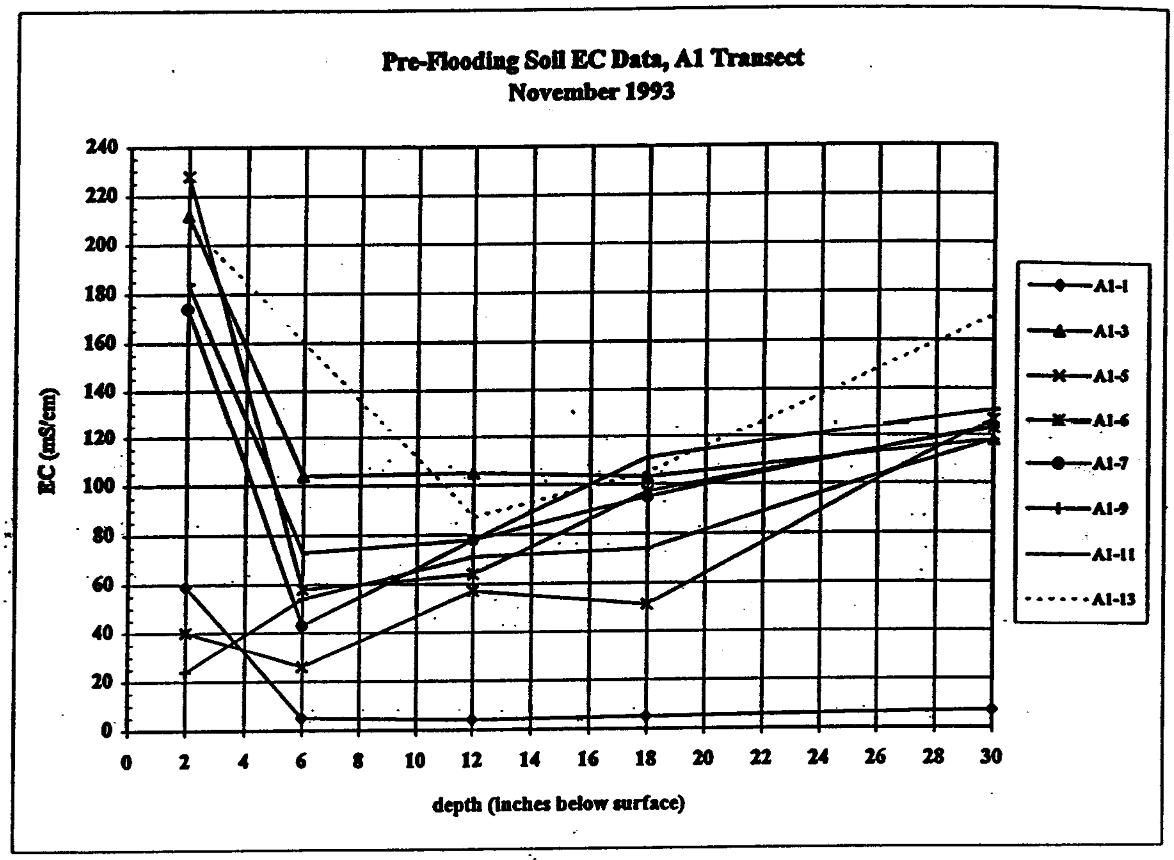
A few of the sites are characterized by having relatively depressed EC concentrations at the surface. These sites had a thin salt crust developed on the surface during the sampling, were located close to a spring mound zone (as described above) or were characterized by the presence of loose rippled sands. A rise in EC concentrations observed in many of the sites at 30 inches below the surface results from a secondary salt enrichment forming at or above the shallow water table. The EC profiles collected from December 1993 and November 1993 are similar to each other indicating that the salinity of the soil was relatively constant during the two months of pre-flood monitoring (Holder, 1996).

3.4.2 Soil Results During Flooding:

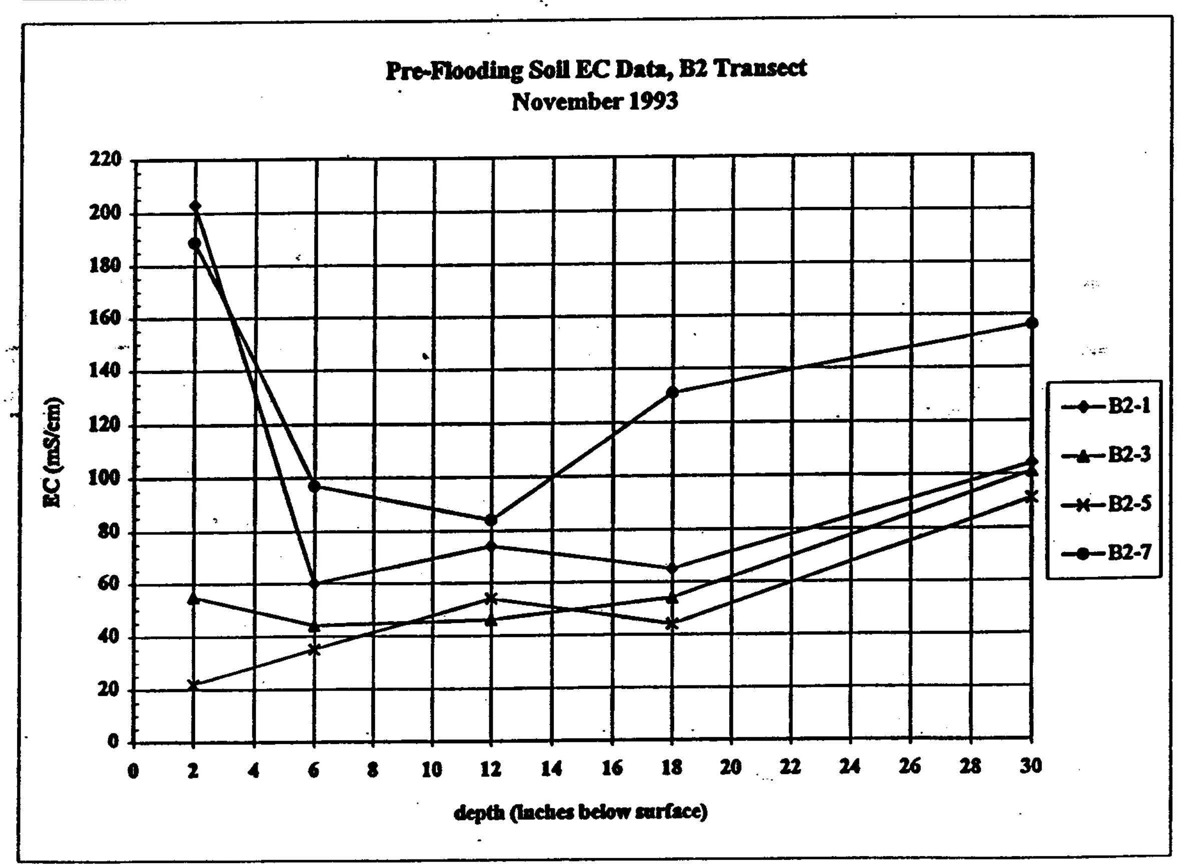
Due to saturated soil conditions, soil samples during flooding were collected with a soil core tube, instead of the 2-inch auger used in pre-flooding sampling. As such, they represent an average EC over an interval extending from the surface to a 30 cm depth (0-30 cm). Consistent with the piezometer data, the sites that show the greatest reduction in EC are the sites located in zones that are periodically flooded (Figure 3.4-2). The water movement across these sites is primarily due to wind-induced migration of surface water across the relatively flat playa surface (Holder, 1996). It is interesting to note that the EC concentrations in 7/95 appear to have risen slightly concomitant with a reduction in the extent of flooding.

3.5 Efficiency of Spreading and Water Use

Seventeen sets of high resolution 35 mm aerial photos were taken during the course of the test from January 8, 1994 to October 2, 1994. These photo sets are on file in the District office. The photos were entered into the District's GIS as discussed in Section 2.3.3 and the acreage of flooded (standing water) and controlled (wet soil) lake bed was calculated. Appendix P contains printouts of each of the 17 digitized photos along with the date and

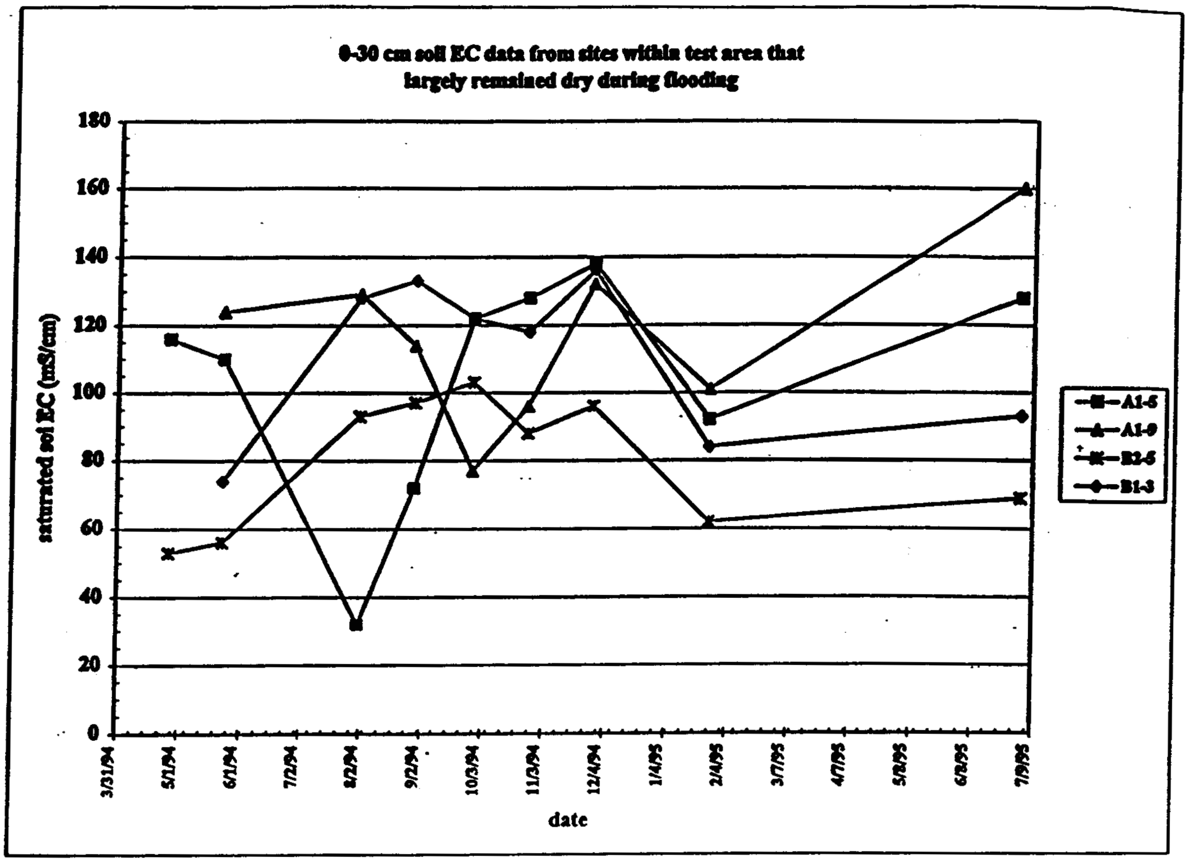


Pre-Flooding Soil EC Data, A1 Transect
November 1993
EC (mS/cm)
240
220
200
180
160
140
120
100
80
60
40
20
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
depth (inches below surface)
A1-1
A1-3
A1-5
A1-6
A1-7
A1-9
A1-11
A1-13



Pre-Flooding Soil EC Data, B2 Transect
November 1993
EC (mS/cm)
220
200
180
160
140
120
100
80
60
40
20
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
depth (inches below surface)
B2-1
B2-3
B2-5
B2-7

Figure 3.4-1


0-30 cm soil EC data from sites within test area that largely remained dry during flooding
saturated soil EC (mS/cm)
date
A1-5
A1-9
B2-5
B1-3

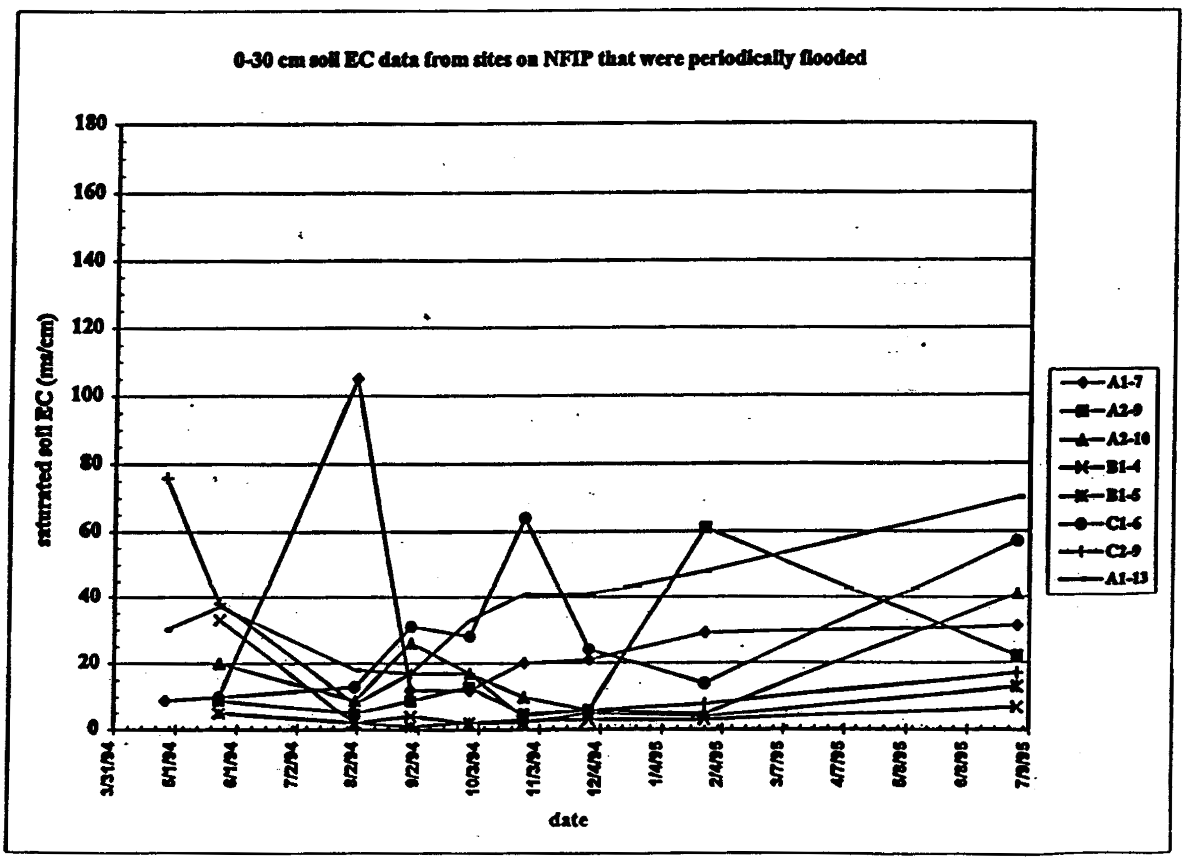

0-30 cm soil EC data from sites on NFIP that were periodically flooded
saturated soil EC (ms/cm)
date
A1-7
A2-9
A2-10
B1-4
B1-5
C1-6
C2-9
A1-13

Figure 3.4-2

acreage controlled. The maximum flooded area of 552 acres occurred on April 29, 1994. The maximum acreage of controlled lake bed was 735 acres on October 2, 1994.

During the period that aerial photographs were taken, detailed water delivery data were collected as discussed in Section 2.3.5. These data are compiled in Appendix Q, "Flood Irrigation Dust Mitigation Project - Flood Area Analysis." This water use information was then used in conjunction with the acreage flooded and acreage controlled data derived from the aerial photographs to determine the quantity of water required to control an acre of flood irrigated lake bed (ac-ft/acre/year). This information is also contained in Appendix Q. The data is compiled in two ways: using the total acreage flooded with standing water and using the total acreage of wetted soil which was found to be non-emissive. This information is summarized along with the total acres flooded and wetted in Figures 3.5-1 and 3.5-2.

3.5.1 Acreage Controlled.
From the dashed line in Figure 3.5-1 it can be seen that when the water was first turned on in January 1994, the amount of area covered with standing water (flooded) steadily increased as the water filled the air voids in the soil and brought the groundwater table to the surface. The amount of water required to flood each acre is very high during the initial phase of flooding because most of the water goes toward raising the groundwater levels to the surface.

The acreage flooded started to level off in March at about 500 acres as an equilibrium was reached on the site. The average air temperature (1 and 4 m heights) on the test site between March 1 and May 31 was 61°F. In June, however, as temperatures increased, increased evaporation rates caused the acreage flooded to decrease even when both pumps were turned on to provide additional water (June 2 to July 13). The average site air temperature between June 1 and August 31 was 82°F. This condition of reduced flooded acreage continued until the temperatures cooled in September and the amount of flooded acreage started to increase once again. This increase required much less water because the groundwater level was still very near to the surface. The average test site air temperature between September 1 and October 31 was 65°F.

The dashed line in Figure 3.5-2 indicates the acreage of wetted or controlled lake bed and shows less impact due to increased summer temperatures. As Spring winds caused the standing water to move across the test site, large areas remained wet at the surface even though they contained no standing water. In fact, during the last part of the test (aerial photos 7/28/94 and 10/2/94 in Appendix P) the water from the "A" outlets was either turned off or reduced and much of the surface still remained wet. Thus, the dashed line in Figure 3.5-2 shows that the total acreage controlled remained high, generally between 550 and 700 acres, during the entire period from March to October. However, to the extent possible, water use should be minimized during the summer when wind speeds are generally lower (meaning fewer severe dust storms), and evaporation rates are high. Water use efficiency will be lower during hot weather due to evaporation losses.

Figure 3.5-1

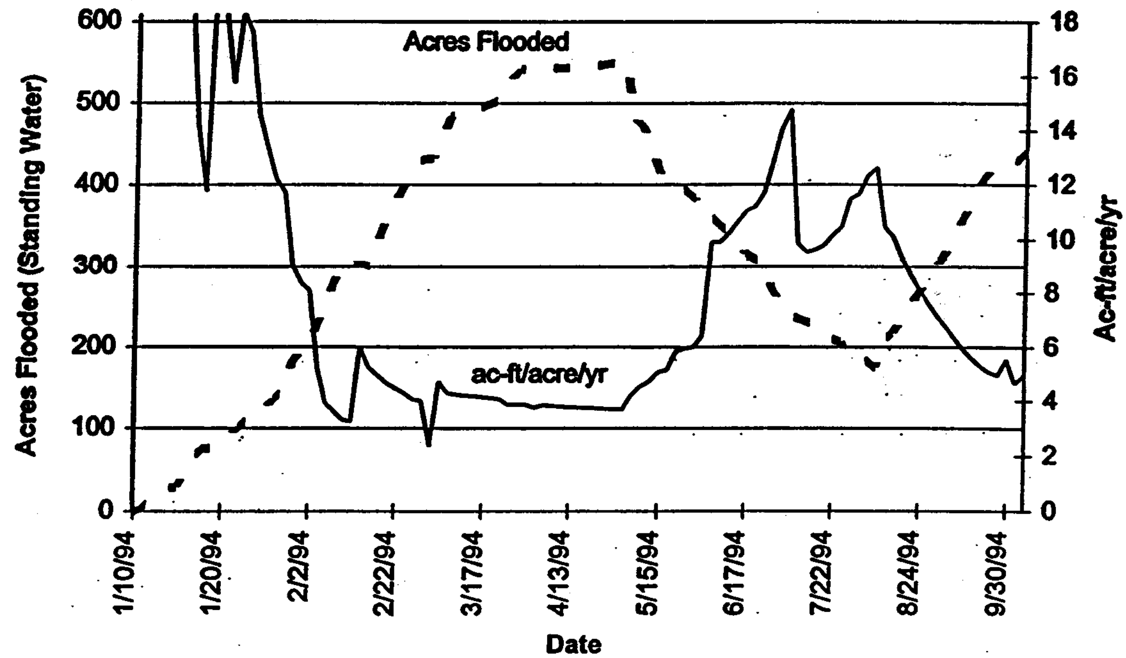
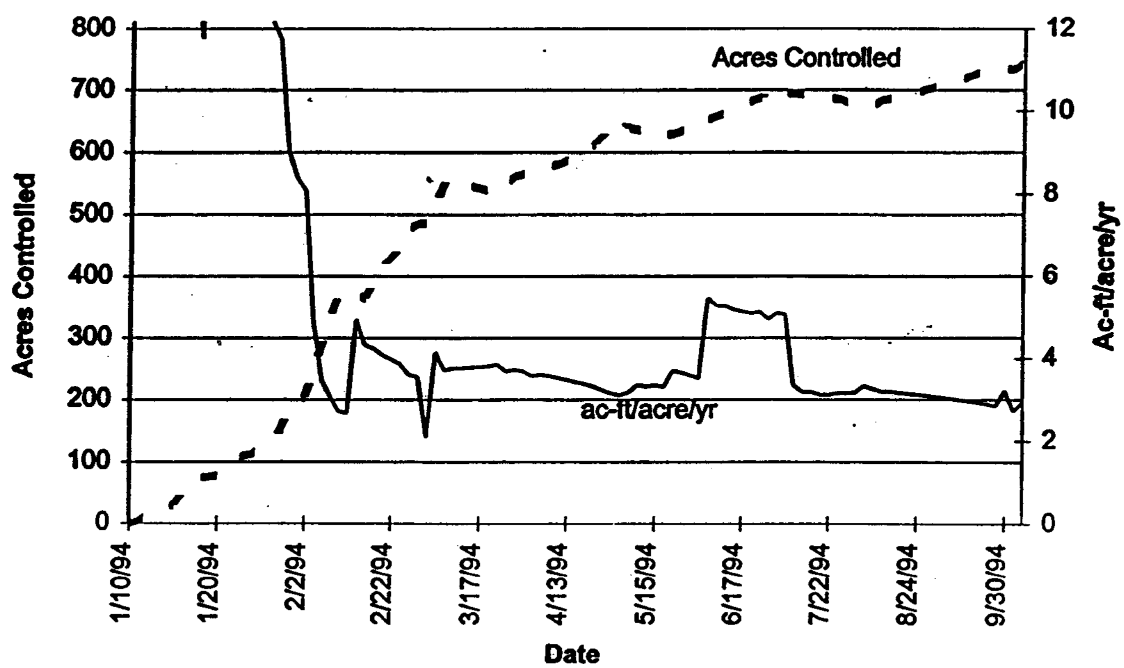


Figure 3.5-2



3.5.2 Water Use Efficiency.
Once the groundwater table was brought to the surface (by March), the amount of water required to flood an acre of lake bed ranged between about 4 and 14 ac-ft/ acre/ year and averaged 7 ac-ft/ acre/ year (solid line in Figure 3.5-1). However, the amount of water required to maintain a wetted surface ranged from only about 3 to 5.5 ac-ft/ acre/ yr and averaged 3.6 ac-ft/ acre/ yr (solid line in Figure 3.5-2). To be conservative, sand dominated areas of the lake bed designated for flood irrigation should be allocated up to 4 ac-ft/acre/yr to maintain a non-emissive surface.

3.5.3 Water Management.
All or sections of the test plot had water flows shut off during the Summer of 1994 and the Fall of 1995 for detailed on-site observations to determine how quickly the surface dried to the point that PM-10 emissions would occur. These observations are contained in two memos from Bill Cox dated October 17, 1994 and July 29, 1996 (attached as Appendix R). During both periods, wetted areas remained in a condition that resisted wind erosion for periods of up to 3 weeks. This would indicate that with careful water management techniques and procedures, water use efficiency can be increased. For instance, periodic flood intervals, when a site is flooded for perhaps a two week period and then the water shut off for a week to two weeks, may maintain irrigated areas in a wet condition that resists wind erosion while conserving water resources. If operational techniques can be developed to decrease the annual duty of approximately 4 feet/year, either additional areas could be controlled with flood irrigation or the total amount of water used for control could be reduced.

3.5.4 Loss of "Summer Crust".
Currently many areas on the bed of Owens Lake develop what is called a "summer crust" that protects the soil from wind erosion during the hot summer months. This crust is formed when salty water evaporating from the soil surface leaves a durable salt deposit on the surface that cements the soil particles together. This crust does not form during the cool, wet conditions usually present during the Fall, Winter and Spring. The relatively fresh water used on flood irrigated areas may leach the near surface salts and prevent the formation of a summer crust. Therefore, even though water use efficiencies are lowest during the summer, some quantity of water may need to be used during the summer to replace the protection lost by leaching salts.

On the other hand, the leaching action of flood irrigation should also remove soluble PM-10 sized salts from the surface and make them unavailable for air emission. Flood irrigation will also wash small clay- and silt-sized soil particles to lower portions of the flooded area, such as into shallow channels, where they can be wetted with lower amounts of water or where blowing sand will cover them.

3.6 Cost

The cost of the North FIP test provides an upper limit on the cost to construct flood irrigation because of the long distance from the existing water supply to the test site. Even though two wells and pump stations were available for the project, only one well/pump station will be used in the cost calculation, because generally only one pump station was operated at a time.

The approximate construction cost of the project is summarized below:

Item	Total
Production Well	$100,000
Pump Station	110,000
Leased Outlet Pipe	34,000
Pipeline	359,000
TOTAL	$603,000

After the initial wetting period from January through February, when much of the water went toward bringing the groundwater table to the surface, the test site averaged 383 acres of standing water and 648 acres of controlled (wetted) lake bed. Therefore the construction cost for control of PM-10 was $930 per acre.

Operation and maintenance costs consist of the cost of electricity to pump the water, the cost of manpower to operate the system and the cost of maintaining the infrastructure. The approximate operation and maintenance cost is summarized below:

Item	Unit Price	Total
1,598 ac-ft of water used	$36/ac-ft	$57,528
1 employee	60,000/emp	60,000
Pump & pipe maint.	approx. 10,000	10,000
TOTAL		$127,528

Again, from the period March to October the test site averaged 383 acres of standing water and 648 acres of controlled (wetted) lake bed. Therefore the operation and maintenance cost for control of PM-10 was $197 per acre.

The total annualized cost is calculated using the procedure set forth by the Environmental Protection Agency (EPA, 1992). The annualized cost is determined using the following equation:

$$C_a = (CRF \times C_c) + C_o + 0.5C_o + C_i$$

where: C_a = annualized cost

C_c = direct construction costs

C_o = annual direct operating costs

$0.5C_o$ = annual overhead cost

C_i = direct annual enforcement costs = $.15((CRF \times C_c) + C_o + 0.5C_o)$

CRF = capital recovery factor = $(i(1 + i)^n) / ((1 + i)^n - 1)$

= 0.0858 for interest rate, i = 7% and life, n = 25 years

Therefore, the annualized cost per acre for the North FIP was:

$$C_a = (0.0858 \times \$930) + \$197 + 0.5(\$197) + .15((0.0858 \times \$930) + \$197 + 0.5(\$197))$$
$$= \$432$$

3.7 Vegetation

3.7.1 Volunteer vegetation.

The release of fresh water on the sandy playa surface of the FIP allowed for spontaneous colonization by a large number of cattail plants, as well as some sedges, saltgrass, and assorted other grasses. The most dense stands were within 200 feet of the outlets, with survivorship and diversity decreasing with greater distance from the fresh water source (Paulus, 1994). During the first winter, unpredictable water movement within the channels caused high mortality in plants more than 200 feet from the outlets due to advancing salt fronts that rapidly killed formerly healthy plants. The cattail stands close to the outlets, however, have endured in healthy condition for 3 seasons. Even when the flooding was discontinued as a test, reduced flows have been released at both outlets for the express purpose of maintaining the cattail stands.

3.7.2 FIP experimental plantings.

There were four different types of experimental saltgrass plantings associated with the FIP (Scheidlinger,1996). The first one was associated with the piezometer network already in place on the FIP area. Soil, surface water, and shallow groundwater data were used to select 15 sites at piezometer locations that indicated soil and water conditions that would support saltgrass growth. Plants from nine different local populations were selected for each site based on the salt tolerance that had already been established for each population based on a previous study (Scheidlinger, 1994). Thus, high salt sites received plants known to be very salt tolerant, and low salt sites received less tolerant introductions. Planting was done in April 1994, and the plants were monitored through June 1996.

The "B" outlets of the FIP were in continuous operation between January 1994 and March 1995, and both outlets were off all summer of 1995. Plants survived at 8 of the 15 sites, but only 22% of all plants were still alive at that point. A summer without irrigation was stressful for these plants. Flooding had been irregular and intermittent since Fall 1995. Plants were sampled in June 1996, and survivors were found at 5 of the original 15 sites, with overall survivorship of 13%. Survivorship was greatest in areas with continual and predictable access to freshwater, and was lowest where changes in channel location reduced water availability or increased salt migration. Live plants persisted into June 1996 at locations B1-4, B1-5, and A1-7, which is consistent with low soil EC measured at these locations (Figure 3.4-2).

The second study involved the planting of small saltgrass plugs in grids at 22 locations below the B-line outlets of the FIP. By September 1995, after a summer without irrigation, there were survivors at 12 of these sites, with survivorship ranging from 1% to

70%. Survivorship was related to distance from the outlets, with plants close to a fresh water source and stable channel configurations having higher survivorship rates. By June, 1996, survivors were found on only 6 of these sites, and never exceeded 5% at any site. Lack of water was probably a contributing factor to mortality, but the effects of sand blasting were also evident, as flooding had been discontinued or irregular during the winter months, and sand movement on the FIP was again active. Survivorship was confined to sites within 200 feet of the outlets; but even there, sand damage was evident.

In the third study, saltgrass plugs were planted in rows oriented perpendicular to the prevailing winds, in an effort to create a biological fence array. With plants located near the B outlets, survivorship approached 60 percent after a season with irrigation. The more distant array had survivorship of only 22%. Plants introduced downstream from the A outlets, at a greater distance from the outlets, had survivorship after one season of essentially zero. Changing soil conditions associated with unstable channel configuration account for the high mortality rates.

The fourth study was a seeding experiment, in which saltgrass and sedge *(Scirpus americanus)* seeds were sown at the downstream edge of the natural cattail stands associated with each outlet line. Where prevailing winds blew the seeds back into the wetted areas, recruitment was excellent, and saltgrass and sedges are still growing after two seasons at least 50 feet away from the cattails, where irrigation has remained in effect.

3.8 Wildlife

Flooding of large portions of the Owens Lake playa for dust control provides the added bonus of a significant improvement in habitat for wildlife. Experiments in flood irrigation that began in January 1994 quickly generated surprisingly well-vegetated habitat close to the outlets that was used by a diverse assemblage of wildlife species. Open, flooded playa developed blooms of algae that formed the basis of a newly-formed food chain. The dense stands of cattails, described in the previous section, provided limited additional structural diversity.

3.8.1 Aquatic macroinvertebrates.

Soon after wetting of the North Flood Irrigation Project began, dense clots of alkali (brine) flies were observed on the surface of the standing or slowly moving water. The most abundant aquatic macroinvertebrates on flooded playa surfaces are alkali flies, shore flies, long-legged flies and various beetles (Herbst, D. 1996). Under conditions of higher rates of water release and full flooding, alkali flies will become by far the dominant species. All of the flies mentioned above, plus the larvae of dragonflies and damselflies are the major food source for the flocks of shorebirds that are attracted to the wetted playa habitat.

3.8.2 Birds.

The most conspicuous component of wildlife use of the North Flood Irrigation Project was its birdlife. The greatest variety of bird species was observed on wet playa, feeding on aquatic macroinvertebrates. Clumps of cattails provided habitat for species not normally expected on dry lake beds, even when flooded with water.

Shorebirds.
Large numbers of shorebirds use suitable habitat, such as flooded playa, at Owens Lake during spring and fall migration. Their numbers may fluctuate in concert with numbers of alkali flies to be found at any given time on the flooded areas. Conspicuous species observed at the North Flood Irrigation Project include snowy plover, semipalmated plover, American avocet, black-necked stilt, spotted sandpiper, greater yellowlegs, lesser yellowlegs, willet, long-billed curlew, western sandpiper, least sandpiper, and dunlin. Both American avocet and western snowy plover are known to breed at the Owens Lake Flood Irrigation Projects. The western subspecies of snowy plover (*Charadrius alexandrinus nivosus*) is a California Species of Special Concern. Records show that the total population of snowy plovers at Owens Lake has declined significantly over the last 20 years. It is quite possible, however, that water-based dust control measures, such as Flood Irrigation Projects, will provide a significant improvement in snowy plover habitat on the Owens Lake playa (Gary Page, personal communication, 5/24/95).

Marsh Birds.
Clumps of cattails in moderately deep (to about 1 foot depth) water provide excellent habitat for certain birds that prefer marshy habitat. In summer and fall of 1994, within six months of the start of flows on the North Flood Irrigation Project, these clumps contained at least a dozen each of Virginia rail, sora and marsh wren, plus a smattering of other marsh-frequenting species such as common yellowthroat, northern waterthrush, savannah sparrow, song sparrow, red-winged blackbird and yellow-headed blackbird. The presence of these species is an excellent indication of the potential of flood irrigation to produce an abundance of marshy habitat to replace, in part, that lost when Owens Lake dried up.

Land Birds.
The cattail clumps also provided a fair amount of land bird habitat. Birds were attracted by the lush green vegetation and were enticed to stay by the abundance of flying insects that provided food. Their numbers included five different species of swallow, house wren, ruby-crowned kinglet, loggerhead shrike, orange-crowned warbler, yellow-rumped warbler, MacGillivray's warbler and house finch. These are not the type of birds expected in the middle of a dry lake bed, and point out the potential the addition of water has for overall habitat improvement.

3.8.3 Mammals.
Bats are the primary mammalian users of aquatic habitat at Owens Lake. Three species of bats have been observed foraging over aquatic habitats within the area: Yuma myotis, small-footed myotis and spotted bat. However, terrestrial mammals, such as raccoons, mice and jackrabbits, forage at the water's edge, and coyotes and bobcats will prey on rabbits, mice and aquatic birds. Tracks of deer and elk have been observed near the North Flood Irrigation Project.

4.0 CONCLUSIONS

4.1 Effectiveness for Sand Motion

Shallow flood irrigation was very effective in reducing sand motion on the north sand sheet on Owens Lake. None of the potential problems - poor coverage due to topography or desiccation cracks, shifting of the water by strong winds reducing the effectiveness of the wetted area, large salt blooms around the wetted area - materialized. A 100% reduction can be obtained under ideal conditions, and about a 95% reduction under less than ideal conditions. The two-dimensional analyses of sand flux on the FIP show that the wet areas can achieve a 99% reduction in sand movement with 70% water coverage.

4.2 Effectiveness for PM-10

The Wind Tunnel results showed that the average PM-10 control efficiency in the spring was 99.9% and in the fall 98.7% if there is 75% water coverage during the windy period.

4.3 Cost per Ton of PM-10 Reduced

The "Owens Valley PM-10 Planning Area Best Available Control Measures State Implementation Plan" which was adopted by the Great Basin board on June 29, 1994 estimates that between 500,000 and 4,000,000 tons of PM-10 are emitted from the Owens Lake playa each year. Great Basin estimates that the PM-10 emission area is approximately 35 square miles or 22,400 acres. Therefore, the annual emission rate in tons per acre ranges from 22 to 179.

The annualized cost for the North FIP was $432 per acre. Assuming that flood irrigation provides nearly 100% control, the cost per ton of PM-10 reduced ranges from $2.41 to $19.63.

4.4 Effectiveness for Vegetation Establishment

We conclude from these studies that using a FIP-type situation as implemented in this study - with continuous flooding for up to 15 months, and followed by summer shut off - must be considered to be inefficient for plant introduction. Since a FIP is designed to keep soils continuously wet during the windy season, leaching of soils is accomplished only in patches, and slowly, if at all. When water is turned off during the non-windy summer months, newly established plants suffer from drought stress. Vegetation introduced onto such a FIP remains vulnerable to changing soil salinities that may prove to be lethal. Such changes are extremely difficult to predict (except for proximity to a fresh water source, which consistently allows for high recruitment and survivorship), and a single pulse of high salinity water into the rooting zone of healthy plants may be sufficient to kill them.

A flooding program such as was conducted in this study will allow for plant growth only within about 500 feet of the water outlets, providing that the water is of sufficiently good quality and that at least minimal flows are provided during the summer to sustain plant growth. With time, areas at greater distances from the outlets may become suitable habitat, especially if water application from the beginning is in pulses rather than by continuous flooding. Pulsed application provides for the leaching of salts out of the rooting zone and into the shallow water table, thus flushing the upper reaches of the soil column so that salt will not migrate with meandering channels.

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Appendix E

Vegetation as a Control Measure (May 1997)

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

Vegetation as a Control Measure

Carla Schiedlinger

MAY 1997

APPENDIX E

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157 Short Street, Bishop, California 93514
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Updated Report:
Vegetation as a Control Measure
14 May 1997

Effectiveness

Vegetation can be an effective means of reducing PM-10 emissions on the Owens Lake playa. Not only do plants provide direct cover for the soil, they also extract momentum from the air flow, and thereby decrease surface wind speeds to below the threshold velocity required to loft particles into the air. On the Owens playa, then, vegetation can serve to prevent soil particles from eroding from the vegetated surfaces, thus eliminating PM-10 emissions.

Vegetation as a surface cover has been used in a variety of circumstances to control the wind erosion of soils. A variety of field and laboratory research efforts have been directed at determining the degree of protection against wind erosion provided by different types of vegetation cover (Musick and Gillette 1990). Most of the data have been generated by simulating vegetation configurations in the field or in a wind tunnel using idealized geometric forms, but natural vegetation has been studied as well. Since few studies conform to each other in all soil, plant element, and data collection protocols, much less to the model assumptions developed for the soils and wind speeds of the Owens Lake, it is difficult to apply directly other research findings to the Owens Lake situation. The research summarized below, however, indicates that vegetation can reduce soil erosion and PM-10 by up to 100% if a cover (live or dead) of 50% is achieved (Table 1). For purposes of comparison, minimum threshold wind speed measured as an hourly average at a height of 10 m at Owens Lake is 17 mph (7.6 m/sec), and threshold friction velocity is 26 cm/sec. Maximum hourly average wind speed measured at 10 m at the Owens Lake is about 40 mph. Winds in excess of this velocity occur less than 1 day per year at owens Lake.

An important example of erosion control using vegetation is in agriculture, where farmers have long been concerned with the ability of wind to remove valuable topsoil from fields unless the soil surface is stabilized. One effective measure used to prevent soil loss by wind is to maintain vegetation or vegetative residues on the land. Planting cover crops during fallow periods is a frequently used technique. An important aspect of such practices is the fact that standing vegetation is effective in reducing erosion and dust emissions even when it is dormant or dead (Wolfe and Nickling 1993). Also, allowing plant stubble to remain in the field after harvest can effectively reduce wind erosion during the dormant seasons. Wind tunnel data using dowels of various diameters and heights showed that in free-stream velocities of 20-36 mph, stubble of only 4-5 inches in height at densities of about 30 stems per square foot can decrease soil loss by wind erosion to zero in soils where the threshold velocity for erosion was 19.28 mph (8.62 m/s) (van de Ven et al. 1989). To model for live plants, field and wind tunnel studies (Fryrear 1994) have developed a relationship between soil loss and canopy cover. Figure 1 (Fryrear 1994) shows that 96.3% reduction in soil loss can be accomplished in a wind tunnel with about 50% canopy cover at wind speeds of 36 mph (16 m/sec) measured at a height of about 0.5 m in the tunnel. This is equivalent to about 48 mph measured at 10 meters at Owens Lake. The conclusions from studies such as these are that perennial plant cover can protect soil surfaces even during the winter, when above-ground plant material is dead but still standing.

Another example is the use of vegetation to stabilize soils disturbed by activities such as mining, road cuts, and removal of vegetation due to desertification. Such activities make these surfaces susceptible to wind erosion and dust emission (Wolfe and Nickling 1993). There are state and federal regulations that now require using vegetation to aid in the reclamation of mine sites and margins of road cuts (the 1977 Surface Mine Control and Reclamation Act and the 1976 Resource Conservation and Recovery Act are examples of such legislation).

A variety of field and laboratory research efforts have been directed at determining the degree of protection against wind erosion provided by different types of vegetation cover. Most of the pertinent data have been generated by simulating vegetation configurations in a wind tunnel, but natural vegetation has been studied as well. Musick and Gillette (1990) conducted field studies in sandy soils with a bare soil threshold friction velocity of 30 cm/sec (wind speed of 19 mph measured at 10 m), and report that these soils can be stabilized at that wind velocity with a vegetation lateral cover of approximately 25%. Finer-textured surfaces more resistant to erosion would be stable with even less cover.

Other studies suggesting that sparse vegetation is sufficient to control PM-10 emissions were conducted by Buckley (1987) and Grantz et. al (1995). Although site differences and soil types do not permit direct comparison, and wind speed data were not reported in these papers, the conclusions support the proposition that 100% cover is not necessary in a field condition to stabilize soils surfaces and eliminate PM-10. Buckley's conclusions were that ground cover of only 8% was sufficient to suppress movement of sand by 50%, and 30% ground cover may reduce it by as much as 99%. Grantz et al. showed that a revegetated sandy soil with a total plant cover of 31% suppressed PM-10 (as measured by Sensit) by as much as 99.8%.

Recent field and wind tunnel research on Owens playa sands and actual saltgrass vegetation has been conducted by Lancaster (1996) on Owens Lake and White et al. (1997) in the University of California Davis wind tunnel. These studies indicate that even sparse populations of saltgrass function very effectively in reducing sand migration within the stand. Lancaster (1996) concluded that for the coarse sands of the Owens Lake's north sand sheet, 95% reduction in sand movement can be achieved with a saltgrass cover of between 16-23%, depending on wind speed and direction (Figure 2). Furthermore, this study developed a relationship between roughness density, which is the aerodynamic measure of cover, and actual plant cover, which relates directly to projected water use (Figure 3). White et al. found that both mass flux and PM-10 measured in the wind tunnel for wind velocities of 12-13 m/sec (corrected to 44 mph at 10 m height) decreased dramatically, showing a 97.1% reduction in PM-10 with a vegetation roughness density of only 0.093 (12% cover). Sand flux and PM-10 emissions dropped to almost zero with a roughness density of 0.461 (42% cover) (Fig 4).

Wind tunnel studies were conducted in February 1997 on untreated, leached, vegetated, and "simulated" vegetated sites on the Owens Lake clay soils (Nickling et al. 1997). Although the vegetation increased the aerodynamic roughness of the surface, there was no statistically significant difference between PM-10 emissions from the vegetated and from the control (leached but unvegetated) sites. Both of these sites, however, showed PM-10 reductions of two orders of magnitude compared to the natural playa surfaces. Nickling et al. show the wind speed for lake bed vegetation areas to emit significant amounts of PM-10 on the treated clay surface of the lake bed is around 40 to 45 miles per hour (18-20 m/sec) (Figure 6). The threshold for untreated clay surfaces is around 7.6 m/s (17 mph at 10 m) based on field observations and portable wind tunnel measurements at Owens Lake. This indicates that treatment of the clay surfaces at owens Lake by watering and leaching surface salts can by itself significantly reduce wind erosion without vegetation. However, saltgrass vegetation cover will provide additional surface protection after the initial protection provided by watering decreases (Nickling et al. 1997).

In a companion project, clay soils with saltgrass were moistened and then allowed to dry, and the resulting arrays were subjected to various windspeeds in a wind tunnel at University of California Davis. Preliminary results (Bruce White, pers comm. 13 May 1997, and Figure 7) indicate that 54% vegetation cover reduces the emission rate of PM-10 at wind speed of 45 mph by 99.2%. Unvegetated wetted surfaces alone reduced PM-10 emission by 96.5% (Figure 7).

Although a PM-10 control efficiency is not provided by the White and Nickling studies, the measured emissions from their studies can be used with the uncontrolled emissions from the air quality model (SIP, Eq. 4-3) to determine control effectiveness. Nickling showed that the surface emitted 1.2 x 10(-5) $g/m^2/s$ of PM-10 with a surface saltgrass cover of 11% on a clay surface at Owens Lake under a wind tunnel speed of 45 mph at 10 m. The uncontrolled PM-10 emissions used for the air quality model estimates an emission rate of 2.6 x 10(-3) $g/m^2/s$ for a wind speed of 45 mph. This results in a 99.5% control efficiency for vegetation control in the test performed at Owens Lake with 11% salt grass cover. White measured PM-10 emissions of 2.0 x 10(-5) $g/m^2/s$ for the UC Davis wind tunnel with 54% saltgrass cover on a clay surface at 45 mph. This results in a 99.2% control efficiency as compared to the uncontrolled emissions from Owens Lake.

Both laboratory and field studies confirm, then, that plant material-- whether live, dormant, or dead--stabilizes soil surfaces and can control erosion and PM-10 emissions with an effectiveness of greater than 95%. The only studies measuring sand flux and PM-10 emission from dry lake playas vegetated with saltgrass have been conducted by Lancaster (1996), Lancaster and Nickling (1997), and White et al. (1997). Saltgrass meadows, however, have provided protection from PM-10 emissions on Lake Texcoco, a dry lake playa near Mexico City. This playa had been a source of blowing dust for over sixty years, following its deliberate dewatering in the early 1900's. A 15,000 acre (6,000 hectare) area of the playa was planted with saltgrass during the 1970's (Gonzalez Vicente 1982 and Llerena 1994), and has diversified into extensive meadows currently used for pasturing cattle, deer, and horses.

Although quantitative effectiveness data were not available, dust control has been extremely effective, so that fugitive dust is no longer considered an element of air pollution in the Mexico City basin (Bravo Alvarez 1985). GBUAPCD staff interviews and site visits with the Texcoco project personnel reveal that portions of the project remain dormant over the period of several years, and that dust protection remains effective even when the vegetation is not actively growing (Scheidlinger 1995).

The evidence from Lake Texcoco as well as from studies conducted on abandoned agricultural land support the conclusion that vegetation does not need to be either constantly living nor uninterrupted in its extent in order to contain dust. A field study that revegetated abandoned agricultural land resulted in the absence of PM-10 exceedances at the nearest downwind sampling site (Grantz et al. 1995). This project achieved this degree of dust control with a vegetation distribution that included barren patches of greater than 25 feet (8 m) across.

Intensively managing vegetation as parcels of native species can meet the air quality standards without planting the entire playa. The efficient distribution and irrigation of vegetated parcels on the playa could allow for a mosaic of live and dead/dormant vegetation and unvegetated parcels, resulting in adequate dust containment for the entire area. The unvegetated portions of the playa need only to be narrow enough to be shielded from the wind by the vegetated strips, or treated with another effective control measure such as tilling.

The other role that vegetation can play in reduction of dust emissions is with the use of trees as windbreaks. A windbreak may consist of single or multiple rows of trees or shrubs that provide the benefit of reducing surface soil erosion that generates PM-10. The US Soil Conservation Service (now the Natural Resources Conservation Service NRCS) advises that open field wind speeds may be reduced by 60-70% using field windbreaks (SCS Davis, CA). The degree of wind reduction depends upon the spacing of the windbreaks, with spacing of 6-8 times the tree height providing "excellent" protection by reducing wind speeds by 50-70%. If wind reduction of 70% is achieved, a 40 mph wind would be reduced to 12 mph, which is below the threshold wind velocity for these surfaces. Thus, 100% control could be achieved. The greater the spacing, the less protection is afforded downwind of the tree rows (Figure 5). Recommended spacing and species selection varies with location, but trees must be spaced closely within the row to effectively block the wind at the soil surface as well as downwind of the row itself. For maximum effectiveness, tree rows must be planted perpendicular to the angle of the prevailing winds.

Feasibility

Vegetation types that currently occur naturally on the Owens Lake playa include those associated with the deltaic deposits of the Owens River delta; spring mound vegetation; and meadow vegetation associated with "shoreline" seep and spring zones. Elements of these three vegetation associations include a number of native, salt-tolerant species that can be introduced onto unvegetated portions of the playa to accomplish the goal of reduced PM-10 emissions. The existence of vegetation on the playa indicates that plants can spread naturally to bare areas, provided the soil type is suitable, adequate leaching of salts occurs prior to establishment, and sufficient and sustained water supply is available.

For the purposes of dust control, there are several target plant species or communities that could be established on the playa surface. Saltgrass (*Distichlis spicata* var. *stricta*) is a perennial grass dominating the dry alkaline meadow community that is well-represented on the margins of the Owens Lake playa and on spring mounds located at a variety of locations on the playa itself. Where soil conditions are relatively saline and water is limited, this species occurs where no other species grows, and is a colonizer of bare playa soils where leaching from spring openings has occurred. It spreads rapidly via rhizome growth when conditions are favorable, and tolerates a wide range of moisture and salinity conditions. Furthermore, it is easily grown and has been successfully introduced onto playa soils, including both sand and clay substrates, using minimal water management (GBUAPCD 1996a and 1996c).

Field experiments have been conducted by GBUAPCD in a variety of settings and soil types. Some of the first work was associated with shallow flooding. Saltgrass plants in 1-gallon pots were planted at 15 locations on the north Flood Irrigation Project (NFIP), and grids of smaller plugs were introduced at 22 locations. In addition, rows of saltgrass plugs were planted at 2 locations on the NFIP. The same factors that limit natural establishment, i.e. unreliable water supply due to inconsistency of channeling, and the unpredictable migration of salt fronts, affected these plants. (GBUAPCD 1996c). Survivorship was extremely variable for these plantings, and related most clearly to water distribution patterns that in turn affected salinity. As with other plantings on the NFIP, survivorship was greatest nearest to the water outlets, and mortality increased when the water supply was discontinued or made irregular. These results, in conjunction with studies conducted on naturally established vegetation on the NFIP, support the conclusion that establishment of vegetation in association with shallow flooding as implemented on the NFIP experiment is inefficient, as predicting locations for successful establishment is extremely difficult (GBUAPCD 1994c).

Another experiment was conducted on a sandy plot consisting of 20 acres (8 ha), which was managed exclusively for vegetation. The water distribution method was similar to that on the shallow flooding site. Water was delivered to the uphill edge of the site on the surface, and allowed to flow downhill following the natural topography and slope of the land. Water distribution on this site was erratic due to low delivery volumes and irregular topography, and plant establishment from planted plugs was very patchy (GBUAPCD 1996b). This problem is inevitable on large plots using uncontrolled water spreading, Plants reproducing vegetatively, such as saltgrass, can be expected to expand into less favorable habitat as they establish, but survivorship will depend on the ability of the water management system to permanently remove salts from the rooting zone. Two other problems encountered on this plot were sand abrasion, and the encroachment of the saline shallow water table into the rooting zone of the plants, which accelerated mortality.

These experiments revealed three issues that will need to be addressed in any vegetation efforts implemented on the lake. The first is water delivery method. Low volume water delivery on sandy soils results in irregular water distribution and inefficient water use due to the high permeability of the sands. On the fractured clay soils, large and small cracks have been shown to impede the movement of water across and through the undisturbed soils with low volume water delivery, limiting both leaching and irrigation capability (GBUAPCD unpublished data). Methods of efficient and high volume water delivery that include surface treatment to defeat major clay soil fractures are needed to accelerate the establishment of vegetation on a large scale.

The second issue is drainage. In areas where the water table is close to the surface, highly saline and anoxic water can intrude into the rooting zone during the winter, causing extensive plant dieback. This phenomenon has been observed in natural stands as well as in both experimental locations. Earlier work regarding plant-soil interactions on the Owens Lake playa had predicted this effect for the sandy soils of the lake (Dahlgren 1994 and Richards 1994), and proposed that natural saltgrass populations formed only on already established sand dunes that elevated the rooting zone of the plants above the water table. Excavation of an existing spring mound on the playa revealed that saltgrass establishes directly on the playa surface when spring water has leached sufficient salt, and that blown sand creates the mound or dune (GBUAPCD 1994). These spring mounds are subject to dieback when spring flows are reduced, allowing the migration of salts to occur into the rooting zone. For shoreline saltgrass populations during wet years, dieback occurs when the shallow water table elevates into their rooting zone (Jim Paulus, pers. comm.). Rather than establish plants on dunes, it is preferable to install a drainage system into vegetation plots that would provide an adequate and cost-effective solution to the deleterious effects of the encroaching shallow water table. Where the water table is greater than 6-8 feet below the ground surface, as is the case in much of the clay soil areas of the playa, encroachment into the rooting zone will not be a serious problem.

Finally, sand abrasion can seriously impact vegetation. On some of the small, unprotected plots on the north sand sheet, including the 20 acre (8 ha) plot, blowing sand severely impacted the developing saltgrass plants during winter wind events. Where blowing sand is less, such as on the clay soils, this will not be as large a problem. In any areas, however, initial protection of vegetated sites will be necessary by applying other soil stabilization methods to adjacent sites, such as a moat and row array, shallow flooding, or gravel blankets.

Vegetation can, however, be successfully established on the playa in association with intensive water management specifically designed to leach, drain, and irrigate soil. GBUAPCD has conducted a number of saltgrass establishment experiments on the Owens Lake playa using seeds, plugs, and rhizomes. On the north sand sheet, first year establishment using all three methods was very successful in small (60 x 50 feet, or 18 x 15 m) plots, where water could be distributed evenly. The plant cover established uniformly and created a meadow-like environment colonized eventually by other plant species. After 2 seasons, plots that were protected from sand abrasion and for which drainage was not a problem, had developed cover sufficient to stabilize the soil surface (GBUAPCD 1996a). During the third season, water use was cut back to only a single irrigation during the summer season, for a total yearly application of 0.9 ac-ft/ac. The resulting plots consist of the remaining standing dead material as well as live stems. The total cover is 71%, with dead stems comprising 87% of the total cover and live stems accounting for 13% of the cover (GBUAPCD 1997b). About 50% of the dead cover can be expected to remain intact and functional as stabilizing cover for 2 seasons (Groeneveld 1994), while the reduced amount of new live material continues to expand onto the unvegetated surfaces adjacent to the plots.

In clay soils, saltgrass plants have also been successfully established from plugs on small (60 feet x 50 ft) plots using minimal water management. In four plots flooded without furrowing, early mortality was only 2%. After one season of growth, total cover ranged from 16%-35%, with three of the four plots achieving greater than 30% cover (GBUAPCD 1997a). Irrigation duties were high during this first season (up to 9 acft/ac), but the establishment data comparing soil salinity at the time of planting with first season growth indicate that leaching and irrigation can successfully be combined in order to conserve on water use. Data from a small clay soil plot elsewhere on the lake demonstrate that after establishment, stable cover of about 15% and viability of saltgrass was maintained on 0.2 acft/ac of water during the 1996 growing season (E. Wilson, *pers. comm.*). On these clay soil plots, sand abrasion was not a problem, and the shallow water table was sufficiently deep to not require drainage for such small scale plots.

The required annual water duty for such saltgrass stands, then, could be highly variable, consisting of intensive watering of an estimated 4 acft/ac for the first year of establishment, followed by normal duties of about 2 acft/ac for one year in three, using for the remaining two years approximately 1 acft/ac for low-level maintenance. Providing that at least 50% live cover was initially achieved after two to three growing seasons with the normal water duty, the low water use would still maintain this cover, which is sufficiently dense and continuous to provide sufficient control of PM-10 emissions to meet air quality standards (GBUAPCD 1996a and 1997b).

From the above experience on the Owens Lake, we conclude that managed water use and controlled water distribution provide a viable alternative for establishing vegetation on the playa. Clay soils provide the best opportunity for large-scale vegetated plots, for the following reasons: 1) Clay soils allow for the construction of long, narrow fields or panels to which water can be delivered quickly and intensively from a large-capacity earthen ditch and reservoir system, which permits rapid and inexpensive reclamation of the saline/sodic soils of the Owens playa to an extent that would allow for the introduction of saltgrass (Willardson 1996); 2) The shallow water table is sufficiently deep as to not pose a serious threat for the resalinization of soils; and 3) open drains can be inexpensively installed to remove saline drain water from the site during leaching and irrigation, thus allowing for permanent leaching of the soil.

Theory and practical experience indicate that different soils require different amounts of water to be applied in order to leach them. The amount of water required depends first of all on the target salinity, which in turn depends upon the type of plant proposed for introduction. In order to remove 80% of the soluble salts, one foot of water must be applied per foot of soil depth. This applies under ponded conditions, which means that the water must be applied in a short period without runoff, ideally with several intermittent rapid applications (Bresler et al. 1982). Additional considerations involve soil texture. For the Owens Lake clay soils, which consist of approximately 70% clay, 20% silt, and 10% sand and have a porosity of 50%, an estimated leaching requirement to achieve an EC of about 10 mS/cm is approximately 3 pore volumes or 1.5 feet of water per foot of soil (Dr. Jerry Jurinack, *pers. comm.*). That is, to leach a rooting zone of 3 feet could require about 4.5 feet of water.

The high salinity and sodicity of the Owens Lake clay soils, and the fractured nature of those soils, could make leaching far less efficient than theory might predict. A small-scale experiment conducted in spring of 1996 in a 450 foot long compacted channel revealed that following intermittent low rate water application for seven cycles, the site attained a soil salinity suitable for introduction of saltgrass (GBUAPCD 1996e). After 3 months, the soils were leached to about 8 inches deep to the EC level of the irrigation water. That is, all soil salt had been removed.

A research project was initiated on the Owens Lake in July 1996 by Agrarian Research and Management to test the potential for leaching soils, draining the site to discharge or recover water, and irrigating a saltgrass crop on the fractured clay soils of the Owens Lake. The site was constructed on contour, which resulted in 32 level panels of irregular size and shape ranging in area from about 3/4 acre to 2-1/2 acres. Panel length was between 600 feet and 2400 feet. The surface of some of the panels was modified by disking, shallow ripping, deep ripping, or compacting. Construction took place during July and August 1996, and leaching began in August. By late September, several of the panels had salinity levels tolerable to saltgrass, and planting was done. Soil analysis was completed, and water application rates were measured. The construction details for the plot are reported by Stradling (1997), and the soil and water results of the study are summarized by Ayars (1997). The study concluded that surface treatment reduced the water use required for leaching; and that depending on the surface treatment, between 3.5 and 6 feet of water would be required to reclaim the upper 2 feet of soil. This field result is consistent with the predictions outlined above. The saltgrass plants survived the winter in spite of the late planting date, and have resumed growth in the spring of 1997. The remaining panels, which continued to be leached during the winter, are being planted to saltgrass in spring of 1997.

In addition to the small-scale panels constructed on the Agrarian research site, several large panels measuring 180 feet wide and 4000 feet long (about 15 acres) have been constructed on the south portion of the lake. The use of head ditches and a water delivery system that can irrigate the entire area in several hours has greatly increased the efficiency and effectiveness of water distribution at this site, and demonstrates the scale at which managed vegetation would be implemented as a control measure on the Owens Lake playa.

An important component of the Agrarian research site design is drainage. Where active leaching is occurring, drainage is required to remove the saline water from the rooting zone. Drainage can be accomplished either using conventional tile drains, as would be necessary in sandy soils, or with excavated drain systems, as has been done in the clay soils on the Agrarian site. Drainage water is discharged from the site during initial stages of leaching to dispose of the salts removed by the irrigation water. As leaching progresses, and less salt is contained in the drain water, this water can be collected and recycled either by applying it to new panels with extremely salty and sodic soils, which respond better to initial treatments of somewhat saline water (Bresler et al. 1982), or by alternating its use with fresh water in irrigating vegetation. Salt-tolerant vegetation is able to tolerate such an irrigation schedule, thus conserving on use of fresh water resources while achieving maximum acreage of vegetation. Therefore, the use of drainage water and water recycling can allow for many more vegetated acres than would be possible with the same volume of water under low or moderate management.

Although saltgrass is the plant species of choice for achieving PM-10 standards, soil reclamation and water recycling could allow for a great diversity of plant species to be grown on the playa. There are a number of salt-tolerant native plants that already occur in some numbers on the Owens Lake playa, such as saltgrass and Parry saltbush (*Atriplex parryi)*. Among agricultural species, there are plants that are both highly salt tolerant (such as pickleweed or *Salicornia bigelovii)* and moderately salt tolerant (such as sorghum, common barley, Sudan grass, Montezuma oats, and twin wheat). Other native grasses such as alkali sacaton (*Sporobolus airoides)* and wheatgrass (*Agropyron* sp.) are also known to be relatively salt tolerant. Preliminary germination experiments indicate that the above species will germinate in salt solutions of 20 mS/cm (unpublished GBUAPCD data). The ability to leach and reclaim saline/sodic soils, along with the availability of a variety of irrigation waters that can be developed using combinations of fresh and recycled water, could expand the plant species available for vegetation projects on the playa (Hamdy 1996). Where it is possible to grow crops with commercial value, revenue from such plantings could offset some of the project costs.

Tree row establishment is also currently being researched on a small scale on the north sand sheet of the Owens Lake playa. There are a variety of tree species that could be established on the Owens Lake playa with appropriate leaching and water delivery. The most logical choice is the Italian-Canadian hybrid poplar, which is currently being grown on woodlots in Independence and Lone Pine. This hybrid was developed in Nevada under conditions of harsh desert soils with the goal of maximizing survivorship and growth rate. These trees grow at a rate of about 6-8 feet per year, and achieve a maximum height of 50-60 feet (Dan Greytak, Washoe Nursery, pers. comm.). The trees would have to be planted in closely spaced rows initially to provide adequate surface control when they are still young, but rows could be abandoned in order to conserve water as the trees increase in height. The trees grow tall and straight, with short lateral branches creating a brushy profile beginning almost at ground level. Consumptive water use of about 6 feet per year in this species is well documented from the woodlots established in the Owens Valley. Other appropriate species for this location include native cottonwoods, Mondell pine, and selected shrubby halophytic species.

There are two major requirements for successful implementation of this vegetation-based dust control measure: leaching and drainage. First, soils must be leached sufficiently for the establishment and survival of the trees. Sandy soils are readily leached of salts, as has been demonstrated in the saltgrass establishment work elsewhere on the sand sheet (GBUAPCD

1996a). For the establishment of tree rows, leaching and irrigation are being done with a below-ground irrigation network installed with an above-ground emitter in place for each tree. This practice limits the leached zone only to the rooting area of the trees rather than to the entire playa surface targeted for control. In addition, this system will allow for continued water delivery for ongoing irrigation. To deal with drainage of leaching water, as well as to prevent the incursion of the saline shallow water table into the rooting zone of the trees, the site has 6 inch tile drain installed to a depth of 5.5 feet.

A pilot tree row project has been initiated on a 20-acre plot in sandy soils drained to a rooting depth of 5 feet on the Owens Lake in spring 1997. In spring 1997, five arrays of 3 rows each of trees were planted on a 20 acre site on the north sand sheet. Rows are spaced 12 feet apart within an array, and trees are spaced 12 feet apart within rows. Arrays are 250 feet apart, and are oriented perpendicular to the direction of the prevailing winds. Trees were planted when soil EC to a depth of 2 feet was measured at less than 5 dS/m. The trees currently planted are hybrid poplars, Fremont cottonwood, and Mondell pine. Additional shrubby species are proposed for a summer planting. Each tree is supplied with a protective structure to shield it from blowing sand and intense sunlight.

Conclusions. Vegetation has been shown to be an effective means of suppressing dust emissions from soil surfaces. Studies using agricultural land, natural vegetation in arid regions, and wind tunnel models all concur that sand flux and fine particle emission can be reduced by 95% or more at wind speeds typical to the Owens Lake with a vegetation cover ranging from 25-45%, depending on the vegetation type and on the soil particle size and structure. Furthermore, the vegetation cover need not be continuous, as patchy vegetation has been shown to reduce PM-10 emissions to within acceptable levels in the field. Trees planted as wind breaks are also examples of non-continuous vegetation that can contain PM-10 emissions from the soil surface.

Vegetation exists already in certain locations on the Owens Lake playa where water has been available in sufficient quality and quantity to leach the salt from the soils, and to provide for consumptive use by the plants. Where water is delivered to the playa surface from groundwater sources, such as in the NFIP experiments, vegetation has established spontaneously up to 200 feet from the outlets when the water quality and regularity of delivery permits it. Introducing plants such as saltgrass to flooded areas in conjunction with shallow flooding has had only limited success, as the habitat suitable for native vegetation created by shallow flooding is patchy and unpredictable in both space and time. Modifying the patterns of water delivery by increasing the volume of water per treated area, pulsing the flooding events, providing suitable drainage, and/or continuing water supply at least intermittently during the summer season could improve the ability of a flooded site to support vegetation. At this time, however, any vegetation that might arise in conjunction with shallow flooding is considered to have habitat value only, but will not be a major consideration in the implementation of dust control.

Saltgrass has been successfully established, however, on both sand and clay soils. After three seasons, the sandy plots have achieved a cover of 71%, which has been shown to be sufficient to reduce PM-10 emissions by at least 99%. The plots have retained these high cover values with minimal irrigation. Slow water delivery and lack of surface uniformity in a larger sand soil plot did not allow for the efficient and uniform spreading of water for either leaching or for irrigation. Furthermore, lack of drainage and of protection from blowing sand has jeopardized the long-term survival of some of these plots. Saltgrass recently established on clay soils in test plots is growing vigorously in the second season after planting; and a very small plot has plants that are not only surviving but also expanding with less than 0.25 af/a of water application after 2 seasons.

Managing water delivery using relatively small (1-15 acre) panels and the large delivery and storage systems constructed on the Agrarian research site in conjunction with drainage and water recycling structures has greatly accelerated leaching and soil reclamation. This site has also allowed for more rapid, predictable, and uniform establishment of saltgrass vegetation. Effective leaching and irrigation that reduce soil salinities to within levels of plant tolerance have provided for an increased acreage of soil surface suitable for vegetation, and saltgrass is currently being grown on the site. Using recycled water for leaching and irrigation expands the amount of land that can be treated with vegetation, and using agricultural crop species could allow for revenue that would offset some of the project costs.

Tree rows can have an important application for dust control in sandy areas that are readily leached and drained using drip irrigation systems and tile drains. Tall trees adapted to harsh desert conditions can control large areas of sandy surfaces with a minimum of water use when planted according to recommended spacing and configurations.

SUMMARY OF VEGETATION COVER AND CONTROL EFFECTIVENESS STUDIES

Reference	Surface Cover Characteristics	Wind Speed[1]	% Control
van de Ven, et al., 1989	4-5 inch high stubble, 30 stems/ sq. ft 19.28 mph threshold on bare surface.	NA	100%
Fryrear, 1994	50% canopy cover.	48 mph	96.3%
Musick & Gillette, 1990	25% vegetation lateral cover, 19.4 mph threshold on bare surface. (1)	NA	100%
Buckley, 1987	30% ground cover.	NA	99%
Grantz, et al., 1995	31% cover on sandy soil.	NA	99.8%
Lancaster, 1996	16-23% salt grass cover at Owens Lake on sandy soil.	39 mph	95%
White, et al., 1997	42% cover on loose Owens Lake sand in a wind tunnel.	44 mph	97.1%[2]
Nickling et al. 1997	11-30% saltgrass cover at Owens Lake on clay soil.	>-45 mph	99.5%[3]
White, 1997	54% saltgrass cover in wind tunnel at UC Davis in clay soil	45 mph	99.4%[3]

Notes:

[1] Wind speeds are normalized to an equivalent 10 meter wind speed at Owens Lake. This conversion uses the surface boundary layer equation assuming 0.01 cm surface roughness and the free stream speed for a given height if 10 meter wind speeds are not available.

[2] Measured PM-10 emission reduction in the wind tunnel.

[3] use uncontrolled PM-10 = 2.6 E-03g/m^2/s, SIP Eq. 4-3 for 45 mph.

Table 1. Summary of studies relating the surface cover of vegetation to percent control of PM-10 emissions.

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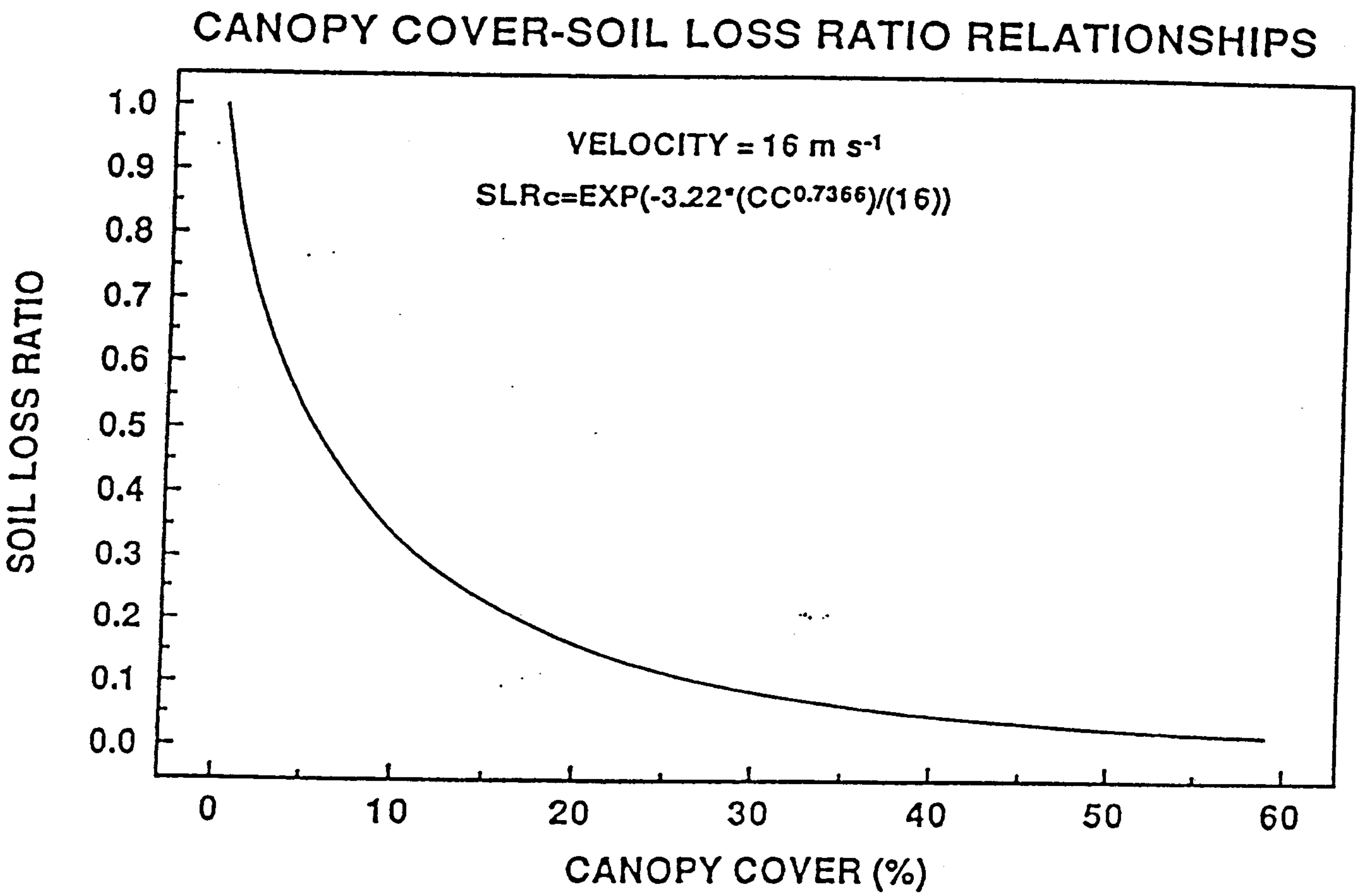


Figure 1. Relationship between percent of the soil surface covered with growing crop canopy and soil loss ratio. From Fryrear (1994).

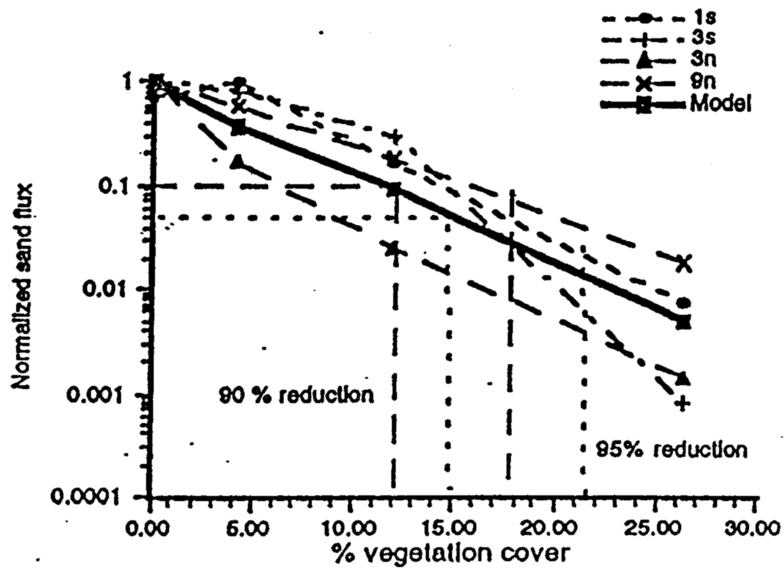


Figure 2. Relations between normalized sand flux and vegetation cover. The relation can also be expressed as a predictive equation of the form

$$Qn = 0.95\ e^{-0.20\,C}$$

where Qn is the sand flux normalized with respect to an equivalent unvegetated sand surface and C is the percent vegetation cover. From Lancaster (1996).

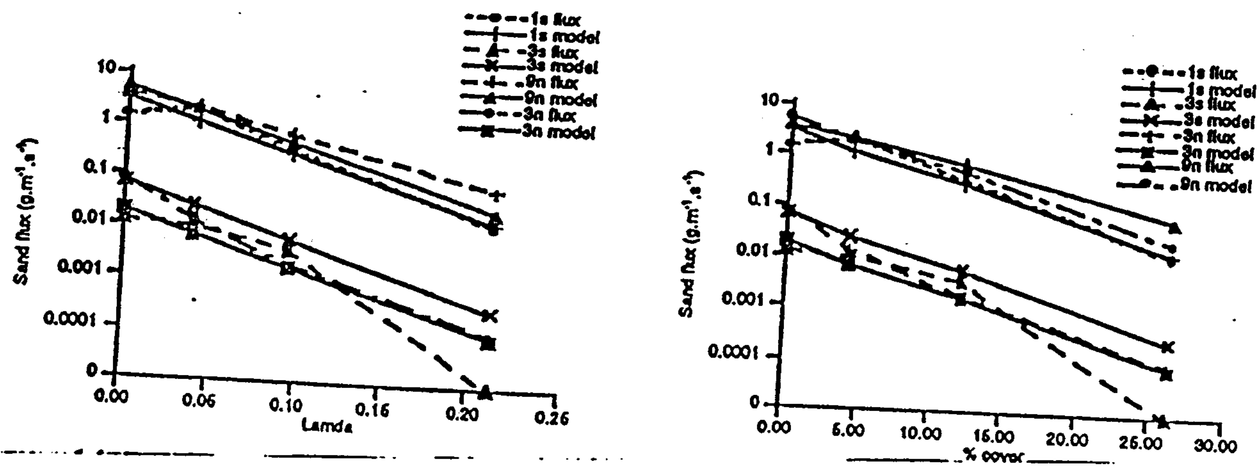
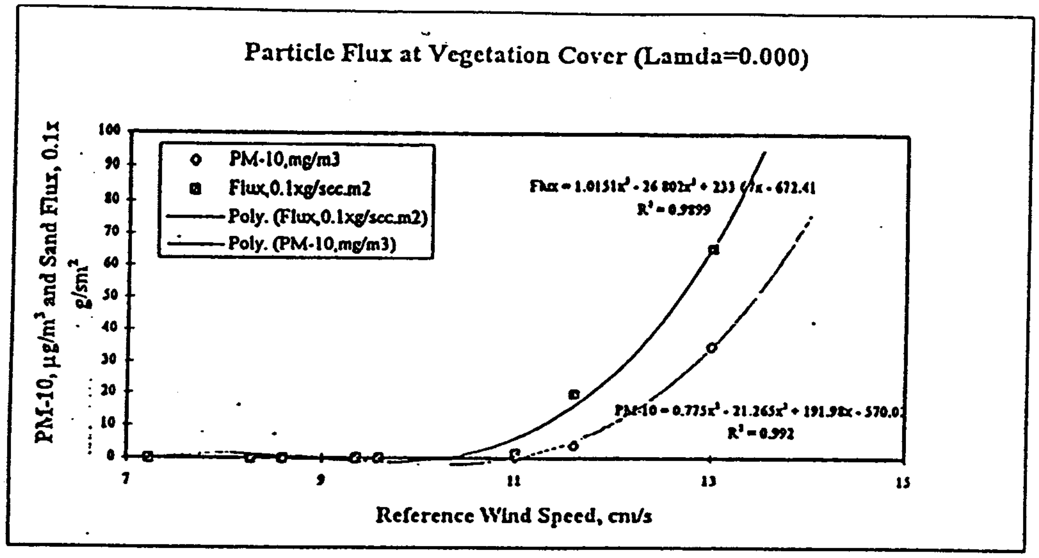
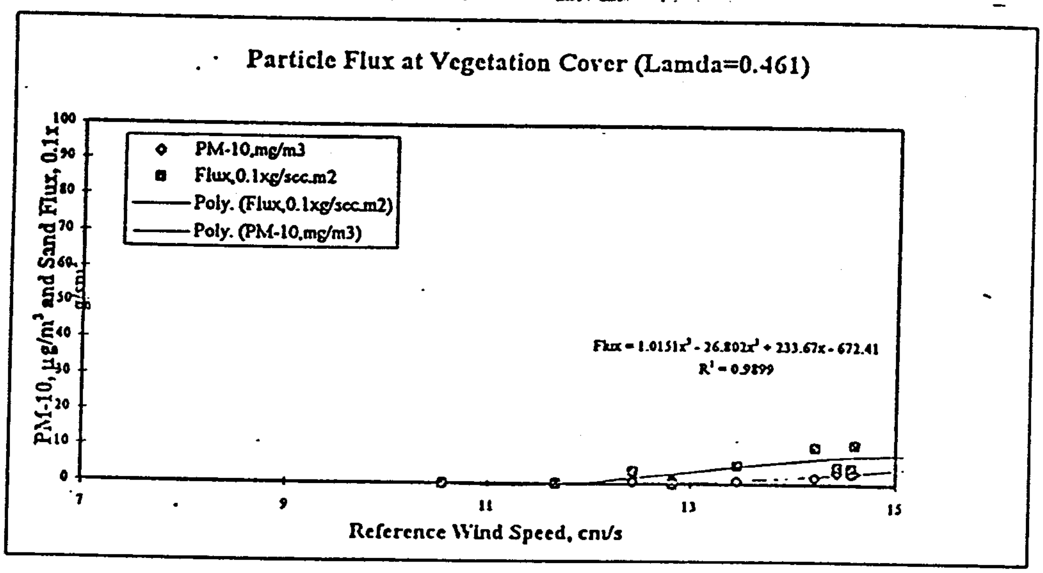


Figure 3. Relations between modeled and measured values of sand flux as a function of roughness density (lambda) and vegetation cover for selected sand transport events. From Lancaster (1996).





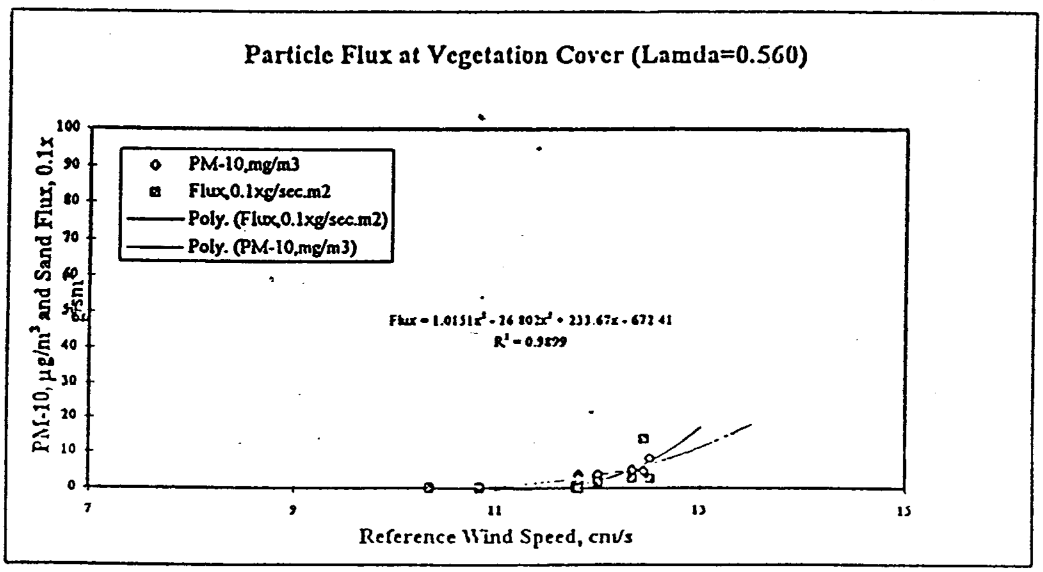


Figure 4. Mass flux and PM-10 emission at measured in a wind tunnel at various vegetation cover value for Owens Lake sand and saltgrass arrays. From White et al. (1997). Lamda values translate to 0% cover, 42%cover, and 53% cover.

EFFECTIVENESS

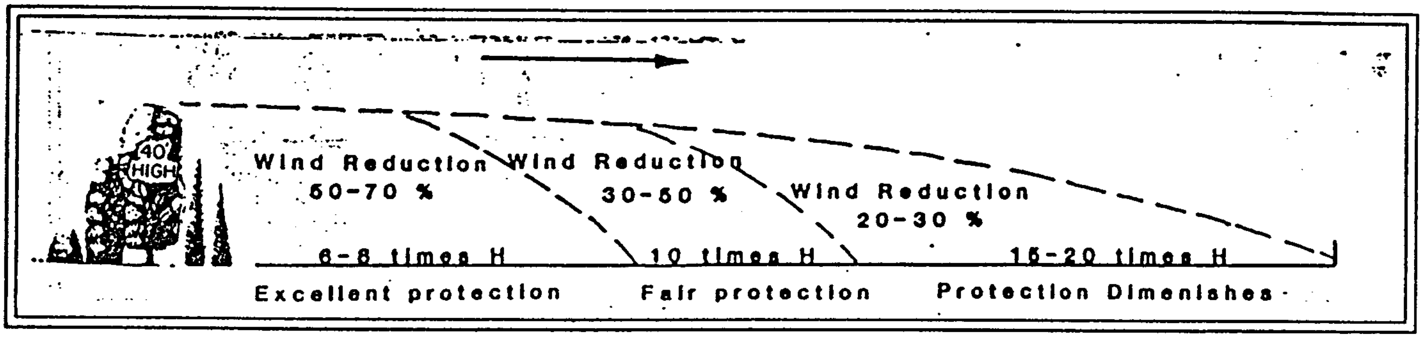


Figure 5. Effectiveness of tree rows as wind breaks. For spacing of 6-8 times the height of the tallest tree, reduction in wind speeds is between 50-70%. From Soil Conservation Service (now National Resources Conservation Service) data.

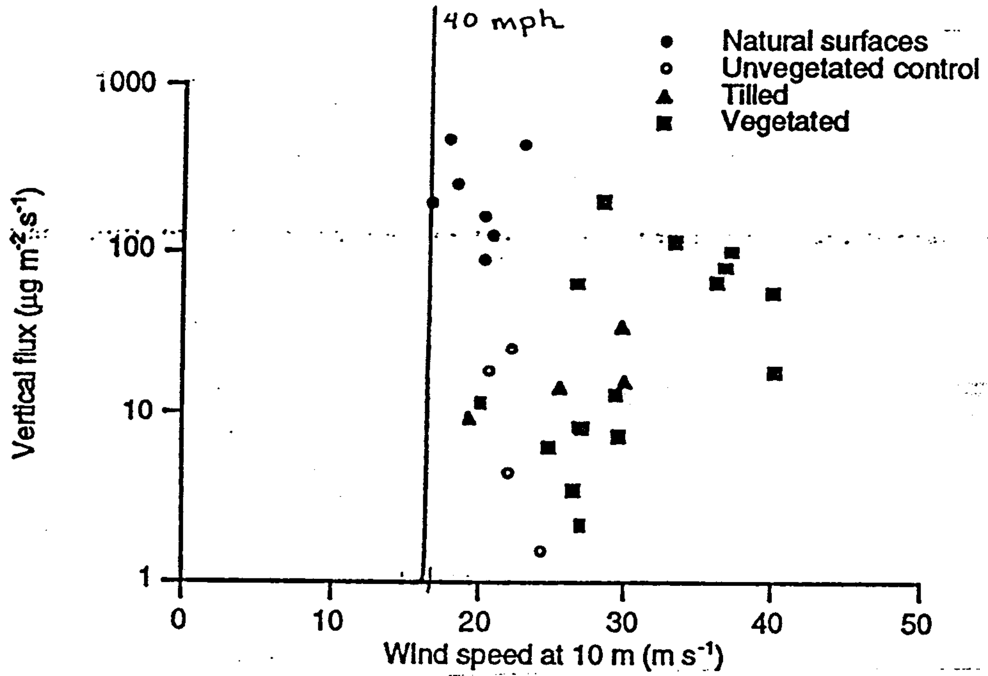


Figure 6. Relations between the vertical flux of dust and wind speed at 10 m height. Note logarithmic scale of Y axis. Data from Nickling et al. (1997).

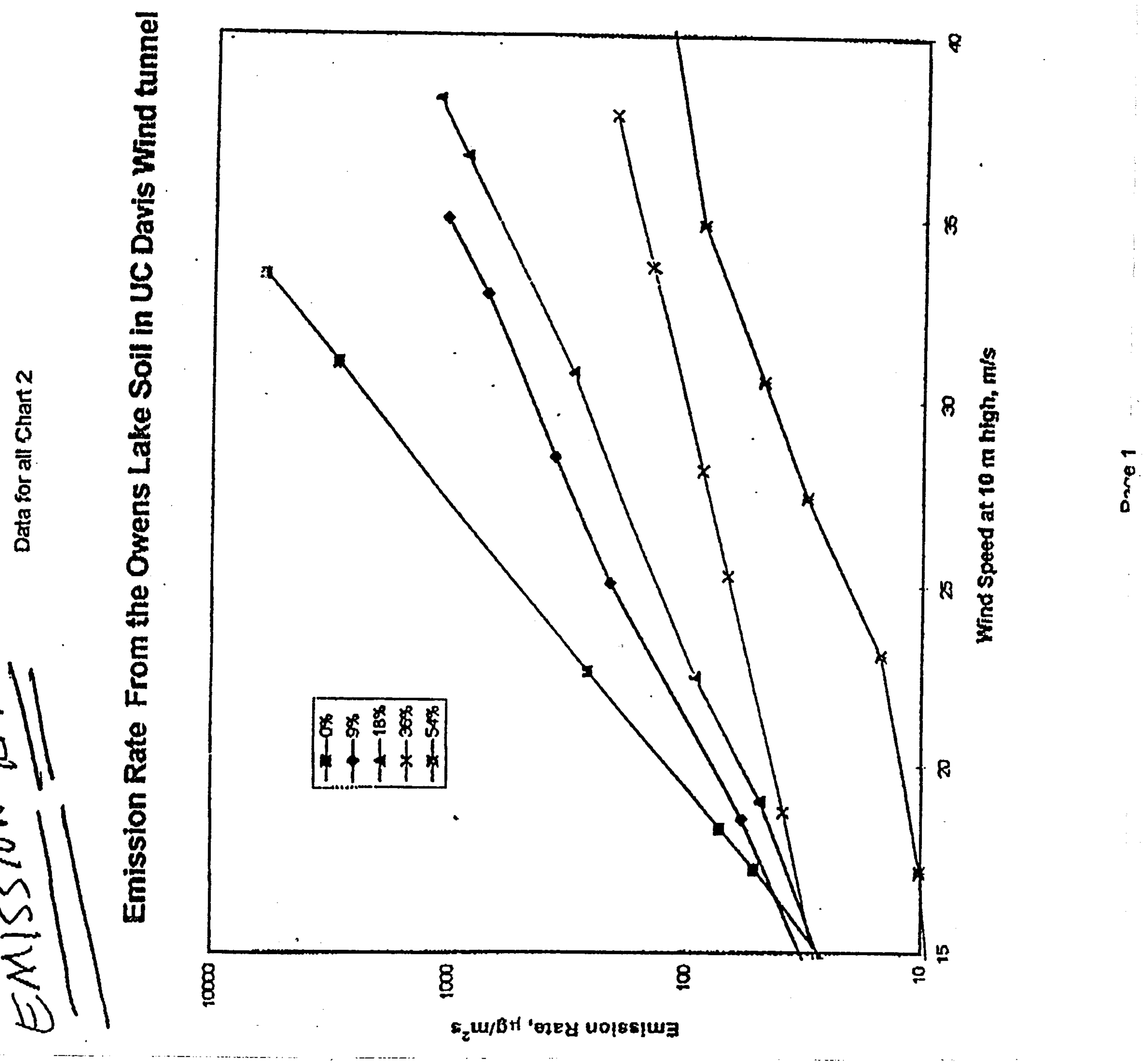


Figure 7. PM-10 emission rates for various saltgrass cover values from 9%-54%, and an unvegetated surface, on clay soils in the wind tunnel. Wind speeds vary from 15-40 m/sec. Data from White (pers. comm. 1997).

Appendix F

Gravel as a Dust Mitigation Measure on Owens Lake

GREAT BASIN UNIFIED
AIR POLLUTION CONTROL DISTRICT

Gravel as a Dust Mitigation Measure on Owens Lake

Duane Ono, Bill Cox, Jr. and Mark Keisler

APPENDIX F

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Effect of a Gravel Cover on PM-10 Emissions from the Owens Lake Playa

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July 1996

Introduction

Gravel and rock coverings have been used successfully to prevent wind erosion from mine tailings in Arizona (Chow and Ono, 1992) and are proposed as a wind erosion control method for the Owens Lake playa. A gravel cover forms a non-erodible surface when the size of the gravel is large enough that the wind cannot move the surface. If the gravel surface does not move, it will protect finer particles from being emitted from the surface. The potential PM-10 emissions from a gravel surface can be estimated using the US EPA emission calculation method for industrial wind erosion for wind speeds above the threshold for the surface (US EPA, 1985). PM-10 will not be emitted if the wind speed is below the threshold speed.

Gravel Threshold Wind Speed

Based on the particle size mode of 1/4", the proposed Owens Lake gravel cover will have a threshold wind speed of 90 miles per hour at 10 meters (US EPA, 1992). This wind speed is rarely exceeded in the Owens Lake area. A more typical extreme gust for Owens Lake may be around 50 mph. See the attached work sheet for the threshold calculation and selected references.

A concern for the gravel cover at Owens Lake is that fine particles should not be allowed to cover or significantly invade the gravel. This will lower the particle size mode and lower the threshold wind speed. The proposed 4" thick gravel cover is intended to prevent capillary movement of salt and silt particles to the surface. In addition, the gravel cover will be the last mitigation placed on the lake to avoid allowing wind blown material from other areas to invade the gravel.

PM-10 Emissions

The PM-10 emissions are expected to be zero for the gravel cover since the threshold wind speed to entrain gravel and PM-10 will be above the highest wind speeds expected for the area.

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Attachment

Reference: AP-42, Industrial Wind Erosion, section 13.2.5, (USEPA 1/95)

Predictive Emission Factor Equation

$e = 0.5\ \Sigma\ P_i$ Eqn. 1

$e = PM_{10}$ emissions (g/m^2/event)

The erosion potential function for a dry exposed surface:

$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$ Eqn. 2

$P = 0$ for $u^* \leq u_t^*$

where; u^* = Friction Velocity (m/s)
u_t^*= Threshold friction velocity (m/s)

The wind speed profile in the surface boundary layer:

$u(z) = (u^*/0.4)\ \ln(z/z_0)$ Eqn. 3

where: $u(z)$ = wind speed at a certain height above the surface (cm/s), typically 10 m
u^* = friction velocity
z = height above the surface (cm), 1000 cm for 10 meter anemometer height
z_0 = surface roughness height (cm), assume 0.01 cm for Owens Lake
0.4 von Karman's constant, dimensionless

Uncontrolled Wind Erosion:

Maximum wind speed 50 MPH (2,235.2 cm/s) at 10 meters, (Control Measure Wind Speed Design Info.)

2,235.1 cm/s = $(u^*/0.4)\ \ln(1000/0.01)$

u^* = 77.7 cm/s

u_t^*= 0.26 m/s, threshold friction velocity (Control Measure Wind Speed Design Info.)

$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$

$P = 58(0.78\text{m/s} - 0.26\text{m/s})^2 + 25(0.78 - 0.26)$ m/s

$P = 28.7$ g/m^2/event

$e = 0.5\ \Sigma\ P_i$

$e = 14.3$ g/m^2/event

for a 6 hour event (2.16×10^{-4} s)

$e = 6.6 \times 10^{-4} g/m^2/s$

Gravel Controlled Wind Erosion:

Size distribution of gravel ¼" to 6" (letter from Larry Thompson, Nik and Nik):

smallest size ¼" (6.35 mm) from figure 2-2 (page 2-22, EPA-450/2-92-004) u_t^* = 140 cm/s

Controlled by gravel if: $u^* \leq u_t^*$,no PM_{10} emissions will be generated for the surface. Assuming u_t^* = 140 cm/s for gravel, and using eqn. 3 and assuming z_0 = 0.01 cm, gravel can protect up to 90 MPH gusts.

13.2.5 Industrial Wind Erosion

13.2.5.1 General[1-3]

Dust emissions may be generated by wind erosion of open aggregate storage piles and exposed areas within an industrial facility. These sources typically are characterized by nonhomogeneous surfaces impregnated with nonerodible elements (particles larger than approximately 1 centimeter [cm] in diameter). Field testing of coal piles and other exposed materials using a portable wind tunnel has shown that (a) threshold wind speeds exceed 5 meters per second (m/s) (11 miles per hour [mph]) at 15 cm above the surface or 10 m/s (22 mph) at 7 m above the surface, and (b) particulate emission rates tend to decay rapidly (half-life of a few minutes) during an erosion event. In other words, these aggregate material surfaces are characterized by finite availability of erodible material (mass/area) referred to as the erosion potential. Any natural crusting of the surface binds the erodible material, thereby reducing the erosion potential.

13.2.5.2 Emissions And Correction Parameters

If typical values for threshold wind speed at 15 cm are corrected to typical wind sensor height (7 - 10 m), the resulting values exceed the upper extremes of hourly mean wind speeds observed in most areas of the country. In other words, mean atmospheric wind speeds are not sufficient to sustain wind erosion from flat surfaces of the type tested. However, wind gusts may quickly deplete a substantial portion of the erosion potential. Because erosion potential has been found to increase rapidly with increasing wind speed, estimated emissions should be related to the gusts of highest magnitude.

The routinely measured meteorological variable that best reflects the magnitude of wind gusts is the fastest mile. This quantity represents the wind speed corresponding to the whole mile of wind movement that has passed by the 1 mile contact anemometer in the least amount of time. Daily measurements of the fastest mile are presented in the monthly Local Climatological Data (LCD) summaries. The duration of the fastest mile, typically about 2 minutes (for a fastest mile of 30 mph), matches well with the half-life of the erosion process, which ranges between 1 and 4 minutes. It should be noted, however, that peak winds can significantly exceed the daily fastest mile.

The wind speed profile in the surface boundary layer is found to follow a logarithmic distribution:

$$u(z) = \frac{u^*}{0.4} \ln \frac{z}{z_0} \qquad (z > z_0) \tag{1}$$

where:

u = wind speed, cm/s
u^* = friction velocity, cm/s
z = height above test surface, cm
z_0 = roughness height, cm
0.4 = von Karman's constant, dimensionless

The friction velocity (u^*) is a measure of wind shear stress on the erodible surface, as determined from the slope of the logarithmic velocity profile. The roughness height (z_0) is a measure of the roughness of the exposed surface as determined from the y intercept of the velocity profile, i. e., the height at which the wind speed is zero. These parameters are illustrated in Figure 13.2.5-1 for a roughness height of 0.1 cm.

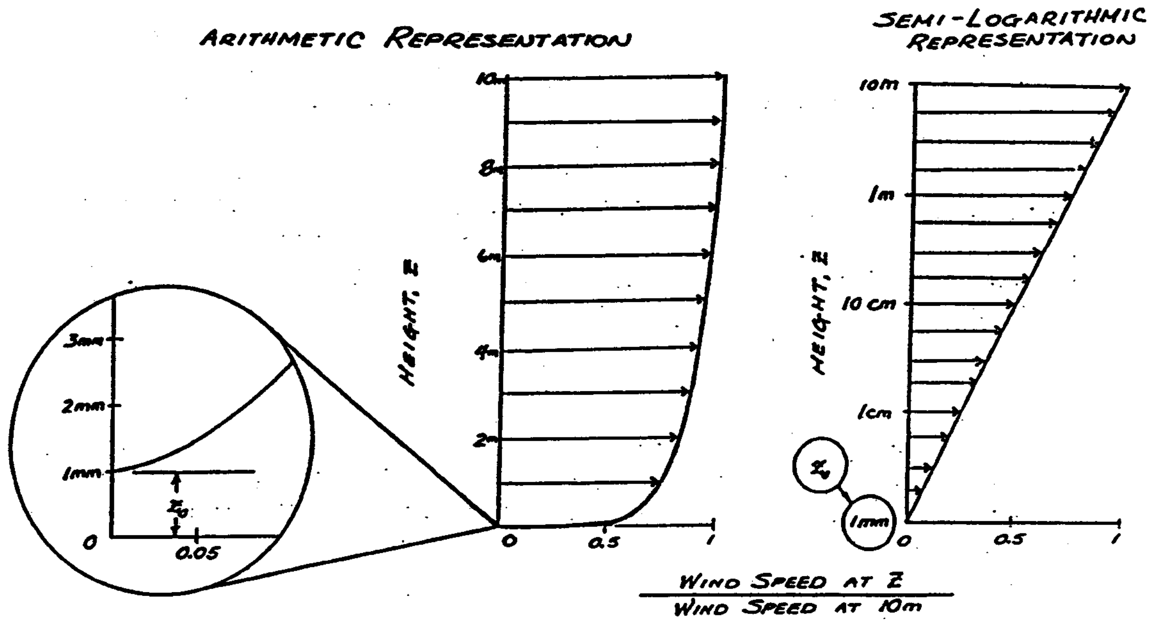


Figure 13.2.5-1. Illustration of logarithmic velocity profile.

Emissions generated by wind erosion are also dependent on the frequency of disturbance of the erodible surface because each time that a surface is disturbed, its erosion potential is restored. A disturbance is defined as an action that results in the exposure of fresh surface material. On a storage pile, this would occur whenever aggregate material is either added to or removed from the old surface. A disturbance of an exposed area may also result from the turning of surface material to a depth exceeding the size of the largest pieces of material present.

13.2.5.3 Predictive Emission Factor Equation[4]

The emission factor for wind-generated particulate emissions from mixtures of erodible and nonerodible surface material subject to disturbance may be expressed in units of grams per square meter (g/m^2) per year as follows:

$$\text{Emission factor} = k \sum_{i=1}^{N} P_i \qquad (2)$$

where:

k = particle size multiplier
N = number of disturbances per year
P_i = erosion potential corresponding to the observed (or probable) fastest mile of wind for the ith period between disturbances, g/m^2

The particle size multiplier (k) for Equation 2 varies with aerodynamic particle size, as follows:

Aerodynamic Particle Size Multipliers For Equation 2			
30 µm	<15 µm	<10 µm	<2.5 µm
1.0	0.6	0.5	0.2

This distribution of particle size within the under 30 micrometer (µm) fraction is comparable to the distributions reported for other fugitive dust sources where wind speed is a factor. This is illustrated, for example, in the distributions for batch and continuous drop operations encompassing a number of test aggregate materials (see Section 13.2.4).

In calculating emission factors, each area of an erodible surface that is subject to a different frequency of disturbance should be treated separately. For a surface disturbed daily, N = 365 per year, and for a surface disturbance once every 6 months, N = 2 per year.

The erosion potential function for a dry, exposed surface is:

$$P = 58\,(u^* - u_t^*)^2 + 25\,(u^* - u_t^*)$$
$$P = 0 \text{ for } u^* \le u_t^* \qquad (3)$$

where:

u^* = friction velocity (m/s)
u_t = threshold friction velocity (m/s)

Because of the nonlinear form of the erosion potential function, each erosion event must be treated separately.

Equations 2 and 3 apply only to dry, exposed materials with limited erosion potential. The resulting calculation is valid only for a time period as long or longer than the period between disturbances. Calculated emissions represent intermittent events and should not be input directly into dispersion models that assume steady-state emission rates.

For uncrusted surfaces, the threshold friction velocity is best estimated from the dry aggregate structure of the soil. A simple hand sieving test of surface soil can be used to determine the mode of the surface aggregate size distribution by inspection of relative sieve catch amounts, following the procedure described below.

FIELD PROCEDURE FOR DETERMINATION OF THRESHOLD FRICTION VELOCITY (from a 1952 laboratory procedure published by W. S. Chepil):

1. Prepare a nest of sieves with the following openings: 4 mm, 2 mm, 1 mm, 0.5 mm, and 0.25 mm. Place a collector pan below the bottom (0.25 mm) sieve.

2. Collect a sample representing the surface layer of loose particles (approximately 1 cm in depth, for an encrusted surface), removing any rocks larger than about 1 cm in average physical diameter. The area to be sampled should be not less than 30 cm by 30 cm.

3. Pour the sample into the top sieve (4-mm opening), and place a lid on the top.

4. Move the covered sieve/pan unit by hand, using a broad circular arm motion in the horizontal plane. Complete 20 circular movements at a speed just necessary to achieve some relative horizontal motion between the sieve and the particles.

5. Inspect the relative quantities of catch within each sieve, and determine where the mode in the aggregate size distribution lies; i. e., between the opening size of the sieve with the largest catch and the opening size of the next largest sieve.

6. Determine the threshold friction velocity from Table 13.2.5-1.

The results of the sieving can be interpreted using Table 13.2.5-1. Alternatively, the threshold friction velocity for erosion can be determined from the mode of the aggregate size distribution using the graphical relationship described by Gillette.[5-6] If the surface material contains nonerodible elements that are too large to include in the sieving (i. e., greater than about 1 cm in diameter), the effect of the elements must be taken into account by increasing the threshold friction velocity.[10]

Table 13.2.5-1 (Metric Units). FIELD PROCEDURE FOR DETERMINATION OF THRESHOLD FRICTION VELOCITY

Tyler Sieve No.	Opening (mm)	Midpoint (mm)	u_t^* (cm/s)
5	4		
9	2	3	100
16	1	1.5	76
32	0.5	0.75	58
60	0.25	0.375	43

Threshold friction velocities for several surface types have been determined by field measurements with a portable wind tunnel. These values are presented in Table 13.2.5-2.

Table 13.2.5-2 (Metric Units). THRESHOLD FRICTION VELOCITIES

Material	Threshold Friction Velocity (m/s)	Roughness Height (cm)	Threshold Wind Velocity At 10 m (m/s)	
			z_o = Act	z_o = 0.5 cm
Overburden[a]	1.02	0.3	21	19
Scoria (roadbed material)[a]	1.33	0.3	27	25
Ground coal (surrounding coal pile)[a]	0.55	0.01	16	10
Uncrusted coal pile[a]	1.12	0.3	23	21
Scraper tracks on coal pile[a,b]	0.62	0.06	15	12
Fine coal dust on concrete pad[c]	0.54	0.2	11	10

[a] Western surface coal mine. Reference 2.
[b] Lightly crusted.
[c] Eastern power plant. Reference 3.

The fastest mile of wind for the periods between disturbances may be obtained from the monthly LCD summaries for the nearest reporting weather station that is representative of the site in question.[7] These summaries report actual fastest mile values for each day of a given month. Because the erosion potential is a highly nonlinear function of the fastest mile, mean values of the fastest mile are inappropriate. The anemometer heights of reporting weather stations are found in Reference 8, and should be corrected to a 10-m reference height using Equation 1.

To convert the fastest mile of wind (u^+) from a reference anemometer height of 10 m to the equivalent friction velocity (u^*), the logarithmic wind speed profile may be used to yield the following equation:

$$u^* = 0.053\, u_{10}^+ \qquad (4)$$

where:

u^* = friction velocity (m/s)

u_{10}^+ = fastest mile of reference anemometer for period between disturbances (m/s)

This assumes a typical roughness height of 0.5 cm for open terrain. Equation 4 is restricted to large relatively flat piles or exposed areas with little penetration into the surface wind layer.

If the pile significantly penetrates the surface wind layer (i. e., with a height-to-base ratio exceeding 0.2), it is necessary to divide the pile area into subareas representing different degrees of exposure to wind. The results of physical modeling show that the frontal face of an elevated pile is exposed to wind speeds of the same order as the approach wind speed at the top of the pile.

For 2 representative pile shapes (conical and oval with flattop, 37-degree side slope), the ratios of surface wind speed (u_s) to approach wind speed (u_r) have been derived from wind tunnel studies.[9] The results are shown in Figure 13.2.5-2 corresponding to an actual pile height of 11 m, a reference (upwind) anemometer height of 10 m, and a pile surface roughness height (z_o) of 0.5 cm. The measured surface winds correspond to a height of 25 cm above the surface. The area fraction within each contour pair is specified in Table 13.2.5-3.

Table 13.2.5-3. SUBAREA DISTRIBUTION FOR REGIMES OF u_s/u_r[a]

Pile Subarea	Percent Of Pile Surface Area			
	Pile A	Pile B1	Pile B2	Pile B3
0.2a	5	5	3	3
0.2b	35	2	28	25
0.2c	NA	29	NA	NA
0.6a	48	26	29	28
0.6b	NA	24	22	26
0.9	12	14	15	14
1.1	NA	NA	3	4

[a] NA = not applicable.

The profiles of u_s/u_r in Figure 13.2.5-2 can be used to estimate the surface friction velocity distribution around similarly shaped piles, using the following procedure:

1. Correct the fastest mile value (u^+) for the period of interest from the anemometer height (z) to a reference height of 10 m u_{10}^+ using a variation of Equation 1:

$$u_{10}^+ = u^+ \frac{\ln (10/0.005)}{\ln (z/0.005)} \tag{5}$$

   where a typical roughness height of 0.5 cm (0.005 m) has been assumed. If a site-specific roughness height is available, it should be used.

2. Use the appropriate part of Figure 13.2.5-2 based on the pile shape and orientation to the fastest mile of wind, to obtain the corresponding surface wind speed distribution (u_s^+)

$$u_s^+ = \frac{(u_s)}{u_r} \quad u_{10}^+ \tag{6}$$

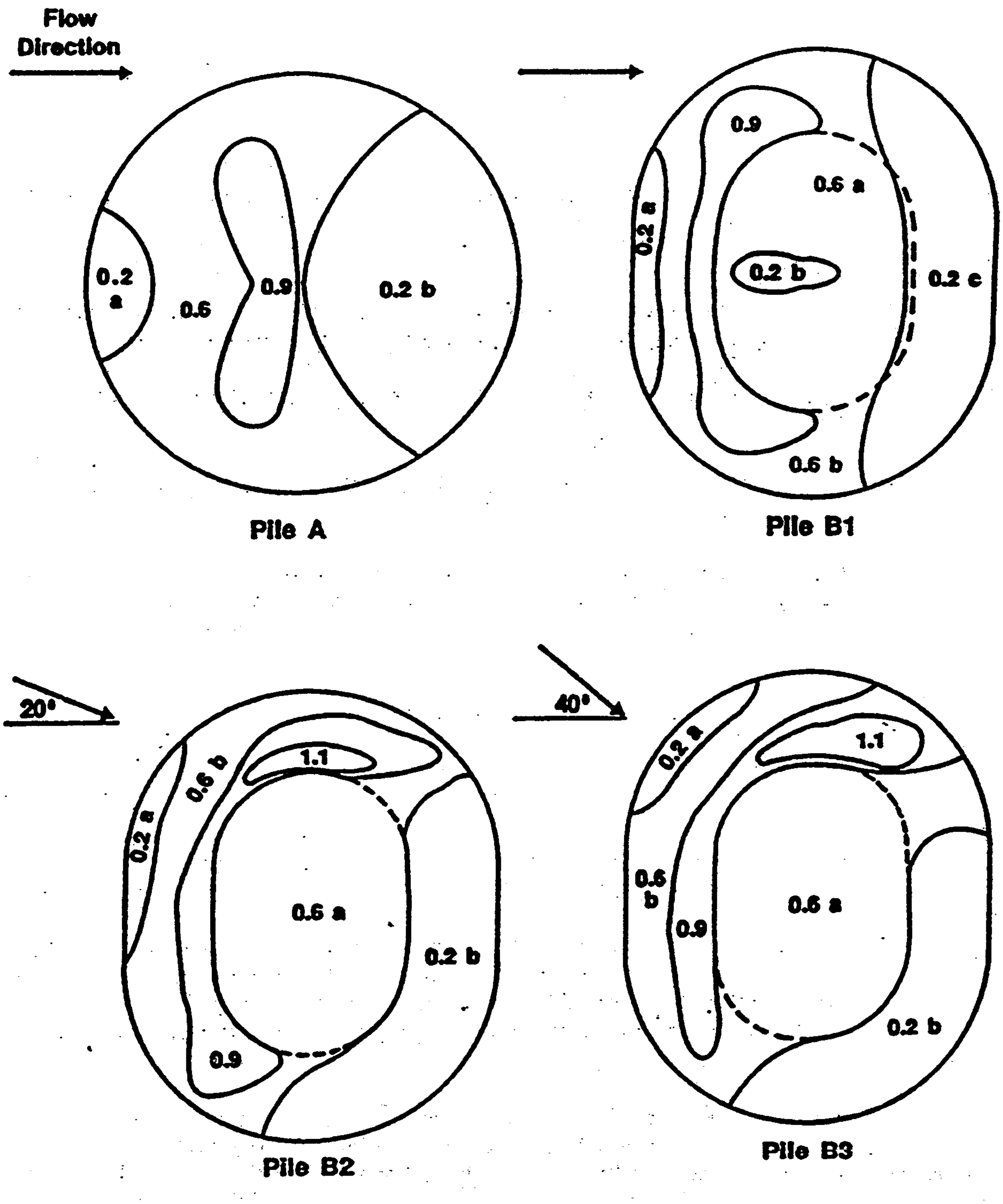


Figure 13.2.5-2. Contours of normalized surface windspeeds, u_s/u_r.

3. For any subarea of the pile surface having a narrow range of surface wind speed, use a variation of Equation 1 to calculate the equivalent friction velocity (u^*):

$$u^* = \frac{0.4 u_s^+}{\frac{25}{\ln 0.5}} = 0.10 u_s^+ \qquad (7)$$

From this point on, the procedure is identical to that used for a flat pile, as described above.

Implementation of the above procedure is carried out in the following steps:

1. Determine threshold friction velocity for erodible material of interest (see Table 13.2.5-2 or determine from mode of aggregate size distribution).

2. Divide the exposed surface area into subareas of constant frequency of disturbance (N).

3. Tabulate fastest mile values (u^+) for each frequency of disturbance and correct them to 10 m (u_{10}^+) using Equation 5.5

4. Convert fastest mile values (u_{10}) to equivalent friction velocities (u^*), taking into account (a) the uniform wind exposure of nonelevated surfaces, using Equation 4, or (b) the nonuniform wind exposure of elevated surfaces (piles), using Equations 6 and 7.

5. For elevated surfaces (piles), subdivide areas of constant N into subareas of constant u^* (i. e., within the isopleth values of u_s/u_r in Figure 13.2.5-2 and Table 13.2.5-3) and determine the size of each subarea.

6. Treating each subarea (of constant N and u^*) as a separate source, calculate the erosion potential (P_i) for each period between disturbances using Equation 3 and the emission factor using Equation 2.

7. Multiply the resulting emission factor for each subarea by the size of the subarea, and add the emission contributions of all subareas. Note that the highest 24-hour (hr) emissions would be expected to occur on the windiest day of the year. Maximum emissions are calculated assuming a single event with the highest fastest mile value for the annual period.

The recommended emission factor equation presented above assumes that all of the erosion potential corresponding to the fastest mile of wind is lost during the period between disturbances. Because the fastest mile event typically lasts only about 2 minutes, which corresponds roughly to the half-life for the decay of actual erosion potential, it could be argued that the emission factor overestimates particulate emissions. However, there are other aspects of the wind erosion process that offset this apparent conservatism:

1. The fastest mile event contains peak winds that substantially exceed the mean value for the event.

2. Whenever the fastest mile event occurs, there are usually a number of periods of slightly lower mean wind speed that contain peak gusts of the same order as the fastest mile wind speed.

Of greater concern is the likelihood of overprediction of wind erosion emissions in the case of surfaces disturbed infrequently in comparison to the rate of crust formation.

13.2.5.4 Example 1: Calculation for wind erosion emissions from conically shaped coal pile

A coal burning facility maintains a conically shaped surge pile 11 m in height and 29.2 m in base diameter, containing about 2000 megagrams (Mg) of coal, with a bulk density of 800 kilograms per cubic meter (kg/m^3) (50 pounds per cubic feet [lb/ft^3]). The total exposed surface area of the pile is calculated as follows:

$$S = \pi r (r^2 + h^2)$$

$$= 3.14(14.6)\ (14.6)^2 + (11.0)^2$$

$$= 838\ m^2$$

Coal is added to the pile by means of a fixed stacker and reclaimed by front-end loaders operating at the base of the pile on the downwind side. In addition, every 3 days 250 Mg (12.5 percent of the stored capacity of coal) is added back to the pile by a topping off operation, thereby restoring the full capacity of the pile. It is assumed that (a) the reclaiming operation disturbs only a limited portion of the surface area where the daily activity is occurring, such that the remainder of the pile surface remains intact, and (b) the topping off operation creates a fresh surface on the entire pile while restoring its original shape in the area depleted by daily reclaiming activity.

Because of the high frequency of disturbance of the pile, a large number of calculations must be made to determine each contribution to the total annual wind erosion emissions. This illustration will use a single month as an example.

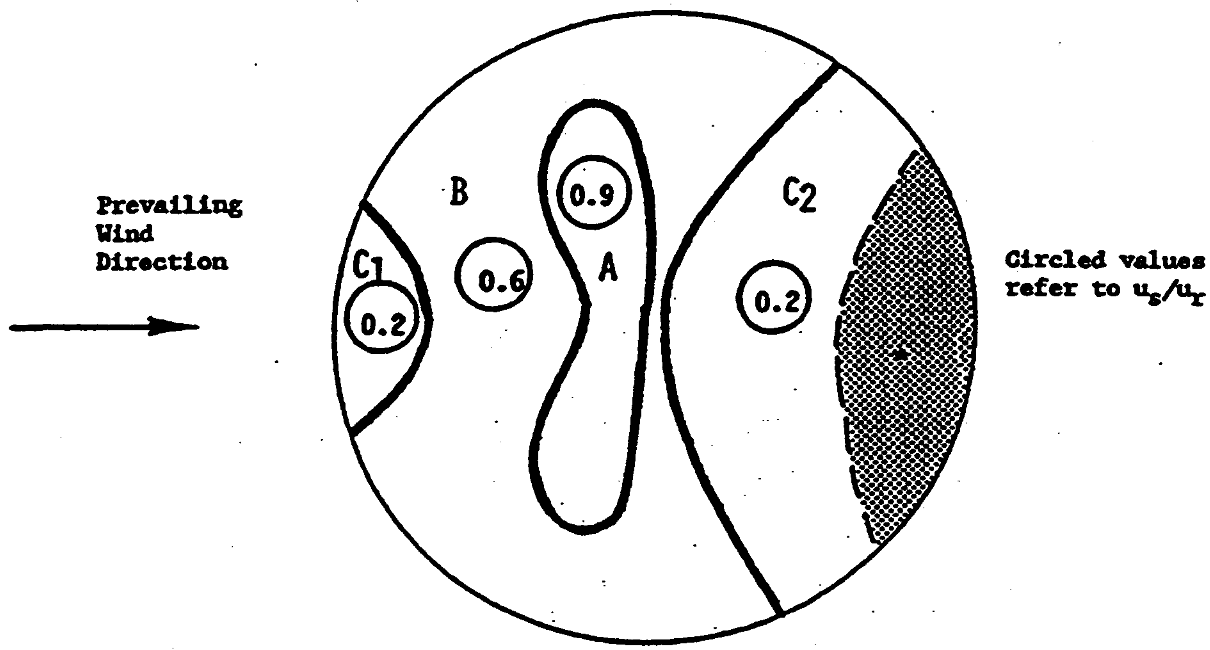
<u>Step 1</u>: In the absence of field data for estimating the threshold friction velocity, a value of 1.12 m/s is obtained from Table 13.2.5-2.

<u>Step 2</u>: Except for a small area near the base of the pile (see Figure 13.2.5-3), the entire pile surface is disturbed every 3 days, corresponding to a value of N = 120 per year. It will be shown that the contribution of the area where daily activity occurs is negligible so that it does not need to be treated separately in the calculations.

<u>Step 3</u>: The calculation procedure involves determination of the fastest mile for each period of disturbance. Figure 13.2.5-4 shows a representative set of values (for a 1-month period) that are assumed to be applicable to the geographic area of the pile location. The values have been separated into 3-day periods, and the highest value in each period is indicated. In this example, the anemometer height is 7 m, so that a height correction to 10 m is needed for the fastest mile values. From Equation 5,

$$u_{10}^{+} = u_{7}^{+} \left[\frac{\ln (10/0.005)}{\ln (7/0.005)}\right]$$

$$u_{10}^{+} = 1.05\ u_{7}^{+}$$



* A portion of C_2 is disturbed daily by reclaiming activities.

Area ID	$\frac{u_s}{u_r}$	Pile Surface %	Pile Surface Area (m^2)
A	0.9	12	101
B	0.6	48	402
$C_1 + C_2$	0.2	40	335
		Total	838

Figure 13.2.5-3. Example 1: Pile surface areas within each wind speed regime.

Local Climatological Data

MONTHLY SUMMARY

WIND					
RESULTANT DIR.	RESULTANT SPEED M.P.H.	AVERAGE SPEED M.P.H.	FASTEST MILE SPEED M.P.H.	FASTEST MILE DIRECTION	DATE
13	14	15	16	17	22
30	5.3	6.9	9	36	1
01	10.5	10.6	14	01	2
10	2.4	6.0	10	02	3
13	11.0	11.4	16	13	4
12	11.3	11.9	15	11	5
20	11.1	19.0	23	30	6
29	19.6	19.8	[illegible]	30	7
29	10.9	11.2	17	30	8
22	3.0	8.1	15	13	9
14	14.6	15.1	23	12	10
29	22.3	23.3	31	29	11
17	7.9	13.5	23	17	12
21	7.7	15.5	18	18	13
10	4.5	9.6	22	13	14
10	6.7	8.8	13	11	15
01	13.7	13.8	21	36	16
33	11.2	11.5	15	34	17
27	4.3	5.8	12	31	18
32	9.3	10.2	14	35	19
24	7.5	7.8	16	24	20
22	10.3	10.6	16	20	21
32	17.1	17.3	25	32	22
29	2.4	8.5	14	13	23
07	5.9	8.8	15	02	24
34	11.3	11.7	17	32	25
31	12.1	12.2	16	32	26
30	8.3	8.5	16	26	27
30	8.2	8.3	13	32	28
33	5.0	6.6	10	32	29
34	3.1	5.2	9	31	30
29	4.9	5.5	8	25	31
FOR THE MONTH:					
30	3.3	11.1	31	29	
—	—	—	DATE: 11		

Figure 13.2.5-4. Example daily fastest miles wind for periods of interest.

Step 4: The next step is to convert the fastest mile value for each 3-day period into the equivalent friction velocities for each surface wind regime (i. e., u_s/u_r ratio) of the pile, using Equations 6 and 7. Figure 13.2.5-3 shows the surface wind speed pattern (expressed as a fraction of the approach wind speed at a height of 10 m). The surface areas lying within each wind speed regime are tabulated below the figure.

The calculated friction velocities are presented in Table 13.2.5-4. As indicated, only 3 of the periods contain a friction velocity which exceeds the threshold value of 1.12 m/s for an uncrusted coal pile. These 3 values all occur within the u_s/u_r = 0.9 regime of the pile surface.

Table 13.2.5-4 (Metric And English Units). EXAMPLE 1:
CALCULATION OF FRICTION VELOCITIES

	u_7^+		u_{10}^+		$u^* = 0.1u_s^+$ (m/s)		
3-Day Period	mph	m/s	mph	m/s	u_s/u_r: 0.2	u_s/u_r: 0.6	u_s/u_r: 0.9
1	14	6.3	15	6.6	0.13	0.40	0.59
2	29	13.0	31	13.7	0.27	0.82	1.23
3	30	13.4	32	14.1	0.28	0.84	1.27
4	31	13.9	33	14.6	0.29	0.88	1.31
5	22	9.8	23	10.3	0.21	0.62	0.93
6	21	9.4	22	9.9	0.20	0.59	0.89
7	16	7.2	17	7.6	0.15	0.46	0.68
8	25	11.2	26	11.8	0.24	0.71	1.06
9	17	7.6	18	8.0	0.16	0.48	0.72
10	13	5.8	14	6.1	0.12	0.37	0.55

Step 5: This step is not necessary because there is only 1 frequency of disturbance used in the calculations. It is clear that the small area of daily disturbance (which lies entirely within the u_s/u_r = 0.2 regime) is never subject to wind speeds exceeding the threshold value.

Steps 6 and 7: The final set of calculations (shown in Table 13.2.5-5) involves the tabulation and summation of emissions for each disturbance period and for the affected subarea. The erosion potential (P) is calculated from Equation 3.

For example, the calculation for the second 3-day period is:

$$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$$

$$P_2 = 58(1.23 - 1.12)^2 + 25(1.23 - 1.12)$$

$$= 0.70 + 2.75 = 3.45 \ g/m^2$$

Table 13.2.5-5 (Metric Units). EXAMPLE 1: CALCULATION OF PM-10 EMISSIONS[a]

3-Day Period	u^* (m/s)	$u^* - u_t^*$ (m/s)	P (g/m^2)	ID	Pile Surface Area (m^2)	kPA (g)
2	1.23	0.11	3.45	A	101	170
3	1.27	0.15	5.06	A	101	260
4	1.31	0.19	6.84	A	101	350
TOTAL						780

[a] Where $u_t^* = 1.12$ m/s for uncrusted coal and k = 0.5 for PM-10.

The emissions of particulate matter greater than 10 μm (PM-10) generated by each event are found as the product of the PM-10 multiplier (k = 0.5), the erosion potential (P), and the affected area of the pile (A).

As shown in Table 13.2.5-5, the results of these calculations indicate a monthly PM-10 emission total of 780 g.

13.2.5.5 Example 2: Calculation for wind erosion from flat area covered with coal dust

A flat circular area 29.2 m in diameter is covered with coal dust left over from the total reclaiming of a conical coal pile described in the example above. The total exposed surface area is calculated as follows:

$$s = \frac{\pi}{4} d^2 = 0.785\ (29.2)^2 = 670\ m^2$$

This area will remain exposed for a period of 1 month when a new pile will be formed.

Step 1: In the absence of field data for estimating the threshold friction velocity, a value of 0.54 m/s is obtained from Table 13.2.5-2.

Step 2: The entire surface area is exposed for a period of 1 month after removal of a pile and N = 1/yr.

Step 3: From Figure 13.2.5-4, the highest value of fastest mile for the 30-day period (31 mph) occurs on the 11th day of the period. In this example, the reference anemometer height is 7 m, so that a height correction is needed for the fastest mile value. From Step 3 of the previous example, $u_{10}^+ = 1.05\ u_7^+$, so that $u_{10}^+ = 33$ mph.

Step 4: Equation 4 is used to convert the fastest mile value of 14.6 m/s (33 mph) to an equivalent friction velocity of 0.77 m/s. This value exceeds the threshold friction velocity from Step 1 so that erosion does occur.

Step 5: This step is not necessary, because there is only 1 frequency of disturbance for the entire source area.

Steps 6 and 7: The PM-10 emissions generated by the erosion event are calculated as the product of the PM-10 multiplier (k = 0.5), the erosion potential (P) and the source area (A). The erosion potential is calculated from Equation 3 as follows:

$$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$$

$$P = 58(0.77 - 0.54)^2 + 25(0.77 - 0.54)$$

$$= 3.07 + 5.75$$

$$= 8.82 \text{ g/m}^2$$

Thus the PM-10 emissions for the 1-month period are found to be:

$$E = (0.5)(8.82 \text{ g/m}^2)(670 \text{ m}^2)$$

$$= 3.0 \text{ kg}$$

References For Section 13.2.5

1. C. Cowherd, Jr., "A New Approach To Estimating Wind Generated Emissions From Coal Storage Piles", Presented at the APCA Specialty Conference on Fugitive Dust Issues in the Coal Use Cycle, Pittsburgh, PA, April 1983.

2. K. Axtell and C. Cowherd, Jr., *Improved Emission Factors For Fugitive Dust From Surface Coal Mining Sources*, EPA-600/7-84-048, U. S. Environmental Protection Agency, Cincinnati, OH, March 1984.

3. G. E Muleski, "Coal Yard Wind Erosion Measurement", Midwest Research Institute, Kansas City, MO, March 1985.

4. *Update Of Fugitive Dust Emissions Factors In AP-42 Section 11.2 — Wind Erosion*, MRI No. 8985-K, Midwest Research Institute, Kansas City, MO, 1988.

5. W. S. Chepil, "Improved Rotary Sieve For Measuring State And Stability Of Dry Soil Structure", *Soil Science Society Of America Proceedings*, *16*:113-117, 1952.

6. D. A. Gillette, *et al.*, "Threshold Velocities For Input Of Soil Particles Into The Air By Desert Soils", *Journal Of Geophysical Research*, *85*(C10):5621-5630.

7. Local Climatological Data, National Climatic Center, Asheville, NC.

8. M. J. Changery, *National Wind Data Index Final Report*, HCO/T1041-01 UC-60, National Climatic Center, Asheville, NC, December 1978.

9. B. J. B. Stunder and S. P. S. Arya, "Windbreak Effectiveness For Storage Pile Fugitive Dust Control: A Wind Tunnel Study", *Journal Of The Air Pollution Control Association*, *38*:135-143, 1988.

10. C. Cowherd, Jr., *et al.*, *Control Of Open Fugitive Dust Sources*, EPA 450/3-88-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

EPA-450/2-92-004

FUGITIVE DUST BACKGROUND DOCUMENT AND TECHNICAL INFORMATION DOCUMENT FOR BEST AVAILABLE CONTROL MEASURES

U.S. Environmental Protection Agency
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

September 1992

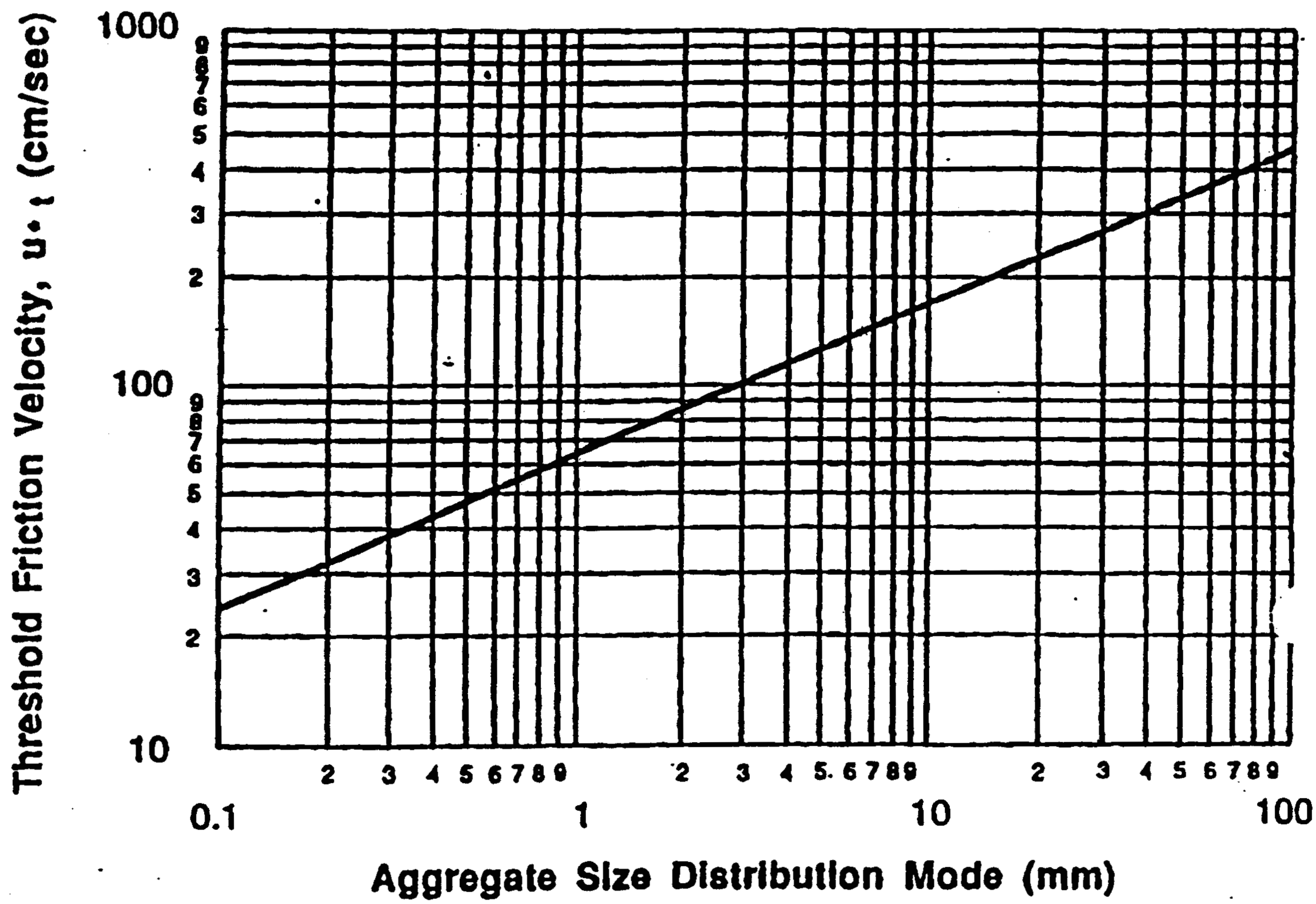


Figure 2-2. Relationship of Threshold Friction Velocity to Size Distribution Mode.

Table 13.2.5-5 (Metric Units). EXAMPLE 1: CALCULATION OF PM-10 EMISSIONS[a]

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$$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$$

$$P = 58(0.77 - 0.54)^2 + 25(0.77 - 0.54)$$

$$= 3.07 + 5.75$$

$$= 8.82 \text{ g/m}^2$$

Thus the PM-10 emissions for the 1-month period are found to be:

$$E = (0.5)(8.82 \text{ g/m}^2)(670 \text{ m}^2)$$

$$= 3.0 \text{ kg}$$

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4. *Update Of Fugitive Dust Emissions Factors In AP-42 Section 11.2 — Wind Erosion*, MRI No. 8985-K, Midwest Research Institute, Kansas City, MO, 1988.

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10. C. Cowherd, Jr., *et al.*, *Control Of Open Fugitive Dust Sources*, EPA 450/3-88-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

GRAVEL AS A DUST MITIGATION MEASURE ON OWENS LAKE

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October 1996

Work Completed

Two sites were established on the Owens Lake playa in June 1986, figure 1. One site was located on a thick salt crust in the northeast portion of the lake. This site was identified as NE1. A second site was located in the southern portion of the lake. This site was identified as SE1. Salt efflorescence had been observed at both sites in previous years. The sites were located adjacent to existing roads to allow access by truck.

Three plots were established at each site. The plots were approximately 10 feet by 10 feet square. One plot identified as the control plot was not disturbed leaving the natural lakebed surface untouched. Soil and rock from a nearby alluvial fan was placed over the second plot. The third plot was covered with washed gravel.

A pickup truck was used to haul gravel and alluvium to the sites. The gravel was obtained from Nikolaus and Nikolaus, Inc. located at Five Bridges road in Bishop. The gravel was washed 1/4 to 1 1/2 inch rounded granite rock. It was hauled to each site and spread by shovel over the surface to produce a layer of gravel approximately four inches deep. Material for the soil plot was obtained from a pit located on the alluvial fan along the Sulfate road on the east side of the lake. This alluvial material consisted of soil and angular rock. The alluvium was also spread by hand to produce a layer approximately four inches deep.

Observations

The goal of the test was to compare the presence of efflorescence on the surface of each plot. The hypothesis was that salt accumulation or efflorescence at the ground surface could be stopped by the application of a layer of coarser material over the surface. This layer would impede or stop the capillary migration of salt laden water to the surface. Therefore, coarse alluvium and washed gravel were used in the test.

Observations were completed on each of the three plots. Descriptions of the surface salt efflorescence and photographs were used to characterize the effectiveness of each plot. A percentage of area with efflorescence was estimated by observation and each plot was photographed. The salt efflorescence was measured for thickness and strength. Descriptions of the efflorescent crust and changes in the surface were documented, Appendix A.

Results

Figure 2 is a graph of the percent of surface area with salt efflorescence for each plot at the NE1 site. The control, or untreated plot, had salt efflorescence on the surface for 14 of the 19 observation dates. Salt efflorescence was observed over 100 percent of this plot on 4 of the 14 dates. The soil plot had salt efflorescence for 10 of the 19 observations. The gravel plot had no efflorescence observed throughout the year. At this site, gravel at approximately four inch depth completely eliminated salt efflorescence.

Figure 3 is a graph of the percent of surface salt efflorescence for each of the plots at the SE1 site. Fifteen of the 20 observations had efflorescence on the control plot. The soil plot had efflorescence on 12 of the 20 observation dates. One percent of the gravel plot had efflorescence for 9 of the observation dates. Salt was observed on a small circular area about one foot in diameter on the gravel plot, but this is considered insignificant. The salt on this circular area accumulated to a thickness of approximately 1/8 inch in March 1987. Under closer examination it was determined that this circular area had a thinner layer of gravel and was located on a raised lakebed surface.

Conclusions

Salt efflorescence to the surface of the Owens Lake playa can be stopped by placing a cap of gravel over the surface. Alluvium from the local alluvial fans is not sufficient to stop the capillarity and salt efflorescence. Approximately four inches of washed gravel and rock larger than 1/4 inch in diameter will effectively stop salt efflorescence. However, the large interstices produced by the gravel must be maintained to preserve effectiveness. If the intersticial area becomes filled with finer soil the salt would again have a capillary path to the surface. However, only the salt that accumulated on top of the gravel would be available for erosion. The lakebed soil beneath the gravel and the soil trapped in the gravel interstices would still be protected from erosion by the layer of gravel and rock after the salt was stripped away.

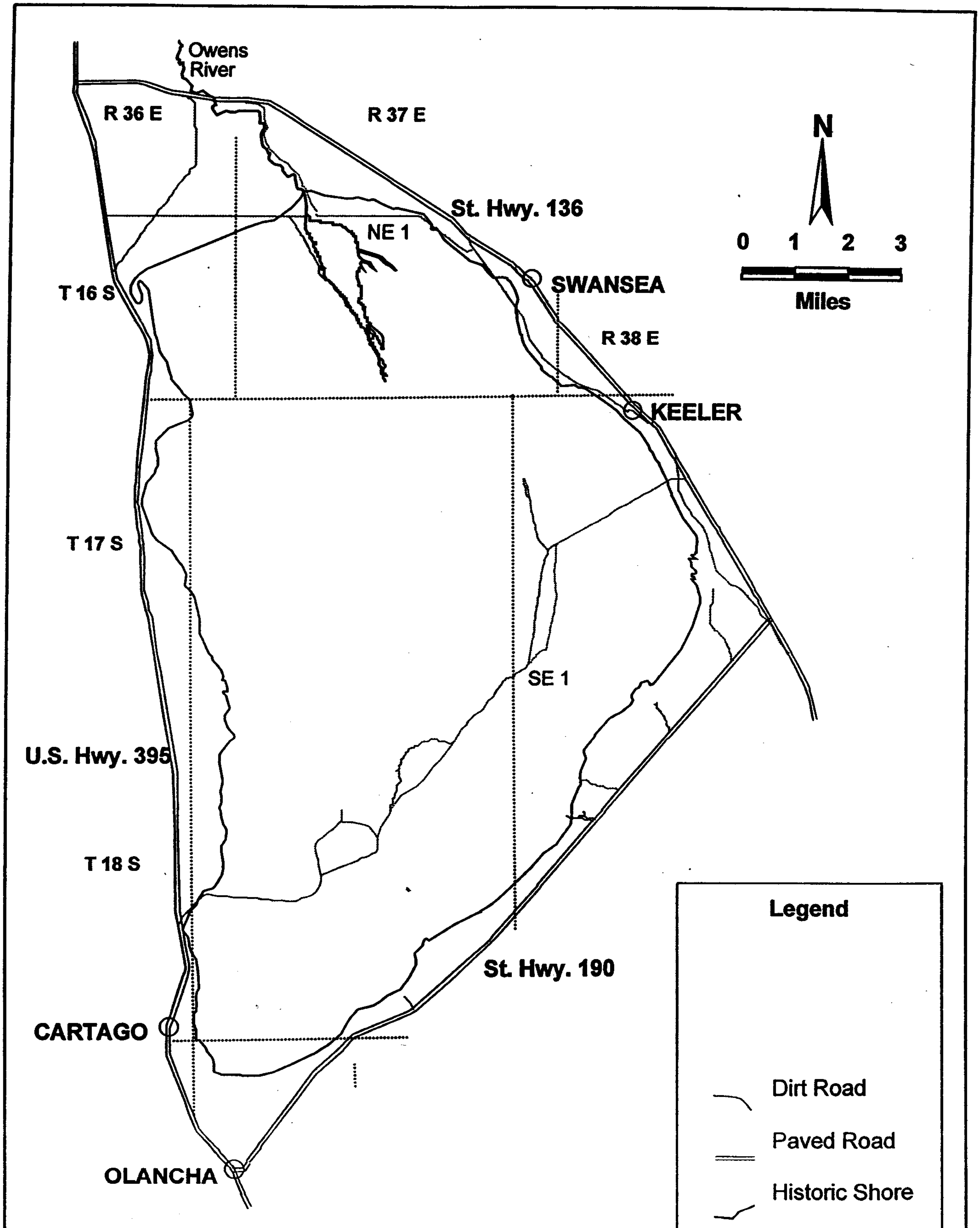


Figure 1

BASEMAP.DS4 - MAS - 6/14/95

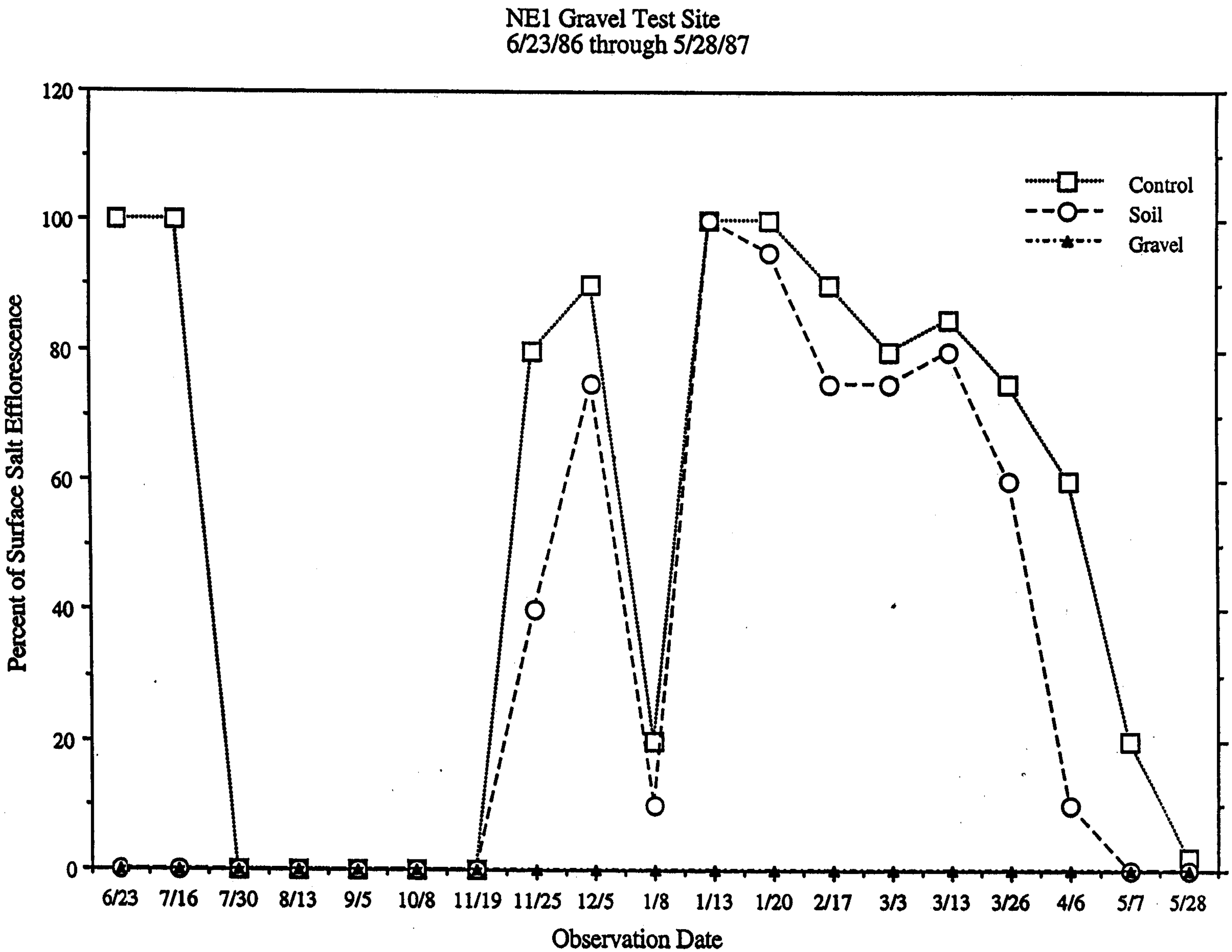
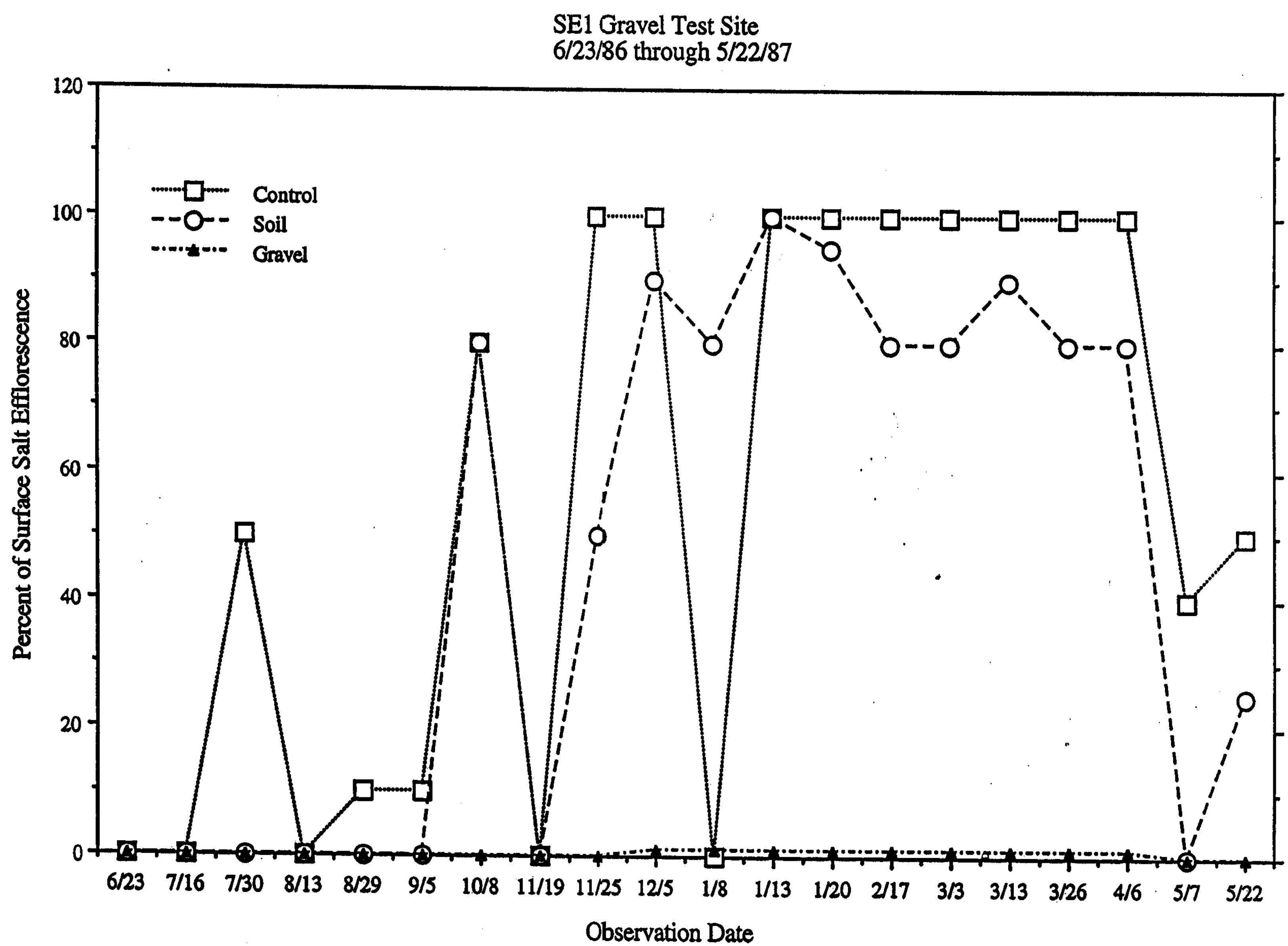

NE1 Gravel Test Site
6/23/86 through 5/28/87
Percent of Surface Salt Efflorescence
120
100
80
60
40
20
0
6/23
7/16
7/30
8/13
9/5
10/8
11/19
11/25
12/5
1/8
1/13
1/20
2/17
3/3
3/13
3/26
4/6
5/7
5/28
Observation Date
Control
Soil
Gravel

Figure 2



SE1 Gravel Test Site
6/23/86 through 5/22/87
Control
Soil
Gravel
Percent of Surface Salt Efflorescence
120
100
80
60
40
20
0
6/23
7/16
7/30
8/13
8/29
9/5
10/8
11/19
11/25
12/5
1/8
1/13
1/20
2/17
3/3
3/13
3/26
4/6
5/7
5/22
Observation Date

Figure 3

Site ID	Date	Time	Phot Log #	Plot Name	Surface Rank	Salt Growth	Thickness	Percent Plot Cover
Salt Description								
NE1	11/19/86	1:20 PM	31B6-32B1	Soil		No		
NE1	11/25/86	2:25 PM	33B5	Soil	-	Yes	-	40
Very thin light white salt growth. Too thin to measure.								
NE1	12/5/86	4:20 PM	36B2	Soil	-	Yes	1/16 inch	75
Very thin light white salt growth.								
NE1	1/8/87	1:40 PM	40B4	Soil	-	Yes	-	10
Salt growth too thin to measure.								
NE1	1/13/87	2:50	41B2	Soil	2	Yes	1/16 inch	100
White crust rough in texture.								
NE1	1/20/87	2:20 PM	41B5	Soil	3	Yes	1/16 inch	95
Salt covers everything except the very tops of some rocks. White in color and grainy in texture.								
NE1	2/17/87	2:15 PM	42B5	Soil	2	Yes	1/16 inch	75
Offwhite in color with hard texture.								
NE1	3/3/87	1:00 PM	43B4	Soil	2	Yes	1/16 inch	75
Crust is gray white in color and fairly hard.								
NE1	3/13/87	-	44B2	Soil	3	Yes	1/16 inch	80
Very thin salt growth on very hard crust.								

Appendix A

Site ID	Date	Time	Phot Log #	Plot Name	Surface Rank	Salt Growth	Thickness	Percent Plot Cover
Salt Description								
NE1	4/6/87	1:50 PM	45B3	Gravel		No		
NE1	5/7/87	1:10 PM	46B5	Gravel		No		
NE1	5/28/87	2:20 PM	47B5	Gravel		No		
NE1	6/23/86	11:50 AM	22B5	Soil		No		
NE1	7/16/86	3:15 PM	23B2	Soil		No		
NE1	7/30/86	1:15 PM	23B6	Soil		No		
NE1	8/13/86	1:24 PM	24B2	Soil		No		
NE1	9/5/86	1:55 PM	25B6-26B1	Soil		No		
NE1	10/8/86	1:15 PM	27B4	Soil		No		

Site ID	Date	Time	Phot Log #	Plot Name	Surface Rank	Salt Growth	Thickness	Percent Plot Cover
Salt Description								
SE1	9/5/86	12:50 PM	25B5	Control	3	Yes	< 1/32	10
Small amount of salt growth on lower areas that had sand deposites.								
SE1	10/8/86	12:00 PM	27B3	Control	2	Yes	< 1/16	80
Very thin light white salt growth with heavier growth where crack lines were across plot.								
SE1	11/19/86	12:30 PM	31B5	Control		No		
SE1	11/25/86	12:20 PM	33B4	Control	3	Yes	1/16 inch	100
Heavy white salt growth. Did not blow with the 25-30 mph winds will at site.								
SE1	12/5/86	1:30 PM	36B1	Control	3	Yes	1/8 inch	100
Very thick and heavy salt crust. Will not break easily. Starting to crack and break open.								
SE1	1/8/87	12:20 PM	40B3	Control	-	Yes	1/16 inch	-
Crust is very thin and light. Salt appears to be just starting to grow. Soil is damp from rain and snow. No hard crust.								
SE1	1/13/87	1:10 PM	40B6-41B1	Control	-	Yes	1/16 to	100
White crust over entire surface of plot.								
SE1	1/20/87	1:30 PM	41B4	Control	-	Yes	1/8 inch	100
Heavy thick salt growth with a soft surface. Very white in color and soft in texture.								
SE1	2/17/87	12:15 PM	42B4	Control	1	Yes	1/8 inch	100
Soft white powder								

Site ID	Date	Time	Phot Log #	Plot Name	Surface Rank	Salt Growth	Thickness	Percent Plot Cover
NE1	3/26/87	1:50 PM	44B6	Soil	3	Yes	1/16 inch	60
Very thin gray white salt growth on the plot.								
NE1	4/6/87	1:50 PM	45B3	Soil	2	Yes	1/16 inch	10
Very thin light salt coverage.								
NE1	5/7/87	1:10 PM	46B5	Soil		No		
NE1	5/28/87	2:20 PM	47B5	Soil		No		
SE1	6/23/86	11:15 AM	22B4	Control		No		
SE1	7/16/86	12:25 PM	22B8-23B1	Control		No		
SE1	7/30/86	11:58 AM	23B5	Control	-	Yes	-	50
Very light salt growth. Too little to measure.								
SE1	8/13/86	11:48 AM	23B9-24B1	Control		No		
SE1	8/29/86	-	25B2	Control	1	Yes	< 1/32	10
Salt growth is white and very thin. Only areas where thin (approx. 0-1 inch) sand deposites had salt growth.								

Salt Description (given in the rows following each entry)

Appendix A

Site ID	Date	Time	Phot Log #	Plot Name	Surface Rank	Salt Growth	Thickness	Percent Plot Cover
Salt Description								
NE1	6/23/86	11:50 AM	22B5	Control	-	Yes	1/8 inch	100
Fine white salt growth with hard crust below. Moist soil under crust.								
NE1	7/16/86	3:15 PM	23B2	Control	-	Yes	1/4 inch	100
Crust was hard								
NE1	7/30/86	1:15 PM	23B6	Control		No		
NE1	8/13/86	1:24 PM	24B2	Control		No		
NE1	9/5/86	1:55 PM	25B6-26B1	Control		No		
NE1	10/8/86	1:15 PM	27B4	Control		No		
NE1	11/19/86	1:20 PM	31B6-32B1	Control		No		
NE1	11/25/86	2:25 PM	33B5	Control	3	Yes	1/16 inch	80
Salt growth is very crusty. It is pushing up and starting to break open. Sand/silt is not blowing in a 15-25 mph wind.								
NE1	12/5/86	4:20 PM	36B2	Control	3	Yes	1/8 inch	90
Very thick and heavy salt crust. Does not break easily.								

Site ID	Date	Time	Phot Log #	Plot Name	Surface Rank	Salt Growth	Thickness	Percent Plot Cover
Salt Description								
SE1	8/13/86	11:48 AM	23B9-24B1	Gravel		No		
SE1	8/29/86	-	25B2	Gravel		No		
SE1	9/5/86	12:50 PM	25B5	Gravel		No		
SE1	10/8/86	12:00 PM	27B3	Gravel		No		
SE1	11/19/86	12:30 PM	31B5	Gravel		No		
SE1	11/25/86	12:20 PM	33B4	Gravel		No		
SE1	12/5/86	1:30 PM	36B1	Gravel	-	Yes	-	1
One small area about one foot in diameter on NW side of plot. Crust too thin to measure.								
SE1	1/8/87	12:20 PM	40B3	Gravel	-	Yes	-	1
One small circle about one foot in diameter on NW side of plot.								
SE1	1/13/87	1:10 PM	40B6-41B1	Gravel	-	Yes	< 1/16	1
White crust very thin on surface of rock in a circle pattern about one foot in diameter.								

Site ID	Date	Time	Phot Log #	Plot Name	Surface Rank	Salt Growth	Thickness	Percent Plot Cover
Salt Description								
NE1	5/28/87	2:20 PM	47B5	Control	2	Yes	-	2
Salt crust looks wet from rain. Growth too thin to measure.								
NE1	6/23/86	11:50 AM	22B5	Gravel		No		
NE1	7/16/86	3:15 PM	23B2	Gravel		No		
NE1	7/30/86	1:15 PM	23B6	Gravel		No		
NE1	8/13/86	1:24 PM	24B2	Gravel		No		
NE1	9/5/86	1:55 PM	25B6-26B1	Gravel		No		
NE1	10/8/86	1:15 PM	27B4	Gravel		No		
NE1	11/19/86	1:20 PM	31B6-32B1	Gravel		No		
NE1	11/25/86	2:25 PM	33B5	Gravel		No		

Site ID	Date	Time	Phot Log #	Plot Name	Surface Rank	Salt Growth	Thickness	Percent Plot Cover
Salt Description								
NE1	12/5/86	4:20 PM	36B2	Gravel		No		
NE1	1/8/87	1:40 PM	40B4	Gravel		No		
NE1	1/13/87	2:50 PM	41B2	Gravel		No		
NE1	1/13/87	2:50 PM	41B2	Gravel		No		
NE1	1/20/87	2:20 PM	41B5	Gravel		No		
NE1	2/17/87	2:15 PM	42B5	Gravel		No		
NE1	3/3/87	1:00 PM	43B4	Gravel		No		
NE1	3/13/87	-	44B2	Gravel		No		
NE1	3/26/87	1:50 PM	44B6	Gravel		No		

Site ID	Date	Time	Phot Log #	Plot Name	Surface Rank	Salt Growth	Thickness	Percent Plot Cover
Salt Description								
SE1	1/20/87	1:30 PM	41B4	Gravel	-	Yes	1/16 inch	1
One small circle about one foot in diameter on NW side of plot.								
SE1	2/17/87	12:15 PM	42B4	Gravel	-	Yes	1/16 inch	1
Small one foot circle on WNW side of plot has soft white powder.								
SE1	3/3/87	12:10 PM	43B3	Gravel	-	Yes	1/8 inch	1
One foot circle on NW side of plot. Gray in color and very soft.								
SE1	3/13/87	1:00 PM	43B6-44B1	Gravel	-	Yes	1/8 inch	1
One small circle about one foot in diameter on NW side of plot.								
SE1	3/26/87	12:50 PM	44B5	Gravel	-	Yes	1/16 inch	1
A one foot diameter area on NW side of plot has salt growth. Growth is very powdery.								
SE1	4/6/87	12:20 PM	45B2	Gravel	-	Yes	1/8 inch	1
A one foot diameter area on NW side of plot has very soft white and fluffy salt growth.								
SE1	5/7/87	12:15 PM	46B4	Gravel		No		
SE1	5/22/87	1:15 PM	47B3	Gravel		No		
SE1	6/23/86	11:15 AM	22B4	Soil		No		

Site ID	Date	Time	Phot Log #	Plot Name	Surface Rank	Salt Growth	Thickness	Percent Plot Cover
Salt Description								
SE1	5/22/87	1:15 PM	47B3	Soil	-	Yes	-	25
Salt crust looks wet from rain.								

Appendix G

Comparative Cost Estimates (March 1997)

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

OWENS VALLEY PM_{10} PLANNING AREA DEMONSTRATION OF ATTAINMENT STATE IMPLEMENTATION PLAN

COMPARATIVE COST ESTIMATES

MARCH 1997

APPENDIX G

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Owens Valley PM_{10} Attainment State Implementation Plan
Comparative Cost Estimates

The following cost estimates are for the purpose of comparing the relative preliminary construction and annual costs associated with the Proposed Project and the nine alternatives under consideration for implementation to control PM_{10} emissions from the Owens Lake playa. These are not engineering cost estimates, as only the most basic design has occurred at this time. These estimates have been prepared using consistent costs, so that the construction and annual costs of the alternatives can be compared among each other. No other inferences or use of these estimates is appropriate. Whenever possible, estimates of costs for actual work performed on the Owens Lake playa have been used.

Table 1 on the following page presents a summary of the cost of the proposed project and the eight alternatives under consideration for implementation on Owens Lake. The construction cost, annual operation and maintenance cost and annualized cost are given for each alternative. Calculation of annualized costs was based on methodology set forth by the EPA for fugitive dust best available control measures. Pertinent excerpts from EPA document EPA–450/2–92–004 detailing the annualization methodology are attached. Also on the following page is a summary of the estimated employment for the annual operation and maintenance for the proposed project and each of the alternatives.

Table 2 is a summary of the cost per to of PM_{10} controlled for each of the alternatives. Based on emission estimated developed in the District's 1997 Demonstration of Attainment SIP, an annual emission range of 130,000 to 400,000 tons is used. Based on these estimates, a range of control costs are presented.

Tables 3 through 11 are the details used to develop each of the cost estimates. The assumptions and methodology used to prepare the cost estimates follow the tables. Maps showing the control alternatives are also attached. Finally, a report prepared by TEAM Engineering and Management titled "Preliminary Economic Review - Owens Lake Gravel Cover PM_{10} Control Measure" is attached that provides additional information regarding the cost of the gravel cover.

Table 1 - Summary of Control Measure Costs and Manpower Requirements

PM-10 Control Measure Alternatives
Comparative Cost Estimate - Summary

Alternative	Construction	Annual O and M	Annualized Cost*
Proposed project	$91,143,235	$26,315,085	$37,822,217
A - Low Volume - Groundwater	71,904,739	5,051,101	15,746,078
A1 - Low Volume - Aqueduct	63,058,295	17,403,001	26,089,903
B - Moderate Volume - Groundwater	49,053,641	6,234,261	15,560,194
B1 - Moderate Volume - Aqueduct	33,431,995	26,947,581	32,689,837
C - No Water Use	172,284,720	6,316,970	26,257,484
D - Managed Low Volume - Groundwater	64,289,899	6,674,261	17,527,465
D1 - Managed Low Volume - Aqueduct	55,416,131	19,026,161	27,868,946
E - High Volume - Aqueduct	78,936,000	144,039,600	152,832,109

*Annualized Cost is based on method set forth in document EPA-450/2-92-004 titled "Fugitive Dust Background Document and Technical Information for Best Available Control Measures" dated September 1992.

$Ca = (CRF \times Cc) + Co + ½Co + Ci$

where:

Ca = annualized cost

CRF = capital recovery factor = 0.0858, for interest rate (i) = 7% and recovery period (n) = 25 years

Cc = construction cost

Co = annual operating cost

½Co = annual overhead cost (overhead not applied to annual cost of purchased water)

Ci = annual enforcement and inspection cost (assumed $2,000,000 flat rate)

Estimated Operation and Maintenance Manpower Requirements

Alternative	FTEEs
Proposed Project	14
A - Low Volume Water - Groundwater	23
A1 - Low Volume Water - Aqueduct	21
B - Moderate Volume Water - Groundwater	16
B1 - Moderate Volume Water - Aqueduct	13
C - No Water Use	73
D - Managed Low Volume Water-Groundwater	18
D1 - Managed Low Volume Water - Aqueduct	16
E - High Volume Water Use	1

Notes:

1. FTEE = Full-time equivalent employee
2. Manpower requirements:

Shallow flooding = 1 FTEE/ 3200 ac

Managed vegetation = 1 FTEE/ 1500 ac

Tilling = 1 FTEE/ 2100 ac

Roads, berms, etc. = 1 FTEE/ 50 mi.

Electrical lines = 1 FTEE/ 100 mi.

Salt flats = 1 FTEE/ 6400 ac

Gravel = 1 FTEE/ 3200 ac

Sand fences = 1 FTEE/ 84 ac

Wells = 1 FTEE/ 15 wells

Recirc. pumps = 1 FTEE/ 10 pumps

Table 2 - Cost Per Ton of PM_{10} Controlled Based on Annualized Costs

Alternative	Annualized Cost	$/Ton of PM_{10} Controlled[a] 130K ton/yr	400K tn/yr
Proposed project	$37,822,217	291	95
A - Low Volume - Groundwater	15,746,078	121	39
A1 - Low Volume - Aqueduct	26,089,903	201	65
B - Moderate Volume - Groundwater	15,560,194	120	39
B1 - Moderate Volume - Aqueduct	32,689,837	251	82
C - No Water Use	26,257,484	202	66
D - Managed Low Volume - Groundwater	17,527,465	135	44
D1 - Managed Low Volume - Aqueduct	27,868,946	214	70
E - High Volume - Aqueduct	152,832,109	1,176	382

[a] A range of 130,000 to 400,000 tons per year of PM_{10} emitted from Owens Lake is based on emission estimates contained in the 1997 Demonstration of Attainment SIP.

Table 3 - Proposed Project

Comparative Construction Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	8,395	ac	$60	$ 503,700
Managed veg	8,700	ac	1,874	16,303,800
Gravel	5,305	ac	7,115	37,745,075
Tilling	-		60	-
Salt flat	-		45	-
Fences	-		4,667	-
Recirculation pump	9	ea	60,000	540,000
Groundwater well	-		340,000	-
Water transmission	23.1	mi	see below	17,654,472
Water outlet	14.3	mi	145,000	2,073,500
Water recirculation	12.9	mi	79,200	1,021,680
Berm	47.8	mi	41,000	1,959,800
Road*	7.6	mi	20,100	152,760
Flood channel	11.0	mi	64,200	706,200
Electrical power	19.8	mi	30,000	594,000
Engineering	15	%		11,888,248
			TOTAL	$91,143,235

*The cost estimate for roads is for roads not associated with water lines, berms or flood channels. These infrastructure have attendant roads included in their construction costs.

Water Line Construction Cost Estimate				
Diameter	Quantity	Units	Unit Price	Item Price
60"	16.0	mi	971,520	15,544,320
36"	6.8	mi	306,240	2,082,432
18"	0.3	mi	92,400	27,720
TOTAL	23.1	mi	TOTAL	$17,654,472

Comparative Operation and Maintenance Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	8,395	ac	$38	$ 319,010
Managed veg	8,700	ac	230	2,001,000
Gravel	5,305	ac	94	498,670
Tilling	-		89	-
Salt flat	-		10	-
Fences	-		735	-
Recirculation pump	9	ea	10,750	96,750
Groundwater well	-		78,600	-
Water transmission	23.1	mi	1,200	27,720
Water outlet	14.3	mi	1,200	17,160
Water recirculation	12.9	mi	1,200	15,480
Berm	47.8	mi	1,200	57,360
Road*	7.6	mi	1,200	9,120
Flood channel	11.0	mi	1,200	13,200
Electrical power	19.8	mi	600	11,880
Contingencies	10	%		306,735
Purchased water	50,980	ac-ft	450	22,941,000
			TOTAL	$26,315,085

Operation and maintenance Manpower Requirements	
Full-time Equiv. Employees Required	14

Table 4 - Alternative A

Comparative Construction Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	7,200	ac	$60	$ 432,000
Managed veg	1,500	ac	1,874	2,811,000
Gravel	4,100	ac	7,115	29,171,500
Tilling	5,500		60	330,000
Salt flat	3,400		45	153,000
Fences	700		4,667	3,266,900
Recirculation pump	9	ea	60,000	540,000
Groundwater well	29.0		340,000	9,860,000
Water transmission	44.0	mi	see below	8,730,480
Water outlet	23.0	mi	145,000	3,335,000
Water recirculation	12.9	mi	79,200	1,021,680
Berm	33.0	mi	41,000	1,353,000
Road*	11.0	mi	20,100	221,100
Flood channel	11.0	mi	64,200	706,200
Electrical power	19.8	mi	30,000	594,000
Engineering	15	%		9,378,879
			TOTAL	$71,904,739

*The cost estimate for roads is for roads not associated with water lines, berms or flood channels. These infrastructure have attendant roads included in their construction costs.

Water Line Construction Cost Estimate				
Diameter	Quantity	Units	Unit Price	Item Price
30"	37.0	mi	219,120	8,107,440
18"	6.0	mi	92,400	554,400
12"	1.0	mi	68,640	68,640
TOTAL	44.0	mi	TOTAL	$8,730,480

Comparative Operation and Maintenance Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	7,200	ac	$38	$ 273,600
Managed veg	1,500	ac	230	345,000
Gravel	4,100	ac	94	385,400
Tilling	5,500		89	489,500
Salt flat	3,400		10	34,000
Fences	700		735	514,500
Recirculation pump	9	ea.	10,750	96,750
Groundwater well	29		78,600	2,279,400
Water transmission	44.0	mi	1,200	52,800
Water outlet	23.0	mi	1,200	27,600
Water recirculation	12.9	mi	1,200	15,480
Berm	33.0	mi	1,200	39,600
Road*	11.0	mi	1,200	13,200
Flood channel	11.0	mi	1,200	13,200
Electrical power	19.8	mi	600	11,880
Contingencies	10	%		459,191
Purchased water	-	ac-ft	450	0
			TOTAL	$5,051,101

Operation and maintenance Manpower Requirements	
Full-time Equiv. Employees Required	23

Table 5 - Alternative A1

Comparative Construction Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	7,200	ac	$60	$ 432,000
Managed veg	1,500	ac	1,874	2,811,000
Gravel	4,100	ac	7,115	29,171,500
Tilling	5,500		60	330,000
Salt flat	3,400		45	153,000
Fences	700		4,667	3,266,900
Recirculation pump	9	ea	60,000	540,000
Groundwater well	-		340,000	-
Water transmission	51.0	mi	see below	10,897,920
Water outlet	23.0	mi	145,000	3,335,000
Water recirculation	12.9	mi	79,200	1,021,680
Berm	33.0	mi	41,000	1,353,000
Road*	11.0	mi	20,100	221,100
Flood channel	11.0	mi	64,200	706,200
Electrical power	19.8	mi	30,000	594,000
Engineering	15	%		8,224,995
			TOTAL	$63,058,295

*The cost estimate for roads is for roads not associated with water lines, berms or flood channels. These infrastructure have attendant roads included in their construction costs.

Water Line Construction Cost Estimate				
Diameter	Quantity	Units	Unit Price	Item Price
36"	7.0	mi	306,240	2,143,680
30"	37.0	mi	219,120	8,107,440
18"	7.0	mi	92,400	646,800
TOTAL	51.0	mi	TOTAL	$10,897,920

Comparative Operation and Maintenance Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	7,200	ac	$38	$ 273,600
Managed veg	1,500	ac	230	345,000
Gravel	4,100	ac	94	385,400
Tilling	5,500		89	489,500
Salt flat	3,400		10	34,000
Fences	700		735	514,500
Recirculation pump	9	ea	10,750	96,750
Groundwater well	-		78,600	-
Water transmission	51.0	mi	1,200	61,200
Water outlet	23.0	mi	1,200	27,600
Water recirculation	12.9	mi	1,200	15,480
Berm	33.0	mi	1,200	39,600
Road*	11.0	mi	1,200	13,200
Flood channel	11.0	mi	1,200	13,200
Electrical power	19.8	mi	600	11,880
Contingencies	10	%		232,091
Purchased water	33,000	ac-ft	450	14,850,000
			TOTAL	$17,403,001

Operation and maintenance Manpower Requirements	
Full-time Equiv. Employees Required	21

Table 6 - Alternative B

Comparative Construction Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	12,100	ac	$60	$ 726,000
Managed veg	1,500	ac	1,874	2,811,000
Gravel	-	ac	7,115	-
Tilling	5,400		60	324,000
Salt flat	3,400		45	153,000
Fences	-		4,667	-
Recirculation pump	9	ea	60,000	540,000
Groundwater well	52.0		340,000	17,680,000
Water transmission	50.0	mi	see below	12,979,560
Water outlet	33.0	mi	145,000	4,785,000
Water recirculation	12.9	mi	79,200	1,021,680
Berm	20.0	mi	41,000	820,000
Road*	11.0	mi	20,100	221,100
Flood channel	-	mi	64,200	-
Electrical power	19.8	mi	30,000	594,000
Engineering	15	%		6,398,301
			TOTAL	$49,053,641

*The cost estimate for roads is for roads not associated with water lines, berms or flood channels. These infrastructure have attendant roads included in their construction costs.

Water Line Construction Cost Estimate				
Diameter	Quantity	Units	Unit Price	Item Price
36"	37.0	mi	306,240	11,330,880
24"	5.0	mi	143,880	719,400
20"	8.0	mi	116,160	929,280
TOTAL	50.0	mi	TOTAL	$12,979,560

Comparative Operation and Maintenance Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	12,100	ac	$38	$ 459,800
Managed veg	1,500	ac	230	345,000
Gravel	-	ac	94	-
Tilling	5,400		89	480,600
Salt flat	3,400		10	34,000
Fences	-		735	-
Recirculation pump	9	ea	10,750	96,750
Groundwater well	52		78,600	4,087,200
Water transmission	50.0	mi	1,200	60,000
Water outlet	33.0	mi	1,200	39,600
Water recirculation	12.9	mi	1,200	15,480
Berm	20.0	mi	1,200	24,000
Road*	11.0	mi	1,200	13,200
Flood channel	-	mi	1,200	-
Electrical power	19.8	mi	600	11,880
Contingencies	10	%		566,751
Purchased water	-	ac-ft	450	0
			TOTAL	$6,234,261

Operation and maintenance Manpower Requirements	
Full-time Equiv. Employees Required	16

Table 7 - Alternative B1

Comparative Construction Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	12,100	ac	$60	$ 726,000
Managed veg	1,500	ac	1,874	2,811,000
Gravel	-	ac	7,115	-
Tilling	5,400		60	324,000
Salt flat	3,400		45	153,000
Fences	-		4,667	-
Recirculation pump	9	ea	60,000	540,000
Groundwater well	-		340,000	-
Water transmission	57.0	mi	see below	17,075,520
Water outlet	33.0	mi	145,000	4,785,000
Water recirculation	12.9	mi	79,200	1,021,680
Berm	20.0	mi	41,000	820,000
Road*	11.0	mi	20,100	221,100
Flood channel	-	mi	64,200	-
Electrical power	19.8	mi	30,000	594,000
Engineering	15	%		4,360,695
			TOTAL	$33,431,995

*The cost estimate for roads is for roads not associated with water lines, berms or flood channels. These infrastructure have attendant roads included in their construction costs.

Water Line Construction Cost Estimate				
Diameter	Quantity	Units	Unit Price	Item Price
48"	7.0	mi	496,320	3,474,240
36"	41.0	mi	306,240	12,555,840
20"	9.0	mi	116,160	1,045,440
TOTAL	57.0	mi	TOTAL	$17,075,520

Comparative Operation and Maintenance Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	12,100	ac	$38	$ 459,800
Managed veg	1,500	ac	230	345,000
Gravel	-	ac	94	-
Tilling	5,400		89	480,600
Salt flat	3,400		10	34,000
Fences	-		735	-
Recirculation pump	9	ea	10,750	96,750
Groundwater well	-		78,600	-
Water transmission	57.0	mi	1,200	68,400
Water outlet	33.0	mi	1,200	39,600
Water recirculation	12.9	mi	1,200	15,480
Berm	20.0	mi	1,200	24,000
Road*	11.0	mi	1,200	13,200
Flood channel	-	mi	1,200	-
Electrical power	19.8	mi	600	11,880
Contingencies	10	%		158,871
Purchased water	56,000	ac-ft	450	25,200,000
			TOTAL	$26,947,581

Operation and maintenance Manpower Requirements	
Full-time Equiv. Employees Required	13

Table 8 - Alternative C

Comparative Construction Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	-	ac	$60	$ -
Managed veg	-	ac	1,874	-
Gravel	16,900	ac	7,115	120,243,500
Tilling	-		60	-
Salt flat	-		45	-
Fences	5,500		4,667	25,668,500
Recirculation pump	-	ea	60,000	-
Groundwater well	-		340,000	-
Water transmission	-	mi	see below	-
Water outlet	-	mi	145,000	-
Water recirculation	-	mi	79,200	-
Berm	55.0	mi	41,000	2,255,000
Road*	18.0	mi	20,100	361,800
Flood channel	20.0	mi	64,200	1,284,000
Electrical power	-	mi	30,000	-
Engineering	15	%		22,471,920
			TOTAL	$172,284,720

*The cost estimate for roads is for roads not associated with water lines, berms or flood channels. These infrastructure have attendant roads included in their construction costs.

Water Line Construction Cost Estimate				
Diameter	Quantity	Units	Unit Price	Item Price
0	-	mi	0	0
0	-	mi	0	0
0	-	mi	0	0
TOTAL	-	mi	TOTAL	$0

Comparative Operation and Maintenance Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	-	ac	$38	$ -
Managed veg	-	ac	230	-
Gravel	16,900	ac	94	1,588,600
Tilling	-		89	-
Salt flat	-		10	-
Fences	5,500		735	4,042,500
Recirculation pump	-	ea	10,750	-
Groundwater well	-		78,600	-
Water transmission	-	mi	1,200	-
Water outlet	-	mi	1,200	-
Water recirculation	-	mi	1,200	-
Berm	55.0	mi	1,200	66,000
Road*	18.0	mi	1,200	21,600
Flood channel	20.0	mi	1,200	24,000
Electrical power	-	mi	600	-
Contingencies	10	%		574,270
Purchased water	-	ac-ft	450	0
			TOTAL	$6,316,970

Operation and maintenance Manpower Requirements	
Full-time Equiv. Employees Required	73

Table 9 - Alternative D

Comparative Construction Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	5,600	ac	$60	$ 336,000
Managed veg	14,400	ac	1,874	26,985,600
Gravel	-	ac	7,115	-
Tilling	-		60	-
Salt flat	2,400		45	108,000
Fences	-		4,667	-
Recirculation pump	9	ea	60,000	540,000
Groundwater well	29.0		340,000	9,860,000
Water transmission	34.0	mi	see below	12,122,880
Water outlet	15.0	mi	145,000	2,175,000
Water recirculation	12.9	mi	79,200	1,021,680
Berm	16.0	mi	41,000	656,000
Road*	11.0	mi	20,100	221,100
Flood channel	20.0	mi	64,200	1,284,000
Electrical power	19.8	mi	30,000	594,000
Engineering	15	%		8,385,639
			TOTAL	$64,289,899

*The cost estimate for roads is for roads not associated with water lines, berms or flood channels. These infrastructure have attendant roads included in their construction costs.

Water Line Construction Cost Estimate				
Diameter	Quantity	Units	Unit Price	Item Price
48"	18.0	mi	496,320	8,933,760
36"	7.0	mi	306,240	2,143,680
20"	9.0	mi	116,160	1,045,440
TOTAL	34.0	mi	TOTAL	$12,122,880

Comparative Operation and Maintenance Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	5,600	ac	$38	$ 212,800
Managed veg	14,400	ac	230	3,312,000
Gravel	-	ac	94	-
Tilling	-		89	-
Salt flat	2,400		10	24,000
Fences	-		735	-
Recirculation pump	9	ea	10,750	96,750
Groundwater well	29		78,600	2,279,400
Water transmission	34.0	mi	1,200	40,800
Water outlet	15.0	mi	1,200	18,000
Water recirculation	12.9	mi	1,200	15,480
Berm	16.0	mi	1,200	19,200
Road*	11.0	mi	1,200	13,200
Flood channel	20.0	mi	1,200	24,000
Electrical power	19.8	mi	600	11,880
Contingencies	10	%		606,751
Purchased water	-	ac-ft	450	0
			TOTAL	$6,674,261

Operation and maintenance Manpower Requirements	
Full-time Equiv. Employees Required	18

Table 10 - Alternative D1

Comparative Construction Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	5,600	ac	$60	$ 336,000
Managed veg	14,400	ac	1,874	26,985,600
Gravel	-	ac	7,115	-
Tilling	-		60	-
Salt flat	2,400		45	108,000
Fences	-		4,667	-
Recirculation pump	9	ea	60,000	540,000
Groundwater well	-		340,000	-
Water transmission	41.0	mi	see below	14,266,560
Water outlet	15.0	mi	145,000	2,175,000
Water recirculation	12.9	mi	79,200	1,021,680
Berm	16.0	mi	41,000	656,000
Road*	11.0	mi	20,100	221,100
Flood channel	20.0	mi	64,200	1,284,000
Electrical power	19.8	mi	30,000	594,000
Engineering	15	%		7,228,191
			TOTAL	$55,416,131

*The cost estimate for roads is for roads not associated with water lines, berms or flood channels. These infrastructure have attendant roads included in their construction costs.

Water Line Construction Cost Estimate				
Diameter	Quantity	Units	Unit Price	Item Price
48"	18.0	mi	496,320	8,933,760
36"	14.0	mi	306,240	4,287,360
20"	9.0	mi	116,160	1,045,440
TOTAL	41.0	mi	TOTAL	$14,266,560

Comparative Operation and Maintenance Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	5,600	ac	$38	$ 212,800
Managed veg	14,400	ac	230	3,312,000
Gravel	-	ac	94	-
Tilling	-		89	-
Salt flat	2,400		10	24,000
Fences	-		735	-
Recirculation pump	9	ea	10,750	96,750
Groundwater well	-		78,600	-
Water transmission	41.0	mi	1,200	49,200
Water outlet	15.0	mi	1,200	18,000
Water recirculation	12.9	mi	1,200	15,480
Berm	16.0	mi	1,200	19,200
Road*	11.0	mi	1,200	13,200
Flood channel	20.0	mi	1,200	24,000
Electrical power	19.8	mi	600	11,880
Contingencies	10	%		379,651
Purchased water	33,000	ac-ft	450	14,850,000
			TOTAL	$19,026,161

Operation and maintenance Manpower Requirements	
Full-time Equiv. Employees Required	16

Table 11 - Alternative E

Comparative Construction Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	-	ac	$60	$ -
Managed veg	-	ac	1,874	-
Gravel	-	ac	7,115	-
Tilling	-		60	-
Salt flat	-		45	-
Fences	-		4,667	-
Recirculation pump	-	ea	60,000	-
Groundwater well	-		340,000	-
Water transmission	30.0	mi	see below	68,640,000
Water outlet	-	mi	145,000	-
Water recirculation	-	mi	79,200	-
Berm	-	mi	41,000	-
Road*	-	mi	20,100	-
Flood channel	-	mi	64,200	-
Electrical power	-	mi	30,000	-
Engineering	15	%		10,296,000
			TOTAL	$78,936,000

*The cost estimate for roads is for roads not associated with water lines, berms or flood channels. These infrastructure have attendant roads included in their construction costs.

Water Line Construction Cost Estimate				
Diameter	Quantity	Units	Unit Price	Item Price
120"	10.0	mi	3,168,000	31,680,000
96"	10.0	mi	2,376,000	23,760,000
72"	10.0	mi	1,320,000	13,200,000
TOTAL	30.0	mi	TOTAL	$68,640,000

Comparative Operation and Maintenance Cost Estimate				
Item	Quantity	Units	Unit Price	Item Price
Flood irrigation	-	ac	$38	$ -
Managed veg	-	ac	230	-
Gravel	-	ac	94	-
Tilling	-		89	-
Salt flat	-		10	-
Fences	-		735	-
Recirculation pump	-	ea	10,750	-
Groundwater well	-		78,600	-
Water transmission	30.0	mi	1,200	36,000
Water outlet	-	mi	1,200	-
Water recirculation	-	mi	1,200	-
Berm	-	mi	1,200	-
Road*	-	mi	1,200	-
Flood channel	-	mi	1,200	-
Electrical power	-	mi	600	-
Contingencies	10	%		3,600
Purchased water	320,000	ac-ft	450	144,000,000
			TOTAL	$144,039,600

Operation and maintenance Manpower Requirements	
Full-time Equiv. Employees Required	1

ASSUMPTIONS

GENERAL

Earthwork: Lake bed soil structures = \$0.50 to \$1.50/yd^3
Imported aggregate base for road beds = \$15/yd^3

Manpower: 1 full time equivalent employee (f.t.e.e.) = \$60,000/yr

Annualized Costs:

Annualized costs are calculated based on an EPA method set forth in document EPA-450/2-92-004 titled "Fugitive Dust Background Document and Technical Information for Best Available Control Measures" dated September 1992. The pertinent section of this document is attached.

Total annual cost = Ca = (CRF x Cc) + Co + ½Co + Ci

where: Ca = annualized cost
Cc = construction cost
Co = annual operating cost
½Co = annual overhead cost (overhead not applied to annual cost of purchased water)
Ci = annual enforcement and inspection cost (assumed \$2,000,000 flat rate)
CRF = capital recovery factor = 0.0858, for 7% interest rate and 25 yr. term

$$= \frac{i(1+i)^n}{(1+i)^n - 1} = 0.0858$$

FLOOD IRRIGATION

Construction Cost - Infrastructure required for Flood Irrigation construction is included below (recirculation pumps, water lines, water outlets, berms, roads and wells). The only surface treatment that may be required would be grading of minor topographic obstructions. Man with D-8 dozer costs \$150/hr. Equipment works 40 acres per day. Assume two passes with equipment is required.

40 ac/day = 0.2 hr/ac
0.2 hr/ac x \$150/hr = \$30/ac/pass
Total /ac = \$30/ac/pass x 2 passes = **\$60/ac**

Annual Cost -

Manpower: 1 f.t.e.e./3200 acres: \$60,000/f.t.e.e. x 1 f.t.e.e./3,200 acres = \$18.75/acre
Maintenance Equipment: 100% of manpower = \$18.75/acre
Total = \$37.50 say **\$38/ac/yr**

MANAGED VEGETATION

Construction Cost - (from Agrarian Research and Management, January 1997) = **\$1,874/ac**

Annual Cost - (from Agrarian Research and Management, January 1997) = **\$230/ac/yr**

GRAVEL

Construction Cost - 4-inch gravel blanket. Gravel mined from locally developed quarries
Attached report "Preliminary Economic Review-Owens Lake Gravel Cover PM_{10} Control Measure" presents a preliminary range of \$11.39 to \$15.07/yd³. Use mid-range value of \$13.23/yd³. 4-inch blanket requires 538 yd³/ac. \$13.23/yd³ x 538 yd³/ac = \$7,115/acre

Annual Cost -
Manpower: 1 f.t.e.e./ 3,200 acres: \$60,000/f.t.e.e. x 1 f.t.e.e./ 3,200 acres = 18.75/acre
Assume 5 yd³ (1%) of gravel required per acre per year for maintenance purposes.
Material = 5 yd³/acre/yr x \$15.00/ton = \$75/ac/yr
Total = \$93.75 say **\$94/ac/yr**

TILLING

Construction Cost - Infrastructure required for tilling is included below (wells, water lines, water outlets, berms and roads). Man with D-8 dozer costs \$150/hr. Equipment works 40 acres per day. Two passes with equipment required (one for ripping, one for cloding).
40 ac/da = 0.2 hr/ac
0.2 hr/ac x \$150/hr = \$30/ac/pass
Total /ac = \$30/ac/pass x 2 passes = **\$60/ac**

Annual Cost -
Manpower: 1 f.t.e.e./2,100 acres: \$60,000/f.t.e.e. x 1 f.t.e.e./2,100 acres = \$28.57/acre
Retilling: 40 ac/da = 0.2 hr/ac
0.2 hr/ac x \$150/hr = \$30/ac/pass
\$30/ac/pass x 2 passes = \$60/ac
Total = \$88.57 say **\$89/ac/yr**

SALT FLAT

Construction Cost - The significant infrastructure consists of the downhill containment berm that is already included in berm costs. Some secondary berms and ditches may be required. Assume one additional mile of berm and/or ditch per square mile of salt flat.
Berm = \$28,500/mi (see below)
\$28,500 ÷ 640 ac/mi² = \$44.53/acre say **\$45/ac**

Annual Cost -
Manpower: 1 f.t.e.e./6400 acres: \$60,000/f.t.e.e. x 1 f.t.e.e./6400 acres = \$9.37/acre say **\$10/ac/yr**

FENCES

Construction Cost - Based on a material and installation cost of \$4-5/ft for the sand fence array constructed by UC Davis on the southern portion of Owens Lake, assume a material and installation cost of \$3/ft (4-ft high fence). Fences are spaced 28 ft apart (7 fence heights).

Each mi^2 will contain: (5,280 ft/mi ÷ 28 ft) x 5,280 ft/mi = 995,657 ft/mi^2 (189 mi/mi^2)
995,657 ft/mi^2 x \$3/ft ÷ 640 ac/mi^2 = **\$4,667/ac**

Annual Cost -

Manpower: 10 f.t.e.e./mi^2 Oct - May (8 mos)
3 f.t.e.e./mi^2 Jun - Sep (4 mos)
Annual f.t.e.e. = 7.67/mi^2 or 1 f.t.e.e./84 ac
7.67 f.t.e.e./mi^2/yr x \$60,000/f.t.e.e. = \$460,200/mi^2/yr = \$719/ac/yr

Equipment/Materials = \$10,000/mi^2/yr = \$15.63/ac/yr

Total = **\$735/ac/yr**

RECIRCULATION PUMPS

Construction Cost - **\$60,000 /pump**

Annual Cost -

Electricity cost - assume 10% of water delivered is recirculated, pump head = 30 ft, power cost = \$0.10/kwhr and pump capacity = 350 gpm
Cost = 2.62 x gpm x head x rate = \$2,750/pump/yr

Material and equipment = \$2,000/pump/yr

Manpower = 1 f.t.e.e./10 pumps x \$60,000/f.t.e.e. = \$6,000/pump/year

Total = **\$10,750/pump/yr**

GROUNDWATER WELLS

Construction Cost - Includes production well, monitoring well, earth pad, and pump station (cost estimate based on actual costs to construct existing test wells and pump stations).

\$120,000	Production well
70,000	Monitoring well
25,000	Well pad/access road
125,000	Pump station
\$340,000	Total per well site

Annual Cost -

Electricity cost = \$45/ac-ft (based on NFIP pumping costs)
Assume average well output = 1,000 gpm = 1,613 ac-ft/yr
Cost = \$45/ac-ft x 1,613 ac-ft/well/yr = \$72,585/well/yr say \$72,600/well/yr

Material and equipment = \$2,000/well/yr

Manpower = 1 f.t.e.e. / 15 wells x \$60,000/f.t.e.e. = \$4,000/well/year

Total = **\$78,600/well/yr**

WATER LINES

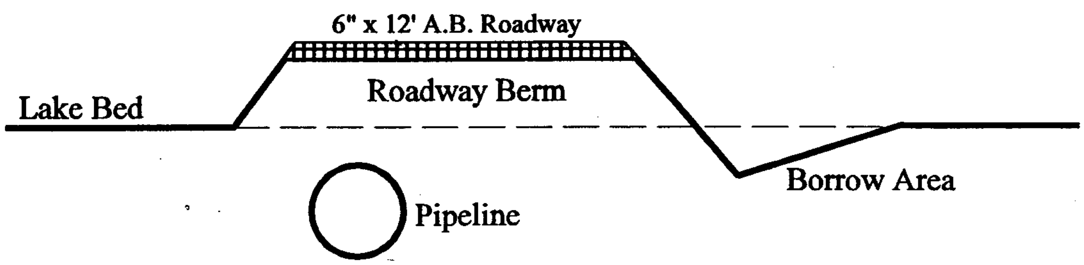
Construction Cost - Cost per mile of buried water line for various sizes of pipe

Diameter (in)	Material ($)[1]	Install ($)[2]	Road ($)[3]	Total /ft ($)	Total /mi ($)
12	6	3	4	13	68,640
18	9	5	4	18	92,400
20	12	6	4	22	116,160
24	15.5	8	4	27	143,880
30	25	13	4	42	219,120
36	36	18	4	58	306,240
48	60	30	4	94	496,320
60	120	60	4	184	971,520
72	167	83	0	250	1,320,000
96	300	150	0	450	2,376,000
120	400	200	0	600	3,168,000

Notes:

1. - Material costs per foot based on PVC for sized 18" to 24", HDPE for sizes 30" to 48" and linear projection for greater than 48". Costs from Rain-for-Rent Company, March 4, 1996.
2. - Pipe installation and fittings cost per foot assumed to be 50% of pipe material cost.
3. - Cost of attendant road per foot based on approx. 1 yd^3 of local lake bed material /ft of roadway ($0.50/cu.yd.) plus 6" by 12' cap of imported a.b. for roadway cap ($15.00/cu.yd.).

Cross Section -



Annual Cost - 1 f.t.e.e. /50 miles of pipe x $60,000/f.t.e.e./yr = **$1,200 /mi/yr**

WATER OUTLETS

Construction Cost - Cost per 1,200 foot outlet assembly

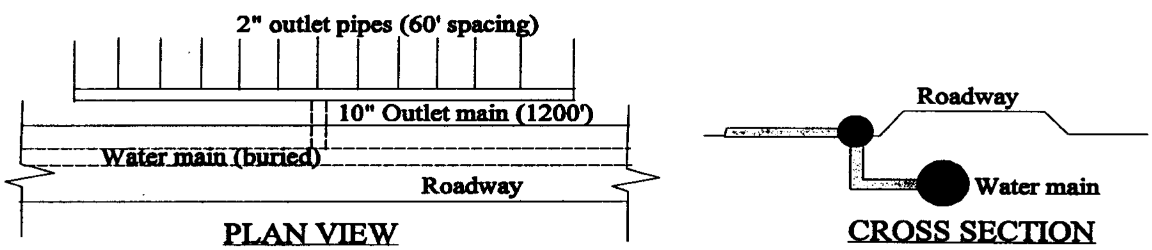
Item	Amount (ft)	Material ($)[2]	Install ($)[3]	Total ($)
10" PVC-UV-RJ[1] pipe	1200	14.90	5.96	25,032.00
2" PVC-UV-RJ pipe	420	1.52	0.61	893.76
Valves, fittings	lump sum	5,000.00	2,000.00	7,000.00
		TOTAL		32,925.76

Notes:

1. - PVC-UV-RJ = Ultraviolet-inhibited, impact-modified, restrained-joint, polyvinyl chloride. Pipe equivalent to Certa-Lok™ Yelomine™ pipe manufactured by Certain Teed Corp.
2. - Unit prices per foot based on 11/15/94 Certa-Lok™ Yelomine™ list prices.
3. - Installation price = 40% of material price

Total = $32,926 /1200 ft assembly x 5280 ft/mi = **$145,000 /mi**

Diagram -



Annual Cost - 1 f.t.e.e. /50 miles of pipe x $60,000/f.t.e.e./yr = **$1,200 /mi/yr**

WATER RECIRCULATION

Construction Cost - Assume 10" diameter PVC pipe @ $15/ft installed w/fittings = **$79,200/mi**

Annual Cost - 1 f.t.e.e. /50 miles of pipe x $60,000/f.t.e.e./yr = **$1,200 /mi/yr**

EARTH BERMS

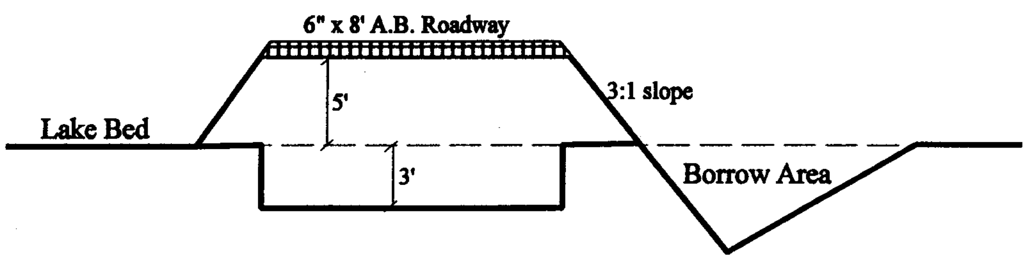
Construction Cost - Cost per foot

Description: 5 ft high, 10 ft top w/ 6" x 8' a.b. road cap, 3:1 side slopes, 3' x 10' key

Item	Volume (cu yd/ft)	Unit Price ($/cu yd)	Total Price ($/ft)
Berm	4.6	1.00	4.60
Road	0.15	15.00	2.25
Key	0.9	1.00	0.90
		TOTAL	7.75

Total = $7.75/ft x 5,280 ft/mi = $40,920/mi say **$41,000/mi**

Cross Section -



Annual Cost - 1 f.t.e.e. /50 miles of berm x $60,000/f.t.e.e./yr = **$1,200 /mi/yr**

ROADS

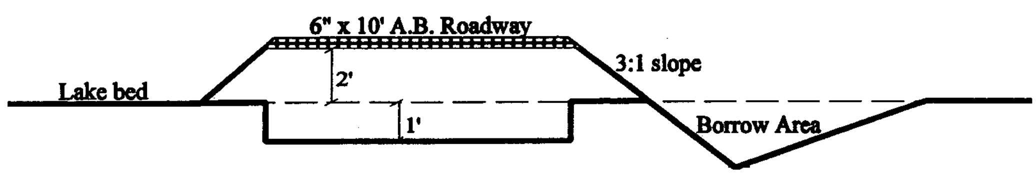
Construction Cost - Cost per foot

Description: 2 ft high, 10 ft top w/ 6" a.b. road cap, 3:1 side slopes, 1' x 10' key

Item	Volume (cu yd/ft)	Unit Price ($/cu yd)	Total Price ($/ft)
Berm	1.2	0.50	0.60
Road	0.2	15.00	3.00
Key	0.4	0.50	0.20
		TOTAL	3.80

Total = $3.80/ft x 5,280 ft/mi = $20,064/mi, say **$20,100/mi**

Cross Section -



Annual Cost - 1 f.t.e.e. /50 miles of berm x $60,000/f.t.e.e./yr = **$1,200 /mi/yr**

FLOOD CHANNEL

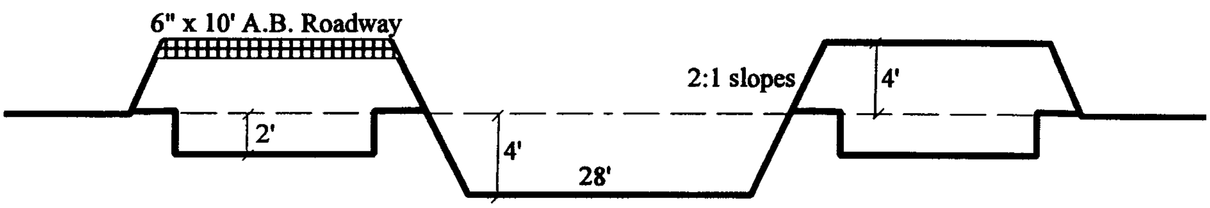
Construction Cost - Cost per foot

Description: 2 berms, each 4 ft high, 10 ft top w/ 6" a.b. road cap on one side, 2:1 side slopes, 2' x 10' key, berms separated by channel 4 ft deep with 28 ft bottom width.

Item	Volume (cu yd/ft)	Unit Price ($/cu yd)	Total Price ($/ft)
Berms/Channel	5.3	1.50	7.95
Road	0.2	15.00	3.00
Key	0.8	1.50	1.20
		TOTAL	12.15

Total = $12.15/ft x 5,280 ft/mi = $64,152/mi say, **$64,200/mi**

Cross Section -



Annual Cost - 1 f.t.e.e. /50 miles of channel x $60,000/f.t.e.e./yr = **$1,200 /mi/yr**

ELECTRICAL POWER

Construction - **$30,000/mi**

Annual Cost - 1 f.t.e.e./ 100 mi = **$600/mi/yr**

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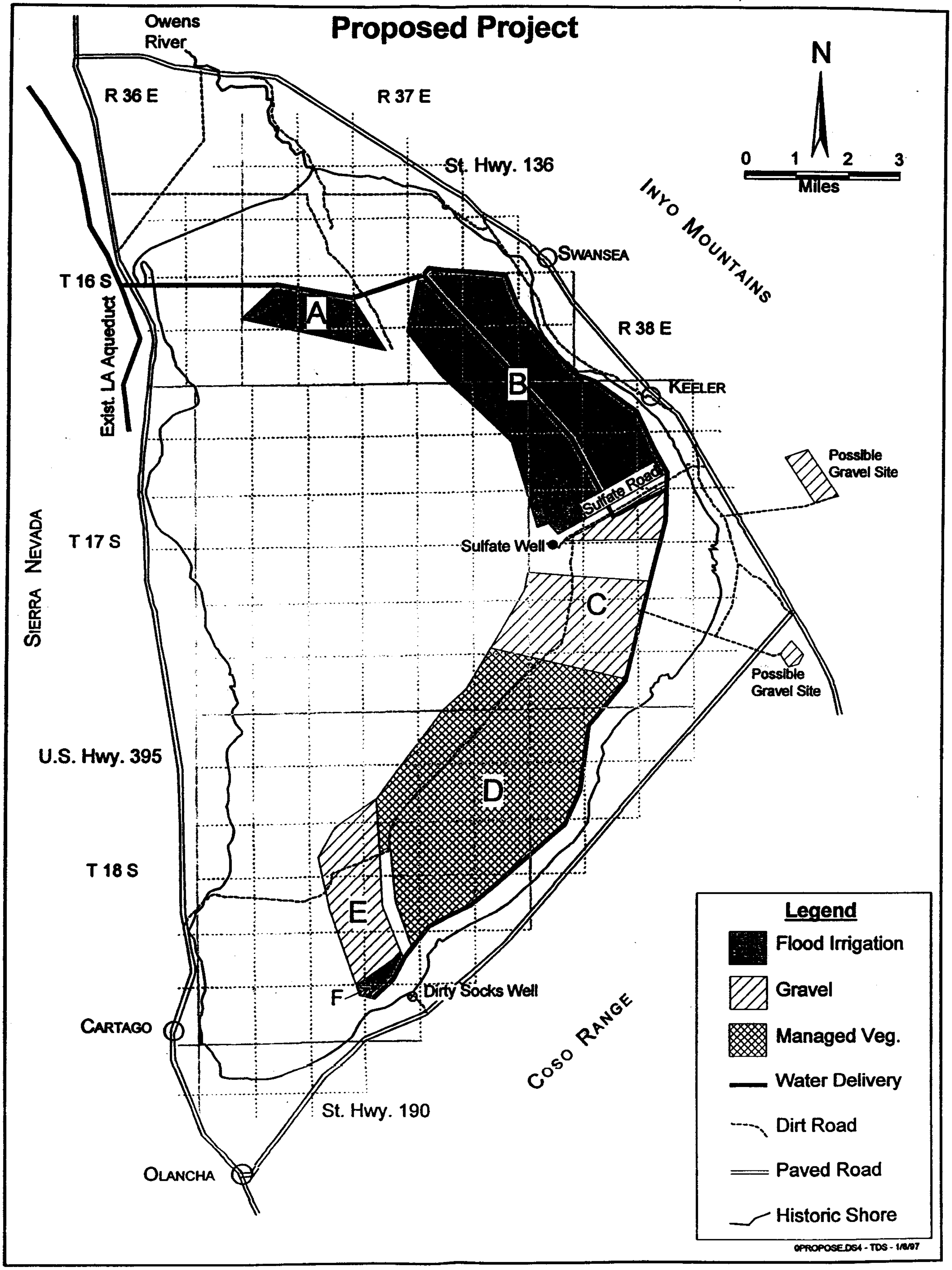
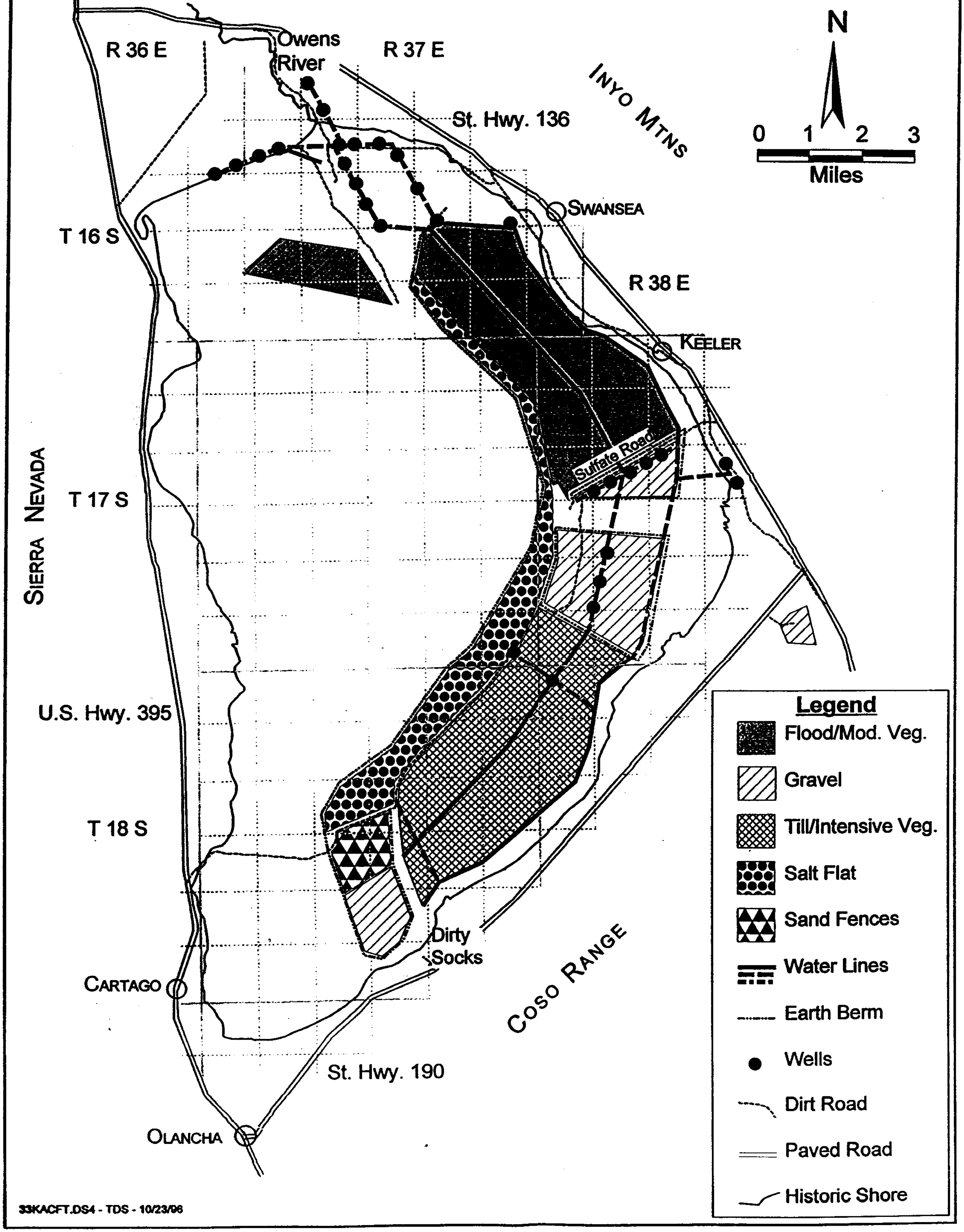
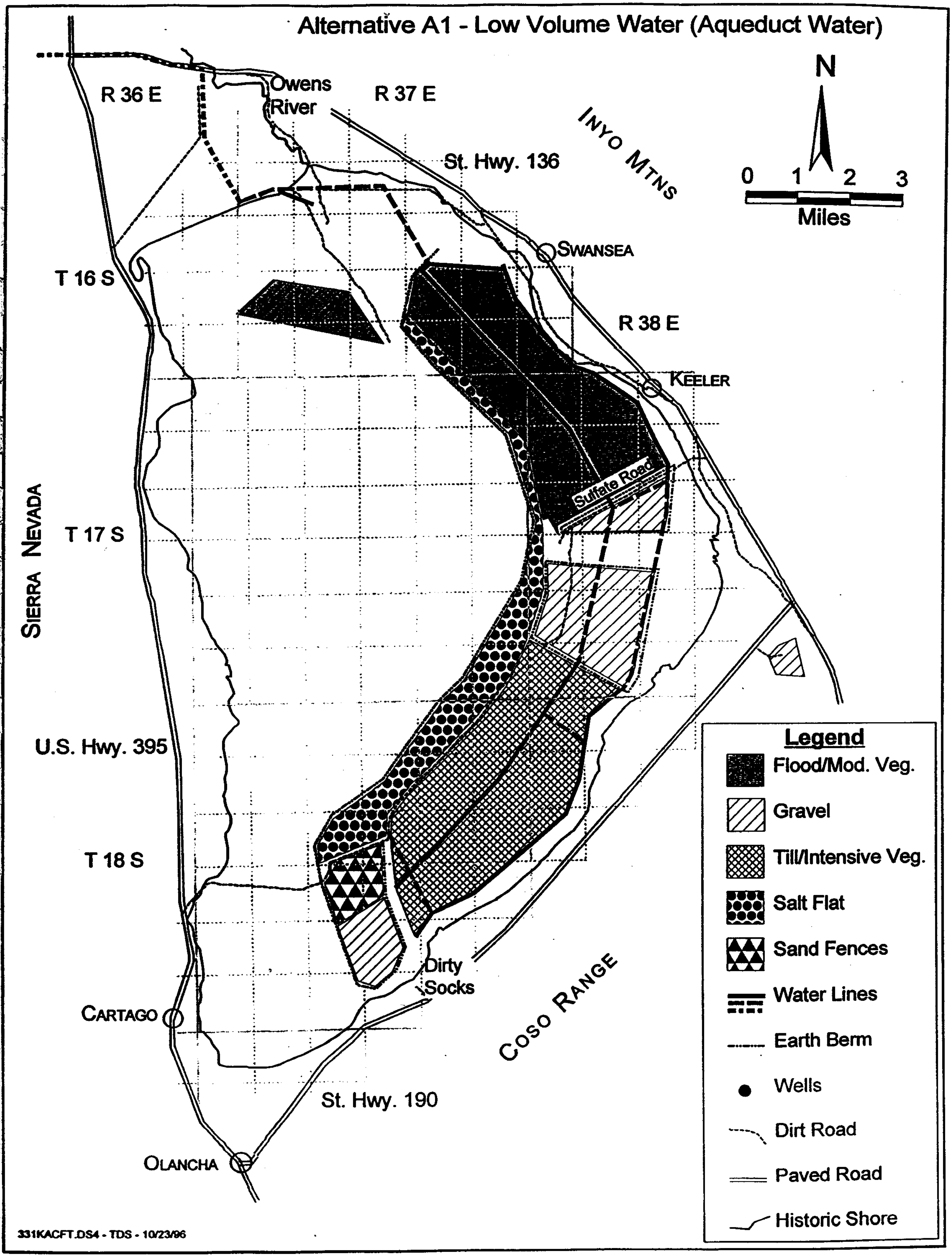


Proposed Project
Owens River
R 36 E
R 37 E
R 38 E
St. Hwy. 136
N
0 1 2 3
Miles
Inyo Mountains
Swansea
T 16 S
Exist. LA Aqueduct
A
B
Keeler
Possible Gravel Site
Sulfate Road
Sulfate Well
T 17 S
Sierra Nevada
C
Possible Gravel Site
U.S. Hwy. 395
D
T 18 S
E
F
Dirty Socks Well
Cartago
Coso Range
St. Hwy. 190
Olancha
Legend
Flood Irrigation
Gravel
Managed Veg.
Water Delivery
Dirt Road
Paved Road
Historic Shore
0PROPOSE.DS4 - TDS - 1/8/97

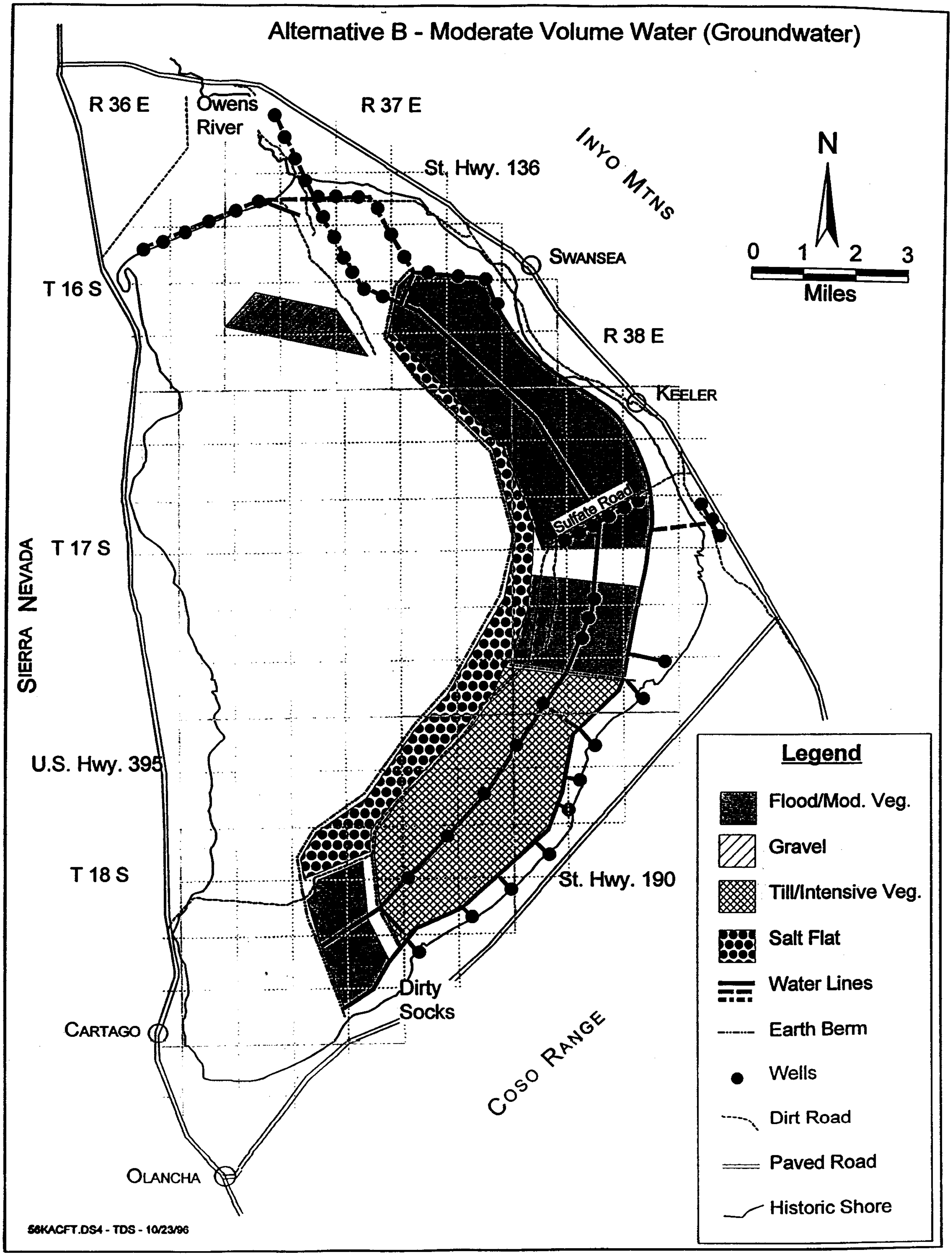
Alternative A - Low Volume Water (Groundwater)



33KACFT.DS4 - TDS - 10/23/96

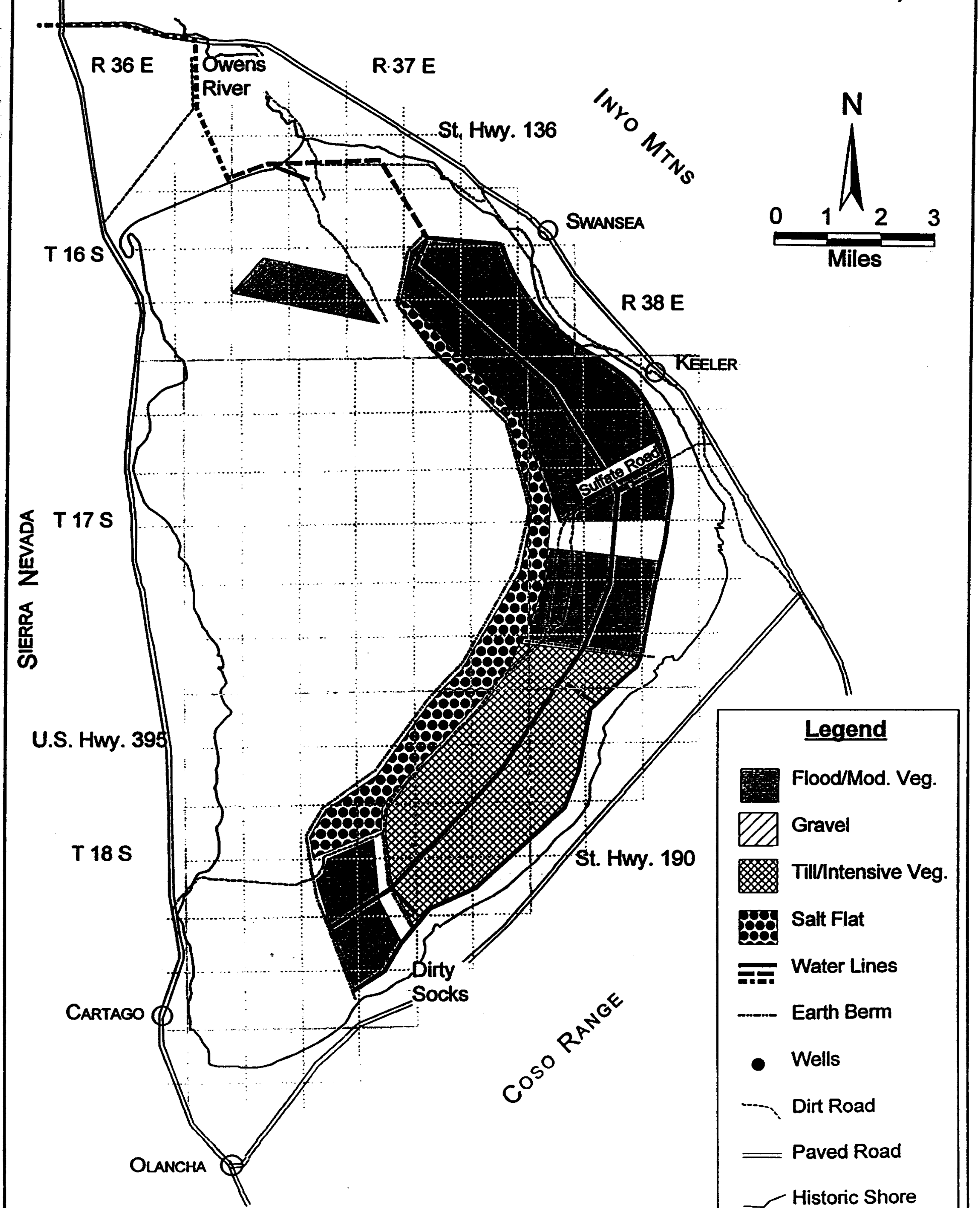


Alternative A1 - Low Volume Water (Aqueduct Water)
N
0
1
2
3
Miles
R 36 E
Owens
River
R 37 E
Inyo Mtns
St. Hwy. 136
Swansea
T 16 S
R 38 E
Keeler
Sulfate Road
Sierra Nevada
T 17 S
U.S. Hwy. 395
T 18 S
Dirty
Socks
Cartago
Coso Range
St. Hwy. 190
Olancha
Legend
Flood/Mod. Veg.
Gravel
Till/Intensive Veg.
Salt Flat
Sand Fences
Water Lines
Earth Berm
Wells
Dirt Road
Paved Road
Historic Shore
331KACFT.DS4 - TDS - 10/23/96

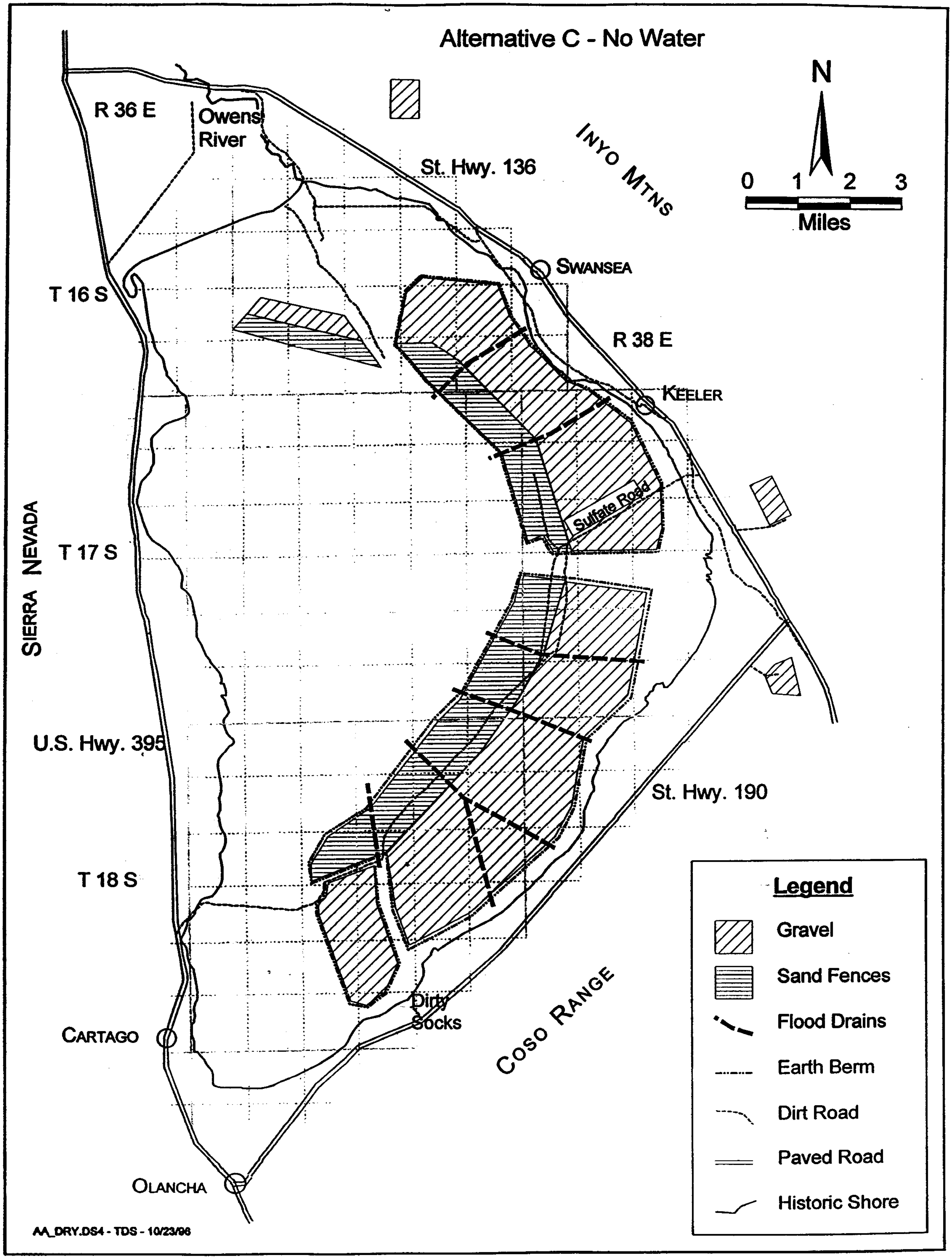


Alternative B - Moderate Volume Water (Groundwater)
R 36 E
Owens River
R 37 E
St. Hwy. 136
INYO MTNS
N
0 1 2 3
Miles
SWANSEA
T 16 S
R 38 E
KEELER
Sulfate Road
T 17 S
SIERRA NEVADA
U.S. Hwy. 395
T 18 S
St. Hwy. 190
Dirty Socks
CARTAGO
COSO RANGE
OLANCHA
Legend
Flood/Mod. Veg.
Gravel
Till/Intensive Veg.
Salt Flat
Water Lines
Earth Berm
Wells
Dirt Road
Paved Road
Historic Shore
56KACFT.DS4 - TDS - 10/23/96

Alternative B1 - Moderate Volume Water (Aqueduct Water)

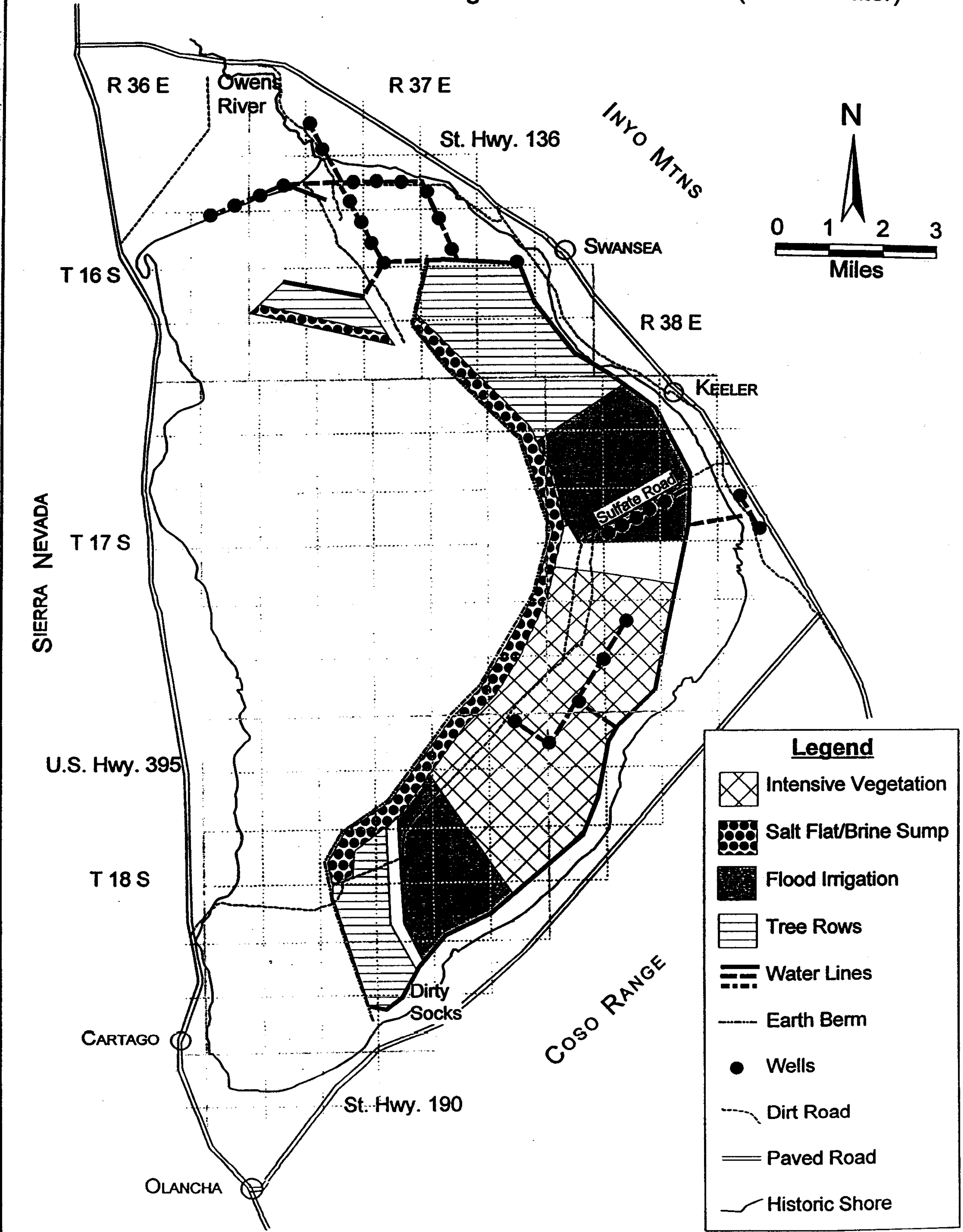


561KACFT.DS4 - TDS - 10/23/96

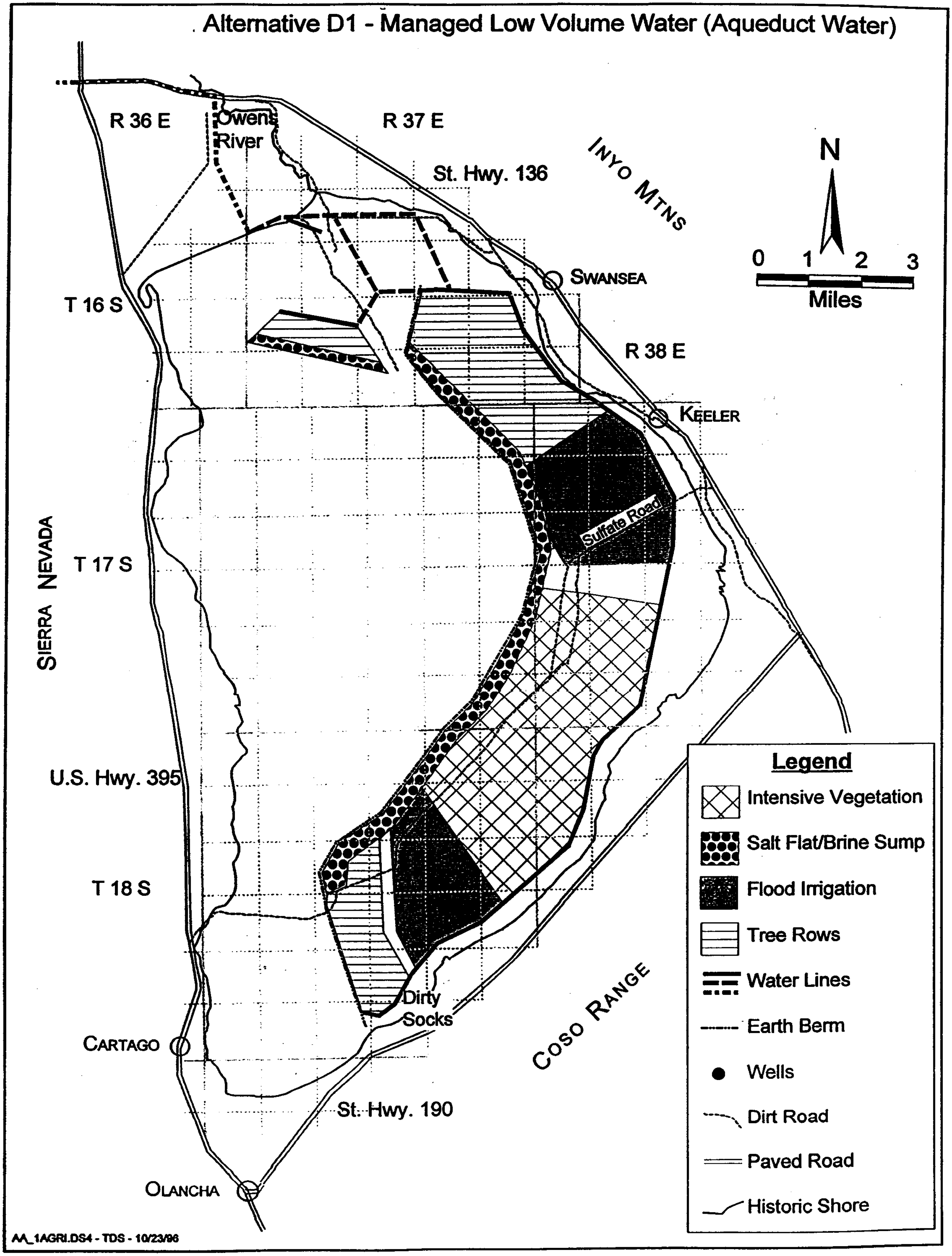


Alternative C - No Water
N
0 1 2 3
Miles
R 36 E
Owens River
St. Hwy. 136
Inyo Mtns
Swansea
T 16 S
R 38 E
Keeler
Sulfate Road
T 17 S
Sierra Nevada
U.S. Hwy. 395
St. Hwy. 190
T 18 S
Dirty Socks
Cartago
Coso Range
Olancha
Legend
Gravel
Sand Fences
Flood Drains
Earth Berm
Dirt Road
Paved Road
Historic Shore
AA_DRY.DS4 - TDS - 10/23/96

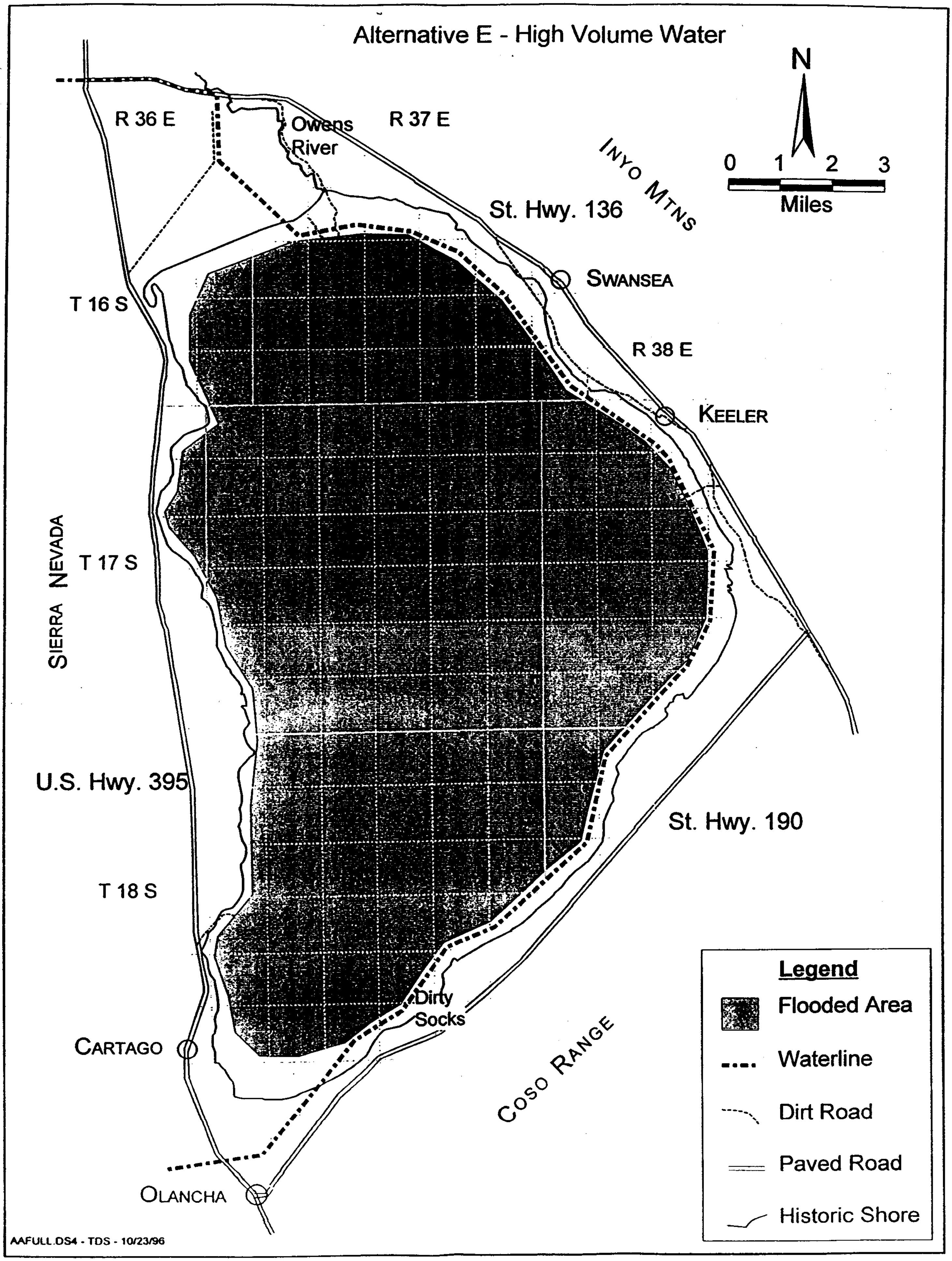
Alternative D - Managed Low Volume Water (Groundwater)



AA_AGRI.DS4 - TDS - 10/23/96



Alternative D1 - Managed Low Volume Water (Aqueduct Water)
R 36 E
Owens River
R 37 E
St. Hwy. 136
INYO MTNS
N
0 1 2 3
Miles
SWANSEA
T 16 S
R 38 E
KEELER
Sulfate Road
SIERRA NEVADA
T 17 S
U.S. Hwy. 395
T 18 S
Dirty Socks
CARTAGO
COSO RANGE
St. Hwy. 190
OLANCHA
Legend
Intensive Vegetation
Salt Flat/Brine Sump
Flood Irrigation
Tree Rows
Water Lines
Earth Berm
Wells
Dirt Road
Paved Road
Historic Shore
AA_1AGRI.DS4 - TDS - 10/23/96


Alternative E - High Volume Water
N
0 1 2 3
Miles
R 36 E
Owens River
R 37 E
INYO MTNS
St. Hwy. 136
SWANSEA
T 16 S
R 38 E
KEELER
SIERRA NEVADA
T 17 S
U.S. Hwy. 395
St. Hwy. 190
T 18 S
Dirty Socks
CARTAGO
COSO RANGE
OLANCHA
Legend
Flooded Area
Waterline
Dirt Road
Paved Road
Historic Shore
AAFULL.DS4 - TDS - 10/23/96

* Excerpts from:

United States Environmental Protection Agency
Air

Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

EPA-450/2-92-004
September 1992

EPA

FUGITIVE DUST BACKGROUND DOCUMENT AND TECHNICAL INFORMATION DOCUMENT FOR BEST AVAILABLE CONTROL MEASURES

GREAT BASIN UNIFIED A.P.C.D.
157 SHORT STREET
BISHOP, CALIFORNIA 93514
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Office of Air Quality
Clean Air
OAQPS
Planning and Standards

SECTION 5

CONTROL COST ANALYSIS METHODOLOGY

The costs of implementing BACM for PM-10 emissions from fugitive dust are presented in this section. These costs have been developed for the model units presented in Section 4. All costs presented in this chapter have been updated to second quarter 1991 dollars.

The following discussion describes the process for calculating the cost of an available control measure for BACM application. Examples are given for selected model units for paved roads, unpaved roads, construction/demolition activities, and wind erosion from open areas.

5.1 ESTIMATING ANNUALIZED COST

Annualized cost is comprised of capital, operating, overhead, and enforcement/compliance costs. Annualized cost, C_a, is determined using the following equation:

$$C_a = (CRF * C_e) + C_o + 0.5C_o + C_i \quad (5\text{-}1)$$

where: CRF = capital recovery factor (defined in Equation 5-3).

C_e = direct capital costs.

C_o = annual direct operating costs.

0.5 = overhead cost rate.

C_i = direct annual enforcement and inspection costs.

Annualized cost for an individual control measure is likely to vary because of economic and environmental conditions. Costs will vary geographically due to differences in wage rates and equipment/material costs by region. Costs will also vary because of differences in availability of existing equipment and personnel. For example, local governments that need to chemically stabilize unpaved roads to meet PM-10 standards and that already own tank trucks capable of distributing chemical dust suppressants will have smaller initial costs than other governments without tank trucks.

The individual elements for Equation 5-1 are described in the following sections.

5.1.1 Capital Costs, Ce

The capital investment in a fugitive dust control system consists of those costs incurred in purchase and installation of equipment, development of support facilities (such as utilities), and associated labor. In general, capital costs are divided into direct and indirect costs. Direct capital costs are the costs of control equipment, support facilities, and labor and materials needed for installation of utilities. For example, implementation of chemical dust suppression measures will require tanks for storage and mixing, spray trucks, pumps, piping, etc.

Direct costs cover the cost of purchase of equipment, support facilities and auxiliaries, and the cost of installation. Structures may require certain restrictions which add to the direct costs. General types of direct capital costs associated with fugitive dust control systems include:

1. Equipment costs for items such as trucks, sweepers or vacuums; chemical application equipment; storage tanks; and facilities.

2. Installation, including adaption into current system (or replacement of old system), and testing and adjustment of control apparatus and procedures.

3. Support facility upgrading costs for items such as newly paved roads or gravel placement over dirt roads.

4. Associated direct costs, such as utility lines and connections, site development, and materials related to the acquisition and installation of the capital items.

Indirect capital costs cover the expenses not attributable to specific equipment or structures. General types of indirect capital costs associated with fugitive dust emissions control systems include:

1. Engineering and administrative costs such as specifications and design work, overhead costs, training of personnel, safety engineering, and modeling.

2. Construction and field expenses, including buildings and equipment, warehouses, repair-work areas, temporary facilities, and tools.

3. Contractor's fee and contingency costs.

The capital cost to be incurred is dependent on the maximum amount of control desired. For instance, chemical suppressants may be applied to unpaved roads a maximum of once every month. In that case, sufficient capital equipment should be obtained to apply chemical suppressants to the unpaved roads in about a month's time. If, however, the maximum number of applications is later increased to twice per month, the current capital investment may not be able to accommodate the increased application intensity, and additional capital equipment will have to be purchased. On the other hand, if enough equipment is purchased to allow a maximum of one application per week (on the assumption that at some time it may be needed), and subsequently only two applications are made per month, then excess capital equipment is wasted. Therefore, the issue in determining capital costs is one of optimization: minimizing the capital cost subject to a minimum equipment utilization rate and minimum emissions reduction percentage, or alternatively, maximizing the emissions reduction percentage subject to a maximum equipment utilization rate and maximum capital cost.

The annualized cost of capital equipment, support facilities, and related capital expenses is calculated by using a Capital Recovery Factor (CRF). The CRF provides an average level of annualized cost associated with one dollar of initial capital investment. The CRF takes into account the real interest rate of borrowed funds (a pretax marginal rate of return on private investment, annual percent as a fraction) and the economic life of the control system (number of years):

$$CRF = \frac{i(1+i)^n}{(1+i)^n - 1} \quad (5\text{-}2)$$

where: i = annual interest rate.
n = economic life of the control system in years.

For instance, given an annual interest rate of 10 percent on borrowed funds, and an economic life of 15 years on capital equipment, the CRF will be approximately 0.13. This factor, multiplied by the total capital costs, provides annualized capital recovery cost, the annualized capital cost over the life of the equipment.

5.1.2 Operating Cost, C_O

Operating cost will be a major component of many control measures. First, those control measures that are mechanical in nature or require repeated applications or maintenance will likely have operating costs exceeding capital costs over time. An example is chemical stabilization of unpaved road surfaces where the costs of labor, fuel, and materials (chemical stabilizers) will, over time, exceed the cost of capital equipment (storage tanks, tank truck, spray equipment). Second, operating costs for many control measures will continue for as long as control is required. Operating costs typically include:

- Utilities: electricity, water, natural gas, telephone, etc.
- Raw materials/process inputs.
- Operating labor.
- Maintenance and repairs: labor and materials.
- By-product costs: material collected during application, or as a result of operations, that must be disposed.
- Fuel costs.

Generally, operating costs will increase linearly with increases in application intensity or expansion of source extent to be controlled (i.e., increase the number of miles of roadway subject to BACM). However, there are many exceptions to this. As an example, increasing application rates may result in an increasing rate of maintenance and repair costs. Estimates of operating costs need to reflect the impact of the varying intensities of BACM application.

Operating costs are calculated for a particular year using the following equation.

$$C_o = C_u + C_r + C_l + C_m + C_b + C_f \qquad (5\text{-}3)$$

where:
C_o = annual direct operating costs.
C_u = annual direct utility costs.
C_r = annual direct raw materials/process inputs.
C_l = annual operating labor.
C_m = annual direct maintenance/repair costs.
C_b = annual direct by-product costs.
C_f = annual direct fuel costs.

All of these costs may not apply to a particular control measure.

5.1.2.1 Utilities, C_u--

Utility costs for the current year are calculated directly based upon utility rates and estimated utility usage. Utility usage can often be determined from the owner's manual or other manufacturer product data.

5.1.2.2 Raw Materials/Process Inputs, C_r--

Some control measures, such as chemical stabilization or paving roads, have raw material and/or process inputs. Determination of these costs are accomplished by contacting area vendors and determining unit costs for these materials.

Listed below are popular publications that provide current cost data:

- *Hydrocarbon* (petroleum-based products)
- *Oil and Gas Journal* (petroleum-based products)
- *Chemical Marketing Reporter* (chemicals)
- *Purchasing World* (major commodities and industrial equipment)
- *Engineering News Research* (construction costs, heavy equipment costs, materials costs—gravel, cement, etc.)
- *McGraw Plant and Equipment Survey* (buildings and equipment)
- *Means Building Construction Cost Data* (construction and materials)

It is important in the planning effort to allow for price swings, because many raw materials and process inputs may be subject to wide changes in price over narrow time frames. It is not unusual to allow for a ±15 percent range in price for basic raw materials like petroleum-based feedstocks. Moreover, an estimate of miscellaneous losses should be added to the costs of raw materials. Estimates for price variation allowance and loss allowance should be determined by local conditions and the specific nature of the raw material. For example, if very little loss is expected either due to the nature of the raw material or the quality of the specific handling and storage equipment, then an appropriately low percent loss should be used in estimating loss allowance.

The amount of raw materials used during the year will depend upon the application intensity which is dependent on the control efficiency sought. (See Section 3 for discussion of emission control effectiveness.) Annual costs for raw materials are estimated using Equation 5-4.

$$C_r = (C_r' * N) * (1 + F_V + F_L) \tag{5-4}$$

where: C_r = Raw materials cost.

C_r' = Cost per raw material unit ($/unit).

N = Total units required.

F_V = Price variation factor.

F_L = Loss factor.

It is important that C_r' is estimated carefully. Many materials are subject to seasonal price swings, and an estimate based on a yearly low price may not reflect real costs. If the material can be stored in sufficient quantities to last through seasonal usage (i.e., it can be stored and storage facilities are available), then the use of a yearly average price would be appropriate. However, if the material is likely to be purchased during a season of historically high prices, then the yearly high price should be used for C_r. Moreover, it is important to observe historic price fluctuations over at least a 5-year period. Those raw materials that experience large changes in price may require the use of a multiyear average or weighted average to accurately reflect C_r.

5.1.2.3 Operating Labor, C_l--

Operating labor costs depend on the control measure size and frequency of application. Costs are calculated by determining the types of labor (by *Dictionary of Occupational Titles* job description) and hours needed for the annual utilization of the control measure. Data on wage rates can be obtained from the U.S. Department of Labor's *Employment and Earnings* (a quarterly publication). Local wage rates can be estimated from data from the State Job Service (Employment Security) agency or from the State Occupational Information Coordinating Council. To cover the costs of supervision, an additional 15 percent of estimated labor costs is added.[R] Equation 5-5 illustrates the method for calculating labor costs:

$$C_l = F_s \sum_{i=1}^{n} W_i H_i \qquad (5\text{-}5)$$

where: C_l = Labor costs ($).
W_i = Hourly wage rate for labor category i ($/hour).
H_i = Total annual hours for labor category i.
F_S = Supervision allowance; factor of 1.15.

5.1.2.4 Cost of Maintenance/Repairs, C_m--

Maintenance labor hours in practice are determined by the maintenance recommendations (as specified by the manufacturer/builder) of the equipment and property to be used. If maintenance/repair labor is at a premium over operating labor, a 10 percent premium should be added to the operating labor wage rates for each operating labor category.

Unfortunately, the Department of Labor's data limitations do not allow for distinguishing between operating labor for a particular operation and the maintenance labor for the operation. Therefore, maintenance labor costs are determined from operating labor costs. There are a few common business service maintenance categories that are recorded, such as heating and air conditioning maintenance workers; however, for most industrial machinery, there is no direct maintenance labor estimate.

In addition to labor, maintenance typically requires materials such as lubricants, solvents, cooling fluids, and replacement parts. Regularly used lubricant, cleaning, cooling, etc. materials costs are usually estimated as 100 percent of total maintenance labor costs. However, when manufacturers' specifications can allow direct cost estimates, these should be used instead.

Equation 5-6 shows the method for estimating maintenance/repair cost.

$$C_m = \sum_{i=1}^{n} W_i H_i + (C_p * CRF) + C_s \qquad (5\text{-}6)$$

where:

W_i = Hourly wage rate for category i.

H_i = Total annual hours for labor category i.

C_s = Cost of supplies ($).

C_p = initial cost of replacement parts, including taxes and freight ($).

C_l = cost of labor ($).

CRF = capital recovery factor for replacement parts; life span should be defined by manufacturers' specifications (See Equation 5-4 for CRF formula).

5.1.2.5 By-Product Costs, C_b--

Some BACM may result in by-product costs (or possibly by-product revenues which would be a negative value in the direct operating costs equation) because of possible costs for disposal, reuse, etc. For example, street vacuuming produces waste material (dirt, trash, organic material, etc.) that must be disposed. These costs will have to be estimated directly based upon local price quotes from local waste disposal firms.

5.1.2.6 Fuel Costs, C_f--

BACM that require machine vehicles, such as street sweepers, will have fuel costs. These costs are calculated by multiplying equipment hourly or mileage fuel consumption estimates by estimated annual operation hours or miles. Due to volatility of petroleum fuel prices, fuel costs should be estimated based on anticipated prices. One method for estimating future prices is to use predicted prices reported by the American Petroleum Institute or other forecasting organization.

5.1.3 Overhead Costs

Overhead represents the costs associated with the control measure activity, but not directly tied to the activity. Payroll overhead costs include worker's compensation, Social Security, pension contributions, vacations, and other fringe benefits. System or operational overhead include security costs (like outfitting vehicles with alarms or storing them in fenced parking lots), facility lighting and heating, parking areas for employees, etc. Overhead is typically calculated as 50 percent of total annualized operating costs (USEPA, 1989).

5.1.4 Enforcement/Compliance Costs

A real cost of implementing control measures will be enforcement/compliance costs. Government agencies or their designees with responsibility for air quality programs will need to insure BACM is being implemented. Industry will need to document and demonstrate to agencies that they are complying with the requirements of operating permits. Moreover, many control measures will be implemented by local or State Government bodies that will require the air pollution control agency to implement monitoring programs with these government bodies. Likely costs to be incurred by enforcement agency and/or industry and government bodies in compliance and enforcement activities include:

- Additional labor to issue permits and conduct inspections;

- Other operating expenses such as recordkeeping materials (such as forms, data bases, etc.), fuel, overhead; etc.
- Capital costs such as inspection vehicles, computer equipment; etc.

Many local governments will be able to add much of the enforcement/compliance functions to existing personnel and equipment. For example, BACM permitting activity at construction sites may be easily handled by current inspection staff within their normal duties. However, costs may vary tremendously from agency to agency.

Likewise, industry operating under air quality permits that cover BACM will have varying compliance costs. For example, firms that currently staff an environmental regulation office may easily be able to handle additional record-keeping activity, but firms without such staffing may be forced to hire additional staff.

Due to such variability, estimating compliance/enforcement costs is very difficult. However, hours per compliance/enforcement activity can be estimated. Typical management/supervisory wage rates for the agency or industry should be used to determine hourly cost. Generally, Government time and resources will be spent on:

- Permit issuance.
- Site inspection/testing.
- Permit review/renewal.
- Enforcement action; issuance of warnings, fines, administrative/legal proceedings.

For industry and Government bodies, time and resources will be spent on:

- Permit application preparation.
- Additional planning necessary to fulfill permit requirements.
- Recordkeeping associated with control measures.

Total annual compliance/enforcement costs are the sum of both government and industry annual compliance/enforcement costs.

5.2 ESTIMATING EMISSION REDUCTION

The annual unit emission reduction, ΔR, is calculated by:

$$\Delta R = M\, e\, c \qquad (5\text{-}7)$$

where:
- ΔR = Annual unit emission reduction.
- M = annual source extent.
- e = uncontrolled emission factor.
- c = average control efficiency expressed as a fraction (see Section 3 for estimates of control efficiencies and uncontrolled emission factors).

For comparison purposes, the source extent should be defined as a model unit that typifies the sources to be controlled. By using the same model unit (quantified source extent) for each source, different control measures for each type of source can be compared.

5.3 MODEL UNIT EXAMPLES

Example costs have been estimated for the model units of paved collector roads, unpaved roads, construction/demolition site, storage pile, and open areas. The calculations follow the general format presented in the above sections and are shown in a stepwise method.

5.3.1 Paved Collector Road Model Unit

The model unit is a paved collector road with 5,000 average daily traffic passes. The collector road is adjacent to a construction site with daily traffic volume of 40 trucks

PRELIMINARY ECONOMIC REVIEW

OWENS LAKE GRAVEL COVER PM_{10} CONTROL MEASURE

PREPARED FOR

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

157 SHORT STREET

BISHOP, CALIFORNIA

PREPARED BY

TEAM ENGINEERING & MANAGEMENT

BISHOP, CALIFORNIA

MARCH 12, 1997

Preliminary Economic Review

Owens Lake Gravel Cover PM_{10} Control Measure

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PRELIMINARY ECONOMIC REVIEW

OWENS LAKE GRAVEL COVER PM_{10} CONTROL MEASURE

1.0 INTRODUCTION

The Great Basin Unified Air Pollution Control District is considering eight alternatives for implementation to control PM_{10} emissions from the Owens Lake playa. This report provides a preliminary economic review of the gravel cover dust control measure at Owens Lake. An explanation of the primary components of this control method as well as parameter values, assumptions, and methodology used to develop the preliminary cost estimates summarized herein are contained in this report.

Costs presented in this report are preliminary and are to be used for comparison purposes.

2.0 PURPOSE AND SCOPE

2.1 PURPOSE

The purpose of the preliminary cost estimates presented in this report are to provide a basis for comparison of the gravel cover dust control measure with other alternatives designed to reduce dust emissions from Owens Lake.

2.2 SCOPE

TEAM Engineering & Management contracted to the GBUAPCD to advise the District on technical and economic matters related to gravel mining, gravel transportation, and gravel placement as pertains to the gravel cover dust control measure at Owens Lake. As part of that service, the District requested that TEAM perform a preliminary economic review of the gravel cover measure. The purpose of the preliminary economic review is to compare the costs of the gravel cover alternative with relative costs associated with other alternatives of a proposed project designed to reduce dust emissions from the Owens Lake playa.

The preliminary economic review examined costs associated with the "Gravel Extraction, Transportation and Reclamation" and "Gravel Cover PM_{10} Control Measure" described in sections 2-3.1.6 and 2-3.1.7 respectively of the "Draft Environmental Impact Report for the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan" (EIR) dated January 15, 1997.

The cost estimates presented in this report are ***preliminary estimates***. The estimates are based on experience in the mining industry and knowledge of gravel production and transportation costs in California. The components of the gravel dust control measure are conceptual and formative at this time. It was not within the scope of this study to perform a detailed engineering design and economic analysis for each element of the gravel cover dust control measure.

TABLE 1

PRELIMINARY COST ESTIMATES

GRAVEL COVER PM_{10} CONTROL MEASURE

	Low		High	
	Total $	**$ per yd³**	**Total $**	**$ per yd³**
Pre-Development	$1,700,000	$0.61	$2,500,000	0.89
Development	400,000	0.14	600,000	0.21
Mining	12,000,000	4.29	16,000,000	5.71
Transportation	12,000,000	4.29	14,000,000	5.00
Gravel Placement	4,300,000	1.54	7,100,000	2.54
Reclamation	1,500,000	0.54	2,000,000	0.71
PROJECT TOTAL	$31,900,000	$11.39	$42,200,000	$15.07

* Note: Estimated cost per cubic yard (yd^3) is based on 2,800,000 yd^3 of gravel placed on the Owens Lake playa.

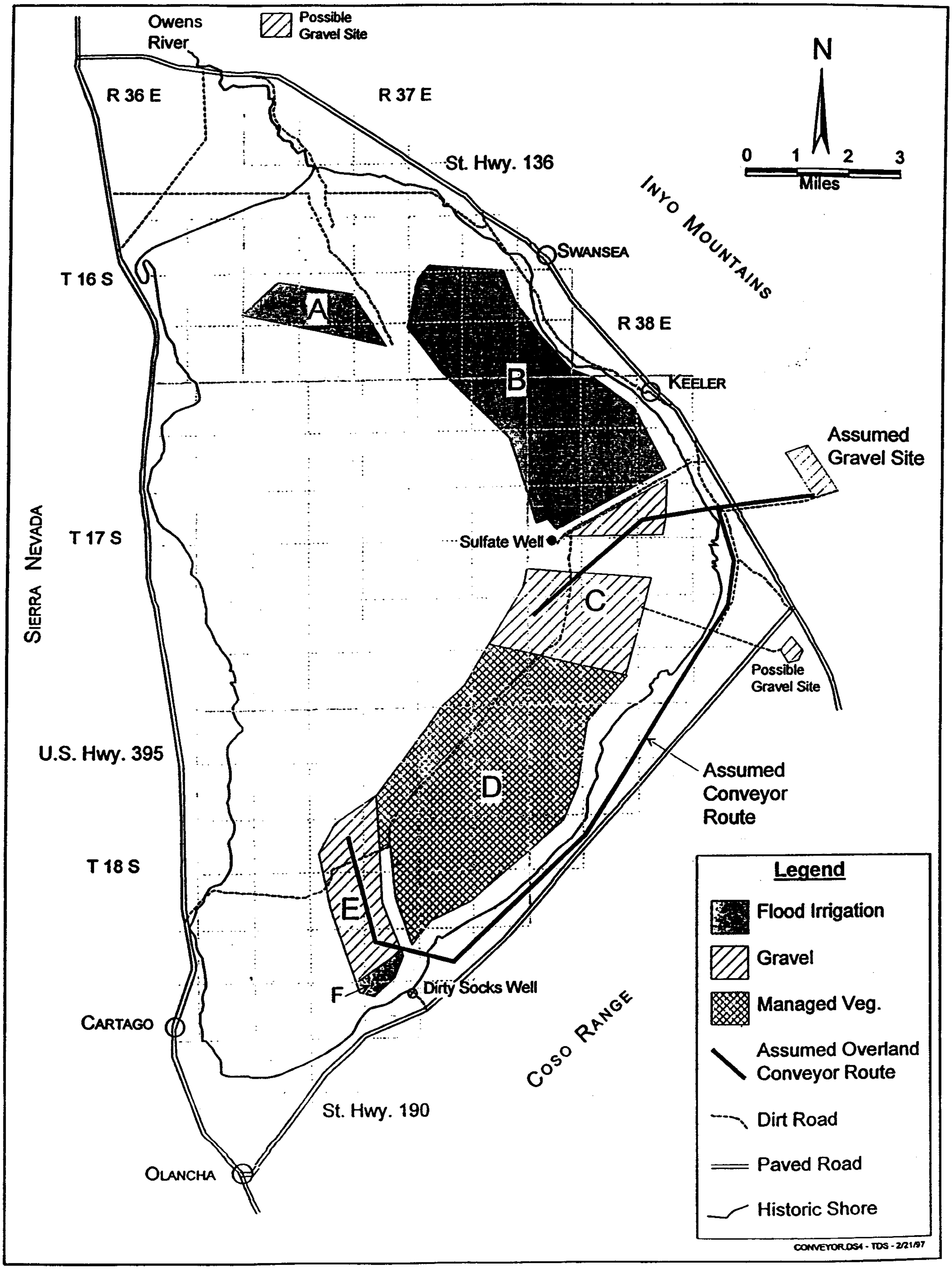

Figure 1: Conceptual site plan with assumed gravel site and overland conveyor route

3.0 SITE SELECTION

Three potential sites for gravel extraction are presented in the "Draft Environmental Impact Report for the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan" (EIR) dated January 15, 1997. Those potential sites are referred to as: Basalt Flow, Keeler Fan, and Dolomite Rock Quarry. For the purposes of this study the Basalt Flow and Dolomite Rock Quarry site were excluded by TEAM. The Basalt Flow was excluded due to anticipated high costs related to crushing and handling the basalt which can be tough and abrasive. Land status is also a question with respect to the Basalt Flow site. The Dolomite Rock Quarry was excluded due to distance from the gravel cover areas, questions with respect to physical characteristics of the rock types, and possible land status issues.

The Keeler Fan site was selected as a **conceptual** gravel production site for the purposes of this preliminary cost study. Using the Keeler Fan site as the theoretical source for gravel production results in preliminary cost estimates that are likely to be neither extremely high nor exceptionally low.

It is likely that other sites are superior in some respects to the Keeler Fan site. Depending on their location, multiple sites may have benefits related to reduced transportation costs and environmental impact. It is recommended that for more detailed cost studies, multiple sites be considered for sequential or simultaneous production of gravel.

4.0 GRAVEL PRODUCTION PROCESS DESCRIPTION

A typical sequence of mining and gravel production activities at the conceptual site is as follows:

1. Growth media will be removed either by scraper, dozer, or loaders and trucks. The growth media will be stockpiled with consideration given to prevailing winds so as to minimize erosion and encourage revegetation.

2. The alluvial fan material will be ripped by a dozer and when necessary, blasted to loosen it for loading by front-end-loaders into off-highway haultrucks. Approximately 450 cubic yards of alluvial material will be loaded per hour.

3. Haultrucks will transport the alluvial fan material to a hopper and vibrating grizzly for initial size separation (average through-put = 650 tons per hour (tph), maximum through-put = 1000 tph). Material greater than 4 inches will be conveyed to a stockpile from which it will be loaded into haul trucks or onto a conveyor system and returned to the mined-out portions of the pit to back-fill the pit. Material less than 4 inches will be conveyed to a screen where material less than ½ inch will be separated and conveyed to a stockpile for temporary storage until it is also returned to the mined-out pit for reclamation. Based on District staff estimates and TEAM's review of the District estimate, approximately 50% of the alluvial material consists of clasts (rock fragments) within the size range of larger than ½ inch and less than 4 inches. Therefore the ratio of gravel to be used on the playa to waste material is expected to be 1:1.

4. Separated material in the size range of ½ inch to 4 inches (average through-put = 300 tons per hour, maximum through-put = 600 tph) will be conveyed to a surge pile where it will gravity flow to an underground feeder and conveyor. The material will be conveyed to an overland conveyor system that will transport the gravel at an average rate of 300 tons per hour to the designated sites on the lake bed.

5. At the designated gravel placement site on the lake bed, the gravel will be discharged from the overland conveyor to either a temporary stockpile or into equipment for spreading onto the lake bed.

6. The gravel will be placed on the playa using a combination of tracked and wheeled equipment. Lake bed conditions will determine the type of equipment to be used in this operation. Geofabric will be placed on some areas of the lake bed prior to gravel placement to reduce the possibility of gravel being imbedded into the playa surface.

7. Reclamation of the gravel pit will be concurrent with mining. As mining in an area of the pit is completed, oversized and undersized material from the separation process will be returned to the pit for back-filling and recontouring. Stockpiled growth media will be replaced. Revegetation will be accomplished through natural revegetation wherever possible and assisted with seeding with native seed mixes where necessary.

4.1 DUST CONTROL

Fugitive dust emissions at the gravel pit and main plant area will be controlled via:

1. Water truck spraying of the active pit area
2. Water truck spraying of haulroads
3. Shrouded conveyor transfer points
4. Baghouse dust control at screens and conveyor transfer points (where necessary)
5. Water spray of conveyor discharge onto stockpiles

5.0 COMPONENTS OF THE GRAVEL COVER PM_{10} CONTROL MEASURE

The gravel cover dust control measure can be divided into six components. Those components are: Pre-Development, Development, Mining, Transportation, Gravel Placement, and Reclamation. A description of each of the components and the costs attributable to that component is presented in this section.

5.1 PRE-DEVELOPMENT

The pre-development stage consists of preliminary work necessary to assure that the gravel extraction site is viable, that the operation can be put into production, and that the National Environmental Policy Act (NEPA), California Surface Mining and Reclamation Act (SMARA), and the California Environmental Quality Act (CEQA) are complied with.

5.1.1 Pre-development tasks and costs

Surveying and mapping	$ 20,000	to	30,000
Land Acquisition	10,000	to	100,000
Exploration Drilling and Geology	50,000	to	75,000
Feasibility and Engineering	50,000	to	75,000
Application and Permit Fees	30,000	to	50,000
NEPA and CEQA Process (EIS/EIR)	1,500,000	to	2,200,000
	$1,660,000	to	2,530,000

Pre-Development Subtotal: $1,700,000 to 2,500,000

5.2 DEVELOPMENT

The development stage consists of:

1. Improvement of access to the gravel extraction area, main plant area, and gravel placement areas on the dry bed of Owens Lake.
2. Construction of administrative, maintenance, and parts storage facilities.
3. Installation of power distribution systems.
4. Erection of all non-mobile equipment to include the screening and conveying systems.
5. Pre-stripping of the first bench to be mined and stockpiling of growth media to prepare for extraction of the alluvial material.

The preliminary cost estimate for the development stage is based on a lump-sum estimate to accomplish the tasks outlined above.

Development Subtotal: $400,000 to 600,000

5.3 MINING

The mining component of the gravel cover dust control measure consists of:

1. Removal and stockpiling of growth media in advance of mining in the gravel extraction area.
2. Dozer ripping, loading, and hauling of the alluvial material from the active mine pit to the screening (main plant) area.
3. Screening of the alluvial material to separate the material to be transported to the lake bed from the material to be returned to the mined-out area of the pit.
4. Conveying ½ inch to 4 inch rock to the overland conveyor feed surge pile.

Crushing is not included for this conceptual gravel production operation at the Keeler Fan site. The nature of the alluvial fan material and the size distribution of the clasts (rock fragments) at the Keeler Fan site may eliminate the need for crushing.

Preliminary cost estimates for mining are based on knowledge of mining and gravel production costs at a number of operations. Adjustments were made to known costs to account for differences in economies of scale and conditions at the theoretical Keeler Fan gravel production site as compared to other known operations. It is estimated that mining costs will range from $1.50 to $2.00 per ton of alluvial material handled. Given the assumed ratio of 1:1 for gravel to be placed on the playa to waste material, the mining cost per cubic yard of usable gravel is between $4.20 and $5.60.

Mining Subtotal: $4.20 to 5.60 per yd^3 of gravel

5.4 TRANSPORTATION

The transportation component of the gravel cover dust control measure includes:

1. Transferring the screened ½ inch to 4 inch material from the main plant surge pile to the load-out conveyor that will feed an overland conveyor system (or an over-the-road haultruck load-out hopper).
2. Transporting the gravel from the main plant to the gravel placement areas on the Owens Lake playa.

Transportation of the gravel is the largest single cost component of the gravel cover dust control measure. Determining and using the most economic method of gravel transport will significantly affect the overall economics of the project. The decision whether to transport gravel via truck or conveyor is influenced by a number of factors. Those factors include: distance from the gravel production site to the discharge point, rate of delivery required, haulage profile, condition of existing roads, traffic, cost of improving existing roads, costs of repairing existing roads during and after the project, conditions on the Owens Lake, gravel placement methods, initial capital investment and operating costs for the truck fleet versus the conveyor system, salvage value of the truck fleet versus the conveyor system, and environmental considerations.

In performing a comparison between truck haulage and conveyor transport the following values were used:

Time to complete project	1 to 3 years (target = 2 years)
Depth of gravel cover	4 inches
Total acres covered	5,300 acres
Density of gravel	1.4 tons per cubic yard
Total tons of gravel moved	4 million
Transportation schedule	24 hours per day, 350 days per year(1)
Maximum length of conveyor system	15 miles
Conveyor operational availability	>90%
Weighted average truck haul distance	8.5 miles
Truck capacity	25 tons
Conveyor capacity (maximum)	500 tons per hour
Conveyor transport rate (average)	300 tons per hour

(1) Note: The 24 hours per day, 350 days per year schedule may be reduced as a result of operating permit conditions.

5.4.1 Conveyor transport cost estimate:

To complete the gravel placement in 2 years, it is necessary to move an average of approximately 300 tons of gravel per hour from the Keeler Fan production site to the gravel cover areas. This production requirement could be met with a 30 inch wide conveyor, however thirty-six inch wide conveyors are more common for overland applications and have a superior resale value. For the purpose of this cost estimate, 36 inch conveyors are used.

The weighted average cost per ton to transport one ton of gravel from the Keeler Fan main plant to the gravel placement areas on the Owens Lake was approximated by:

$$\frac{\text{(Initial cost of conveyor) - (Salvage value) + (Operating cost over life of project)}}{\text{(Total tons transported over life of project)}}$$

For this conceptual project:

Initial purchase cost of conveyor (36 inch) (2)	$15,000,000
Installation cost (includes power distribution system)	1,000,000
Salvage value (=.4 x initial purchase cost uninstalled)(2)	6,000,000
Operating costs over life of project	
Power (at $0.12 per ton)	480,000
Labor (5 mechanics @ $35,000/year)	350,000
Parts (at 4% of initial purchase cost per year)	1,200,000
Total tons transported over life of project	4,000,000 tons

(2) Note: Information based on input from conveyor manufacturer.

$$\frac{(\$16{,}000{,}000) - (\$6{,}000{,}000) + (\$2{,}030{,}000)}{4{,}000{,}000 \text{ tons}}$$

Conveyor transport cost = $3.00 per ton

5.4.2 Truck transport cost estimate:

To approximate the gravel truck haulage costs it was assumed that this portion of the project would be contracted to an independent trucking firm. Minimum rates for independent aggregate truckers are set by the California Public Utilities Commission (PUC). The PUC rate schedule for the Barstow - Victorville area dated March 2, 1992 specifies a rate of $1.85 for a haul of 8 to 9 miles (the weighted average haul distance for this project). According to local truckers this rate can be increased by 10% to reflect increases since 1992. The adjusted rate for truck haulage is approximately $2.00 per ton.

At 25 tons per load, 160,000 truck loads of gravel would be hauled from the Keeler Fan site to the Owens Lake gravel placement areas over the 2 year life of this project. The payloads in conjunction with the volume of truck traffic would cause significant degradation to portions of

California State Highways 136 and 190. It is assumed that at the conclusion of this project the length of highway used to transport gravel (13 miles) would have to be rebuilt at a cost of approximately $400,000 per mile. The total estimated road repair or rebuild cost is $5,200,000. On a per ton basis this equals $1.30 per ton of gravel transported.

The total cost for transporting gravel by truck from the Keeler Fan theoretical gravel production site to the gravel placement areas on Owens Lake is $2.00 plus $1.30 per ton.

Truck transportation costs = $3.30 per ton

5.4.3 Conclusion

On a cost per ton basis, the conveyor option for transporting gravel from the Keeler Fan site to the gravel cover dust control areas on Owens Lake is more economic. In addition, there are other advantages of the conveyor option as compared to truck haulage. The conveyor option will: generate less fugitive or uncontrolled dust emissions, will not have an impact on traffic on highways 136 and 190, and will not generate as much noise.

Based on the relative estimated costs for truck haulage versus conveyor transport and the environmental advantages of conveyor transport, the conveyor transport option was selected for use in this preliminary cost estimate study.

5.5 GRAVEL PLACEMENT

The gravel placement component of this project consists of receiving ½ inch to 4 inch gravel from the discharge of the overland conveyor and ultimately spreading the gravel in a 4 inch thick layer (lift) over two areas totaling 5300 acres on the Owens Lake playa. (Refer to Figure 1.) Portions of the gravel covered areas will have a geofabric placed on the surface prior to gravel placement to reduce the possibility of gravel imbedding into the surface of the playa.

Conditions on the Owens Lake playa present a number of technical challenges to designing a bulk gravel placement method. Portions of the playa are not capable of supporting heavy equipment traffic during most times of the year. To be effective, the gravel cover can not be embedded into the surface of the playa. Therefore, equipment that is used to spread the gravel can not travel over the gravel. The pore space between the clasts must be maintained in order for the gravel cover to be effective in preventing the formation of efflorescent salt crusts.

Tests have not been conducted on the Owens Lake playa to determine the effectiveness of various bulk gravel placement methods and equipment combinations. As part of this economic study, various conceptual gravel placement equipment alternatives and sequencing options were considered. There was no one option that met all of the requirements for successful bulk spreading of a 4 inch lift of gravel on the Owens Lake playa. It is likely that with prudent use of geofabric and thoughtful sequencing of the placement and "dressing" of the gravel, desired results can be achieved. It is recommended that pilot tests of alternatives for placing and spreading gravel be conducted on the Owens Lake playa.

With consideration of the conceptual gravel placement alternatives, and given a basic understanding for conditions on the Owens Lake playa, a "best estimate" for placing and spreading a 4 inch lift of gravel was arrived at. A preliminary cost estimate for gravel placement is from $1.50 to $2.50 per cubic yard (per 81 square feet of coverage).

Gravel Placement Subtotal: $4,300,000 to $7,100,000

5.6 RECLAMATION

The objective of the reclamation effort of the gravel cover dust control measure is to return the affected lands to a condition that is consistent with their use prior to the development of the gravel extraction site and conveyor route. Reclamation tasks include:

1. Hauling oversized and undersized material from the main plant area to the mined-out area of the pit. (This is done concurrent with the mining operation.)
2. Recontouring the filled-in pit. (This is done as back-filling progresses.)
3. Removing all equipment and structures from the project area.
4. Replacing stockpiled growth media.
5. Revegetating impacted areas to comply with permit conditions.

Inyo County has established reclamation cost guidelines for the purpose of estimating mining project bonding requirements as required by SMARA. Based on those quidelines, the range of costs to perform reclamation of the affected lands at the Keeler Fan gravel extraction site over the life of this project is from $1,000,000 to $2,000,000.

Reclamation Cost Subtotal: $1,000,000 to $2,000,000

6.0 SUMMARY

This preliminary economic review examined costs associated with the "Gravel Extraction, Transportation and Reclamation" and "Gravel Cover PM_{10} Control Measure" described in sections 2-3.1.6 and 2-3.1.7 respectively of the "Draft Environmental Impact Report for the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan" (EIR) dated January 15, 1997. Based on the preliminary economic review of the Owens Lake gravel PM_{10} control measure outlined in this report, the project total estimated cost ranges from $31,900,000 to $42,200,000. On a per cubic yard of gravel basis the estimated cost range is from $11.39 to $15.07. These preliminary cost estimates are based on a conceptualized gravel production operation and overland conveyor transport of the gravel to the Owens Lake playa.

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan

Appendix H

Public Comments and District Responses

July 2, 1997

157 Short Street, Bishop, California 93514
(760) 872-8211

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan

Public Comments and Staff Responses on Draft State Implementation Plan

and

Environmental Impact Report Comments Received After the Close of the Comment Period

July 2, 1997

Ellen Hardebeck, Air Pollution Control Officer
157 Short Street, Bishop, California 93514
(619) 872-8211

Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan
Public Comments and Staff Responses on Draft State Implementation Plan
and
Environmental Impact Report Comments Received After the Close of the Comment Period

This document contains two sections. The first section contains those comments received by the District regarding the Draft State Implementation Plan (Draft SIP). Three sets of comments were received from two parties. The City of Los Angeles submitted comments dated May 8, 1997 in response to a Draft SIP dated March 1997 and it also submitted comments dated June 18, 1997 in response to a revised Draft SIP dated May 1997. In addition, the District received comments from the Kern County Air Pollution Control District.

District staff has prepared responses to the May 8 comments from the City of Los Angeles and the comments from Kern County APCD. These responses follow the comments. Staff is reviewing the City of Los Angeles' June 18 comments. If responses are required, staff will present them to the District Board at the July 2 meeting.

The second section of this document contains comments on the Draft Environmental Impact Report (Draft EIR). Two sets of comments are included: June 18, 1997 comments from the City of Los Angeles and June 19, 1997 comments from California Indian Legal Services, representing the Tribes of the Owens Valley. Although the District is not required to respond to EIR comments received after the close of the public comment period, District staff will review these comments and, if they raise significant environmental issues, may present responses to the Board at the July 2 meeting.

9706231

Public Comments and Staff Responses on Draft Demonstration of Attainment State Implementation Plan

Department of Water and Power the City of Los Angeles

RICHARD J. RIORDAN
Mayor

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PHYLLIS E. CURRIE, *Chief Financial Officer*

May 8, 1997

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GREAT BASIN
UNIFIED APCD

Dr. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street, Suite 6
Bishop, California 93514

Dear Dr. Hardebeck:

Owens Valley PM-10 Planning Area Demonstration of Attainment
Draft State Implementation Plan (DSIP)

The Los Angeles Department of Water and Power (LADWP) appreciates the opportunity to comment on the DSIP. The comments provided reflect concerns expressed numerous times regarding the uncertainties of the proposed control strategies and the methodologies employed to develop the plan.

In its rush and focus to comply with SIP provisions of the federal Clean Air Act (CAA), the Great Basin Unified Air Pollution Control District (GBUAPCD) has failed to recognize the flexibility provided under the CAA in Section 188(f) (Natural Events Policy). Rather, GBUAPCD has developed a rigid air quality management strategy that is based upon experimental control strategies and the inappropriate application of air quality planning tools. As a result, the DSIP does not assure improved protection of public health, but does place at risk millions of dollars and the State's natural resources. Therefore, the LADWP opposes the DSIP with its proposed control measures at this time.

Control measures as complex, potentially environmentally damaging, and as costly as those proposed by the GBUAPCD for use on the Owens Lake bed require thorough development and planning. Many examples of the GBUAPCD's failure to contemplate and consider the various aspects of the proposed control strategies, attainment demonstration modeling inconsistencies, and emission inventory discrepancies are outlined in the enclosed comments on the DSIP and the related GBUAPCD document, *Demonstration of Attainment, State Implementation Plan - Comparative Cost Estimates*, as well as the comments submitted on the Draft Environmental Impact Report (DEIR), herein incorporated by reference. The LADWP continues to evaluate and refine the assumptions and methodologies utilized in the GBUAPCD air quality modeling and emission inventory calculations. Additional information and data on these issues will be provided as it becomes available.

Water and Power Conservation ... a way of life

111 North Hope Street, Los Angeles, California ☐ *Mailing address:* Box 111, Los Angeles 90051-0100
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In reviewing both the DSIP and the DEIR, the LADWP does not believe that the environmental damage created by the DSIP is overridden by the benefits. Rather, control strategies need to be refocused on realistic and reasonable control measures that minimize environmental impacts. Furthermore, implementation of the DSIP requires 51,000 acre feet of water. The LADWP is unaware of any source of water of that magnitude which is available for air quality controls; therefore the DSIP is not feasible. As LADWP has commented numerous times previously, State law (Section 42316 of the Health and Safety Code) precludes the GBUAPCD from specifying dust control measures for the Owens Valley which require City of Los Angeles water. Therefore, the LADWP recommends that the GBUAPCD continue Owens Valley air quality planning efforts under federal CAA Section 188 (f) (Natural Events Policy).

The DSIP is inconsistent with planning efforts for fugitive dust sources both nationally and statewide. In areas of the State of Washington, Colorado, and California, research programs to comprehensively define both anthropogenic and non-anthropogenic PM-10 emission sources and meteorological conditions have been initiated. These studies are being undertaken through a cooperative effort by the U.S. EPA, other federal agencies, the State, and industry. In these areas, agricultural activity creates a large portion of the PM-10 emission sources. Rather than reducing activity levels, as is proposed by GBUAPCD for LADWP water gathering activities, the strategies to control agricultural emissions are largely proposed to be voluntary, with implementation of best management practices which have little if any cost, and have the added benefits of soil conservation. The substantial regulatory program proposed by the GBUAPCD, aimed solely at the LADWP, is inconsistent with other state and federal programs and therefore is inequitable and unreasonable.

Economic feasibility has not been considered by the GBUAPCD in the development of the DSIP. The costs of the proposed control strategy, estimated at $91 million by the GBUAPCD and $313 million by Parsons Engineering Science, is prohibitive. The GBUAPCD has failed to develop funding sources for air quality planning activities in the Owens Valley, relying solely on LADWP, which has provided funding in excess of $20 million over the past several years. For a public entity such as LADWP, the funding of a control program that costs tens of millions of dollars is problematic and difficult.

Cooperative funding will be essential in furthering promising research of reasonable control measures and in implementing those Best Available Control Measures (BACM) identified. In other areas of the State, such as the San Joaquin Valley, PM-10 planning efforts have been funded and are anticipated to be funded in the future by all stakeholders, making the control strategy and necessary research more feasible. The LADWP therefore recommends that a cooperative multi-agency group be established to provide funding for air quality efforts in the Owens Valley Planning Area.

In an effort to obtain the information and data necessary to move forward with air quality planning in the Owens Valley Planning Area, the LADWP recommends that a scientific review panel be established. This panel could identify, oversee, and evaluate BACM research, pilot projects, additional meteorological research, research on lake bed variability over time and space, and emission inventory work. Scientific answers to these air quality and control measure issues would allow the Owens Valley Planning Area to move forward with reasonable solutions to its air quality problems. CAA Section 188 (f) provides the regulatory flexibility and time necessary for the gathering of such important and fundamental air quality planning information.

The LADWP has been a partner with GBUAPCD in addressing the air quality issues of the Owens Valley Planning Area for over 14 years. We look forward to continuing to work with the GBUAPCD and expanding our air quality program partnership to include all stakeholders and a scientific review panel. Such a partnership will assure the best opportunity for arrival at reasonable solutions to the Owens Valley Planning Area air quality problems with facts and knowledge.

Sincerely,

Harry M Sizemore/ed

HARRY M. SIZEMORE
General Manager

Enclosure

c: Mr. Dean Saito
Mr. Gerald A. Gewe

City of Los Angeles Department of Water and Power
Comments on the Draft Owens Valley PM-10 Planning Area Demonstration of Attainment State Implementation Plan (DSIP) (March, 1997)

EXECUTIVE SUMMARY

The DSIP fails to present a balanced and accurate representation of the air quality of the Owens Valley region. Throughout the document data is presented illustrating the worst PM-10 events, utilizing TEOM data which is known to overestimate PM-10 ambient air concentrations by an average of 50%. These worst case PM-10 events are not placed in the context of the overall air quality of the area. The development of a control strategy is dependent upon understanding the overall air quality impacts, and their long-term variability. In addition, to provide for informed decision making, the public needs to understand the air quality overall, in order to balance the benefits which may be achieved by a plan with the financial and environmental costs of the plan.

On page ES-2, the DSIP states that " the NAAQS for PM-10 is frequently violated." In fact, the PM-10 NAAQS is exceeded in the Owens Valley Planning area only an average of 19 days every year (5% of the year), which can hardly be characterized as frequent. This information needs to be juxtaposed with the relatively pristine air conditions experienced the remainder of the year, typically with PM-10 ambient air quality levels of below 20 ug/m3 (Appendix A).

In 1995, which could be characterized as one of the worst PM-10 air quality years in the vicinity of Owens Lake since 1987, the NAAQS was exceeded only 22 days at Keeler. Of the exceedance air quality events experienced in 1995 at Keeler, two days did approach 3,000 ug/m3 (0.75 TEOM adjusted, i.e. correcting the TEOM assuming a 33% overestimation bias, a conservative assumption). In 1995, emissions tended to be higher on average for most PM-10 exceedance days at Keeler. This increased level of PM-10 emissions can be attributed to the unique meteorological year experienced in the Owens Valley area in 1994-95. Data from previous years indicate a much less severe PM-10 problem resulting in lower levels of exceedances. Such long-term emissions data and information needs to be presented to the public by the GBUAPCD, and considered in the planning process.

The correlation between meteorological trends, natural events (i.e., droughts, excessively wet years, and winds), and emission rates was not considered in the DSIP. Such parameters need to be recognized and considered when developing an air quality management plan for fugitive dust sources, in determining the reasonableness of control measures, and in evaluating cost. In fact, in one area of the state, control measures for PM-10 emissions associated with fallow and nutrient depleted farmland were investigated, but the need to implement controls was eliminated by the ending of the drought and return of farming to the land. Expenditure of substantial resources to address unique conditions directly linked to varying natural conditions is inappropriate and unwarranted. The inappropriateness of designing costly fugitive dust PM-10 control measures for extreme events, such as drought, winds, and other natural occurring anomalies, was recognized by Congress and is documented and accounted for in Section 188 (f) of the federal Clean Air Act (CAA).

On pages ES-2, as well as other sections of the DSIP, it is stated that "studies of dust transport from Owens Lake show that violations of the standard can be experienced more than 50 miles away." The LADWP is unaware of any studies which document that transport of fugitive emissions alone from the Owens Lake create violations of the NAAQS standard at Ridgecrest, Bishop, or any locations outside of Owens Valley. In fact, the intense off-Lake monitoring program performed by GBUAPCD from 1993 to 1995, documents only one exceedance day (not a violation) at a level of 253 ug/m3, on April 8, 1995 (Appendix A page A-2) at Ridgecrest (it is unclear whether this is an actual exceedance, as the data on page A-2 is inconsistent with Appendix A, page 23, which does not document this exceedance). As discussed above, 1995 was a very unique meteorological year for the region, and there is no conclusive evidence that the Ridgecrest exceedance is solely attributable to transport of emissions from the Owens Lake bed. No data for Bishop are presented, and the LADWP is unaware of any exceedances of the NAAQS in the Bishop area.

Exeedances experienced at the Coso Junction area, a location much closer to the lake bed than Ridgecrest, are very infrequent and are not directly attributable to Owens Lake bed. On April 23, 1990, Coso Junction experienced an exceedance episode of 866 ug/m3. A review of the wind data for that day clearly illustrates that sources other than the Owens Lake bed were responsible for the exceedance. This episode documents that PM-10 source emissions other than Owens Lake substantially contribute to exceedances in the Owens Valley Planning Area. Such sources, and transport of such emissions, would be expected to impact both the Owens Lake area and Ridgecrest. As commented previously, it is important for the decision makers and the public to have an accurate picture of the air quality and sources of emissions in the planning area. The numerous inaccuracies presented throughout the DSIP need to be corrected and the incomplete representation of air quality data remedied.

On page ES-2, as well as being repeated in other DSIP sections, it is stated that "the National Park Service is concerned about the health hazard posed to an estimated 250,000 to 350,000 visitors that are expected to annually visit the Manzanar National Historic Site." The DSIP fails to respond to the Park Service that the impacts to the site are minimal, if any. Lone Pine experiences an average of only two PM-10 exceedances a year, with no exceedances recorded from 1989 to 1993. Lone Pine exceedances as documented in Appendix A, have a historic high of 374 ug/m3 (0.75 TEOM adjusted) with an average concentration across exceedance days since 1987 estimated at 227 ug/m3 (0.75 TEOM adjusted). The ambient PM-10 concentrations experienced at Manzanar, located north of Lone Pine, would be much less than those experienced at Lone Pine, and would be expected to occur very infrequently. Further, the extreme wind conditions which trigger PM-10 exceedances in the Owens Valley would not be the periods in which visitors are likely to venture to the Historic Site. Therefore, health concerns for even the most sensitive populations would be expected to be minimal. The Owens Lake Health Advisory Program, which alerts persons to potential unhealthful levels of particulate pollution, would assist in avoiding health impacts, as children, the elderly, and individuals with heart and lung disease would be advised that outdoor activities should be limited. It is interesting to note that such advisories are currently initiated at PM-10 concentrations of 400 ug/m3, a concentration which has never been experienced at Lone Pine.

Figures 2 and 3.3 (pages ES-14 and 3-7) are inaccurate and need to be corrected or deleted from the document. As commented previously, the LADWP is unaware of any exceedances of the NAAQS at Bishop, let alone a violation. There is no evidence substantiating the assertion that the one exceedance (not a violation) documented at Ridgecrest is directly attributable to Owens Lake fugitive dust emissions. With these inaccuracies portrayed within the smallest sphere of proposed influence, the larger level of influence is totally unsubstantiated. The DSIP should be a factual document.

The Executive Summary contains numerous inaccuracies regarding the emission inventory, proposed control measures, attainment demonstration, costs, and implementation schedule. These inaccuracies need to be corrected throughout the document. Please refer to the specific comments on the various subject areas for additional information and discussion.

SECTION 2 - PROJECT HISTORY

Legal History

On page 2-5, the GBUAPCD asserts that "all control measures and supporting infrastructure are proposed to be owned by the City of Los Angeles on property owned by the City or on leases or easements from the underlying owners." These assumptions are completely inaccurate and the GBUAPCD has no authority to require the LADWP to acquire property, leases, or easements, or accept any liability for environmental damage associated with or required for any proposed control strategies. See additional comments and discussion on Section 8.

Clean Air Act Requirements/Natural Event Policy

The 1994 BACM SIP committed to additional studies on various control strategies for the lake bed surface. Substantial research efforts have been undertaken since 1994, with approximately $9 million being provided by LADWP. Some potential control strategies have been identified by the GBUAPCD and some research continues. Those potential control strategies identified, have been demonstrated on small test plots and have not been investigated on a larger scale and for a sufficient amount of time to accurately measure their effectiveness. Furthermore, the technological feasibility of the potential control strategies, within the constraints of available resources in the Owens Valley region, has not been demonstrated. Without larger scale testing and a comprehensive assessment of technological feasibility and resource availability, the effectiveness and long-term viability of the proposed strategies is much too uncertain to warrant the expenditure of the substantial public funds required to implement the strategies.

On page 2-9, the GBUAPCD inaccurately portrays the requirements of the federal Clean Air Act (CAA) with regard to control of fugitive PM-10 emissions and implies that additional studies of control options are precluded by CAA time lines. The discussion indicates that the CAA is very rigid in its requirements for fugitive emission sources, such as Owens Lake. In fact the CAA was crafted by Congress to provide great flexibility in addressing unique PM-10 sources such as Owen Lake. Section 188 (f) of the CAA provides additional time to investigate and address fugitive dust sources and problems, and ultimately recognizes that the reasonable control of such sources may not be achievable. Section 188(f), which has been clarified through the U.S. EPA's Natural Event Policy, provides that appropriate reasonable measures need to be undertaken to control fugitive emission sources (i.e. BACM) and clearly applies to the Owens Valley Planning Area.

The site-specific feasibility analysis required for BACM determinations includes both technical and economic evaluations on a case-by-case basis. In the absence of tested technology, no BACM is currently available for Owens Lake. Since the future technology provisions of the CAA, 182(e)(5), apply to ozone only, reliance on future BACM technologies is precluded in the SIP. Therefore, rather than the Natural Events Policy (CAA Section 188 (f)) applying to Owens Valley only after control strategies have been implemented as asserted in the DSIP (page 2-9); it is the only method available to the GBUAPCD for complying with the requirements of the CAA in the Owens Valley Planning Area at the present time.

The Natural Event Policy states that "dust raised by unusually high winds will be treated as uncontrollable natural events under the following conditions ......the dust originated from an anthropogenic source controlled with best available control measures (BACM)." The Policy further states that "the conditions that create high wind events vary from area to area with soil type, precipitation and the speed of wind gusts." The policy provides that each area define a high wind event based upon its specific conditions and available BACM. If BACM for the source has not been defined, as is the case in Owens Valley, then the Policy provides that a region may commit to conducting "pilot tests on new emission reduction techniques."

The states of Washington and Colorado will be utilizing the Natural Events Policy, CAA Section 188(f) to address PM-10 emissions. The areas utilizing the Natural Event Policy generally experience fugitive dust emissions from agricultural activities. Such emission sources are the direct result of human activity. The fugitive dust generated from Owens Lake is an indirect result of human activity, and is not created directly by human activity. Therefore, the Natural Event Policy is even more applicable to the Owens Valley Planning Area than to agricultural areas.

In the DSIP, GBUAPCD proposes to arbitrarily establish a wind speed of 40 miles per hour or greater, which historically occurs at a frequency of less than once a year, as an "exceptionally high wind" for the purposes of the Natural Event Policy. Such an arbitrary designation is inconsistent with the purpose and intent of the Natural Events Policy and is inconsistent with the application of the Natural Event Policy in other areas of the state and nation. Natural Events exceptional wind speeds should be defined based upon when BACM degrades, and emissions become uncontrollable. Therefore, in the absence of BACM for Owens Valley, the final exceptional event wind speed cannot be defined. Furthermore, the U.S. EPA's Exceptional Event Policy, which is incorporated into the Natural Event Policy and is still applicable, establishes exceptional wind speeds at 30 miles per hour. It is interesting to note that the DSIP characterizes PM-10 exceedance episodes being "accompanied by high winds" (page 6-1 and other sections).

The GBUAPCD proposed definition of exceptionally high winds as winds at 40 miles per hour is also inconsistent with various other statements made in the DSIP. The most problematic is presented on page 7-3: "it [the District] reserves its authority under both state law (in determining which control measures are reasonable) and under federal law (in determining which control measures are the "best available") to prohibit the use of water resources which cannot be tapped without causing significant adverse environmental consequences." As discussed in the LAWDP's DEIR comments, which have been incorporated herein by reference, Los Angeles Aqueduct water supplies are unavailable for the proposed control measures and municipal water supplies would be significantly impacted if they were tapped. In the absence of water, two of the proposed control strategies become infeasible and would drop out of the plan. However, due to the 40 mile per hour threshold wind speed proposed by the District, the Natural Events Policy could not be utilized. This would throw the GBUAPCD into non-compliance with the federal CAA and subject the region to federal sanctions. Such a policy would be undesirable for the region, the state, and its citizens. As stated above, the Natural Events exceptional wind speeds should be defined based upon when BACM degrades, and emissions become uncontrollable. In the absence of BACM, as asserted by the GBUAPCD disclaiming statement, the final exceptional event wind speed cannot be defined at this time.

The lack of information required for the designation of BACM, accompanied with the lack of data and or/review of data makes it impossible to develop an effective air quality management plan. As commented previously, the correlation between meteorological trends, natural events (i.e.droughts and winds), and emissions rates need to be recognized and considered when developing an air quality management plan for fugitive dust sources. Such an evaluation has yet to occur. In addition, the storm location data gathered by Tezz Niemeyer has not been evaluated to identify those areas which experience frequent storms in areas that impact PM-10 concentrations in the adjacent communities. Such an evaluation is crucial to developing the most effective plan at the least cost.

Additional emission inventory work is necessary as well. As previously indicated, non-Lake sources may contribute to violations in the area. A review of off-lake fugitive emissions is necessary to understand the dynamics of the air quality of the area, as well as to identify the most efficient air quality plan possible. In addition, a better understanding of the actual emission inventory, which the GBUAPCD documents with a tremendous range (all of which overestimate emissions; see emission inventory comments), and its variation over space and time, will provide for the best planning information, as well as assist in determining the reasonableness of the cost of proposed emission control measures. This issue is of even greater importance, in light of the modeling results that indicate that emissions from off-lake sources result in exceedances of the NAAQS even with application of the proposed control strategy (see modeling comments).

Further study of the area, emissions, and sources, as well as further control option research is consistent with actions taken throughout the State of California and the nation, for fugitive emission sources, as well as a myriad of other sources. Implementation of regulations without scientific data supporting their long term effectiveness and reasonableness is unprecedented. In the absence of BACM for Owens Lake, it is recommended that Section 188(f) be utilized to guide the GBUAPCD in identifying BACM.

In addition to completing the technical studies, the GBUAPCD needs to complete economic feasibility analyses for the control measures. The cost presented by the GBUAPCD significantly underestimates the true cost of the control measures (see Section 7 comments). Since the PM-10 problem in the Owens Valley area is confined to 19 days a year, and is not a chronic exposure problem, establishment of cost-effectiveness criteria to complement the cost per tons criteria needs to be developed. In addition, the availability of funds needs to be considered. The U.S. Environmental Protection Agency recognizes the constrained funding ability of public entities and therefore provides special consideration for measures requiring public funds, such as the Owens Lake proposed control measures. Specifically, the EPA will consider past funding of similar activity, as well as availability of funding sources, to determine whether a good faith effort is being made to expeditiously implement available control measures.

Revision to PM NAAQS

On page 2-10 the DSIP indicates that there is a "strong link" between ambient PM levels and the number of premature deaths. Rather there is casual association between PM levels and the number of premature deaths. It is because of this casual association that such significant debate, including Congressional debate, surrounds the proposed particulate NAAQS revisions. The information provided in the document needs to be factual and not biased by the presentation of perceived air quality impacts.

SECTION 3 - SETTING

The DSIP fails to present a balanced and accurate representation of the air quality of the Owens Valley region. On page 3-4, Table 3.2, and throughout the DSIP, TEOM data is presented which is known to overestimate ambient air PM-10 concentrations by an average of 50%, and only the highest exceedance days are presented. These worst case PM-10 events need to be placed in the context of the overall air quality of the area. The number of average annual exceedance days, 19, in the Owens Valley Planning Area is small enough that the comprehensive data could be presented. At a minimum, Tables such as 3.2 and discussions such as that presented on 3-4 should present both the highest and lowest exceedance levels, using corrected TEOM data. The variability of the magnitude of the number and level of NAAQS exceedances over a several year period also needs to be presented. This information then needs to be placed in the context of the air quality experienced for the remaining 95% of the year, when the air quality of Owens Valley is relatively pristine. The development of a reasonable control strategy is dependent upon understanding the overall air quality impacts, and their long-term variability. In addition, to provide for informed decision making the public needs to understand the air quality overall, to balance the benefits which may be achieved by a plan with the financial and environmental costs of the plan.

On page 3-5 an inaccurate and unsubstantiated discussion of dust transport is presented. As commented previously (see page ES-2 comments), the data gather by the GBUAPCD and presented in Appendix A illustrates that some of the PM-10 exceedances experienced in the Owens Valley Planing Area are attributable to emission sources other than the Owens Lake bed. There is no data substantiating the assertion presented on DSIP page 3-5 that 40,000 residents are annually affected by PM-10 concentrations above the federal standard, let alone that emissions from Owens Lake bed are solely responsible for the infrequent exceedance events that are experienced. As commented previously, it is important for the decision makers and the public to have an accurate picture of the air quality of the area and the true impacts attributable to the Owens Lake bed. The numerous inaccuracies presented throughout the DSIP need to be corrected and the incomplete representation of air quality data remedied.

Cancer Risk

On page 3-12 the GBUAPCD presents information regarding cancer risks associated with PM-10 emissions from Owens Lake which greatly overestimates the risk as well as fails to provide the public the information necessary to place the risks posed in context. The health risk assessment was based upon an average air quality of 50 ug/m3. Although this may be the average calculated concentration, a quick review of the data presented in Appendix A clearly illustrates that this is not the level of chronic exposure over the period of a year.

Exposure to PM-10 emissions from Owens Lake is not chronic, but rather acute. Health risk assessment methodologies are available which would better characterize the risks associated with the actual exposure conditions and duration and the dosage of exposure. In preparing such an analysis, use of the actual ambient air concentrations is inappropriate, as concentrations indoors would be much less, and the public Health Advisory Program, as discussed on DSIP page 3-5, reduces adverse health effects. Typical health risk assessment studies assume that indoor concentrations to be half that of outdoors. For Owens Valley, we would expect indoor concentrations to be less than half. The discussion needs to further clarify that such risks are applicable only to the Keeler area. Risks at Olancha would be substantially less, with risks beyond the Lake bed area being minimal, if any.

The DSIP inappropriately compares the risks established to the requirements set by the GBUAPCD for stationary/permitted sources. This is an inappropriate comparison, as such criteria are not applicable to area or fugitive emission sources. The DSIP should assist decision makers and the public in understanding the risks posed by the activity. For example, the air inhaled while refueling a car at a gas station, assuming a 70 year time period and 15 minutes of re-fueling a week, results in a 3 in one million cancer risk (SCAQMD, 1992). The health risk associated with the air in a motor vehicle during a one hour/day commute over a 70 year period in the South Coast Air Basin is calculated at 72 in a million (SCAQMD, 1992).

The potential increase in cancer risk due to more chronic Owens Lake PM-10 emissions, and other emission sources associated with implementation of the proposed control strategy, is not discussed in the DSIP or the associated DEIR. As documented in the Agrarian Test Area Construction Cost Summary (Stradling, no date) and noted by Professor Cahill of University of

California, Davis, high on-site dust loads occurred during construction of the relatively small test plots as a result of construction activity. With implementation of the project and daily construction of a much larger magnitude, potential cancer health risks of adjacent residents associated with a more chronic exposure needs to be assessed. As commented numerous times on the DSIP and DEIR, to provide for informed decision making, the decision makers and the public need to understand the air quality overall and the air quality changes associated with implementation of the proposed control strategies, to balance the benefits which may be achieved by the plan with the financial and environmental costs of the plan.

On page 3-13, the DSIP states that Owens Lake dust storms significantly impact visibility at China Lake Naval Air Weapons Station (NAWS). As commented previously, there is no data substantiating that such impacts are attributable solely to dust from Owens Lake (see previous comments).

SECTION 4 - EMISSION INVENTORY

On page 4-2 it is indicated that the emission inventory is not expected to grow significantly. Table 4.1 indicates that Federal White Aggregate emits 28 tons of PM-10 emissions annually. Assuming 365 days of operation, an estimated 153 lbs. of PM-10 emissions would be emitted per day. With implementation of the DSIP, substantial gravel mining operations would be required, resulting in substantially greater emissions the Federal White Aggregate. In addition, substantial earth moving is required for project construction, extending over a several-year period (see DEIR comments), which will result in substantial daily PM-10 emissions. The DSIP emission inventory needs to reflect these future emission sources.

Table 4.1 presents on-lake and off-lake wind erosion as 291,100 tons per year. This is inconsistent with the data used in the attainment demonstration modeling. 129,900 tons is used in the modeling exercise and therefore should be used in the DSIP. 24 hour peak emission needs to be corrected accordingly. These corrections need to be made throughout the section and the DSIP.

Pages 4-2 and 4-3 discuss road dust. The DSIP should included estimates of projected increases in road dust due to implementation of DSIP control measures (see comment on DSIP page 4-2).

The DSIP assumes that no dust is emitted from non-lake source areas at any speed. This is inconsistent with observations and documented data (WESTEC, 1984; Cox, 1996; Niemeyer, 1996; UC Davis proposal, 1991).

On page 4-13, Section 4-3.3., last paragraph, the reader is left with the incorrect impression that the annual emissions estimated by Sahu (for LADWP) were 420,672 tons during the period October 1994 to October 1995. The paragraph needs to be corrected. The 420,672 ton estimate was calculated by the GBUAPCD using storm durations and areas (including filled-in areas) used by Sahu but with the higher fluxes presented in the Niemeyer data (see comment below). The planning emission inventory estimated by LADWP is 11,100 tons per year, with a range of 2,100 tons to 41,600 tons.

In comments submitted to the GBUAPCD (memo dated February 24, 1997), Niemeyer comments on the use of the higher flux. Based on those comments, the GBUAPCD needs to correct (downward) the higher fluxes it has used per suggestions made by Niemeyer to account for temporal and lateral variability and deduce more accurate and lower emissions estimates (which we think will be closer to the estimates developed by LADWP). If such corrections are not made, the GBUAPCD needs to explain and justify its continued use of the higher flux in the emission inventory calculations.

Revised Emission Inventory

The LADWP, with assistance from Parsons Engineering Science, has completed a revised emission inventory for the Owens Lake. The LADWP employed the general methodology utilized by the GBUAPCD with refinements in combination with data collected by the GBUAPCD to estimate annual PM-10 emissions from the lake using a bottom up approach. Results of the refined emission estimation methodology resulted in an estimated emission inventory several magnitudes smaller than the GBUAPCD emission estimates.

The methodology used by LADWPwas as follows: 1. Using the seasonal flux correlations (flux in grams/square meter/second as a function of wind speed) developed by the District (one for Fall/Winter and the other for Spring/Summer), the flux was calculated for each storm event based on wind data recorded at the Geomet site. 2. The wind data were also used to determine the duration (in hours) for each event day on which the wind speed exceeded the known threshold wind speed for emissions at the Lake (i.e., 7.5 meters/second). 3. Finally, source areas (in square meters for the entire lake bed) for each event during October 1994 and October 1995 that were carefully identified by Dr. Niemeyer using visual as well as recorded data were used to scale the flux to area emissions. 4. Using the flux, the duration, and the source areas, the emissions of PM-10 for each event day were calculated and summed for the full year to yield the annual emissions.

Additional assumptions include:

(a) Data gaps (such as missing wind speed data, source area data, and event days) have been filled in using conservative values;

(i) The wind speed data collected at the Geomet station and at Tower B were correlated and the bias determined. The results of this analysis show excellent agreement between the two sites for the period under consideration. Therefore, the Tower B data was used to determine average and maximum wind speeds as well as durations greater than the threshold wind speed. When B Tower data were unavailable, the Geomet data have been used;

(ii) In order properly to include events that may have been initiated at nighttime (for which Dr. Niemeyer's visual observational data may have been limited), the hourly wind-speed record at the B Tower was used as a surrogate - i.e., if the wind speed exceeded the threshold during the nighttime hours (typically 6:00 p.m. to 6:00 a.m.), it was assumed that a storm event had occurred. The source area of that storm was then taken to be (depending on the degree of conservativeness used) either the average or the maximum of all the areas observed by Dr. Niemeyer.

(iii) On certain days, no winds were observed above the 7.5 m/s threshold; however, source areas (generally very small) were observed. For such days, a lower threshold value of the wind (5 m/s) was used so as not to undercount the emissions.

(b) Using different conservative combinations of the basic parameters, a rudimentary uncertainty analysis of the data was conducted to determine the range of plausible annual PM-10 emissions estimates as opposed to one number. Thus for each event the fluxes were calculated using either the maximum value of the wind-speed (worst-case) recorded or the average value of the wind-speed above the threshold to determine the maximum and average fluxes, respectively. Similarly, missing source area data on certain event days (for example, where nighttime events were detected) were filled in using the maximum or average values of the observed source areas. Finally, combinations of these basic data (i.e., maximum flux with maximum source area or average flux with average source area, etc.) yielded the range of expected annual emissions.

(c) The emissions flux correlation was kept the same as the District's. Continuing analysis of the underlying flux data to determine the plausible statistical uncertainty in the flux correlations is being undertaken. When completed, the appropriate flux uncertainty should be included to refine further the annual emissions inventory. However, using the average seasonal correlations (as done by the District) is an acceptable methodology (with one notable exception discussed in [d] below) for arriving at an annual inventory.

(d) One refinement was introduced into the flux calculation in determining the range of lake bed emissions. It is clear from the District's flux measurements that the initial flux decays with time, roughly dropping to approximately 20% of its initial value after 30 minutes or so when all the data are considered. This reflects the physical fact that as a particular event progresses, the flux will decay as the amount of available erodible material is reduced. This flux decay was utilized in the calculations to estimate the lower range of estimated lake bed emissions.

Using this methodology the annual PM-10 planning emission inventory is estimated at 11,100 tons. Accounting for the variability and uncertainty in the underlying data, the range of expected annual PM-10 emissions is estimated at between 2,100 tons and 41,600 tons. The high end of this range is calculated using the maximum observed area as a data filler (when actual data were unavailable). The low end of this range is calculated using the average observed areas as the data filler, including the observed flux decay (as discussed in [d] above).

The planning estimate was based on the arithmetic average of the estimates obtained using the average area as data filler (for average and maximum windspeeds) without the flux decay. Estimates obtained using the maximum area are very conservative, since the maximum area was observed only one out of 678 values and resembles an outlier data point.

The range of lake bed emissions estimated as well as the planning estimate are both far less than the District's estimates of 130,000 to 400,000+ million tons per year. The calculation details are shown in the attached spreadsheets (one for the case where the average area was used to fill in the missing areas and the other where the maximum area was used to do the same). The average case spreadsheet also includes the case of the flux decay adjustment (labeled "Adjusted Emissions").

The GBUAPCD has raised a couple of issues pertaining to the emissions inventory calculated by LADWP. In a meeting held with the GBUAPCD and the California Air Resources Board in December 1996 in Los Angeles, the GBUAPCD claimed that the source areas measured by Tezz Niemeyer (which were used by LADWP in its emissions estimates) were inaccurately applied in the revised emission inventory since they were observed from "distant" locations. Further, the District postulated that the areas observed by Niemeyer were likely to be smaller than actual emitting areas since portions of emitting areas with very low fluxes cannot be reliably discerned from great distances. The GBUAPCD mentioned that it had taken accurate field measurements of source areas and that these areas had eroded after specific storm events on six occasions. LADWP agreed to evaluate the GBUAPCD's observations relating to source areas, and, in principle, to enlarge the areas observed by Niemeyer, if appropriate, by an "erosion factor." In February 1997 LADWP received the source area maps mentioned by the GBUAPCD in the December meeting. The initial set of areas received were not for specific events; rather, they were aggregate areas measured over longer times ("Interim Owens Lake Aeolian Report," Cox, August 1996) and thus not directly usable for the determination of the erosion factors discussed above. Upon further request, the GBUAPCD sent LADWP several daily areas (fax from Grace Holder, dated April 15, 1997) presumably measured via GPS during the period 1993 through 1995. However, even these areas do not show eroding regions before and after storm events; thus, any growth or erosion factor could not be computed. LADWP did try to compare the GBUAPCD's areas with those observed by Niemeyer. Although not directly comparable in some instances (since they covered many days, and, presumably, many events), on other days (e.g., March 6, 1995, March 7, 1995, and March 8, 1995) the areas observed and noted by Niemeyer were larger than those observed by the GBUAPCD. A comment memo from Niemeyer to the GBUAPCD (February 24, 1997) provides an explanation of why the GIS method used by the District is likely to overestimate storm areas (since it does not account for source area migration on the lake). Thus, LADWP was unable to substantiate a consistent bias towards smaller areas in the Niemeyer data as was conjectured by the District at the December meeting, and believes that the Niemeyer areas as used in its inventory are appropriate.

At the same December meeting, the GBUAPCD further asserted that the emissions flux values used by LADWP (which were directly based on wind tunnel measurements taken by the GBUAPCD over a three year period) were not appropriate and that higher fluxes deduced from the Niemeyer data (slated to be in the 2.7E-03 to 7.62E-02 g/m2/s range in the DSIP, page 4-13) should be used instead to estimate emissions. In February 1997, the GBUAPCD received comments from Niemeyer (memo dated February 24, 1997) which sheds some light on this issue. The Niemeyer memo affirms that there is, as expected, temporal variability in dust storm emissions, and that using the average vertical fluxes noted above is likely to overestimate PM-10 emissions. Further, based on observations in 1996, Niemeyer reports in the same memo that the fluxes "...vary greatly laterally as well as temporally." In other words, for a specific storm event, it is unlikely that the emissions fluxes remain the same above all source area locations for the entire duration of the storm. Niemeyer mentions that the likely range of the vertical fluxes ranges from 9.35E-05 to 4.62E-02 g/m2/s prior to accounting for temporal variations. This further reaffirms that the emissions calculated using the GBUAPCD's values of the average vertical fluxes are likely to substantially overestimate emissions. The flux values from the wind tunnel data are in a similar range to that suggested by Niemeyer. Although there is obvious variability in the flux, using the uncorrected (for temporal and lateral variability) Niemeyer flux is clearly a gross overestimate of the emissions. Therefore, on balance, the revised emissions estimate developed by LADWP remains valid.

SECTION 5 - CONTROL MEASURES

The LADWP has submitted comments on the three proposed control measures previously (comment letter on the alternatives selection document dated November 27, 1996). Many of the comments submitted by the LADWP remain unaddressed in the DSIP and DEIR. Rather than repeat those previously submitted comments here, the LADWP incorporates its November 27, 1996, letter by reference, and supplements those comments with the additional items presented below.

The three control measures proposed are experimental in nature, have not been demonstrated in practice on the lake bed, are cost prohibitive, and are inconsistent with BACM proposed for direct anthropological fugitive emissions sources state and nationwide. Substantial effort and financial resources have been committed to control measure research by the LADWP over the past several years. Unfortunately, to date this research has repeatedly illustrated that "standard emission control measures" are ineffective in the unique Owens Lake bed environment. In the absence of scientific data supporting the proposed control strategy, the LADWP opposes moving forward with implementation of control measures.

The standard erosion control practices of watering emissive areas with sprinklers during high wind events, when tested by the GBUAPCD on the lake bed, resulted in a lake bed which was actually more emissive. Chemical stabilization, another standard erosion control mitigation, was proven ineffective on the Lake bed. Most recently, tilling was determined to be much less effective than anticipated. Thorough and complete lake bed testing is necessary to adequately document the feasibility, long term viability, and control effectiveness of all proposed control measures.

GBUAPCD has proposed a control strategy that is a combination of three different control measures, each to be applied on specific portions of the Lake. The composite effectiveness of the control strategy and special implementation consideration of combined implementation has not been examined. Rather, only the individual control efficiencies and construction/implementation for each of the primary measures are briefly examined. The composite effectiveness values, costs of composite construction/implementation, and special problems associated with composite implementation must be addressed.

Although general criteria are presented for spatial allocation of the control measures over the lake bed, little rationale is given for optimization of the allocation as a function of the variations in lake bed surface characteristics, interfacing of the control measure boundaries and protection of control measure integrity during the 5-year implementation phase from 1997 through 2001.

Throughout the large volume of interrelated reports supplied by the District in support of the Owens Lake SIP, it was not possible to discern a unified approach that describes how the different analyses of the proposed control measures fit together and how the final combination of different control measures was determined. For example, the dispersion modeling was used only to show that a "given" set of control efficiencies would result in modeled attainment, rather than to optimize the control measure application. Even though the control measure documents contain a large amount of field measurement data from a variety of sampler types (e.g., sand transport samplers, Sensits,™ portable wind tunnel PM-10 monitors), nowhere is there a clear-cut discussion of how results from certain measurement techniques reinforce results from other methods.

All BACM measures must be reasonable and feasible. Implementation of the proposed DSIP is estimated to require 51,000 acre feet of water a year. The GBUAPCD DSIP and the DEIR, although not explicitly stated in the DSIP or the DEIR (see comment on DSIP page 7-3), identify the Los Angeles Aqueduct (Aqueduct) as the only source of possible water. Health and Safety Code Section 42316 precludes the use of City of Los Angeles water for GBUAPCD air quality measures. In the absence of another identified source of water the proposed control strategy is infeasible. Furthermore, the LADWP is unaware of any water source that could provide such a quantity of water without significant adverse environmental impacts. As asserted in the DSIP (page 7-3) water use is for control strategies that would result in significant adverse impacts would not be reasonable and not considered BACM.

The use of control efficiencies of 99 to 100% in the Owens Lake SIP to demonstrate attainment requires detailed justification, especially because of the large expanse of the emissive areas on the lake bed and the spatial and temporal variations of emission potential. The credibility of such high control efficiency projections for Owens Lake necessitates that they be supported by site-specific control effectiveness demonstrations utilizing test plots that are (a) representative of the emissive areas to be controlled by the method in question and (b) of sufficient size to test the feasibility of implementation. In addition, the measurement of near-zero controlled emission rates may entail significant uncertainty simply because of the limits of quantification of the measurement methods.

Finally, the feasibility of maintaining the control measure in its tested state should be addressed. This analysis should encompass two implementation phases: the start-up phase (when adjacent emissive areas remain uncontrolled) and the long-term maintenance phase (when some of the controlled areas temporarily fail).

The LADWP continues to support further research of potential BACM control strategies that focus on reasonable control options. The time necessary to complete research activities and demonstrate the long-term viability and effectiveness of potential BACM measures can be accommodated through Section 188 (f) of the CAA.

Shallow Flooding

Of all the control measures investigated by the GBUAPCD, flood irrigation seems to have been the most thoroughly studied. Although the results show that portions of the FIP experiments showed high dust control effectiveness, the long-term success of the approach cannot be assessed with the data presented. The effects of off-lake soil deposition and sand sheet movement across the Lake, for example, cannot be adequately judged given the limited duration of the experimental study.

The effectiveness of approaches that rely on water spreading on the lake bed are also problematic in view of the fact that surface cracking precludes efficient spreading of the water. This mechanism can cause the loss of large quantities of water without any benefits whatsoever. Infrastructure failures experienced with managed vegetation may occur with flood irrigation as well. Furthermore, water resources adequate to implement the measure are unavailable.

On page 5-3, the issue of salt efflorescence is discussed, and dismissed as insignificant. However, salt efflorescence is more emissive than the regular Lake bed surface and, depending upon the large scale application of the measure, could increase in magnitude. With application of reclaimed water, efflorescence may increase as well.

Effectiveness: On page 5-5 the DSIP discusses a 99% control efficiency for shallow flooding and the various methods utilized to establish that effectiveness. The following comments pertain to the technical document wherein this data is presented (Hardebeck et al., no date).

Between 1993 and 1996, a 600-acre (240-ha) test program was conducted on the sand sheet between Swansea and Keeler. The control effectiveness of shallow flooding was evaluated (a) from two-dimensional and three-dimensional analyses of sand motion measurements, and (b) from portable wind tunnel measurements of test and control areas. Review of the results presented and the conclusions drawn in the referenced document is hampered because it does not clearly summarize (either before or after the results are presented) how the data were reduced and interpreted for control efficiency determination.

Test Site: The north sand sheet of Owens Lake was chosen as the test site because it is dominated by sandy soil at the surface, is subject to high levels of sand transport, is located in an area of the lake bed that is extremely flat, and provides a long, unobstructed (10,000 ft [3,000 m]) downwind dimension. Field instrumentation included sand transport samplers, Sensits™ for electronic monitoring of sand transport, meteorological stations, low-volume PM-10 samplers, and a portable wind tunnel.

The control efficiency testing encompassed three phases:

Dry Period: 2/22/93 through 1/10/94
Wet Period: 3/15/94 through 3/8/95
Post Flooding: 1/30/96 through 4/12/96

The primary control efficiency calculation methods relied on sand transport data and wind tunnel data. PM-10 concentration data could not be readily interpreted because of the problem of distinguishing test area contributions from background.

Sand Transport Calculations: It was concluded from a lengthy analysis of sand transport data that a control efficiency of 100% can be obtained under "ideal conditions" and an efficiency of about 95% under "less than ideal conditions." More specifically, an analysis of sand flux data was used to support the conclusion that the wet areas can achieve a 99% reduction in sand movement under conditions of 70% water coverage that were encountered in the wet period testing. An identical control efficiency were projected for PM-10 emissions, based on the assumed constant proportionality between sand transport rate and PM-10 emission rate. The error on the estimated efficiency was stated to be in the range of 5 to 10%.

In the analysis of sand transport data, the assumption that the vertical flux of PM-10 is proportional to the horizontal flux of sand, is usually defensible for a given surface condition. However, an Owens Lake surface condition involving an abundance of salt efflorescence (fluff) will produce much greater PM-10 emissions per unit of sand transport, than a more tightly bound salt/sand mixture. A variation in the ratio of PM-10 emissions/sand flux would be expected as the fine particle availability shifts either within an erosion event or between separate erosion events.

Wind Tunnel Calculations: In a separate analysis, the results of wind tunnel testing were used to show that "the average PM-10 control efficiency in the spring was 99.9% and in the fall 98.7%, if there is 75% water coverage during the windy period." With regard to the wind tunnel data, however, there were a number of indications of significant test measurement problems in relation to demonstration of a 99% control efficiency for the wetted area, as follows:

> The measured PM-10 emission rates were not strongly related to wind speed (within any of three test phases).
>
> Two-thirds of the surfaces tested in the wet group had (a) initial PM-10 threshold wind speeds that exceeded the upper limit for the portable wind tunnel (45 mph) and (b) PM-10 emissions below the detection limit.
>
> The final overall PM-10 emission rate proposed to represent wet conditions (4.1×10^{-6} g/m^2-s) was not dependent on wind speed above the threshold wind speed of 11.2 m/s (25 mph) at 10 meters. (This average included non-detectable values.)

All of these outcomes are contrary to typical findings regarding the dynamics of fine particle emissions from sustained wind erosion.

Furthermore, it is unclear exactly what surfaces and conditions were tested with the wind tunnel during the wet period. The wind tunnel tests were described as being performed "near wet surfaces," but saturated and damp surfaces were not clearly distinguished. Also, the stated percentage of the flooded area that was covered with water cannot be reproduced from the specified acreages given in the control technology report.

The wind tunnel test methodology used on Owens Lake does not account for the drying of wet (or damp) surfaces that will occur during hours of sustained high winds under low humidity conditions. Under such conditions, damp soils will dry sufficiently in minutes, resulting in substantial emissions. This was demonstrated by Cowherd (1996) from wind tunnel testing of damp soils used as landfill cover in the Los Angeles area. The drying winds created a strong moisture gradient on the soil surface, such that particles could be released, even though dampness remained in the soil just below the surface. The results of this testing showed a typical dependence of PM-10 emissions on wind speed but with a significantly higher threshold velocity than found for the fully dry soil.

In the case of Owens Lake, drying of damp areas will often produce a salt/sand particle reservoir for suspension. A 99% control efficiency appears to be impossible to achieve unless the remaining unflooded surface area (approximately 25% of the total area) is saturated with water, as contrasted to a damp condition. In order to characterize the control efficiency of transitional wet/dry surfaces under sustained dry winds of different speeds, the wind tunnel test methodology should be revised to incorporate much longer test periods that better represent the duration of an Owens Lake high wind event. The test duration for the wind tunnel was approximately 10 min, a time period that was probably too brief to significantly change the surface moisture content.

The ability of the wind tunnel to measure the reported emission rates of the order of 10^{-6} g/m^2-s is highly questionable. For example, the emission rate of 4.1 x 10^{-6} g/m^2-s from a 0.1 m by 1.5 m (0.33 by 5 ft) working section generates 0.37 mg of PM-10 emissions during a 10-min test period. Because of the design of the tunnel, only one-fourth of this mass (0.09 mg) will be collected on an 8 in. by 10 in. backup filter in the PM-10 sampling train (assuming no impactor substrates). This small mass is below the typical limit of detection for an 8 in. by 10 in. filter.

Two types of QA checks should be used to determine limits of detection and limits of quantification of collected particle mass: audits of filter weights and use of blank filters. Audit limits represent allowable variations on repeated weighings of the same filter. The audit limits of 8 in. by 10 in. filters are typically 1.0 mg for a tared filter and 2.0 mg for an exposed filter. Blank filters are also used to account for weight changes that occur during filter handling in both the laboratory and the field. It is our experience that the average blank correction for 8 in. by 10 in. filters normally ranges from 0.1 to 0.3 mg, with standard deviations approximately as large. As a general rule, a filter catch is "quantifiable" if the blank corrected net filter mass (weight gain) is at least 3 times the standard deviation of the blank corrections. Clearly, a filter weight gain of 0.09 mg would not be quantifiable.

Typically 2 to 3 mg of particulate must be collected on an 8 in. by 10 in. filter to obtain a quantifiable PM-10 concentration. For the Owens Lake portable wind tunnel, this would represent a minimum quantifiable mass emission rate on the order of 1×10^{-4} g/m^2-s. This verifiable controlled emission rate can be compared to the uncontrolled emission rate of 3.1×10^{-4} g/m^2-s for October through December, leading to the conclusion that a verifiable control efficiency is in the range of 60% to 70%, rather than 99%.

On page 5-9 the introduction of mosquito fish as a mosquito control measure is discussed. The ability of mosquito fish to survive in the shallow flood area, with the significant variability in temperature and salinity, has not been demonstrated. There is a high likelihood that the use of pesticides will be required. Pesticides could have impacts on groundwater and biological impacts other than thinning of bird egg shells. The GBUAPCD needs to address this issue.

Managed Vegetation

Various types of vegetation have been shown to reduce sand migration, soil loss, and ultimately PM-10 fugitive emissions from open areas. However, the actual feasibility and effectiveness of the managed vegetation control measure proposed in the DSIP depends upon (and varies tremendously with) the ability to create practical conditions for the initiation and survival of such vegetation on Owens Lake, and the long term viability of both the plants and the infrastructure. This has not been practically demonstrated.

The managed vegetation test pilot project was initiated in July 1996. The DSIP presents an areal photo of the managed vegetation test plot of 40 acres, which is misleading. Only five acres of the test plot were planted in fall of 1996, with a small amount of additional planting occurring only recently. As of February 19, 1997, "no reliable estimates of success" could be made (GBUAPCD Memorandum, Monthly Report on Managed Vegetation, February 19, 1997). The Agrarian Test Area Construction Cost Summary Report (Stradling, no date; page 4) clearly states that the issue of colonization of vegetation and operation and maintenance issues associated with the managed vegetation test were not fully developed or evaluated. The control measure requires 50% plant coverage, so plant survival, colonization, and long-term viability is fundamental to its success. Despite the fact that no data as to the survivability of saltgrass on the managed vegetation test plot is available, the DSIP and draft Board Order propose managed vegetation as a control measure with a cost of hundreds of million of dollars. Implementation of such a requirement, without substantial information, data, research, and clear demonstration of feasibility and effectiveness in the application and area proposed, is unprecedented.

As discussed in the WESTEC Services, Inc. Report (March, 1984), which detailed research on the lake bed regarding survival and long-term viability of drought resistant plants for a two year period, tests over several growing seasons are necessary to assure long-term effectiveness over variable natural conditions. Despite a lack of data, and the historical experiences regarding other proposed control measures which looked promising but failed over time, the GBUAPCD has proposed this as a control measure to be implemented immediately. The LADWP cannot support any control measures that are not based upon sound and proven science, and therefore opposes the DSIP and the managed vegetation measure specifically.

The DSIP indicates that saltgrass stands can subsist with minimal amounts of applied water during the summer months (page 5-14). Saltgrass on managed vegetation plots have not been tested over a growing season, and therefore information on summer water use is currently unavailable. Furthermore, page 5-12 indicates that leaching and irrigation water is needed to prevent salt from the shallow water table from rising into the rooting zone by capillary action, which is independent of water needs for survival purposes. Agrarian Test Area Construction Cost Summary Report indicates that assuming that salt grass pulls moisture from 2 feet of clay, salt grass will require irrigation every 10 days during the hottest time of the year. The report further indicates that "one more very important water management idea that needs additional substantial testing is forcing the saltgrass into dormancy through the hot period." Therefore, the amount of water necessary to maintain the proposed managed vegetation control measure, from both a minimal survival and prevention of intrusion of salty ground water perspective, is uncertain and untested. Without such fundamental information it is impossible to fully determine water demand for the proposed measure, associated environmental impacts, and measure feasibility.

Page 5-10 of the DSIP states that "proposed methods of soil reclamation are similar to those used elsewhere in the country and world-wide." Clearly, vegetation based control measures on Owens Lake are unique because of the problematic chemistry of the Lake bed soils and the intrusion of salty groundwater, which require continual leaching of the soil. The success of such a program and the efficiency of the associated control measure cannot be extrapolated from other areas where such extraordinary efforts are unnecessary to maintain vegetation.

There are many infrastructure requirements which are critical to the efficiency and success of the managed vegetation operation, such as the drainage system discussed on DSIP page 5-12. The monthly reports on the managed vegetation and the Agrarian Test Area Report (GBUAPC, February, 19, 1997; GBUAPCD April 9, 1997; Stradling, no date) clearly document many infrastructure failures and problems. The various reports document reservoirs as "leaking badly," interceptor drains being impacted by accumulating windblown sediments, and berm and irrigation infrastructure and channels requiring continual repairs. The LADWP recognizes that such failures are anticipated in test projects; however, typically such pilot projects and experimentation are continued until problems have been addressed and it is clearly documented that such projects can be successfully managed.

The Agrarian Test Area Report indicates in some cases piping, which is more expensive, rather than earthen infrastructure, may be preferable due to water loss rates associated with earthen structures. The report specifically states "to get the best numbers regarding water loss and resulting efficiencies applicable to this project, however, will require operation of a pilot for a year or two. Obviously the more years a pilot is operated, the better confidence will be in the data." The LADWP agrees with the report's assessment that additional study is warranted. Evaluation of water loss is critical, and as asserted by the GBUAPCD (DSIP page 7-3) gets to the very core of determining reasonableness and feasibility of the control measure. GBUAPCD needs to clearly present its rationalization for moving forward in light of such significant information gaps and recommendations from the test project development team.

The GBUAPCD proposes to move forward with the managed vegetation control measure despite the several documented infrastructure failures and concerns, lack of data on saltgrass viability, lack of data on water needs and water loss, and with full knowledge that many of the suggestions to remedy problems remain untested. The LADWP cannot support control measures that are not scientifically proven and demonstrated in practice.

Gravel

The gravel control strategy requires the establishment of a significant size of gravel operation, having its own environmental and air quality impacts, at a substantial cost. When first proposed in the alternatives document circulated by the GBUAPCD in the fall of 1996, comments were submitted expressing several concerns, most of which remain unaddressed, regarding the gravel proposal. One specific concern expressed was that due to the low load bearing capacity of the Lake bed soils, the gravel would sink. The GBUAPCD concurred with the comment and in the DSIP, has now included a requirement that a permeable liner be utilized under the gravel to ensure that gravel does not sink. The LADWP is greatly concerned that due to the GBUAPCD rush to regulate, many such project elements which are fundamental to the success of the control strategies, and have substantial cost and environmental implications in and of themselves, have been overlooked and continue to go unrecognized and unaddressed.

It is interesting to note that the solution to the issue raised, the placement of a permeable liner, is untested in the unique application proposed on the Lake bed. The impacts of ultraviolet radiation on the liner during placement and over the long-term have not been addressed. There is simply no analysis or testing on this component of the proposed control measure. Damage of products and infrastructure by solar radiation has been experienced by GBUAPCD and is specifically called out in the Agrarian Test Area Report.

Furthermore, with introduction of such a project element, the depth and size of gravel necessary to achieve the desired effectiveness needs to be revisited. By reducing the depth of gravel cover necessary and potentially changing the size of gravel used, the amount of gravel needed to implement the measure could be substantially reduced. Reduction in the use of gravel would reduce environmental impacts, long-term consumption of mineral resources, and costs. The alternative gravel depths and sizes need to be investigated prior to implementation of the measure.

The GBUAPCD cites experiments on two 10 foot by 10 foot plots, without liners, placed at locations for convenient road access (not necessarily representative of the areas where the gravel control strategy is proposed for application) as adequate testing to mandate a control measure. Large scale testing over a several year period is necessary to assess the long-term viability and effectiveness of any proposed gravel control strategy.

The three gravel sites proposed by GBUAPCD have not been investigated as to color of gravel, which is mandated by a proposed DEIR mitigation, or quality and type of gravel. Availability of gravel meeting specified requirements is fundamental to the feasibility of the project.

At an estimated cost in excess of $100 million dollars, it important to assure, prior to moving forward with such a control strategy, that the measure has been throughly tested, as proposed, on an appropriate scale. In the absence of such fundamental scientific documentation, the LADWP disagrees that the proposed control measure is reasonable, and ready for implementation.

A concern that has not been addressed is protecting the gravel during the several year surface application phase of the control measure. The sequence of areas where gravel will be first placed needs to be evaluated and information presented.

Alternative Control Measures that Must be Investigated

The LADWP has previously requested that the GBUAPCD investigate the proposal submitted by Professor Thomas Cahill, University of California, Davis. The control strategy proposed by Professor Cahill requires minimal water to implement and appears to greatly minimize environmental impacts and long term consumption of natural resources. The proposed control option is supported by the two year research project undertaken by WESTEC Services, Inc. (March, 1984) for the State Lands Commission.

The GBUAPCD has dismissed this proposal as being previously submitted by Professor Cahill and rejected. The concept regarding colonization of drought resistant plants is one which was not included in the previous proposal, and is supported by two years of preliminary research conducted on the Lake bed.

It is unclear why the GBUAPCD includes managed vegetation as a control measure in the DSIP, while completely dismissing colonization of drought resistant plants. The proposed managed vegetation control measure is water intensive, results in several adverse environmental impacts, would not be able to withstand variable meteorological conditions (i.e. drought), consumes valuable and essential natural resources long-term, is infrastructure intensive, and no measures of its success are available. The colonization of drought resistant plants minimizes water use, has no long-term consumption needs, creates a measure that is more tolerant of variable lake bed conditions, requires minimal infrastructure and maintenance, would minimize costs, and has been preliminarily tested over a two year period on the lake bed with generally positive results. The proposal submitted by Professor Cahill therefore more closely meets the objectives of the DSIP, but has been excluded from consideration.

The LADWP supports and recommends research regarding colonization of drought resistant plants as a control measure. The flexibility and time needed to implement such research is provided in Section 188 (f) of the CAA.

The DSIP overcontrols emissions. Therefore, the area necessary to be controlled needs to be reviewed. The data collected by Tezz Niemeyer have never been evaluated to determine those areas which are most emissive or the frequency of activity in each area. Such an analysis would assist in confining control measures to the most emissive areas, and reducing impacts, costs, and resource consumption. In addition, the control of off-Lake sources should be investigated, as control of those areas may prove more cost-efficient in the long-term.

CHAPTER 6 - AIR QUALITY MODELING

The LADWP, and its consultant Environ, previously reviewed and commented on the preliminary Owens Valley PM-10 model performance evaluation (MFG, 1996a) and attainment demonstration modeling (MFG, 1996b), and the draft Modeling Protocol for the OVPA Attainment Demonstration (AD) modeling in memorandums dated November 21, 1996 and January 23, 1997. Many of the comments and recommendations submitted previously are reflected in the Draft OVPA SIP modeling. For example, the review identified inconsistencies in the modeling methodologies used in the model performance evaluation and attainment demonstration. Some of these inconsistencies have been corrected, whereas others still exist in the draft OVPA SIP Modeling.

There are many assumptions in the draft OVPA SIP modeling which appear to bias the modeling toward significant overestimation. LADWP recognizes that there are many uncertainties and there may be a desire to build in a margin of safety by making worse case (conservative) assumptions. However, in the draft OVPA SIP attainment demonstration modeling a series of overly conservative assumptions are being made which combine to produce a significant overestimation of the level of control needed to demonstrate attainment of the PM-10 National Ambient Air Quality Standard (NAAQS). This overestimation tendency raises questions concerning the adequacy of the proposed control plan. LADWP recognizes that assumptions must be made to perform modeling of PM-10 in the Owens Valley. In many cases, there is no one clear correct assumption. However, in the draft OVPA SIP modeling it appears that conservative, rather than best estimate, assumptions are always made which tend to bias the modeling results toward serious overestimation of the level of control needed demonstrate attainment of the PM-10 NAAQS. Many of these biased assumptions are recognized in the draft OVPA SIP. For example, on Page 6-9 of the SIP it is noted that "...the emission factor relationships are biased toward the higher values...". LADWP is also concerned that the proposed control plan fails to account for the unusual aspects of the OVPA PM-10 problem, which limit the application of routine $_{PM-10}$ control measures. In summary, our main concerns regarding the draft OVPA attainment demonstration modeling are as follows:

1. The draft OVPA SIP modeling for attainment demonstration is overly conservative resulting in significant overestimation of the controls required to achieve attainment of the 24-hour PM-10 National Ambient Air Quality Standard (NAAQS);

2. The proposed OVPA SIP control plan is inappropriate given the unique situation of the OVPA. Flexibility is built into the Clean Air Act Amendments (CAA) to account for unusual and unique situations such as the OVPA. Owens Lake is a nonstandard source type with no known proven demonstrable control measure and the occurrence of the unusual circumstances when it is emissive (high winds) is fairly rare.

3. The uncertainties in the OVPA attainment demonstration modeling and control plan are so great that attainment is not guaranteed. This is compounded by the

fact that only one source (Owens Lake) is "blamed" for the nonattainment problem and, as such, only one entity is saddled with the entire control costs. Yet the attainment demonstration control plan greatly overshoots the PM-10 NAAQS and after implementation of the control plan, over 40% of the resultant peak $_{PM-10}$ concentration is attributable to sources other than Owens Lake. Clearly, this is not the most cost-effective nor an equitable control plan.

4. The draft OVPA SIP modeling procedures for developing a control plan are highly irregular and inconsistent with procedures used, and approved by EPA, for other regions.

Owens Valley PM-10 Problem

The 24-hour PM-10 NAAQS (150 ug/m^3) is exceeded in the Owens Valley more than four times in a three year period, on average, resulting in the region being classified as nonattainment for PM-10. The Owens Valley region is classified as nonattainment based on violations of the 24-hour PM-10 NAAQS at three sites: Keeler, Olancha, and Lone Pine. From 1987 through 1995, the PM-10 NAAQS was exceeded, on average, approximately 19, 5, and 2 times per year at the Keeler, Olancha, and Lone Pine sites, respectively. The violations are primarily due to wind blown dust. The dry lake bed of Owens Lake is recognized as a significant source of wind blown dust in the region which contributes to the PM-10 violations.

The Owens Valley Planning Area (OVPA) is classified as a serious PM-10 nonattainment area and the federal Clean Air Act Amendments (CAA) require the submission of an emissions control plan and attainment demonstration which shows that the control plan will lead to attainment by 2001. The CAA is also flexible in accounting for unusual or unique situations which may hinder a region's ability to reduce PM-10 to below the NAAQS. For example, in May 1996 U.S. EPA issued a natural events policy (NEP) to clarify Section 188(f) of the CAA in regards to areas which would be in compliance with the NAAQS except for exceedances due to natural events. The NEP allows the U.S. EPA to not include PM-10 violations in determining a regions attainment status if the monitoring data are affected by natural events, such as unusually high winds, wildfires, seismic activities, or volcanos. In the case where wind blown dust due to anthropogenic origins are the cause of the PM-10 violations, then such monitoring data can be excluded only if PM-10 Best Available Control Measures (BACM) for wind erosion have been implemented.

Owens Lake is considered an "anthropogenic" source because man-made activities accelerated the draining of the lake. Thus in order to invoke the NEP for wind blown dust off the lake bed, PM BACM must be defined. Given the unique and unusual circumstances surrounding wind blown dust from Owens Lake, standard anthropogenic control measures for wind erosion (e.g., use of a water truck at a construction site) are not applicable. Therefore, BACM needs to be defined for the Owens Lake source.

Overview of the Owens Valley Draft SIP Modeling Approach

PM-10 modeling for attainment demonstration was performed by McCulley, Frick, and Gilman (MFG) for the Great Basin Unified Air Pollution Control District (GBUAPCD) (MFG, 1997b). Version 3 of the Industrial Source Complex Short Term (ISC3) steady-state Gaussian Plume dispersion model was used to simulate wind blown dust off of the 35 mi^2 emissive area of Owens Lake, as well as a few areas off of the lake which were solely attributed to deposited dust from on-lake sources. The ISC modeling was performed for a two year period of 1994 through 1995. In reality, only 227 days (62%) from 1994 and 201 days (55%) for 1995 were simulated in the ISC modeling. Days from 1994-1995 were eliminated from the 1994-1995 ISC modeling data base due to incomplete or missing Tower-B wind data (which are needed to derive emission estimates) or if the Tower-B wind speeds failed to exceed the 7.5 m/s threshold velocity required to suspend dust from the lake bed (i.e., there are no emissions).

Their ISC requires four basic types of data to estimate ambient PM-10 concentrations:

Emission Estimates: locations and configuration (e.g., size of an area source) of each emissions source and hourly emissions rates.

Meteorological Data: ISC is a steady-state Gaussian plume model, thus it assumes instantaneous transport from sources to receptors for each hour and utilizes only one wind speed, wind direction, temperature, stability, and mixing height for each hour to define the transport and dispersion characteristics.

Receptor Network: PM-10 concentration estimates are obtained at a user-specified receptor network.

Background Concentrations: The contribution of PM-10 due to sources not modeled is obtained by adding an assumed background concentration to the ISC modeling results.

Emissions were estimated assuming the entire 35 mi^2 potential emissive area of Owens Lake was emitting whenever the wind speeds from the 10 m Tower B meteorological site exceeded the threshold wind speed of 7.5 m/s. Emissions were estimated as a function of Tower B wind speed and season using two emission flux regression equations as a function of wind speed one for February to June and another for the remainder of the year. These emission flux regression equations were based on wind tunnel tests taken on the dry lake bed. Two different sets of emission flux algorithms were evaluated: Method 1 based on six historical episodes used in model evaluation in the past (MFG, 1996b); and Method 2 based on additional wind tunnel measurements which resulted in higher PM-10 fluxes. For the few off-lake emissive areas analyzed in modeling attributed to deposited dust from the lake, the on-lake emissions flux equations but off-lake wind speeds (from either Keeler or Olancha) were used.

Because wind speeds are not uniform in the Owens Valley region, three separate modeling domains were used to estimate PM-10 concentrations in the Keeler, Olancha, and Lone Pine areas. The draft OVPA SIP modeling evaluated three types of wind inputs for the modeling: (1)

use of the Tower B wind speed and wind direction; (2) use of the receptor site (Keeler, Olancha, or Lone Pine) wind speed and wind direction; or (3) use of the "vector average" wind speed and wind direction from the Tower B and receptor site wind data (note that a true vector average was not used, rather the scaler average of the wind speeds and unit vector average of the wind directions were used). Mixing heights (which define the height at which pollutants are trapped and thus limiting their dispersion) were based on climatological mixing heights for the region as compiled by Holzworth (1972). Stability class (which determines the diffusion rate of the pollutants) were based on sigma-theta measurements and time of day according to guidelines specified by EPA (EPA, 1972).

Different receptor networks were used in the draft OVPA SIP model performance evaluation (MPE) modeling and the attainment demonstration (AD) modeling. For the MPE modeling, PM-10 concentration estimates were obtained for the three monitoring sites around Owens Lake: Keeler, Olancha, and Lone Pine. For the AD modeling, a receptor network of 68 sites was used: the 3 monitoring sites and a ring of 65 sites at the historical shoreline of the lake (3,600 ft msl).

For both the MPE and AD modeling, 28 ug/m^3 PM-10 background concentrations was assumed for all days modeled during the 1994-1995 period. This value was obtained by analyzing the 24-hour PM-10 concentration at sites upwind of Owens Lake during exceedances in the region (i.e., Lone Pine during northern winds and Olancha during southern winds).

The ISC was run for the two years (1994-1995) and three modeling domains using two sets of uncontrolled (current) emission estimates (Methods 1 and 2) and three different meteorological databases (B-Tower, receptor, and vector average). Ambient PM-10 concentration estimates were obtained at the three Owens Valley PM-10 monitoring sites. The ISC concentration estimates (with 28 ug/m^3 background value added) were then compared with the measured PM-10 (using TEOM measurements). Based on the model performance evaluation (MPE), the vector average meteorological database and Method 1 emissions were selected for use in the attainment demonstration (AD) modeling. The effects of the proposed control plan on the emissions were then accounted for in the ISC emissions and the model was run again using the AD 68 receptor network. The third highest 24-hour PM-10 concentrations (i.e., the "design value") obtained by the ISC at any of the 68 receptor sites for the two years of data with the proposed control plan was 66.6 ug/m^3, well below the 24-hour PM-10 NAAQS of 150 ug/m^3.

Review of the Draft OVPA SIP Modeling Approach

The LADWP has several serious concerns about the draft OVPA SIP modeling:

- the modeling is overly conservative resulting in an unnecessary level of control;
- the modeling fails to account for the full impact of the selected control plan;
- uncertainties in the modeling and control plan are significant so that attainment may not be realized;
- the enormous costs associated with implementing the control plan cannot be justified; and

- the procedures used to develop the control plan were highly irregular and inconsistent with procedures used, and approved by ARB and EPA, in the past for other regions.

Overly Conservative Modeling Approach

The modeling of Owens Valley fugitive dust is particularly challenging. There are many assumptions which have to be made concerning the emissions rate, the transport (wind speed and direction), the dispersion rate (including horizontal and vertical diffusion and vertical trapping), the deposition rate (coarse PM has a relatively high deposition rate), and the sampling network used to represent potential exposures. For the draft OVPA SIP modeling, a series of assumptions are being made each of which introduces an overestimation bias in the modeling whose cumulative effect results in over a factor of five overestimation tendency and, consequently, over a factor of five overstatement in the level of control needed to achieve attainment in the region.

TEOM PM-10 Measurement Bias

The inlet used in the TEOM measurement instruments at the Keeler, Olancha, and Lone Pine monitoring sites has a known overestimation bias in measuring PM-10 under saturation conditions, as occurs during PM-10 exceedance events in the Owens Valley. This bias has been documented elsewhere (e.g., Thankus et al., 1996; MRI, 1996) and is clearly seen in the GBUAPCD monitoring database during exceedance periods in which collocated TEOM and selective size inlet (SSI) HIVOL measurements are available. A comparison of 15 pairs of data from 1994-1996 during which exceedances of the 24-hour PM-10 NAAQS (> 150 ug/m^3) were recorded using the TEOM technique and collocated TEOM and SSI HIVOL measurements existed revealed a systematic overestimation tendency of the TEOM compared to the SSI HIVOL measurements. This TEOM overestimation tendency ranges from 24 to 126 percent, with an average overestimation of around 50 percent (Chang, 1997). This level of overestimation bias is recognized by the GBUAPCD (Ono, 1997), although no corrective action has been taken to date. Since the model performance evaluation was based solely on the uncorrected biased TEOM data and it focused on exceedance days, then if the model was perfectly reproducing the observed uncorrected TEOM 24-hour PM-10 concentrations, then the model would be estimating concentrations that are approximately 50 percent higher than actually occurred at the Owens Valley monitoring sites. Since the model performance evaluation was used to make decisions concerning the use of emission flux equations (Method 1 or 2) and meteorological database, the TEOM overestimation bias potentially calls into question the adequacy of these decisions, as well as biasing the modeling toward the development of a too stringent control plan. The implications of this issue are discussed in more detail below when discussing the adequacy of the model performance evaluation.

Emissions Estimates

There are several assumptions in the development of the Owens Valley emissions estimates which are biasing the modeling analysis toward overestimating the amount of emissions from and the contributions of Owens Lake to the PM-10 violations.

Emissive Areas: The MPE and AD modeling assumes that the entire 35 mi^2 emissive area of the lake is emitting for each storm event. As is well documented by the GBUAPCD and others (e.g. Niemeyer), only a portion of this emissive area is emitting during any one storm. Thus, the assumption that the entire emissive area is emitting every time the Tower B winds exceed the threshold velocity will overstate the actual emissions rates.

Wind Tunnel Emission Fluxes: Only the initial PM-10 emissions flux in the wind tunnel tests were used to develop the Owens Lake PM-10 emission flux equations. The wind tunnel tests show a decay of emission fluxes with time as the eroded surface soil is suspended leaving a harder crust below. However, this emission flux decay with time is not accounted for in the emission flux equations resulting in overstating the actual PM-10 emissions from Owens Lake. The regression equation of PM-10 fluxes as a function of wind speed derived from the wind tunnel tests fail to account for the fall off in the emission fluxes at high (40 mph) wind speeds. Instead they assume that the emissions flux continues to increase as a function of wind speed which is not supported by the data.

Tower B Wind Data: Wind speeds at 10 m from Tower B are used to represent winds across the entire lake bed, even though the GBUAPCD and their consultant recognize that there is substantial variations in wind speeds and directions across the lake during high wind speed events (e.g., Figure 4 of MFG, 1997b). The draft OVPA SIP states that B-Tower was selected because "B-Tower is centrally located and more representative of winds over these playas than the A-Tower, Keeler, Lone Pine, or Olancha meteorological monitoring sites." Clearly, B-Tower winds are not more representative of winds for those emissive areas located directly below or in the immediate vicinity of A-Tower than A-Tower winds. Further, for those emissive areas close to the historical shoreline, we would expect lower wind speeds than at B-Tower due to the frictional effects of the non-lake surfaces. The emissive source regions close to the historical shoreline are more critical than those located in the middle of the lake because of their closer proximity to the three PM-10 monitoring sites which determines the region's attainment status. Thus, use of Tower B winds to define the on-lake emission fluxes will overstate emissions from Owens Lake and, consequently, overstate the PM-10 impacts from the lake.

Off-Lake Sources: The ISC MPE modeling included several off-lake source regions whose source was assumed to be deposited dust from the lake. Because of their close proximity to Keeler and Olancha, these off-lake source regions may be critically important. The use of on-lake wind tunnel emissions fluxes for these off-lake source regions may be inappropriate, and the comments above on the failure to include the flux decay rate are even more important for these off-lake sources as they will have a limited reservoir of deposited dust. The use of the local (receptor) wind data to estimate emissions appears to be appropriate. The assumption that these off-lake areas are emitting for each storm event in which the wind speed exceeds the threshold value appears to be inconsistent with observed emissive area analyses (e.g., Niemeyer). These assumptions bias the ISC modeling toward overstating the contribution of PM-10 from off-lake sources that are attributed to the lake. The contribution of off-lake sources not due to Owens Lake wind blown dust is contained in the assumed background value of 28 ug/m^3. Note in the final control plan the non-lake background contribution to the final design value is over 40% of the PM-10 However, the control plan does not consider any control measures for these non-lake sources, even though at some point in the control plan the of controlling non-lake sources may be more cost-effective than controlling on-lake sources.

Model Performance Evaluation

As discussed in more detail below, the ISC model performance evaluation reveals that the model exhibits a serious overprediction tendency in both the magnitude of the high 24-hour PM-10 concentrations and their frequency of occurrence. Such overprediction tendency will bias the attainment demonstration modeling toward over control.

Receptor Network

The Model Performance Evaluation (MPE) modeling and Attainment Demonstration (AD) modeling used inconsistent receptor networks. The choice of the AD receptor network (ring of receptors around historical lake shoreline) is arbitrary and inconsistent with bringing the region into attainment of the PM-10 NAAQS (i.e., fourth highest measured PM-10 concentrations < 154 ug/m^3) and the ultimate goal of the compliance with the PM-10 NAAQS; to reduce the inhalation of harmful levels of PM-10. Placing the receptors in such close proximity to the source regions results in much higher concentrations than have ever been observed in the region and a much higher level of control than will actually be needed for the region to attain the 24-hour PM-10 NAAQS.

Mixing Heights

Climatological maximum and minimum mixing heights from Holzworth were used in the analysis along with a standard EPA processor to obtain the hourly mixing height inputs required by ISC. A 100 m minimum was specified so that the emissions would not be trapped in an unrealistically low vertical layer. However, under the high wind speed events which produce wind blown dust off Owens Lake (> 7.5 m/s) we estimate that a minimum mechanical mixing height would be closer to at least 400 m, and even higher as the wind speed increases. Thus, it is possible that emissions from Owens Lake in the ISC modeling are being trapped within an unrealistically low layer resulting in an overestimation of their concentration impacts at the receptors.

Final Design Concentration

After implementation of the proposed control plan, the final 24-hour PM-10 design concentration (third highest concentrations at any receptor) is 66.6 ug/m^3, over a factor of 2 lower than it needs to be (154 ug/m^3). A lower level of control may be possible which still demonstrates attainment (< 154 ug/m^3), yet, at a lower cost. Given the extreme costs associated with the control plan, it is unclear why over-control is being specified.

Model Performance Evaluation

We have several concerns regarding the adequacy of the ISC model performance evaluation (MPE) including the use of known biased monitoring data in the evaluation (TEOM) and use of insufficient statistics measures, displays, and analysis to determine whether the model is correctly replicating the conditions that lead to exceedances of the 24-hour PM-10 NAAQS in the Owens Valley. The ISC MPE focused on: (1) the bias of the mean and standard deviation of the predicted and observed 24-hour PM-10; (2) correlation coefficients; (3) bias in the design concentrations at each of the three monitoring sites; and (4) fractional bias of the "robust highest concentration' (see MFG, 1997b for more details). In the Owens Valley PM-10 Modeling Protocol (MFG, 1997a), no model performance goals are provided, thus there is no way to conclude whether the model performance is adequate for use in an attainment demonstration. Other areas that have performed modeling for attainment demonstration have defined specific performance goals, prior to the modeling, that need to be met in order for the model performance evaluation to be deemed adequate enough to proceed in using the model in an attainment demonstration. These historical model performance goals are discussed in the following section, they are then compared with the draft OVPA SIP model for PM-10 attainment demonstration model performance.

Historical Model Performance Goals for Attainment Demonstration Modeling

For ozone attainment demonstration modeling, EPA requires the model to meet a level of accuracy for several performance statistical measures before it can be used for attainment demonstration modeling (EPA, 1991). Several performance statistics and the EPA ozone modeling model performance goals are as follows:

Model Performance Statistic	Definition	EPA Ozone Performance Goal
Unpaired Peak Prediction Accuracy	$100 * (P_u - O_u)/O_u$	< ± 20 percent
Spatially Paired Peak Prediction Accuracy	$100 * (P_l - O_l)/O_l$	N/A
Spatially and Temporally Paired Peak Prediction Accuracy	$100 * (P_{tl} - O_{tl})/O_{tl}$	N/A
Normalized Bias (paired)	$100/N * SUM (P_{tl} - O_{tl})/O_{tl}$	< ± 15 percent
Normalized Gross Error (paired)	$100/N * SUM \|P_{tl} - O_{tl}\|/O_{tl}$	< 35 percent

Where P and O refer to the predictions and observations and the subscripts u, l, and tl refer to predicted and observed pairs that are, respectively, unmatched by time and location, matched by location only, and matched by time and location.

For the 1997 SIP PM-10 attainment demonstration modeling, the South Coast Air Quality Management District (SCAQMD) set a performance goal of within 30 percent for the three performance measures used by EPA for ozone above before they deemed the model would be adequate for use in the attainment demonstration (SCAQMD, 1996). For the on-going Phoenix regional PM-10 modeling, the Modeling Protocol set performance goals for the unpaired (unmatched) peak prediction accuracy and the paired (matched) fractional bias and fractional gross error statistics of within 50 percent. The more stringent performance goals used for ozone than PM-10 is based on the fact that ozone modeling is more mature than PM-10 modeling and emissions inventory estimates for ozone inventories are probably more accurate than many of the components for PM-10 precursors.

OVPA SIP Modeling Model Performance

We have analyzed the draft OVPA SIP ISC PM-10 modeling and compared its performance with EPA's ozone and the SCAQMD and Phoenix PM-10 performance goals to determine whether it achieves a level of accuracy that in the past has been required of models prior to their use in an attainment demonstration. In addition to using the uncorrected (overstated) TEOM measurements, we have also calculated statistics using two methods for correcting the biased TEOM measurements during exceedance (> 150 ug/m^3) conditions: (1) reductions of the TEOM measurements by 25% (0.75TEOM); and reductions of the TEOM measurements by 50% (0.50TEOM). The Owens Valley SSI HIVOL-TEOM intercomparison suggest a reduction of 33% is most appropriate (Chang, 1997) and other independent comparisons suggest a 29% reduction would be appropriate (Thankus et al., 1996). Thus, our 25% reduction (0.75TEOM) represents a conservative (i.e., tending toward overstatement) estimate of actual PM-10 levels in Owens Valley and the uncorrected TEOM and (0.50TEOM) will bracket the over- and under-estimation of PM-10 levels.

Model Performance for the OVPA SIP Model Options

The OVPA SIP modeling used the model performance evaluation to determine which emissions options (Method 1 or Method 2) and which wind options (Tower B, receptor based, or vector average of the two) to use in the attainment demonstration modeling. Table 1 and Figures 1 through 3 summarize the normalized bias and normalized gross errors at the three Owens Valley monitoring sites for predicted and observed 24-hour PM-10 concentrations on days when the observed 24-hour PM-10 concentrations exceeded 100 ug/m^3 (i.e., 100 ug/m^3 threshold). As concluded by MFG (1997b), the Method 1 emissions factors appears to perform better at all three sites than Method 2. Further, the use of the local wind data always results in poorer model performance than using either the B-Tower or vector average winds. The model performance using the corrected TEOM suggests that use of B-Tower winds for dispersion results in slightly improved model performance over use of the vector average wind data. At Lone Pine and Keeler the Tower B data produces better model performance than the vector average data, whereas at Olancha the reverse is seen. When combining data from all three sites (Figure 4a), use of B-Tower meteorological data results in lower normalized bias than vector average winds with normalized bias values of 85% (B Tower) versus 113% (vector average) using the 0.75 corrected TEOM data. Based solely on model performance, a case could be made that the B-Tower meteorological database may be more appropriate than the vector average database. However, this seemingly improvement in model performance may be due to other biases in the modeling (e.g., overestimated emissions) rather than a conclusion that the Tower B data is more representative. In any event, the final dataset used in the draft OVPA SIP attainment demonstration modeling was the Method 1 emissions and vector average wind data.

Model Performance of the Draft OVPA SIP Model

Paired Comparisons of Bias and Gross Error: Figure 5 summarizes the draft OVPA SIP modeling system (Method 1 and vector average winds) model performance evaluation statistics for normalized bias and normalized gross error at the three sites in the Owens Valley and at all sites combined. The model performance evaluation statistics are calculated using the uncorrected TEOM and the 0.75 and 0.50 corrections to the TEOM data. Based on comparisons within the Owens Valley and elsewhere, the 0.75TEOM measurements probably provide the best (albeit conservative) representation of actual ambient PM-10 concentrations in Owens Valley. The unadjusted TEOM measurements have been shown to severely overestimate actual PM-10 concentrations under exceedance conditions and should not be used for the model performance evaluation, but are included here for completeness and to provide a consistent comparison with the model performance evaluation provided in the draft OVPA SIP. The draft OVPA SIP model is exhibiting a systematic overestimation bias with a normalized bias values (using the 0.75TEOM data) ranging from 20% (Olancha) to 156% (Keeler). Over all sites, the normalized bias is 113%. Even with an overstatement of the observed PM-10 values in Owens Valley (uncorrected TEOM), the normalized bias for all sites is 70%. Thus, the draft OVPA SIP model normalized bias (113%) does not even come close to values considered acceptable model performance for ozone (within 15%) or PM-10 (30% SCAQMD, 50% Phoenix) attainment demonstration modeling. Similar results are seen for the normalized gross error where the OVPA SIP model value (131%) is much higher than the level considered acceptable for ozone (<35%) or PM-10 (<30% SCAQMD and <50% Phoenix) attainment demonstration modeling.

Accuracy of the Peak Concentration Statistical Measures: Although the bias and gross error performance measures provide insight into whether the model is operating correctly, the ultimate level of emissions control in an attainment demonstration will be determined by the very highest predicted concentrations. The Unpaired Peak Prediction Accuracy performance measure compares the percent difference between the very highest measured PM-10 concentrations in the domain with the very highest predicted PM-10 concentration anywhere in the domain unmatched by location and unmatched by time (day). The Spatially Paired Peak Prediction Accuracy performance measure compares the highest observed value with the highest predicted value at the same site, but not necessarily the same day. The Spatially and Temporally Paired Peak Prediction Accuracy performance measure will compare the observed peak concentration with the predicted value at the same time and location as the observed peak. For the OVPA SIP modeling, the limiting PM-10 concentration will actually be the third highest concentration during the modeling period, since that is what will define the attainment demonstration. Thus we calculate the Peak Prediction Accuracy performance measures for the third highest values. We also have compared the predicted and observed six highest concentrations and their average by site and subregion in order to assess the performance of the OVPA SIP model in predicting the very highest observed values.

Tables 2 through 4 compare the six highest predicted and observed concentrations in the, respectively, Lone Pine, Olancha, and Keeler modeling domains. Table 5 summarizes the Peak Prediction Accuracy performance statistics using the third highest predicted and observed concentrations. The historical model performance goals for the Unpaired Peak Prediction Accuracy range from within 20% (EPA ozone) to 50% (Phoenix PM-10). Using the 0.75 corrected TEOM data, the Unpaired Peak Prediction Accuracy measure for the draft OVPA modeling range from a low of 185% (Keeler domain) to a high of 2,147% (Olancha domain). Even when the raw uncorrected TEOM data is used, the OVPA SIP model performance greatly exceeds the historical model performance goals for minimal acceptability by over a factor of 2 (Keeler) to over a factor of 30 (Olancha).

The draft OVPA model performance using spatially paired statistics exhibits better model performances values with overpredictions from 53% (Keeler) to 204% (Olancha). Although there have been no historical performance goals for the Spatially Paired Peak Prediction Accuracy performance measure, historical model performance goals for the unpaired statistics are not met. Also provided in Table 5 are comparisons of the third highest observed value with the model estimate at the same time and location. When examining the model accuracy matched by time and location the model ranges from a 50 percent underprediction (Olancha) to 54 percent overprediction (Keeler).

Additional Reality Checks of the Draft OVPA SIP Model Performance

As reality checks of the draft OVPA SIP modeling, the following two predicted/observed comparisons were made: (1) the model estimated number of exceedance days per year was compared with the number of exceedance days per year which is historically observed in the Owens Valley and with what was observed concurrent with the modeling period; and (2) the modeling period database average predicted and observed long-term PM-10 concentrations were compared. Figure 6 compares the average number of exceedances per year that have been historically recorded at the three Owens Valley sites, and the average exceedances per year observed and predicted across the 1994-1995 modeling period. At Lone Pine, the observed average historical (1987-1995) number of exceedances is 2 per year. During the 1994-1995 modeling period there were 3 observed exceedances per year at Lone Pine (0.75TEOM). The OVPA SIP modeling estimates there would be 18 exceedance days per year at the Lone Pine site (MPE receptor network) and 78 exceedance days per year in the Lone Pine region (AD receptor network).

In Olancha, historically there have been 5 exceedance days per year with the number of exceedance days per year measured during the 1994-1995 modeling period estimated at 2 (0.75TEOM). The OVPA SIP model estimates there would be 11 exceedance days per year at Olancha and 78 days of exceedances per year within the Olancha subdomain. Similar results are seen in the Keeler region where the historical and modeling period number of exceedance days per year are 19 and 17, respectively, and the OVPA SIP model estimates that there would be 78 to 163 exceedance days per year.

In examining the number of exceedance days per year in the Owens Valley, the OVPA SIP model estimates that during 1994-1995 there would be on average 169.5 exceedances of the 24-hour PM-10 NAAQS per year; almost a factor of 10 more than observed using the 0.75 corrected TEOM data. The model estimates that for almost half of the days per year (100s of days) there would be exceedances of the PM-10 NAAQS in the Owens Valley due to wind blown dust off of Owens Lake, whereas in reality only a handful (18) of exceedance days of the PM-10 NAAQS actually occurred.

The overprediction bias of the draft OVPA SIP model is also seen in the comparison of the 1994-1995 modeling period average PM-10 predicted and observed concentrations shown in Figure 7. Note that because low wind speed periods were not included in the modeling period these database average concentrations should not be interpreted as annual averages. At Lone Pine, the OVPA model overestimates the observed long-term database average PM-10 concentrations by a factor of 3 to 4.3 depending on whether the predicted database average across the MPE or AD receptor network is used, respectively. At the Keeler site, the model estimated database average PM-10 concentrations is 254 ug/m^3, over a factor of three higher than the corrected (0.75) TEOM (74 ug/m^3) value.

Summary of the Model Performance Evaluation of the OVPA SIP Model

In summary, the draft OVPA SIP model performance does not even come close to achieving model performance goals that in the past have been required of a model for it to be used for attainment demonstration modeling. The model is exhibiting a serious overestimation tendency both in the magnitudes of highest 24-hour PM-10 events and in their frequency of occurrence.

Attainment Demonstration Modeling

There are several aspects of the Attainment Demonstration (AD) modeling that are disturbing.

Adequacy of the Model: The adequacy of the model has not been fully established in the model performance evaluation (MPE) to have confidence in the AD modeling.

Overestimation Tendency: Many of the assumptions made in the modeling appear to bias the model toward overprediction. This was verified in the model performance evaluation.

Inconsistencies in the MPE and AD Modeling: The model performance evaluation (MPE) and attainment demonstration (AD) modeling used inconsistent receptor network definitions. The MPE did not address model performance at most of the receptor sites used in the AD modeling, therefore the AD modeling is using an untested and unvalidated model. The AD receptor network produces much higher concentrations than the MPE receptor network further magnifying the model's overestimation problem.

Final Design Concentration: The final design concentration of 66.6 ug/m^3 is much lower than needed to demonstrate attainment of 24-hour NAAQS (154 ug/m^3). The objective of a SIP control plan is to determine the optimally effective control strategy which would achieve attainment of the NAAQS at lowest cost. A control plan which overcontrols to greatly below the

NAAQS with corresponding additional high costs cannot be legally justified within the laws of the CAA. Based on just this one issue, there are serious legal questions concerning the proposed OVPA SIP control plan.

Control Measures: The control measures in the draft OVPA SIP control plan have not been tested as being effective at the scale being considered in the plan. The specification of such untested control measures in a PM-10 SIP control plan may be illegal as section 188(e)(5) of the CAA allows the use of untested control measures in a SIP control plan only for extreme ozone nonattainment regions. Given the untested nature and the extreme costs of the control measures in the proposed plan, more definitive analysis and studies need to be performed before such costs can be justified.

Consistency with the Objectives of thePM-10 NAAQS and CAA

The proposed control plan is inconsistent with the basic goal of the PM-10 NAAQS and the CAA, which is related to the reduction in the relative risk of increased premature mortality and reductions in morbidity. A goal of the proposed control plan should be to minimize personal exposure (inhaled dose) of PM-10 at least cost. The number of exposures to PM-10 concentrations in excess of the NAAQS due to wind blown dust from Owens Valley is small. The population base around the lake is very small and such events are fairly easy to forecast so that personal exposures can be minimized. Transient population along the major roadways will have limited exposure due to the short residence time within the dust cloud and the extra protection of the vehicle. Concerns about exposures at turnouts or scenic view spots are not well founded as the extreme high winds of the storm events associated with high PM-10 levels make such unprotected outdoor viewing inhospitable. The implementation of the control plan would involve the introduction of approximately a hundred additional people to the Owens Valley in close proximity (even on) the lake resulting in an approximate doubling of the daily population within Owens Valley who may be exposed to elevated PM-10 concentrations. Furthermore, many of these people will be engaged in high risk operations (e.g., gravel mining, heavy duty truck driving, truck/car interactions, construction, etc.). In addition, during the construction of the project there will be a substantial increase in PM-10 emissions, including significant amounts of soil erosion potentially increasing the areas of on-lake and off-lake fugitive dust source areas. It appears that implementation of the control plan would not only increase personnel exposures to PM-10, but would also increase the relative risk of premature mortality, the exact opposite effect than the intent of the PM-10 NAAQS. None of these aspects were addressed in the draft OVPA SIP or draft EIR.

Quantitative Estimate of Overestimation Bias of the Draft OVPA SIP Model

Although there were many assumptions entering into the overestimation tendency of the OVPA SIP modeling (e.g., emissions, meteorology, use of uncorrected TEOM, etc.), the model performance evaluation combines these assumptions to provide an estimate of the degree of overestimation and, consequently, a quantitative estimate of the degree of over control in the draft OVPA SIP control plan. This overestimation tendency can be quantified by combining the model overestimation from three components: (1) level which the model predicted design value overestimates the observed design value; (2) the level which the uncorrected TEOM data overestimates actual ambient PM-10 concentrations; and (3) the level which the OVPA SIP control plan overshoots the PM-10 NAAQS.

The model estimated PM-10 design value concentration (i.e., third highest concentration day during the modeling period) is 4,709 ug/m^3 and occurred in the Keeler modeling domain on March 3, 1995 (Tables 4 and 5). The corresponding third highest observed PM-10 day occurred at Keeler on March 21, 1995 with a value of 2,204 ug/m^3 using the uncorrected TEOM data. Thus, the overestimation of the draft OVPA SIP model due to the model overestimating the observed design value is a factor of 2.13 (4,709/2,204).

The comparison of the SSI HIVOL to TEOM measurements suggest that the TEOM data are biased high by about 50%. To provide a margin of safety to the calculations, we have been assuming a conservative best estimate correction factor of 33% overestimation (i.e., 0.75TEOM). Thus, our estimate of the observed design value would be 1,653 ug/m^3, compared to a value of 2,204 ug/m^3 using the uncorrected TEOM data. Thus, the overestimation due to use of the uncorrected TEOM data is estimated to be at least 1.33 (2,204/1,653).

EPA has stated that attainment of the 24-hour PM-10 NAAQS is demonstrated when the model estimated design value is at least 154 ug/m^3. The draft OVPA SIP control plan resulted in a model estimated design value of 66.6 ug/m^3, a factor of 2.31 too low (154/66).

Combining these three overestimation factors results in a conservative estimate of the draft OVPA SIP modeling of 6.5. This suggests that the OVPA SIP control plan is over a factor of 6.5 (550%) more stringent than it needs to be to comply with the CAA PM-10 attainment demonstration requirements.

Comparison with Other PM-10 Attainment Demonstrations

The City was also involved in the develop of a PM-10 control plan and attainment demonstration modeling for the South Coast Air Basin (SoCAB) which was included as part of the 1997 California State Implementation Plan (SIP). The 1997 SoCAB PM-10 control plan was based on the ozone control plan from the 1994 SIP, which has been approved by the EPA. The City worked with the South Coast Air Quality Management District (SCAQMD) in the development of both the 1994 and 1997 control plans and many different alternative control plans were analyzed and modeled to determine whether attainment could be demonstrated. The objective of these iterations was to find the most cost-effect and socioeconomically acceptable control plan that achieved attainment of the NAAQS.

For the 1997 PM-10 control plan, even though the SoCAB PM-10 modeling met or nearly met the 30% performance goal set out in the Modeling Protocol, the SCAQMD felt that the modeling uncertainties (e.g., primary PM-10 emissions inventory) were significant enough so that only the model estimated values at the PM-10 monitoring sites were used in the attainment demonstration (note that PM-10 modeling for attainment demonstration for the San Joaquin Valley was also performed only at the PM-10 monitoring locations). This procedure was approved by the California Air Resources Board (ARB) as they included the SoCAB PM-10 control plan in the 1997 California SIP. After implementation of the SoCAB control plan the highest PM-10 concentration in the SoCAB was 142 ug/m^3, a little below the 24-hour PM-10 NAAQS of 150 ug/m^3.

The procedures for the development of he SoCAB PM-10 control plan should be contrasted with the highly irregular procedures used to develop the Owens Valley PM-10 control plan, even though the Owens Valley has just a small fraction (less than 0.001 percent) of the population base of the SoCAB. In the Owens Valley control plan development, the District did not work with the affected parties (e.g., the City) in the development of the control plan. Only a handful of alternative control plans were examined and no modeling was performed to determine the level of control needed to comply with the NAAQS. The model performance was highly questionable and the attainment demonstration modeling was based on an arbitrary receptor network for which the model was evaluated. When the proposed control plan greatly overshot the NAAQS, there was no attempt to back off on some of the controls to determine whether a lower and more cost-effective level of control is available which would still achieve the NAAQS. Standard procedures that have been approved by EPA and ARB in the past for control plan development were not followed in the development of the Owens Valley PM-10 control plan so that the resultant control plan is not acceptable or approvable.

Assessment of the Uncertainties in Off-Lake PM-10 Contributions on Attainment Demonstration

PM-10 emissions from off-lake sources have been observed in the Owens Valley (Niemeyer, 1996). The PM-10 impacts from four distinct off-lake regions (Keeler Dunes, Upper-Highway 190, Mid-Highway 190, and Olancha Dunes) was included in the DSIP ISC base case modeling analysis. However, the control plan contained no direct measures to reduce PM-10 emissions from these four off-lake source regions. Instead, it is assumed that all PM-10 emissions from these off-lake regions are due to deposited dust from the lake. Thus, "the control strategy assumes re-suspension of deposited material from these secondary sources would eventually be eliminated by control of the on-lake source areas." The DSIP provides no time frame for how long it would take for the complete elimination of these source areas. Furthermore, some of these source areas appear that they would be emissive within their own right even without the presence of the lake (e.g. Keeler and Olancha Dunes and disturbed soil areas).

Thus a sensitivity test was performed using the DSIP ISC control plan, only putting back in the emissions from the four off-lake source regions from the base case simulation. The resultant third highest 24-hour PM-10 concentrations (design value) in each of the three subregions with controlled on-lake sources but uncontrolled off-lake sources were: 934 ug/m3 in Keeler subregion on April 9, 1995; 359 ug/m3 in the Olancha subregion on November 6, 1994; and 57 ug/m3 in Lone Pine subregion on November 6, 1994. This sensitivity test suggest that using the DSIP modeling assumptions if deposited dust from on-lake sources is not the sole cause of the PM-10 emissions from these off-lake areas, then violations of the PM-10 NAAQS would continue in the Owens Valley, even with implementation of the full on-lake control plan.

The LADWP, and its consultant Environ, continue to evaluate the attainment demonstration modeling. Additional comments and information will be provided in the future.

CHAPTER 7 - CONTROL STRATEGY AND ATTAINMENT DEMONSTRATION

The proposed control strategy fails to meet the objectives presented for the DSIP:

1) In failing to investigate measures which utilize less water and gravel, focus on the most emissive and repeatedly emissive areas of the lake bed, and address off-lake sources the DSIP has failed to reduce, avoid, or minimize adverse environmental impacts.

2) The control measure reports prepared by various consultants and GBUAPCD staff present many significant problems regarding implementation of the proposed control measures. Furthermore, the success of the various proposed control measures is questionable, and has not been documented. Without investigating and addressing these issues, the likelihood of success is questionable and delay is inevitable. The attainment demonstration modeling was conducted inappropriately, calling into question the effectiveness and appropriateness of the entire control plan. Implementation of potentially ineffective control measures would not only impact attainment and the attainment schedule, but would be an inappropriate use of public funds.

3) The DSIP does not conform to and /or violates: Health and Safety Code 42316 because it requires Los Angeles Aqueduct water and proposes unreasonable control measures; the federal and state Clean Air Acts by failing to regulate the property owner; the federal Clean Air Act by relying on future technologies to illustrate attainment; the federal CAA by proposing over control of emissions; the City of Los Angeles Charter which requires a 2/3 vote for the transfer of any water rights; a California Supreme Court injunction precluding placement of water on the lake bed; the policies established by the state and EPA regarding anthropogenic sources directly generating PM-10 emissions; the policy of the City to minimize fee increases; the intent of Congress regarding control of unique fugitive dust sources impacted by natural events such as high winds (CAA Section 188 (f)); and funding policies of the state and federal government.

4) The DSIP does not minimize long-term consumption of natural resources, and specifically fails to minimize the use of valuable and essential potable water supplies. The DSIP fails to investigate alternatives that utilize drought resistant plants, which have been tested on the lake bed over a two year growing cycle (WESTEC, 1984); fails to address water losses associated with managed vegetation infrastructure; fails to minimize the control area; fails to evaluate the effectiveness of thinner layers of gravel and therefore, fails to adequately attempt to minimize natural resource use.

5) The DSIP does not minimize costs. The DSIP proposes: substantial overcontrol, thereby maximizing costs; the use of unproven technologies that will result in increased costs and inappropriate expenditure of public funds; strategies that require continued use of natural resources resulting in higher financial and environmental costs; and a control strategy that is very sensitive to natural events such as drought, flood, etc., potentially requiring substantial investment to repair and reinitiate measures subsequent to such an event. Control measures have not been optimized in terms of area size and location.

6) This issue is not discussed in the DSIP, so evaluation of the plan's ability to meet this objective cannot be accomplished.

The DSIP fails to meet the requirements of the federal CAA and to meet the objectives set out for the plan; therefore, the LADWP opposes adoption and implementation of the DSIP. The LADWP recommends that a scientific review panel be established and that further research of reasonable control measures be pursued. In addition, additional research regarding meteorological conditions, variability of the Lake bed over time and space, and emission inventory work needs to be continued. Additional research in an effort to define BACM for the Owens Lake bed can be accomplished under Section 188 (f) of the CAA.

Page 7-1 and Table 7.1 inaccurately indicates that the maximum amount of water required by the DSIP would be 51,000 acre-feet. This amount of water accounts for only the proposed control strategy. It does not address the substantial water needs to control fugitive emissions during construction and continued gravel mining operations, the additional water from June to July to extend the bird habitat, and the large amount of water to leach the managed vegetation area every September. As documented by both Stadling and Cahill, who worked on the Lake bed, substantial fugitive dust emissions were created during construction of pilot projects. These emission will be greatly magnified when work on a large scale is initiated, and work extends over the hot summer months. No estimates of water consumption for fugitive dust control have been provided by the GBUAPCD or considered in the DEIR environmental analyses, but substantial amounts will be necessary.

On page 7-3 the DSIP states that "the proposed implementation order does not prescribe the source(s) of water from which the City of Los Angeles must supply the water-based control measures." This is a disingenuous statement, as the Board action approving the conceptual control strategy greatly limited the potential to use groundwater resources and the only other identifiable water source is the Los Angeles Aqueduct. Furthermore, the DEIR focuses on the Aqueduct as the source of water. As commented upon and discussed with the GBUAPCD on numerous occasions, the use of Los Angeles Aqueduct water is precluded under Health and Safety Code 42316.

The disclaimer statement on page 7-3 indicates that the use of water resources that result in significant impacts would be determined unreasonable by the GBUAPCD. As comments to the DEIR indicate, loss of municipal water sources of any magnitude would be significant.

Therefore, the water based control measures contained in the DSIP are infeasible and unreasonable.

Schedule

The DSIP implementation schedule presented in Section 7 is is overly optimistic and inconsistent with the description of control measure implementation in the DSIP, DEIR, and draft Board Order. Most notably, placement of gravel on the Lake bed is scheduled to be initiated in 1999, concurrent with initiation of managed vegetation. Gravel must be protected from emission sources and therefore is proposed in the DSIP and the DEIR to be the last control measure implemented. The schedule needs to be further extended in recognition that the GBUAPCD asserts that managed vegetation will require approximately 3 years to establish itself and reach anticipated effectiveness.

The BLM permitting process for gravel operations is estimated to take approximately 3 years. Permits would be necessary prior to initiation of contracts for mining operations, and therefore, gravel mining operation would not begin for a minimum of approximately 4 years.

The schedule fails to include the time necessary for the permitting, engineering, and construction bidding processes throughout. Public agency request for proposal (RFP) processes take an estimated 6 months. Discussions with engineering firms indicate that a period of at least a year is necessary to complete site studies and subsequently complete design. Designs would then be released in a construction contract RFP, with the contract execution following in approximately 8 months. This is an optimistic schedule, and may require substantially greater time periods for state agencies, such as the State Lands Commission.

The schedule fails to include the time necessary to accomplish the numerous studies required in the DEIR. Construction and implementation of proposed control measures cannot be initiated until all DEIR requirements are met. Consultation regarding biological issues has been known to take several years. Furthermore, as discussed on DSIP page 7-13, additional environmental review may be necessary. Preparation and completion of CEQA and NEPA documents can take in excess of a year.

Prior to initiation of any project element, funds must be obtained. Depending upon the scope of funds required for the LADWP's portion of the control strategy costs, City of Los Angeles water rates may need to be raised. This process is a lengthy one and is driven by public notification and participation requirements and needs. Funding processes and schedules for the various other agencies responsible for funding the proposed control options, such as the California Air Resources Board, U.S. EPA, State Lands Commission, and the GBUAPCD, need to be included and considered in the schedule as well.

The PM-10 emission reduction trend discussion presented on page 7-9 and in figure 7.2 is overly optimistic. The emission reduction trend is based upon emission reductions from all off-Lake sources being eliminated upon implementation of the measures. This will not be the case.

Furthermore, the DSIP schedule that the projects are based upon are greatly flawed (see comments above).

Costs

The cost numbers presented on page 7-10 grossly underestimate the cost of the proposed control strategy, even at a preliminary level. The GBUAPCD construction cost of $91 million is based upon numerous unsubstantiated assumptions, inaccurate cost of geofabric, and omission of numerous large and small cost items. The LADWP engaged an engineering firm to prepare a cost estimate based upon the DSIP. DSIP construction costs are estimated by Parsons Engineering Science to be approximately $313 million and annualized costs are estimated at $60 million (see attached report). The potential need for a slurry wall, due to concurrent and adjacent control measure placement, was identified as a possibility. Construction of such a slurry wall is estimated to cost an additional $60 million.

These costs do not include enforcement costs and the GBUAPCD SB 270 budget funded by the LADWP. On page 7-12 of the DSIP, the GBUAPCD commits to additional studies. As evidenced in the recently adopted SB 270 budget, the GBUAPCD fully expects the LADWP to fund the studies committed to by the GBUAPCD in the DSIP. The U.S. EPA guidance on BACM indicates that all costs associated with implementation of BACM, including enforcement, monitoring, record keeping, etc., can be included in cost estimates. Therefore, the proposed $6 million SB 270 budget needs to be added to the annualized cost. The cost of electricity loss is estimated at $1 million, bringing the total annualized cost to $67 million (without slurry wall).

The cost estimate fails to include environmental study and mitigation costs required in the DEIR. Many of the proposed biological mitigation measures would be very expensive. As requested previously, the GBUAPCD needs to quantify these costs and include them in the annualized costs.

Accurate and comprehensive cost data is necessary to appropriately assess the reasonableness of the proposed control strategy. As experienced numerous times in the South Coast Air Basin, preliminary planning cost estimates can significantly underestimate actual control costs, rendering proposed control measures unacceptable and unreasonable.

Section 7-10 of the DSIP discusses contingency measures. The contingency measures presented rely solely on the proposed control measures and control of off-lake sources. As commented throughout this document, there is a high probability that the proposed control measures will be ineffective on the Lake bed surface. The control of off-lake sources should be investigated as part of the DSIP as a means on maximizing emission reductions at the lowest cost.

SECTION 8 - ENABLING LEGISLATION TO IMPLEMENT DSIP

Section 8 seems to imply that California Health and Safety Code Section 42316 (HSC 42316) enables the GBUAPCD to require the LADWP to implement the DSIP. HSC 42316 simply

states that LADWP shares in the responsibility for funding research and reasonable control measures, provided LADWP water gathering activities are not impacted. No authority over and beyond this is provided, and the LADWP did not abrogate any of its rights under HSC 42316. The DSIP goes far beyond requiring the implementation of reasonable air quality control measures and requires the use of LA Aqueduct water; therefore the LADWP cannot be held responsible for implementing the DSIP or funding the proposed control strategy.
The GBUAPCD inappropriately focuses the DSIP and its draft Board Order on the LADWP alone. This is inconsistent with state and federal air quality laws. Under air quality legislation, the property owner, in this case the State Lands Commission, is the entity responsible for controlling emissions. California Health and Safety Code Section 42316 does not abrogate the responsibility of the State Lands Commission as property owner to control emissions or the responsibility of the GBUAPCD to require State Lands to do so. HSC 42316 simply specifies that the LADWP shares in the responsibility of funding reasonable studies and measures identified to reduce emissions from Owens Lake bed which are illustrated to result from the indirect impacts of water diversion activities.

The GBUAPCD, and all other regulatory agencies, lacks the authority to require an entity to purchase, lease, or obtain easements from the underlying owners in order to implement air quality control measures. The leasing of property or obtaining easements involves the acceptance of an enormous liability for all actions and injuries on the property, and indemnification of property owners cannot be forced upon an entity through regulation. In addition, with the ability of underlying property owners to regain control of the property, the long term viability of the control measures and ability to recover the cost of investments in infrastructure is questionable and uncertain. Investment of public funds for implementation of control measures on leased property, as proposed in the draft Order and the DSIP, would be irresponsible and will not be agreed to by the LADWP. Therefore, it is imperative that the GBUAPCD require the State Lands Commission, as property owner, to undertake and implement the control strategies.

Although the LADWP accepts its responsibility to assist in any Owens Lake emission control effort, it cannot be expected to fund the entire effort. The legal responsibility for mitigating air quality problems belongs primarily to the property owner; in the case of Owens Lake, the State of California. The State benefits financially from the dry condition of the lake bed through mining royalties and has been party to successful lawsuits to prevent the LADWP from releasing water onto the lake bed. The State is, therefore, responsible for a portion of the proposed control strategy costs.

The GBUAPCD has continually failed to develop funding sources for air quality planning activities in Owens Valley, with the LADWP providing the majority of the funding ($20 million over the past several years). In other areas of the State, such as San Joaquin, PM-10 planning efforts have been funded, and are anticipated to be funded, by all stakeholders, including the U.S. EPA, Bureau of Land Management, Department of Defense, National Park Service, U.S. Forest Service, Department of Transportation, California Air Resources Board, cities, counties, and industry. In this cooperative effort it is interesting to note that industry is the smallest contributor. It is unclear, with as great an air quality problem as asserted by the GBUAPCD, and the concerns expressed by the various public resource agencies and the Naval Weapons Station, why outside funding sources other than LADWP have not been sought. Other funding strategies which should be considered by the GBUAPCD and the State include increased state taxes or issuance of long-term bonds by the State. The Bay-Delta area restoration efforts, which are necessary due to impacts associated with water gathering activities, were funded through such a program.

The GBUAPCD has prepared a DEIR which indicates that implementation of the DSIP would result in many environmental impacts requiring long term mitigation and monitoring. In drafting the plan it is the regulatory agency that must take responsibility for the environmental damage and mitigation measures incurred by the project. The GBUAPCD asserts that LADWP water diversion has created the environmental air quality problem in the Owens Valley, and proposes that LADWP address the air quality problem via strategies that impact other environmental resources. The LADWP will not accept the long term liability of additional environmental damage created by the proposed control strategies. Furthermore, HSC 42316 requires that the LADWP assist in funding reasonable air quality control measures, and does not require funding of substantial unreasonable environmental mitigations.

In reviewing the DSIP and DEIR, the LADWP does not believe that the environmental damage created by the DSIP is overridden by the proposed air quality benefits. Rather, as stated in the DSIP and DEIR comments, control strategies should focus on realistic and reasonable control measures that avoid environmental impacts. Since the GBUAPCD Governing Board is the decision making authority for the DSIP, and will be ultimately responsible for adopting the project and certifying and adopting the associated EIR, it must take responsibility and liability for its actions, not LADWP.

The draft Order mandates activities that require several discretionary approvals (including separate compliance with the National Environmental Protection Act and the California Environmental Quality Act) from numerous federal, state, regional, and local public and regulatory agencies. The GBUAPCD lacks the authority to adopt regulations and orders over which it does not have jurisdiction. Any agency with discretionary approval authority, in carrying out its fiduciary responsibilities, may deny approval or require substantial modifications which could be inconsistent with the regulation or order adopted by the Board. The inconsistencies created through the discretionary approval processes of the numerous agencies with oversight over various aspects of the DSIP would make project implementation difficult if not impossible and would render the regulated entity in violation of the regulation or order, through no fault of its own. The law precludes this situation, by allowing regulatory agencies to adopt regulations and orders which are only within their sole jurisdiction.

Any control strategy identified that requires discretionary approval from several agencies would best be accommodated through the Natural Events Policy, because it provides for a plan of action rather than a stringent regulation. The Natural Event Policy provides the time and flexibility necessary to accommodate various approval actions and permitting needs. Discretionary approval from agencies can take substantial time. Such scheduling difficulties can be accommodated through the Natural Event Policy. In addition, the Natural Events Policy provides the flexibility necessary to continually modify the proposed control strategy, including incorporating new information identified through separate environmental documentation, to conform to the various requirements of the responsible agencies.

Many discrepancies are built into the draft Order, making the draft Order inconsistent with the DSIP, the cost-estimates, and the DEIR. For example, the draft order requires the LADWP to protect the gravel from wind and water borne soil (DSIP page 8-5). However, the DSIP implementation schedule requires that gravel be implemented long before the other proposed control strategies will be effective, therefore making it impossible to protect the gravel from fugitive emissions from the Lake bed. Furthermore, off-Lake sources have not been adequately investigated by the GBUAPCD and therefore are not adequately addressed in the DSIP. Compliance with that single provision of the draft Order would be impossible and erroneous.

CONCLUSIONS

In conclusion, the DSIP has not been well thought out and is not based upon sound science. In an effort to obtain the information and data necessary to move air quality planning in the Owens Valley Planning Area forward, the LADWP recommends that a scientific review panel be established and that promising research of reasonable control measures be pursued. Additional research regarding meteorological conditions, variability of the Lake bed over time and space, and emission inventory work should also be undertaken. Additional research in an effort to define BACM for the Owens Lake bed can be accomplished under Section 188 (f) of the CAA.

The GBUAPCD has failed to develop funding sources for air quality planning activities in Owens Valley, relying solely on LADWP. With a public entity such as LADWP, the funding of the proposed multi million dollar control program is problematic and difficult. Cooperative funding will be essential to moving promising research of reasonable control measures forward and in implementing those best available control measures (BACM) identified. In other areas of the State, such as San Joaquin Valley, PM-10 planning efforts have been funded and are anticipated to be funded in the future by all stakeholders, making the control strategy and necessary research more feasible. The LADWP therefore, recommends that a cooperative multi-agency, multi-disciplinary group be established to provide funding for air quality efforts in the Owens Valley Planning region. As always, the LADWP is committed to work with the GBUAPCD and contribute resources, that are equitable and reasonable, to the development of a reasonable control plan.

ENGINEERING COST ESTIMATE
for the
PROPOSED EIR ALTERNATIVE
at
OWENS LAKE, CA

Prepared for
The Los Angeles Department of Water and Power

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May 6, 1997

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Appendix A

Appendix B

Appendix C

EXECUTIVE SUMMARY

Capital cost for the Proposed Project is estimated at approximately $313 million. Construction would take place over a period of about three years preceded by approximately 18 months of site survey and preliminary and final engineering.

Annualized costs are $59.99 million. This includes $31.14 million in operating costs, $2 million in compliance cost, and $26.84 million for annualized capital cost based on a 7% interest rate and a 25-year project life.

The water transmission pipeline cost is based on preliminary sizing with a flow rate of double the average flow rate (102,000 AF/year). The estimated direct cost of the main water line is approximately $23 million plus an additional $2 million for service roads.

The use of a geotextile fabric between the playa surface and gravel is included for the cost estimate. The direct cost of this material is about $30 million. The results of the geotechnical analysis may indicate a reduced requirement or suggest an alternative material at a reduced cost. Procurement of a large quantity of this material could be at a substantially reduced unit cost from that used in this cost estimate.

Gravel placement for Areas C and E considers the use of large trucks (25 and 10 tons capacity) at low speeds on the playa. Spreading of the gravel would be accomplished by the use of low profile tired motor graders at a rate of about 1 acre every 5 to 6 hours. The recommended method of gravel transportation to the playa is a combination of conveyors and truck hauling.

Areas A, B, and F will be covered with a network of water distribution piping of 18 inch and 12 inch diameter plastic pipe. Each 12 inch diameter pipe (about 1/4 mile long would have about four hundred 2-inch valves and risers. Area A would require 30 units, Area B would require 175 units, and Area F would require 6 units. The 84,000 valves and risers have a direct cost of about $37.50 each or about $3.15 million in total.

Area D requires about 55 water storage dams and delivery channels and about 440 salt grass panels. The requirements for roads, dams, channels, drainage ditches, and interceptor ditches are believed to occupy about 25% of the total acreage. Aqueduct water (17,400 acre-ft/year) is to be applied to the salt grass panels. Approximately 25% of the water (about 4,320 acre-ft/year) is expected to be recovered and collected in the ditches and available for reuse in Areas B and F. This should result in a saving of about $1.8 million per year of Aqueduct water. The necessary pumps and piping are included in the cost estimate, but no credit is taken for the reused water has been taken in the operating cost estimate.

Sales tax (7.5%) on materials only is expected to cost the project about $5.8 million.

The major component of the annual operating cost is water at $22 million per year. Labor costs are estimated assuming operation by a contractor who would hire seasonal labor and subcontract out major maintenance as required. It is expected that major monetary reserve accounts would be set up to cover periodic costs for gravel replacement, water line repair, and replacement of mobile and expendable equipment.

Barrier walls may be necessary in the flooded areas A, B, and F for water retention. Assuming slurry wall type construction, direct costs for these walls may be in the range of about $60 million bringing the total capital cost to $440 million and the annualized cost to $70.85 million.

SECTION 1

INTRODUCTION AND SCOPE OF STUDY

This report presents estimates of costs for systems to reduce dust emissions from the exposed playa of Owens Lake in Inyo County, California.

Costs for the proposed project are presented. The costs are based on technical outlines of the development needed to establish and maintain dust control and the best estimate of the equipment, sitework, and manhours needed to build and operate the control measures.

Owens Lake shrank in surface area in the first quarter of the twentieth century from 110 square miles to 45 square miles. The exposed lake bed consists of playa soil and salt deposits. Particulates are emitted from the dried lake bed because of natural atmospheric conditions. These particulates are characterized as PM_{10} (10-micron particles).

The purpose of the project is to adopt and implement a program of control measures to reduce particulate emissions sufficient to comply with regulatory standards. Specific control measures are aimed at 35 square miles of playa that have been identified as the principal source of dust.

The Great Basin Unified Air Pollution Control District identified several methods to reduce dust emissions (Ref 2). These methods involve combinations of flood irrigation and landscaping aimed at covering the ground with material less likely to produce dust on windy days.

Because of the large area, the cost for PM_{10} abatement is high. Section 2 describes the exposed playa and why it must be addressed. Section 3 describes the proposed project, and section 4 explains the costs associated with the project.

Parsons' scope of work was to review the Great Basin United Air Pollution Control District (GBUAPCD) assessment and cost estimate dated March 1997 (Ref. 1). A cost estimate was developed based on the what GBUAPCD has identified as the 'Proposed Project' for mitigation of dust formation from the Owens Lake area.

The basis for the cost estimate is the GBUAPCD report and a site visit on March 10 and 11, 1997. Clarification to some of the information was provide by Frank Stradling of Agrarian Research and Management for Areas A, B, D, and F. The estimate considers a large construction company providing all of the construction management and performing or supervising all labor or subcontractors. The capital cost estimate contingency is appropriate for a project at a preconceptual stage of development. Cost estimates are conservatively high. After preliminary and definitive engineering, the contingency can be lowered. If during engineering alternatives are developed that provide equal or better emissions abatement at a lower cost, the improved concepts will be incorporated into the project.

SECTION 2

DESCRIPTION OF SITE

Owens Lake is at the south end of the Owens River on the east side of the Sierra Nevada mountains in Inyo County, California. It is highly saline and in a closed lake basin in an arid environment. Diversion of surface water within the last 100 years has reduced the surface area of the lake and exposed a large surface of lake bed. In 1900 the lake occupied 100 sq. mi.; today it is approximately 45 sq.mi.

The exposed area covers the eastern part of the lake bed. Figure 1 shows the lake bed.

To reduce dust, control measures are planned for the parts of the dry bed that have been identified as the worst generators of dust (Ref 1). These areas surround the north and east sides of the existing lake and are typically two to three miles wide.

The dust-generating sections can be classified into six areas, based on soil and drainage patterns. Figure 1 shows the areas, designated A through F.

Areas of the sections are as follows:

A 1,210 acres (1.89 sq mi)

B 6,960 acres (10.88 sq mi)

C 3,365 acres (5.26 sq mi)

D 8,700 acres (13.59 sq mi)

E 1,940 acres (3.03 sq mi)

F 225 acres (0.35 sq mi)

The GBUAPCD has developed plans for controlling dust formation from the dry lake. Reference 1 describes the Proposed Project and reasons control measures were selected for certain areas.

Three control measures are employed. Sections A, B, and F are to be treated by flood irrigation, sections C and E are covered with gravel, and section D is covered with managed vegetation.

Areas A, B, and F have a relatively thick layer of sand covering the surface. Area D has a thin layer of sand overlaying a thick clay bed. Areas C and E have a thick sand layer.

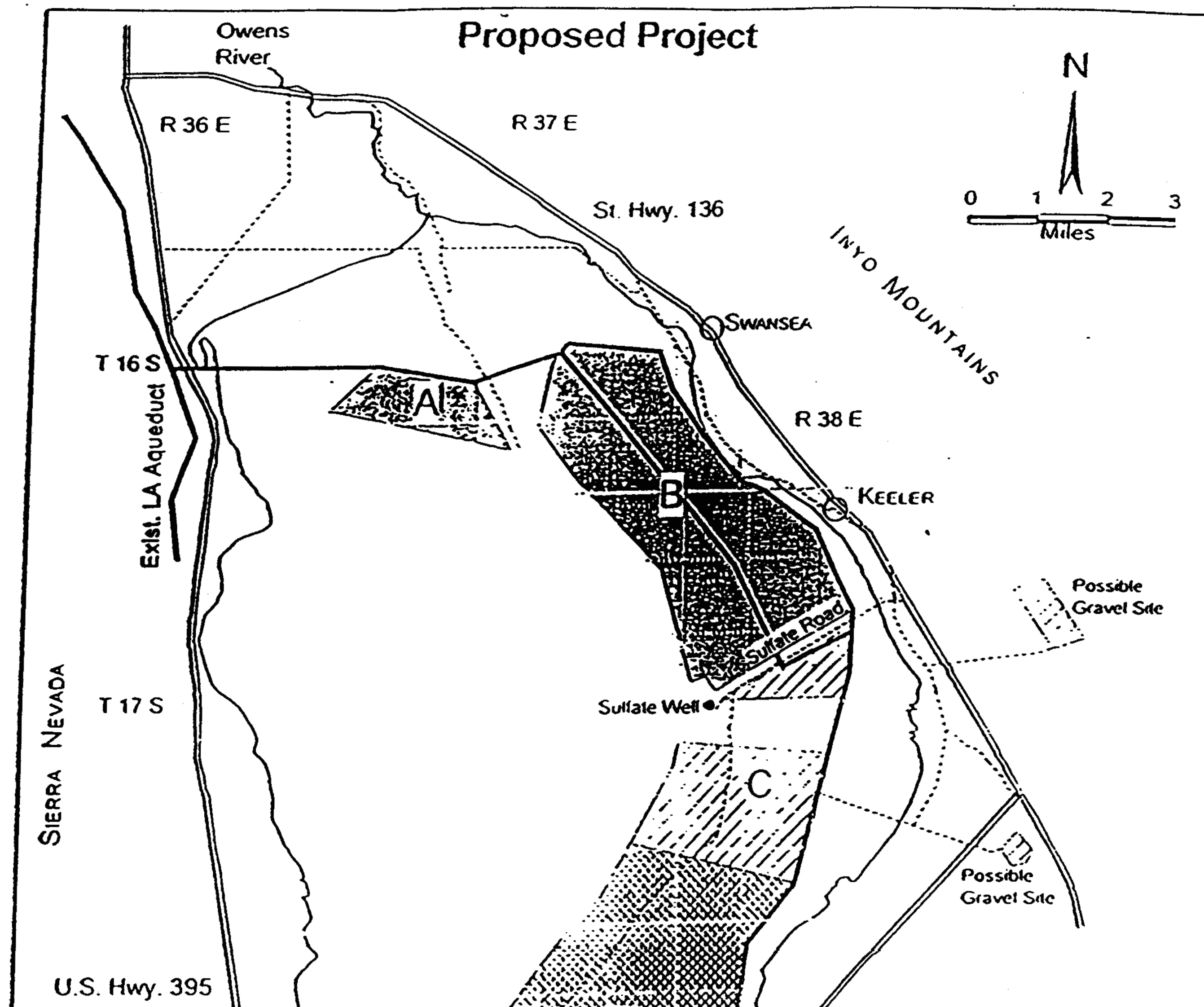

Figure 1: Outline of Owens Lake showing playa to be treated by area
(Reprinted from Ref. 2)

SECTION 3

DESCRIPTION OF PROPOSED PROJECT

3.1 CONTROL MEASURES

GPUAPCD has identified several technologies to mitigate dust formation on the playa. Each technology is anticipated to be highly effective in reducing dust. Following are descriptions of the technologies. A total solution for the Owens Lake dust problem may employ more than one measure. The Proposed Project includes gravel cover for areas C and E, flood irrigation for areas A, B, and F, and managed vegetation for area D.

3.1.1 Gravel

This option involves covering the exposed playa with a 4-in thick layer of gravel. The gravel dimension will be 1/2 in. to 4 in. Test plots have shown alluvial gravel layers to be stable on the lake bed over long periods. The gravel cover will protect the sand and salt from exposure to wind and therefore reduce PM_{10} formation.

Once the gravel has been applied, maintenance will be required to ensure a stable layer is maintained, but operating costs are minimal compared to the flooding and managed vegetation measures. No water is required for the gravel area.

An undeveloped possible gravel site has been identified east of the lake bed. This area, called the Keeler Fan, will be developed as a full-service gravel pit with the capacity to produce sufficient gravel to cover areas C and E. The pit has an estimated potential for about 50 million cu yd of gravel. Use of gravel on areas C and E is expected to require about 4 million cu yd.

Gravel will be conveyed from Keeler Fan to area C on a conveyor. About 150 trucks will haul the gravel from the end of the conveyor to sites around areas C and E. . Gravel costs are estimated at $7/cu yd, delivered to the end of the conveyor. This cost is considered conservative based on discussions with the gravel industry as explained in appendix C.

If the Keeler Fan is not an acceptable source of gravel, another source will have to be developed. If the distance to the lake bed is large, a significantly higher cost may be incurred for the gravel. The cost of gravel depends to a great extent on the distance from source.

3.1.2 Flooding

Flooding involves applying water to the exposed playa to keep the surface sands wet. A network of irrigation pipe will be constructed over the area. Water will be periodically applied to part of the areas.

Flood irrigation, also referred to as shallow flooding, has been proven to be effective on sandy soils such as those found in areas A, B, and F. The drainage water from these areas will be collected and reused.

The anticipated yearly schedule of watering is:

January	0.5 ft	July	0.5 ft
February	0.5 ft	August	0.5 ft
March	0.5 ft	September	0.5 ft
April	0.5 ft	October	0
May	0	November	0.25 ft
June	0	December	0.25 ft
Total	4.0 ft		

Annual consumption of water is estimated at 4 ft per acre for the shallow flooding. Total consumption is therefore:

Area A	4840 acre-ft (211 million cu ft)/yr
Area B	27840 acre-ft (1213 million cu ft)/yr
Area F	900 acre-ft (39 million cu ft)/yr

To establish an estimate of capital cost, a conceptual plan for the irrigation pipe layout was established. The treatment area will be divided into square sections 1/4-mile in length on each side (section area is then 40 acres). A 12-in polyethylene pipe will run along the uphill side of the section. Gates and risers are spaced every 40 inches along the pipe.

Feeding the 12-in lines will be a 18-in header that exits from the main water line. These headers traverse roughly perpendicular to the main water line and head downhill. Estimated quantities of pipe are as follows:

Area A	4	18-in headers, 1-mile long each
	30	12-in irrigation pipes, 1/4-mile long each
Area B	14	18-in headers, 1.5-mile long each
	175	12-in irrigation pipes, 1/4-mile long each
Area F	1	18-in header, 200 ft long
	2	18-in headers, 3000 ft long
	6	12-in irrigation pipes, 1/4-mile long

Along the lowermost side of each area is a drain trench that collects water. Pumps installed in the trench will be used to recycle the recovered water. The requirement for wetting the surface does not exclude brackish water as Parsons understands the concept.

To maintain a wetted surface in the shallow flooding areas, it may be necessary to construct retention walls along the drain trenches. These will raise the water table in the sand layer. The retention wall will be a slurry (cement/sand grout) wall down to a depth a 25 ft below the surface. Based on discussions with those who have worked in the Owens Lake area, this depth is expected to be at or below the clay layer. Clay is less permeable than sand and the combination of the clay below the surface sand and the slurry wall on the downhill side of the area will help retain water.

A value engineering analysis may provide a more effective method of retaining water in flood irrigation areas. The cost estimate does not include retention walls at this time.

3.1.3 Managed Vegetation

Managed vegetation uses an irrigation system to increase the growth of indigenous plants on the playa, thereby reducing the tendency of the playa to evolve dust. Not all parcels in the managed vegetation area are irrigated at all times; the presence of dead and dormant vegetation is planned for. Managed vegetation has been tried in a pilot test at Owens Lake and indigenous salt grass has been successfully grown.

The managed vegetation scheme uses a system of waterworks to deliver water. The water from the main transmission line is accumulated in earthen dams. These dams are square-shaped structures measuring 400 ft on either side and 6 ft deep. Each dam can store 15 acre-ft of water.

Running downhill from each dam is a channel that measures 60 ft wide by 900 ft long by 6 ft deep. Running out from the sides of the channel are eight panels that contain the vegetation. Each panel is about 200 ft wide by 3000 ft long. Gates connect the channel to the panel. Water will run from the dam to the channel to the panels. When watering of a panel is required, the gate will be opened and water allowed to run over the panel.

Area D is the only area planned to have the managed vegetation control measure at this time. An estimated 55 combinations of dams, channels, and panels (8 panels per dam) are required to cover area D. Additionally, an estimated six 18-in pipes, 2.5 miles long each, are required to deliver water from the main transmission line to the dams.

The anticipated yearly schedule of watering is:

January	0
February	0
March	0.5 ft
April	0.5 ft
May	0.5 ft
June	0

July	0
August	0.5 ft
September	0
October	0.5 ft
November	0
December	0
Total	2.5 ft

Annual consumption of water is estimated at 2.5 ft per acre for the wetted area for managed vegetation. It is estimated that only 80% of the area will be wetted, so the average over the whole area is 2 ft per acre per year. Total consumption is therefore 17,400 acre-ft (758 million cu ft)/yr.

Like the shallow flooding areas, the managed vegetation area will have a drainage trench along its lake side. However, there will be no retention wall because the subsurface soil in this area is clay and drainage through it is slow. Water collected in the drainage trench will be recycled to areas B and/or F.

Discussions with GBUAPCD staff did not indicate that sufficient local salt grass starts (sprigs) were available to support the planting of 6,525 acres. Inspection of the test plot indicated a high degree of success with this concept and at least two development panels are to be planted in the spring of 1997. Additional starter plots may be required ahead of the overall project to obtain sufficient starts for all of Area D.

The availability of sufficient salt grass starts may be a problem in maintaining a planting schedule that meets the required completion date. GBUAPCD indicates a planting of salt grass requires about 3 years to develop to the point it can be harvested for starts, and could be harvested annually thereafter. The district has planted two panels with salt grass so far. Assuming a ratio harvestable salt grass starts to planted acreage of one to 100, approximately 65 acres of harvestable salt grass would be required at the time of planting.

An automated harvesting and planting machine appears to be available from a company in Oklahoma. This machine has a reported planting capacity of 4 acres per hour and a harvesting capacity of about 1 acre per hour. One machine could plant 2 panels per 8 hour shift. With about 440 panels in area D, the number of shifts required for planting would be about 220. If the harvesting and planting season starts in April and ends in June to mid July, planting could be accomplished in one season, but two or three seasons appears to be reasonable.

3.1.4 Water Usage

Flooded irrigation water usage is about 4 acre-ft per acre per year, and managed vegetation water usage is about 2 acre-ft per acre per year. Total annual consumption of fresh water is then 51000 acre-ft as shown in Table 3-1. The operating cost estimate considers usage of Los Angeles Aqueduct water at a cost of $450 per acre-ft for all water requirements.

Table 3-1 - Annual Water Consumption

Area	Acres	Acre-ft water /acre/yr	Acre-ft water/yr
A	1210	4.0	4840
B	6960	4.0	27840
C	3365	0	0
D	8700	2.0	17400
E	1940	0	0
F	225	4.0	900
Total			50980

Flooded irrigation could use a brackish water to keep the surface moist, but Area D may require a relatively salt free water for irrigation. It may be possible to reuse recycled Area D water for sections B and F. Recovered water from Areas A, B, and F could also be recycled for use in those areas.

3.2 COMMON INFRASTRUCTURE

The cost estimate is broken down by treatment area, but some structures are necessary for the whole treatment; these are termed common infrastructure.

Infrastructure includes the common water transmission line from the aqueduct serving Areas A, B, D, and F, a service road along the length of the water line, a building that serves as a combination office, warehouse and shop, and required operational capital equipment.

3.2.1 Office, Warehouse, and Maintenance Shop

A pre-engineered building approximately 60 feet wide by 80 long would be provided at the north end of the lake and would serve initially as a construction office. The building would be converted to an operations office prior to the completion of construction.

The building would include:

- Four to six offices, conference room and amenities
- Telephone room and utilities room
- Change rooms for workers and lunch room
- Locked, secure storage area for spare parts
- Maintenance work area for servicing pumps, vehicles, trucks

The building would be inside a secured fenced area with sufficient space for mobile equipment, trucks, spare pump assemblies and the like. Operations service equipment would include ten pickup trucks, ten all-terrain vehicles, a water truck, an oil truck, and a small backhoe.

3.2.2 Water Line

The water line would be tied into the Los Angeles Aqueduct that runs west of Owens Lake. The line would extend approximately 20 miles around the north and east sides of the dry lake along the uphill side of the lake. The water line is sized for twice the average flow rate, and at the head works is 60 inches in diameter. At Area B the line separates into two parallel 42-in. diameter pipes for servicing this Area. South of Area B, the line size is reduced to 36 inches in diameter for servicing Area D. After Area D the line size is reduce to 18 inches in diameter for transferring the water to Area F.

Pipe line costs include a tie-in to the aqueduct (head works). Water flow will be by gravity. No pumps are needed. At the time of tie-in to the aqueduct, it may be necessary to shut down the aqueduct, but only for a maximum of 48 hours.

The line is constructed from fiberglass plastic pipe. The water line is generally two feet below the playa surface. Requirements for crossings have been considered, but not developed. The space between Area A and Area B allows for the free flow of water from the Owens River into the lake.

Drainage capability will be built into the line. Freezing is possible, but flowing aqueduct water should not freeze. Standing water in the pipeline is not expected to freeze, but the line can be drained if required. Appendix C explains the selection of fiberglass and the line sizing.

3.2.3 Service Road

The service road will be a nominal 16 foot wide road with a 6 inch stone base. It will serve as both a service road for the water line and a transport road to those areas of the playa that the water line traverses.

3.3 SCHEDULE

The overall project schedule is about three to four years with a completion date of 2001. Obtaining the permits for the Keeler Fan gravel operation may take up to three years. To prevent accumulation of windblown sand and salt on top of the gravel layer, gravel placement on Areas C and E is planned to take place after establishment of control measures on the other areas. Application for the gravel permits will be made as early as possible, and by the time they are expected, gravel will be required. Mining and placement of the gravel on the playa are estimated to require approximately 3 years based on an 8 hour work day, 5 days per week, 50 weeks per year. A second shift could be added to reduce the overall time required, but this will increase the cost of both mining and gravel placement. An alternative schedule would be 10-hour work days and possibly a sixth work day each week.

The construction contractor will turn the treatment Areas over to the operating contractor once a control measure for the Area is completed. Treatment Area D requires a series of fresh water flushes prior to planting the salt grass. The salt grass planter would come on board at the proper time to plant the salt grass. A definitive work plan has not been developed, but at the end of the first year of construction, Area A should be ready to accept water. Area B and Area F may also be ready to accept water when the water line installation has been completed to those locations.

The construction schedule would be to start infrastructure, (roads, water lines) and lowering of the water table in Area D.

SECTION 4

OPERATING AND ANNUALIZED COSTS

Annualized cost is calculated using the method described in the EPA document "Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures", EPA document number EPA-450/2-92-404 (Ref. 4). A slightly modified method is used in the GBUAPCD document (Ref. 3) for Owens Valley in which no overhead is applied to the water cost. The method presented here includes overhead in the operating cost.

Annualized costs are comprised of capital, operating, and compliance costs, and are calculated using the following equation:

$C_a = (CRF * C_c) + C_o + C_i$

where:
C_a = annualized cost
CRF = capital cost recovery factor
C_c = construction cost
C_o = annual operating cost
C_i = direct annual enforcement and inspection costs

The CRF is based on an interest rate of 7% and a project life of 25 years. Capital Costs are developed from the work-ups presented in Section 4.

$CRF = i\,(1 + i)^n/[(1 + i)^n-1]$
i = interest rate
n = economic life of control system in years

With i=0.07 and n=25, CRF = 0.0858

Direct capital cost includes equipment, support facilities, and the labor required for installation of the facilities.

Operating costs include labor, fuel, maintenance, and insurance. The major component is water. Overhead on labor and other direct costs are included in the operating cost.

Enforcement and inspection costs are assumed to be $2 million.

4.1 CAPITAL COST SUMMARY

A detailed work-up of the capital cost is included in the appendix. Table 4-1 shows the estimate summary.

Total construction cost for the proposed project is $312,834,000.

This cost includes sales tax, insurance, and contingency.

Areas C and E are estimated to require geotech fabric beneath the gravel cover. Total area for gravel is 5300 acres. At a cost of $0.12/sq ft, this fabric cost is over $30 million.

Installation of the groundwater retention walls will increase direct cost by $60 million and bring the total construction cost to $439,430,000.

4.2 OPERATING COSTS

Table 4-2 shows the estimated operating cost breakdown for the proposed project. Annual operating cost is estimated at $31,145,000. Of this, $22,941,000 is annual water cost. Credit is not taken for reuse of collected water from the drainage trenches in areas A, B, D, and F. Table 4-3 shows the estimated annual water consumption.

It is assumed that an operating company will manage the playa after implementation of the control measures. Subcontractors and temporary staff will be employed as required to meet the seasonal demands of the operation.

4.2.1 Labor Costs

Two types of operations support are envisioned; one is an on-going management of the project, involving inspections and monitoring of the site and the second is the supply of water to the four treatment Areas (A, B, D, and F) on a seasonal basis eight or nine months per year. The on-going overview would be a five-day-per-week activity. During the periods when water is flowing, the field crew would be working 24 hours per day, 7 days per week.

Except for monitoring instrumentation all of the operations are by manual control. The field crews will open and close water valves, inspect pumps, and repair dams, channels, and ditches. Minor repairs would be accomplished by the field crews with major repairs being subcontracted.

PARSONS I & T - ESTIMATE WORKSHEET

P:\WINWORD\OWENSLAKE\OVS_EST3.XLS

JOB NO.: 729572-04000	Comparative Cost Estimates	M.T.O. BY: G. Hart	DATE: 04/08/97	EST DATE:	04/08/97
PROJECT: Owens Valley Lake Project	Proposed Project Case	PRICED BY: G. Hart	DATE: 04/08/97	PRINT DATE:	05/01/97
CLIENT: LA Department of Water and Power	Xxxxxx	CHECKED BY: BM	DATE: 04/08/97	REV. 0:	04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT: MATERIAL/ OTHER	LABOR: M/H	LABOR: P.F.	LABOR: RATE	EQUIP. $	SUB	MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ ITEM	TOTAL
	Summary - Base															
	Infrastructure											7,457,574				34,784,465
	Area A 1200 Acres											719,830				4,341,809
	Area B 7000 Acres											3,579,086				21,200,525
	Area C 3300 Acres											2,547,132				69,086,535
	Area D 8700 Acres											7,525,772				32,280,306
	Area E 1900 Acres											1,590,857				41,821,891
	Area F 225 Acres											261,664				1,701,299
	Total											23,681,714				$205,196,830
	Escalation to Mid Point of Construction (from 1/90 1/00, 3% annual)	0.00	%													
	Design Contingency															12,400,407
	Revenue Tax on Total Contract															32,653,098
	Total Construction Cost (TCC)	1	ls												250,347,315	250,347,315
	Permitting	1.50	%													3,755,210
	Prelim. Engineering (Incl. Survey & Geotech. Service															10,013,893
	Final Engineering															7,510,419
	A&E Contingency															1,752,431
	Home Office Support, Overhead, Profit															7,510,419
	Inspection and Testing															2,503,473
	CM and I&T Contingency															1,001,389
	Subtotal	1	ls												284,394,550	284,394,550
	Owner's Engineering & Support															
	Subtotal	1	ls												284,394,550	284,394,550
	Construction Contingency															28,439,455
	TOTAL ESTIMATED COST (TEC)	1	ls												312,834,005	$ 312,834,005

Table 4-1 Capital Cost Estimate Summary

Table 4-2: Operating Cost Breakdown

	Cost
Water	$22,941,000
Labor	$1,690,600
Maintenance and repair costs	
Vehicle replacement allowance	$50,000
Venhicle maintenance and fuel	$24,000
Office Utilities	$12,000
Diesel Pump Fuel at 4000 hr/yr, $2/gal 4.5 gal/yr, 12 pumps	$432,000
Area C and E maintenance	$3,750,000
Infrastructure Repair Fund	$2,000,000
Building and mobile equipment	$200,000
Mobile Equipment Repair Fund	$45,000
Total	$6,513,000
Total Annual Operating Cost	$31,144,600
Total Annual Operating Cost (without water)	$8,203,600

Table 4-3: Annual Water Consumption

Water Consumption							
Water cost, $/acre-ft	$450						
	Area A	Area B	Area C	Area D	Area E	Area F	Total
Area, acres	1210	6960	3365	8700	1940	225	22400
Water, ft/yr	4	4	0	2.5	0	4	
% area watered	100%	100%	0%	80%	0%	100%	
Water Applied, acre-ft/yr	4840	27840	0	17400	0	900	50980
Net Water, gpm	3042	17498		10936		566	
Peak Water, gpm	6084	34996		21873		1131	
Annual Water Cost	$2,178,000	$12,528,000		$7,830,000		$405,000	$22,941,000

Field crews would have pick-up trucks, some with four-wheel drive, and all-terrain vehicles with global positioning systems.

The office and supervisory staff (9.5) includes the following:

- Office Manager
- Field Manager
- Maintenance Manager
- Compliance Manager
- Records Clerk
- Receptionist/clerk
- Bookkeeper
- Field Supervisor
- Maintenance/warehouse supervisor
- Part time janitorial

The permanent field and shop crew would consist of the following:

Lead field operator (6) Areas A and B - (2), Areas D and F - (2), Area C and E - (1) and a rover (1)

Water truck/fuel oil truck operator (1)

Equipment operators (2)

Maintenance workers (2)

The total permanent field and shop crew would be about 11 people

Temporary staff, about 8 and 5 months respectively (average) per year, is estimated as follows:

Areas A, B and F	1	5-person crews at 160 hours/month	=	6,400 hours
	3	2-person crews at 160 hours/month	=	7,680 hours
Area D	1	3-person crews at 160 hours/month	=	2,400 hours
	3	2-person crews at 160 hours/month	=	4,800 hours

Salary costs consider a 100% mark-up to cover payroll taxes, benefits, paid time off, and overhead.

Temporary staff costs are based on a standard rate of $20 per hour including all benefits.

Primary watering and servicing of the four areas receiving water would be on day shift, with the two person crews working afternoons and nights to get complete coverage. The lead field operators would provide training and supervision plus provide extended coverage on the weekends. Table 4-4 shows a breakdown of labor costs. Total labor costs are estimated at $1.69 million per year.

4.2.2 Other Costs

An allowance of 3% of the construction cost of Areas C and E (~$125 million) is included for subcontract maintenance for Areas C and E. This is probably not an annual cost but is considered a reserve fund for future repairs. = $3.75 million.

An allowance of 5% of the cost of the infrastructure (water line and access roads ~$40 million) is included for subcontract maintenance. This is probably not an annual cost but is considered a reserve fund for future repairs. = $2 million.

An allowance of 2% of the building and mobile equipment cost is included for insurance. = $200,000.

An allowance of 15% is included for replacement of mobile equipment. = $45,000.

4.3 ANNUALIZED COST

Annualized costs for the proposed project is estimated at $59,986,000/yr.

As discussed in section 4.1, the capital cost could be significantly lower if certain changes are made. This would also lower the annualized cost.

Table 4-4: Labor Costs

Labor	Number	Annual Cost	Total
Office Staff (year-round)			
Office Manager	1	$150,000	$150,000
Field Manager	1	$100,000	$100,000
Maintenance Manager	1	$80,000	$80,000
Compliance Manager	1	$80,000	$80,000
Records Clerk	1	$50,000	$50,000
Receptionist/Clerk	1	$50,000	$50,000
Bookeeper	1	$45,000	$45,000
Field Supervisor	1	$80,000	$80,000
Maintenenace supervisor	1	$80,000	$80,000
Janitor (part-time)	1	$30,000	$30,000
Total		$715,000	$715,000
Field and shop (year-round)			
Field Operator			
Areas A and B	2	$50,000	$100,000
Areas D and F	2	$50,000	$100,000
Areas C and E	1	$50,000	$50,000
Rover	1	$50,000	$50,000
Water truck operator	1	$50,000	$50,000
Equipment operators	2	$50,000	$100,000
Maintenance workers	2	$50,000	$100,000
Total	11	$350,000	$550,000
Temporary Staff	Hours/year	$/hour	
Areas A, B, and F			
2-person crews	7680	$20	$153,600
5-person crews	6400	$20	$128,000
Area D			
2-person crews	4800	$20	$96,000
3-person crews	2400	$20	$48,000
Total			$425,600
Total Labor Cost			$1,690,600

SECTION 5

REFERENCES

1) Draft Environmental Impact Report for the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan, March 1997

2) Great Basin Unified Air Pollution Control District Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan Comparative Cost Estimates, March 1997

3) "Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures", Environmental Protection Agency, document number EPA-450/2-92-004.

4) Agrarian Research and Management Report "Agrarian Test Area - Construction Cost Report" no date

5) RS Means Building Construction Cost Data, 1997

6) RS Means Mechanical Cost Data, 1997

7) Environmental Cost Handling Options and Solutions, 1997

SECTION 6

ACRONYMS

AMSL	above mean sea level
kW	kilowatt
kWh	kilowatt-hour
lb	pound
lb/hr	pound per hour
mi	mile
ton	short ton (2000 lb)
yd	yard
yd^3	cubic yard
yr	year

APPENDIX A

DETAILED COST ESTIMATE

PARSONS I & T - ESTIMATE WORKSHEET PAVNWORDROWSNROVS_8873.XLS

JOB NO.: 729572-04000
PROJECT: Owens Valley Lake Project
CLIENT: LA Department of Water and Power

Comparative Cost Estimates
Proposed Project Case
Xxxxxx

M.T.O. BY: G. Hart DATE: 04/08/97 EST DATE: 04/08/97
PRICED BY: G. Hart DATE: 04/08/97 PRINT DATE: 05/01/97
CHECKED BY: BM DATE: 04/08/97 REV. 0: 04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT: MATERIAL/ OTHER	LABOR: M/H	LABOR: P.F.	LABOR: RATE	EQUIP. $	SUB	MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ ITEM	TOTAL
	Summary - Base															
	Infrastructure											7,457,574				34,784,465
	Area A 1200 Acres											719,630				4,341,809
	Area B 7000 Acres											3,579,086				21,200,525
	Area C 3300 Acres											2,547,132				69,066,535
	Area D 8700 Acres											7,525,772				32,280,306
	Area E 1900 Acres											1,590,857				41,821,891
	Area F 225 Acres											261,664				1,701,299
	Total											23,681,714				$205,196,830
	Escalation to Mid Point of Construction (from 1/98 - 1/00 , 3% annual)	6.09	%													12,496,487
	Design Contingency															
	Revenue Tax on Total Contract															32,653,998
	Total Construction Cost (TCC)	1	ls												250,347,315	250,347,315
	Permitting	1.50	%													3,755,210
	Prelim. Engineering (Incl. Survey & Geotech. Service															10,013,893
	Final Engineering															7,510,419
	A&E Contingency															1,752,431
	Home Office Support, Overhead, Profit															7,510,419
	Inspection and Testing															2,503,473
	CM and I&T Contingency															1,001,389
	Subtotal	1	ls												284,394,550	284,394,550
	Owner's Engineering & Support															
	Subtotal	1	ls												284,394,550	284,394,550
	Construction Contingency															28,439,455
	TOTAL ESTIMATED COST (TEC)	1	ls												312,834,005	$ 312,834,005

PARSONS I & T - ESTIMATE WORKSHEET

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JOB NO.:	729572-04000	Comparative Cost Estimates	M.T.O. BY: G. Hart	DATE: 04/08/97	EST DATE: 04/08/97
PROJECT:	Owens Valley Lake Project	Proposed Project Case	PRICED BY: G. Hart	DATE: 04/08/97	PRINT DATE: 05/01/97
CLIENT:	LA Department of Water and Power	Xxxxxx	CHECKED BY: BM	DATE: 04/08/97	REV. 0: 04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT: MATERIAL/OTHER	LABOR: M/H	LABOR: P.F.	LABOR: RATE	EQUIP. $	SUB	MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ITEM	TOTAL
	Infrastructure															
	Water Line Piping Requirements															
	Conveyance Structure (Aqueduct/Pipeline)	1	ls			1.00	36.14		1,000,000	-	-	-	-	1,000,000	1,000,000	1,000,000
	60" Fiber Reinforced Pipe	31,680	lf	120.00	1.200	1.00	36.14	3.67		3,801,600	38,016	1,373,898	116,266	-	167.04	5,291,764
	42" Fiber Reinforced Pipe	73,920	lf	65.00	0.926	1.00	36.14	3.25		4,804,800	68,450	2,473,780	240,240	-	101.72	7,518,820
	36" Fiber Reinforced Pipe	52,800	lf	55.00	0.700	1.00	36.14	2.68		2,904,000	36,960	1,335,734	141,504	-	82.98	4,381,238
	18" Fiber Reinforced Pipe	5,280	lf	30.00	0.350	1.00	36.14	1.34		158,400	1,848	66,787	7,075	-	43.89	232,262
	Water Line Trench Excavation															
	60"FRP (31680' x 10' x 8')	93,867	cy		0.071	1.00	36.14	3.67		-	6,665	240,857	344,492	-	6.24	585,349
	Slope Stabilization	75,093	cy		0.071	1.00	36.14	3.67		-	5,332	192,684	275,591	-	6.24	468,275
	42"FRP (73920' x 7.5' x 6.5')	133,467	cy		0.071	1.00	36.14	3.67		-	9,476	342,468	489,824	-	6.24	832,292
	Slope Stabilization	115,671	cy		0.071	1.00	36.14	3.67		-	8,213	296,805	424,513	-	6.24	721,317
	36"FRP (52800' x 7' x 6')	82,133	cy		0.071	1.00	36.14	3.67		-	5,831	210,748	301,428	-	6.24	512,170
	Slope Stabilization	70,400	cy		0.071	1.00	36.14	3.67		-	4,998	180,642	258,368	-	6.24	439,010
	18"FRP (5280' x 5.5' x 4.5')	4,840	cy		0.071	1.00	36.14	3.67		-	344	12,419	17,763	-	6.24	30,182
	Slope Stabilization	3,900	cy		0.071	1.00	36.14	3.67		-	281	10,161	14,533	-	6.24	24,094
	Water Line Trench Backfill															
	60"FRP	145,933	cy		0.030	1.00	36.14	1.28		-	4,378	158,221	186,795	-	2.36	345,016
	42"FRP	222,811	cy		0.030	1.00	36.14	1.28		-	6,684	241,572	285,198	-	2.36	526,769
	36"FRP	138,717	cy		0.030	1.00	36.14	1.28		-	4,162	150,397	177,558	-	2.36	327,955
	18"FRP	8,023	cy		0.030	1.00	36.14	1.28		-	241	8,698	10,269	-	2.36	18,968
	Water Line Maintenance Roadway															
	Service Roadway Fill and Compaction (88,000 lf)	78,222	cy		0.02	1.00	36.14	1.20		-	1,564	56,539	93,866	-	1.92	150,405
	Roadway Gravel Base (163,680' x 16')	290,987	sy	4.15	0.010	1.00	36.14	0.29		1,207,596	2,910	105,163	84,386	-	4.80	1,397,145
	Facilities and General Conditions															
	Office Facilities															
	Office Trailer 24 x 60	1	ea	3,000.00						3,000	-	-	-	-	3,000.00	3,000
	Field Trailers (12' x 40' Area A, Area D)	2		1,500.00						3,000	-	-	-	-	1,500.00	3,000
	Modifications, delivery, and install	3		1,000.00						3,000	-	-	-	-	1,000.00	3,000
	Monthly Rent	36		900.00						32,400	-	-	-	-	900.00	32,400
	Dismantle and Return	3	ea	1,500.00						4,500	-	-	-	-	1,500.00	4,500
	Craft Dress Shack 12/60															
	Office Trailer 12 x 60	3	ea	3,000.00						9,000	-	-	-	-	3,000.00	9,000
	Modifications, delivery, and install	3	ea	1,000.00						3,000	-	-	-	-	1,000.00	3,000
	Monthly Rent	36	mo	900.00						32,400	-	-	-	-	900.00	32,400
	Dismantle and Return	3	ea	1,500.00						4,500	-	-	-	-	1,500.00	4,500
	Office Furniture, Supplies, and Equipment															
	Desks	12	ea	450.00						5,400	-	-	-	-	450.00	5,400
	Chairs	12	ea	200.00						2,400	-	-	-	-	200.00	2,400
	Vistor/Conf. room chairs	12	ea	100.00						1,200	-	-	-	-	100.00	1,200
	File Cabinets	12	ea	250.00						3,000	-	-	-	-	250.00	3,000
	Drawing Racks	6	ea	200.00						1,200	-	-	-	-	200.00	1,200
	Drawing Tables	6	ea	200.00						1,200	-	-	-	-	200.00	1,200
	Book Cases	8	ea	200.00						1,600	-	-	-	-	200.00	1,600
	Office Supplies	36	mo	450.00						16,200	-	-	-	-	450.00	16,200
	Copy Machine	1	ea	5,000.00						5,000	-	-	-	-	5,000.00	5,000
	Copy Machine Maintenance	36	mo	250.00						9,000				-	250	9,000
	Fax Machine	1	ea	1,700.00						1,700	-	-	-	-	1,700.00	1,700
	Computers Hardware	8	ea	2,500.00						20,000	-	-	-	-	2,500.00	20,000
	Computers Software	8	ea	400.00						3,200	-	-	-	-	400.00	3,200

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PARSONS I & T - ESTIMATE WORKSHEET

JOB NO.:	729572-04000	Comparative Cost Estimates	M.T.O. BY: G. Hart	DATE:	04/08/97	EST DATE:	04/08/97
PROJECT:	Owens Valley Lake Project	Proposed Project Case	PRICED BY: G. Hart	DATE:	04/08/97	PRINT DATE:	05/01/97
CLIENT:	LA Department of Water and Power	Xxxxxx	CHECKED BY: BM	DATE:	04/08/97	REV. 0:	04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT						MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ ITEM	TOTAL
				MATERIAL/ OTHER	LABOR M/H	LABOR P.F.	LABOR RATE	EQUIP. $	SUB							
	Construction Operations Requirements															
	Temporary Toilets	12	ea	80.00						960	-	-	-	-	80.00	960
	Portable Radios	8	ea	1,500.00						12,000	-	-	-	-	1,500.00	12,000
	Pickup Trucks/Vehicles	4	ea	750.00						3,000	-	-	-	-	750.00	3,000
	Vehicle Insurance	4	ea	120.00						480	-	-	-	-	120.00	480
	Gasoline and Maintenance	4	ea	120.00						480	-	-	-	-	120	480
	Safety Supplies (Glasses, Hardhats, etc.)	36	mo	500.00						18,000	-	-	-	-	500.00	18,000
	Petty Cash	1	ea	2,500.00						2,500	-	-	-	-	2,500.00	2,500
	Services															
	Water (Bottled for office only)	36	mo	120.00						4,320	-	-	-	-	120.00	4,320
	Telephone Installation	1	ea	800.00						800	-	-	-	-	800.00	800
	Telephone	36	mo	750.00						27,000	-	-	-	-	750.00	27,000
	Celular Telephones	5	ea	500.00						2,500	-	-	-	-	500	2,500
	Janitorial	36	mo	750.00						27,000	-	-	-	-	750.00	27,000
	Power	36	mo	2,000.00						72,000	-	-	-	-	2,000.00	72,000
	Pest Control	36	mo	100.00						3,600	-	-	-	-	100.00	3,600
	Postal & Pouch Service	36	mo	100.00						3,600	-	-	-	-	100.00	3,600
	Fed/Ex-Ups Service	36	mo	200.00						7,200	-	-	-	-	200.00	7,200
	Trips to and from the job site from Pasadena	72	ea	250.00		1.00	36.14			18,000	-	-	-	-	250.00	18,000
	Operations/Maintenance															
	Pre Engineered Building (60' x 80')	4,800	sf			1.00	36.14		22.00	-	-	-	-	105,600	22.00	105,600
	Subtotal									13,245,736	206,352	7,457,574	3,469,669	1,105,600		$ 25,278,579
	Sales Tax	7.50	%													993,430
	Freight on Material & Equipment	incl. above	%													-
	Sub-Contractor Mark-up															4,518,786
	Tax on Subcontracts	N/A	%													-
	Subtotal Direct Cost to Prime	1	ls												30,790,795	30,790,795
	Prime Contractor OH and G & A															2,463,264
	Prime Contractor Fee															997,622
	Bond															342,517
	All Risk Builder's Risk															190,268
	Equipment Floater (1.5% of Equip Value)															
	Note: Builders Risk Annual Cost, adjust for Sched.															
	Total Current Dollar Construction Cost	1	ls												34,784,465	34,784,465

Note: Escalation, design contingency, design, CM services, inspection and testing, owners engineering or construction contingency are shown at the Summary Level.

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PARSONS I & T - ESTIMATE WORKSHEET

JOB NO.:	729572-04000	Comparative Cost Estimates	M.T.O. BY: G. Hart	DATE:	04/08/97	EST DATE:	04/08/97
PROJECT:	Owens Valley Lake Project	Proposed Project Case	PRICED BY: G. Hart	DATE:	04/08/97	PRINT DATE:	05/01/97
CLIENT:	LA Department of Water and Power	Xxxxxx	CHECKED BY: BM	DATE:	04/08/97	REV. 0:	04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT: MATERIAL/ OTHER	LABOR: M/H	LABOR: P.F.	LABOR: RATE	EQUIP. $	SUB	MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ ITEM	TOTAL
	Area A 1200 Acres															
	Site Treatment (Flooding)															
	18" buried feeder pipe (4ea x 5,280')	21,120	lf	30.00	0.35	1.00	36.14	0.75		633,600	7,392	267,147	15,840	.	43.40	916,587
	18" Valves	4	ea	6,125.00	30.00	1.00	36.14	0.75		24,500	120	4,337	3	.	7,209.95	28,840
	12" buried irrigation pipe (30ea x 1320')	39,600	lf	18.00	0.12	1.00	36.14	0.75		712,800	4,752	171,737	29,700	.	23.09	914,237
	12" Valves	30	ea	1,525.00	14.12	1.00	36.14	0.75		45,750	424	15,307	23	.	2,035.97	61,079
	2" Risers @ 40" O.C.	11,880	ea	*37.50	0.34	1.00	36.14	0.75		445,500	4,039	145,977	8,910	.	50.54	600,387
	Excavation/Trenching for 12" & 18" buried pipe															
	80,720' x 1.5' wide x 2' deep	6,746	cy		0.02	1.00	36.14	1.49		.	135	4,876	10,052	.	2.21	14,928
	Backfill pipe	5,397	cy		0.02	1.00	36.14	1.28		.	108	3,901	6,908	.	2.00	10,809
	Collection Ditch at Lake side of Area															
	13,200lf x 10' x 6'	29,333	cy		0.02	1.00	36.14	1.49		.	587	21,202	43,706	.	2.21	64,908
	Return Piping 12"	15,840	lf	18.00	0.12	1.00	36.14	0.75		285,120	1,901	68,695	11,880	.	23.09	365,695
	12" Knife Gate Valves	9	ea	1,525.00	2.00	1.00	41.00			13,725	18	738	.	.	1,607.00	14,463
	Excavation/Trenching for 12" buried pipe															
	15840' x 1.5' wide x 2' deep	1,760	cy		0.02	1.00	36.14	1.49		.	35	1,272	2,622	.	2.21	3,895
	Backfill pipe	1,320	cy		0.030	1.00	36.14	1.28		.	40	1,431	1,690	.	2.36	3,121
	Recirculation Pumps at Collection Ditch (2500gpm)	2	ea	46,450.00	120.000	1.00	36.14	1.49		92,900	240	8,674	3	.	50,788.29	101,577
	Pump House and accessories	2	ea	2,500.00	60.000	1.00	36.14	1.49		5,000	120	4,337	3	.	4,669.89	9,340
	Subtotal									2,258,895	19,910	719,630	131,339	.	$	3,109,864
	Sales Tax	7.50	%													169,417
	Freight on Material & Equipment	incl. above	%													.
	Sub-Contractor Mark-up															564,036
	Tax on Subcontracts	N/A	%													.
	Subtotal Direct Cost to Prime	1	ls												3,843,318	3,843,318
	Prime Contractor OH and G & A															307,465
	Prime Contractor Fee															124,523
	Bond															42,753
	All Risk Builder's Risk															23,749
	Equipment Floater (1.5% of Equip Value)															
	Note: Builders Risk Annual Cost, adjust for Sched.															
	Total Current Dollar Construction Cost	1	ls												4,341,809	4,341,809

Note: Escalation, design contingency, design, CM services, inspection and testing, owners engineering or construction contingency are shown at the Summary Level.

PARSONS I & T - ESTIMATE WORKSHEET [illegible]

JOB NO.:	729572-04000	Comparative Cost Estimates	M.T.O. BY: G. Hart	DATE: 04/08/97	EST DATE:	04/08/97
PROJECT:	Owens Valley Lake Project	Proposed Project Case	PRICED BY: G. Hart	DATE: 04/08/97	PRINT DATE:	05/01/97
CLIENT:	LA Department of Water and Power	Xxxxxx	CHECKED BY: SM	DATE: 04/08/97	REV. 0:	04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT: MATERIAL/ OTHER	LABOR: M/H	LABOR: P.F.	LABOR: RATE	EQUIP. $	SUB	MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ ITEM	TOTAL
	Area 8 7000 Acres															
	Site Treatment (Flooding)															
	18" buried feeder pipe	112,000	lf	30.00	0.35	1.00	36.14	0.75		3,360,000	39,200	1,416,688	84,000	-	43.40	4,860,688
	18" Valves	8	ea	6,125.00	30.00	1.00	36.14	0.75		49,000	240	8,674	6	-	7,209.95	57,680
	12" buried irrigation pipe 7 ea x 17,771'	124,400.00	lf	18.00	0.12	1.00	36.14	0.75		2,239,200	14,928	539,498	93,300	-	23.09	2,871,998
	12" buried irrigation pipe 8 ea x 13,200'	105,600.00	lf	18.00	0.12	1.00	36.14	0.75		1,900,800	12,672	457,966	79,200	-	23.09	2,437,966
	12" Valves	48	ea	1,525.00	14.12	1.00	36.14	0.75		73,200	678	24,491	36	-	2,035.97	97,727
	2" Risers @ 40" O.C.	70,000.00	ea	37.50	0.34	1.00	36.14	0.75		2,625,000	23,800	860,132	52,500	-	50.54	3,537,632
	Excavation/Trenching for 12" buried pipe															
	298,320' x 1.5' wide x 2' deep	33,148	cy		0.02	1.00	36.14	1.49		-	663	23,958	49,388	-	2.21	73,345
	Backfill pipe	24,472	cy		0.02	1.00	36.14	1.28		-	489	17,688	31,324	-	2.00	49,013
	Collection Ditch at Lake side of Area															
	26,400lf x 10' x 6'	58,667	cy		0.02	1.00	36.14	1.49		-	1,173	42,405	87,414	-	2.21	129,818
	Return Piping 12"	36,960	lf	18.00	0.12	1.00	36.14	0.75		665,280	4,435	160,288	27,720	-	23.09	853,288
	12" Knife Gate Valves	18	ea	1,525.00	2.00	1.00	41.00			27,450	36	1,476	-	-	1,607.00	28,926
	Excavation/Trenching for 12" buried pipe															
	36900' x 1.5' wide x 2' deep	4,100	cy		0.02	1.00	36.14	1.49		-	82	2,968	6,118	-	2.21	9,086
	Backfill pipe	3,080	cy		0.030	1.00	36.14	1.28		-	92	3,339	3,942	-	2.36	7,282
	Recirculation Pumps at Collection Ditch (2500gpm)	3	ea	46,450.00	120.000	1.00	36.14	1.49		139,350	360	13,010	4	-	50,788.29	152,365
	Pump House and accessories	3	ea	2,500.00	60.000	1.00	36.14	1.49		7,500	180	6,505	4	-	4,669.89	14,010
	Subtotal									11,086,780	99,029	3,579,086	514,957	-	$	15,180,823
	Sales Tax	7.50	%													831,509
	Freight on Material & Equipment	incl. above	%													-
	Sub-Contractor Mark-up															2,754,121
	Tax on Subcontracts	N/A	%													-
	Subtotal Direct Cost to Prime	1	ls												18,766,452	18,766,452
	Prime Contractor OH and G & A															1,501,316
	Prime Contractor Fee															608,033
	Bond															208,758
	All Risk Builder's Risk															115,965
	Equipment Floater (1.5% of Equip Value)															
	Note: Builders Risk Annual Cost, adjust for Sched.															
	Total Current Dollar Construction Cost	1	ls												21,200,525	21,200,525

Note: Escalation, design contingency, design, CM services, inspection and testing, owners engineering or construction contingency are shown at the Summary Level.

PARSONS I & T - ESTIMATE WORKSHEET

JOB NO.: 729572-04000 — Comparative Cost Estimates — M.T.O. BY: G. Hart — DATE: 04/08/97 — EST DATE: 04/08/97
PROJECT: Owens Valley Lake Project — Proposed Project Case — PRICED BY: G. Hart — DATE: 04/08/97 — PRINT DATE: 05/01/97
CLIENT: LA Department of Water and Power — Xxxxxx — CHECKED BY: BM — DATE: 04/08/97 — REV. 0: 04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT: MATERIAL/ OTHER	LABOR: M/H	LABOR: P.F.	LABOR: RATE	EQUIP. $	SUB	MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ ITEM	TOTAL
	Area C 3300 Acres															
	East Side Haul Road Construction															
	N.E corner Area C to S.E. corner of Area C (7mi.)															
	Excavation (24' x 2'-Cut/Fill)	65,706	cy		0.02	1.00	36.14	1.20		-	1,314	47,492	78,847	-	1.92	126,339
	Base Stone Fill (8")	22,012	cy	7.00	0.010	1.00	36.14	3.65		154,084	220	7,955	80,344	-	11.01	242,383
	Haul Roads on Playa for placement															
	20' wide x 2' fill x 14520'	14,520	cy		0.02	1.00	41.00	1.20		-	290	11,906	17,424	-	2.02	29,330
	500' spacing @ 3 mi = 31 ea	450,120	cy		0.02	1.00	41.00	1.20		-	9,002	369,098	540,144	-	2.02	909,242
	Conveyor for transporting rock from quarry site															
	Quarry to N.E corner of Area C (5 mi.)	26,400	lf			1.00	36.14		550.00	-	-	-	-	14,520,000	550.00	14,520,000
	Salvage Value of conveyor (25%)	26,400	lf			1.00	36.14		(138.00)	-	-	-	-	(3,643,200)	(138.00)	(3,643,200)
	Rock Production															
	Quarry, screening, etc.	1,775,400	cy			1.00	36.14		7.00	-	-	-	-	12,427,800	7.00	12,427,800
	Rock Placement															
	Geotextile Fabric over entire area	15,972,000	sy	1.18	0.001	1.00	41.00	0.03		18,846,960	15,972	654,852	399,300	-	1.25	19,901,112
	Rock Placement on playa	1,775,400	cy		0.020	1.00	41.00	1.53		-	35,508	1,455,828	2,716,362	-	2.35	4,172,190
	Rock Placement transportation to playa	1,775,400	cy			1.00	41.00		3.65	-	-	-	-	6,480,210	3.65	6,480,210
	(Including loading cost)															
	Dust Control during placement/transportation of rock															
	(two each 6000gal water trucks 8800hrs)	1,775,400	cy			1.00	36.14	0.30		-	-	-	532,620	-	0.30	532,620
	Maintenance of Haul Roads															
	Grading and base stone repairs 20% of cost	501,600				1.00	36.14		0.66	-	-	-	-	331,056	0.66	331,056
	Subtotal									19,001,044	62,307	2,547,132	4,365,041	30,115,866	$	56,029,083
	Sales Tax	7.50	%													1,425,078
	Freight on Material & Equipment	incl. above	%													-
	Sub-Contractor Mark-up															4,018,967
	Tax on Subcontracts	N/A	%													-
	Subtotal Direct Cost to Prime	1	ls												61,473,128	61,473,128
	Prime Contractor OH and G & A															4,917,850
	Prime Contractor Fee															1,991,729
	Bond															683,827
	All Risk Builder's Risk															-
	Equipment Floater (1.5% of Equip Value)															
	Note: Builders Risk Annual Cost, adjust for Sched.															
	Total Current Dollar Construction Cost	1	ls												69,086,535	69,086,535

Note: Escalation, design contingency, design, CM services, inspection and testing, owners engineering or construction contingency are shown at the Summary Level.

PARSONS I & T - ESTIMATE WORKSHEET

JOB NO.: 729572-04000	Comparative Cost Estimates	M.T.O. BY: G. Hart	DATE: 04/08/97	EST DATE: 04/08/97
PROJECT: Owens Valley Lake Project	Proposed Project Case	PRICED BY: G. Hart	DATE: 04/08/97	PRINT DATE: 05/01/97
CLIENT: LA Department of Water and Power	Xxxxxx	CHECKED BY: BM	DATE: 04/08/97	REV. 0: 04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT: MATERIAL/ OTHER	LABOR: M/H	LABOR: P.F.	LABOR: RATE	EQUIP. $	SUB	MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ ITEM	TOTAL
	Area D 8700 Acres															
	<u>Dams: Excavation, Berms, and Compaction</u>															
	400' x 400' x 3'deep (each typical)	17,777.00	cy		0.01	1.00	41.00	0.75		-	178	7,289	13,333	-	1.16	20,621
	Dams (54 ea)	959,958.00	cy		0.01	1.00	41.00	0.75		-	9,600	393,583	719,969	-	1.16	1,113,551
	<u>Delivery Channels</u>															
	Delivery Channels (900' x 60' x 6') Typical	12,000	cy		0.01	1.00	41.00	0.75		-	120	4,920	9,000	-	1.16	13,920
	Delivery Channels (54 ea)	648,000.00	cy		0.01	1.00	41.00	0.75		-	6,480	265,680	486,000	-	1.16	751,680
	<u>Panels</u>															
	Flood Panels (3000' x 200' x 1') Typical	22,222	cy		0.01	1.00	41.00	0.75		-	222	9,111	16,667	-	1.16	25,779
	Flood Panels (439 ea)	9,755,458	ea		0.01	1.00	41.00	0.75		-	97,555	3,999,738	7,316,594	-	1.16	11,316,331
	<u>Feed Piping</u>															
	18" Pipe	13,200	lf	30.00	0.35	1.00	36.14	0.75		396,000	4,620	166,967	9,900	-	43.40	572,867
	18" Valves	165	ea	6,125.00	30.00	1.00	36.14	0.75		1,010,625	4,950	178,893	124	-	7,209.95	1,189,642
	12" buried irrigation pipe (4 ea x 20' x 440ea)	35,200.00	lf	18.00	0.12	1.00	36.14	0.75		633,600	4,224	152,655	26,400	-	23.09	812,655
	12" Knife Gate Valves	1,760	ea	1,525.00	2.00	1.00	41.00			2,684,000	3,520	144,320	-	-	1,607.00	2,828,320
	<u>Collector Ditch</u>															
	Collector Ditches (3000' x 10' x 6') Typical	6,667	cy		0.01	1.00	41.00	0.75		-	67	2,733	5,000	-	1.16	7,734
	Collector Ditches (54 ea)	360,018	cy		0.01	1.00	41.00	0.75		-	3,600	147,607	270,014	-	1.16	417,621
	<u>Maintenance Roads and Ditches</u>															
	Each Dam (12' wide-1600lf) Typical	1,600	cy		0.02	1.00	41.00	1.20		-	32	1,312	1,920	-	2.02	3,232
	Roads and Ditches	86,400	cy		0.02	1.00	41.00	1.20		-	1,728	70,848	103,680	-	2.02	174,528
	<u>Managed Vegetation</u>															
	Tilling Area for Planting	6,525			5.00	1.00	36.14	150.00		-	32,625	1,179,068	978,750	-	330.70	2,157,818
	Planting Vegetation	6,525			2.08	1.00	36.14	50.00		-	13,572	490,492	326,250	-	125.17	816,742
	<u>Recirculate Collector Water to Area F</u>															
	12" buried water line (4 miles)	21,120.00	lf	18.00	0.12	1.00	36.14	0.75		380,160	2,534	91,593	15,840	-	23.09	487,593
	12" Valves	12	ea	1,525.00	14.12	1.00	36.14	0.75		18,300	169	6,123	9	-	2,035.97	24,432
	Recirculation Pumps (2500gpm)	4	ea	46,450.00	120.000	1.00	36.14	1.49		185,800	480	17,347	6	-	50,788.29	203,153
	<u>Recirculate Collector Water to Area B</u>															
	12" buried water line (7 miles)	36,960.00	lf	18.00	0.12	1.00	36.14	0.75		665,280	4,435	160,288	27,720	-	23.09	853,288
	12" Valves	18	ea	1,525.00	14.12	1.00	36.14	0.75		27,450	254	9,184	14	-	2,035.97	36,648
	Recirculation Pumps (2500gpm)	4	ea	46,450.00	120.000	1.00	36.14	1.49		185,800	480	17,347	6	-	50,788.29	203,153
	Pump House and accessories	4	ea	2,500.00	60.000	1.00	36.14	1.49		10,000	240	8,674	6	-	4,669.89	18,680
	Subtotal									6,197,015	191,685	7,525,772	10,327,199	-	$	24,049,986
	Sales Tax	7.50	%													464,776
	Freight on Material & Equipment	incl. above	%													-
	Sub-Contractor Mark up															4,216,539
	Tax on Subcontracts	N/A	%													-
	Subtotal Direct Cost to Prime	1	ls												28,731,301	28,731,301

PARSONS I & T - ESTIMATE WORKSHEET

PAWRWORDROWENSOVS_EST3.XLS

JOB NO.: 729572-04000 — Comparative Cost Estimates
PROJECT: Owens Valley Lake Project — Proposed Project Case
CLIENT: LA Department of Water and Power — Xxxxxx

M.T.O. BY: G. Hart — DATE: 04/08/97 — EST DATE: 04/08/97
PRICED BY: G. Hart — DATE: 04/08/97 — PRINT DATE: 05/01/97
CHECKED BY: BM — DATE: 04/08/97 — REV. 0: 04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT						MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ ITEM	TOTAL
				MATERIAL/ OTHER	LABOR M/H	LABOR P.F.	RATE	EQUIP. $	SUB							
	Prime Contractor OH and G & A															2,298,504
	Prime Contractor Fee															930,894
	Bond															319,607
	All Risk Builder's Risk															.
	Equipment Floater (1.5% of Equip Value)															
	Note: Builders Risk Annual Cost, adjust for Sched.															
	Total Current Dollar Construction Cost	1	ls												32,280,306	32,280,306

Note: Escalation, design contingency, design, CM services, inspection and testing, owners engineering or construction contingency are shown at the Summary Level.

PARSONS I & T - ESTIMATE WORKSHEET

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JOB NO.:	729572-04000	Comparative Cost Estimates	M.T.O. BY: G. Hart	DATE: 04/08/97	EST DATE:	04/08/97
PROJECT:	Owens Valley Lake Project	Proposed Project Case	PRICED BY: G. Hart	DATE: 04/08/97	PRINT DATE:	05/01/97
CLIENT:	LA Department of Water and Power	Xxxxxx	CHECKED BY: BM	DATE: 04/08/97	REV. 0:	04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT: MATERIAL/ OTHER	LABOR: M/H	LABOR: P.F.	LABOR: RATE	EQUIP. $	SUB	MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ ITEM	TOTAL
	Area E 1900 Acres															
	East Side Haul Road Construction															
	From South side Area C to South side Area E (10mi.)															
	Excavation (24' wide x 2'-Cut/Fill)	93,867	cy		0.020	1.00	41.00	1.20		-	1,877	76,971	112,640	-	2.02	189,611
	Base Stone Fill (8")	31,445	cy	7.00	0.010	1.00	41.00	5.25		220,115	314	12,892	165,086	-	12.66	398,094
	Haul Roads for placement															
	20' wide x 2' fill x 15840' @ 500 spacing	14,520	cy		0.020	1.00	41.00	1.20		-	290	11,906	17,424	-	2.02	29,330
	500' spacing @ 1.5 mi = 15 ea	217,800	cy		0.020	1.00	41.00	1.20		-	4,356	178,596	261,360	-	2.02	439,956
	Base Stone Fill (8")	232,320	cy	7.00	0.010	1.00	41.00	5.25		1,626,240	2,323	95,251	1,219,680	-	12.66	2,941,171
	Rock production															
	Quarry, Screening, etc.	1,022,200	cy			1.00	36.14		7.00	-	-	-	-	7,155,400	7.00	7,155,400
	Rock Placement															
	Geotextile Fabric over entire area	9,196,000	sy	1.18	0.001	1.00	41.00	0.03		10,851,280	9,196	377,036	275,880	-	1.25	11,504,196
	Rock Placement on playa	1,022,200	cy		0.020	1.00	41.00	1.53		-	20,444	838,204	1,563,966	-	2.35	2,402,170
	Rock Placement transportation to playa	1,022,200	cy			1.00	41.00	5.15		-	-	-	5,264,330	-	5.15	5,264,330
	(Including loading cost)															
	Dust Control during placement/transportation of rock															
	(two each 6000gal water trucks 8800hrs)	1,022,200	cy			1.00	36.14	0.30		-	-	-	306,660	-	0.30	306,660
	Maintenance of Haul Roads															
	Grading and base stone repairs 20% of cost	269,280	lf			1.00	36.14		0.66	-	-	-	-	177,725	0.66	177,725
	Subtotal									12,697,635	38,801	1,590,857	9,187,027	7,333,125	$	30,808,643
	Sales Tax	7.50	%													952,323
	Freight on Material & Equipment	incl. above	%													-
	Sub-Contractor Mark-up															5,462,886
	Tax on Subcontracts	N/A	%													-
	Subtotal Direct Cost to Prime	1	ls												37,223,852	37,223,852
	Prime Contractor OH and G & A															2,977,908
	Prime Contractor Fee															1,206,053
	Bond															414,078
	All Risk Builder's Risk															-
	Equipment Floater (1.5% of Equip Value)															
	Note: Builders Risk Annual Cost, adjust for Sched.															
	Total Current Dollar Construction Cost	1	ls												41,821,891	41,821,891

Note: Escalation, design contingency, design, CM services, inspection and testing, owners engineering or construction contingency are shown at the Summary Level.

PARSONS I & T - ESTIMATE WORKSHEET

JOB NO.:	729572-04000	Comparative Cost Estimates	M.T.O. BY: G. Hart	DATE:	04/08/97	EST DATE:	04/08/97
PROJECT:	Owens Valley Lake Project	Proposed Project Case	PRICED BY: G. Hart	DATE:	04/08/97	PRINT DATE:	05/01/97
CLIENT:	LA Department of Water and Power	Xxxxxx	CHECKED BY: BM	DATE:	04/08/97	REV. 0:	04/08/97

DWG/REF & ACCNT	LOCATION & DESCRIPTION	QUANTITY	UNIT	COST OR M/HOURS PER UNIT MATERIAL/ OTHER	LABOR M/H	LABOR P.F.	LABOR RATE	EQUIP. $	SUB	MATERIAL	LAB HRS	LABOR	EQUIPMENT	SUB	UNIT PRICE/ ITEM	TOTAL
	Area F 225 Acres															
	Site Treatment (Flooding)															
	18" buried feeder pipe	6,200	lf	30.00	0.35	1.00	36.14	0.75		186,000	2,170	78,424	4,650	-	43.40	269,074
	18" Valves	3	ea	6,125.00	30.00	1.00	36.14	0.75		18,375	90	3,253	2	-	7,209.95	21,630
	12" buried irrigation pipe 8,000lf x 3 each	8,000.00	lf	18.00	0.12	1.00	36.14	0.75		144,000	900	34,694	6,000	-	23.09	184,694
	12" Knife Gate Valves	12	ea	1,525.00	2.00	1.00	41.00			18,300	24	984	-	-	1,607.00	19,284
	2" Risers @ 40" O.C.	2,400.00	ea	37.50	0.34	1.00	36.14	0.75		90,000	816	29,490	1,800	-	50.54	121,290
	Excavation/Trenching for 12" buried pipe															
	19,800' x 1.5' wide x 2' deep	2,200	cy		0.02	1.00	36.14	1.49		-	44	1,590	3,278	-	2.21	4,868
	Backfill pipe	1,540	cy		0.030	1.00	36.14	1.28		-	46	1,670	1,971	-	2.36	3,641
	Collection Ditch at Lake side of Area															
	21,200lf x 5' x 3'	11,777	cy		0.02	1.00	36.14	1.49		-	236	8,512	17,548	-	2.21	26,060
	Return Piping 12"	21,200	lf	18.00	0.12	1.00	36.14	0.75		381,600	2,544	91,940	15,900	-	23.09	489,440
	12" Knife Gate Valves	12	ea	1,525.00	2.00	1.00	41.00			18,300	24	984	-	-	1,607.00	19,284
	Excavation/Trenching for 12" buried pipe															
	21200' x 1.5' wide x 2' deep	2,355	cy		0.02	1.00	36.14	1.49		-	47	1,702	3,509	-	2.21	5,211
	Backfill pipe	1,766	cy		0.030	1.00	36.14	1.28		-	53	1,915	2,260	-	2.36	4,175
	Recirculation Pumps at Collection Ditch (2500gpm)	1	ea	46,450.00	120.000	1.00	36.14	1.49		46,450	120	4,337	1	-	50,788.29	50,788
	Pump House and accessories	1	ea	2,500.00	60.000	1.00	36.14	1.49		2,500	60	2,168	1	-	4,669.89	4,670
	Subtotal									905,525	7,234	261,664	56,922	-	$	1,224,110
	Sales Tax	7.50	%													67,914
	Freight on Material & Equipment	incl. above	%													-
	Sub-Contractor Mark-up															222,228
	Tax on Subcontracts	N/A	%													-
	Subtotal Direct Cost to Prime	1	ls												1,514,253	1,514,253
	Prime Contractor OH and G & A															121,140
	Prime Contractor Fee															49,062
	Bond															16,845
	All Risk Builder's Risk															
	Equipment Floater (1.5% of Equip Value)															-
	Note: Builders Risk Annual Cost, adjust for Sched.															
	Total Current Dollar Construction Cost	1	ls												1,701,299	1,701,299

Note: Escalation, design contingency, design, CM services, inspection and testing, owners engineering or construction contingency are shown at the Summary Level.

MID 1996 - MID 1997 WAGE AND BENEFIT RATES

State Prevailing Wages Inyo County 1

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PWWORDWENOVS 1973.X

Craft No.	Craft	J-man w/o Escal	Fringes Rate	Craft Ratio J	A	F	Base Rate	S 00 Sitework	M 01 Mass Excav	N 30&40 Concrete	T 50 Steel	B 70-130 Buildings	Q 11 Equipment	P 150 a & b Piping	H 150 e HVAC	E 160 Electrical	F 90 Painting	I 70 & 150 Insulation	Craft %	Expiration Date
02	Boilermaker	28.31	8.76	28.31	24.06	29.56														
				5	1	1	27.88						15						1.50	
04	Bricklayers	26.57	7.63	25.84	21.96	29.07														
				5	1	1	25.75												0.00	
06	Carpenters	23.23	5.10	23.23	19.75	24.73														
				7	1	1	23.01	20		45	1	40	1						8.70	
08	Cement Masons	21.00	9.31	21.00	17.85	22.00														
				5	1	1	20.69			6									0.60	
18	Electricians	29.54	11.42	29.54	25.11	31.04														
				7	1	1	29.21					0	5			96.5			10.15	
24	Insulators	33.13	6.78	33.13	28.16	34.63														
				5	1	1	32.63					6						88	9.40	
26	Iron Workers - Struct	22.06	12.39	22.06	18.75	24.06														
				9	1	1	21.94	0		19	79	14	7	1		0.5		1	12.15	
27	Iron Workers - Rebar	22.06	12.39	22.06																
																			0.00	N/A
28	Laborers	18.81	9.11	18.81	15.99	19.81														
				9	1	1	18.64	55	20	24		30	17	10		1	4	4	11.00	
32	Millwrights	23.90	10.61	23.90	20.32	25.40														
				5	1	1	23.60						20						2.00	
34	Oilers	21.46	12.33	21.46		0.00														
				1		0	21.46	1			2	1	2	1	1				0.70	
36	Operators	26.84	9.89	26.84		29.52														
				9		1	27.11	14	70	4	15	5	14	1	1	1.5	3		11.45	
38	Painters	23.14	8.05	23.14	19.67	24.39														
				7	1	1	22.89					0	5				93		9.80	
42	Pipefitters	32.02	11.39	32.02	27.22	35.22														
				4	1	1	31.75					0	10	85	27			2	12.40	
48	Sheet Metal	34.15	11.42	34.15	29.03	36.15														
				4	1	1	33.63					2			70			4	7.60	
54	Teamsters	18.81	9.11	18.81		19.11														
				0		0	19.08	10	10	2	3	2	4	2	1	0.5		1	2.55	
17	Foreman (Predominant Craft)						N/A												0.00	
								100	100	100	100	100	100	100	100	100	100	100	1000	
	Average Base Rate Without Benefits	A						20.77	24.61	21.71	22.63	22.45	24.61	29.94	32.79	28.99	22.85	31.85		
	Average Benefit Rate	B						8.45	9.66	7.97	11.84	7.94	10.01	11.12	11.38	11.37	8.15	7.23		
	Workman's Comp Insurance	C = A*c						3.09	2.20	4.73	4.70	4.70	4.99	3.51	4.62	2.90	4.31	7.08		
	Payroll Burdens, (Fica + Sui + Fui + CGL)	D = A*	13.9%					2.88	3.41	3.01	3.13	3.11	3.41	4.15	4.54	4.02	3.16	4.41		
	PL/PD, Insurance	E = A*	1.55%					0.32	0.38	0.34	0.35	0.35	0.38	0.46	0.51	0.45	0.35	0.49		
	Small Tools/Consumables	F = A*	3.0%					0.62	0.74	0.65	0.68	0.67	0.74	0.90	0.98	0.87	0.69	0.96		
	Total Wage Rate/Hr, w/o O&P							36.14	41.00	38.40	43.34	39.23	44.14	50.08	54.83	48.59	39.51	52.03		
	Workmen's Comp Insurance %	c						15%	9%	22%	21%	21%	20%	12%	14%	10%	19%	22%		

MID 1996 - MID 1997 WAGE AND BENEFIT RATES
WORKER'S COMP RATE CALCS

Rates Davis Bacon for NIF - LLNL   Escalation 1

Craft No.	Craft	9/6/96 J-man w/o Escal	Worker's Comp	Craft Ratio J	Craft Ratio A	Craft Ratio F	Base Rate	S 00 Sitework	M 01 Mass Excav	N 30&40 Concrete	T 50 Steel	B 70-130 Buildings	Q 11 Equipment	P 150 a & b Piping	H 150 c HVAC	E 160 Electrical	P 90 Painting	I 70 & 150 Insulation	Craft %	Expiration Date
02	Boilermaker	28.31	12%	28.31 / 5	24.06 / 1	27.43 / 1	27.58						15						1.50	
04	Bricklayers	26.57	15%	25.84 / 5	21.96 / 1	29.07 / 1	25.75												0.00	
06	Carpenters	24.50	28%	24.50 / 7	20.83 / 1	26.00 / 1	24.26	20		45	1	40	1						8.70	
08	Cement Masons	21.00	15%	21.00 / 5	17.85 / 1	22.00 / 1	20.69			6									0.60	
18	Electricians	29.54	10%	29.54 / 7	25.11 / 1	31.04 / 1	29.21					0	5			96.5			10.15	
24	Insulators	33.13	23%	33.13 / 5	28.16 / 1	34.63 / 1	32.63					6						88	9.40	
26	Iron Workers - Struct	22.06	24%	22.06 / 9	18.75 / 1	24.06 / 1	21.94	0		19	79	14	7	1		0.5		1	12.15	
27	Iron Workers - Rebar	22.06	24%	22.06															0.00	N/A
28	Laborers	21.25	13%	21.25 / 9	18.06 / 1	22.25 / 1	21.05	55	20	24		30	17	10		1	4	4	11.00	
32	Millwrights	23.90	28%	23.90 / 5	20.32 / 1	25.40 / 1	23.60						20						2.00	
34	Oilers	21.46	8%	21.46 / 1		0.00 / 0	21.46	1			2	1	2	1	1				0.70	
36	Operators	31.35	8%	31.35 / 9		34.49* / 1	31.66	14	70	4	15	5	14	1	1	1.5	3		11.45	
38	Painters	23.14	19%	23.14 / 7	19.67 / 1	24.39 / 1	22.89					0	5				93		9.80	
42	Pipefitters	32.02	12%	32.02 / 4	27.22 / 1	35.22 / 1	31.75					0	10	85	27			2	12.40	
48	Sheet Metal	34.15	15%	34.15 / 4	29.03 / 1	36.15 / 1	33.63					2			70			4	7.60	
54	Teamsters	20.41	8%	20.41 / 0		20.71 / 0	20.68	10	10	2	3	2	4	2	1	0.5		1	2.55	
17	Foreman (Predominant Craft)						N/A												0.00	
								100	100	100	100	100	100	100	100	100	100	100	1000	
	Average Base Rate Without Benefits	A						23.15	28.44	23.06	23.38	23.93	25.68	30.26	32.85	29.09	23.08	31.97		
	Average Worker's Comp %	B						15%	9%	22%	21%	21%	16%	12%	14%	10%	19%	22%		
	Workmen's Comp Insurance %	A						15%	9%	22%	21%	21%	20%	12%	14%	10%	19%	22%		

APPENDIX B

ASSUMPTIONS USED TO ESTIMATE CAPITAL COST

APPENDIX B

ASSUMPTIONS USED TO ESTIMATE CAPITAL COST

The capital cost is estimated at $312,834,000. The following basis was used to develop the estimate.

General Estimating Assumptions for total project:

- Wage Rates used are State Prevailing Wages for Inyo County.
- Escalation added at 6.09% to mid point of construction January 2000 with a start date anticipated of Jan. 1998 and duration of 4 years.
- Design contingency of 15% added for changes in design and technologies during the construction process. This is a standard contingency applied to estimates in the engineering industry for early stage projects.
- Engineering design costs added as Preliminary Engineering (including Survey and Geotechnical Services); Final Engineering
- 5% contingency added for AE services. This is a standard contingency applied to an early stage projects.
- CM (construction management) services added at 4% to total construction costs. This is a standard value for large construction projects.
- I&T (inspection and testing) estimated at 2% total construction costs. This is a standard value for large construction projects.
- CM and I&T contingency estimated at 5%. This is a standard value for large construction projects.
- Construction contingency added at 10% to bottom line for scope and client changes and additions anticipated during project. At this early stage of project development, a 10% contingency is standard.

General Estimating Assumptions for each area:

- Taxes added to all materials at 7.5%.
- No freight has been added to the estimate for material deliveries. All material pricing includes freight to project site.
- Prime contractor OH and G & A added at 8% and contractor fee at 3%. These are typical values for large construction projects.
- Bond added at 1%. (Typical for large construction projects)
- Builders Risk insurance added at 0.55%. (Typical for large construction projects)

- **A subcontractor mark-up has been added to each area estimate of 17.2%. This is an average in the construction industry based on the experience of Parsons Constructors, Inc.**

Infrastructure:

- **Piping quantities and sizes from preconceptual engineering effort area layout and dimensions.**
- **Piping material prices from pricing received from vendor.**
- **Pipe trenching excavation based on 1' excavation under pipe, 2' fill over pipe, with slope stabilization of 1:1.**
- **Trench backfill estimated using existing sand and materials (no stone backfill or hauled in materials for backfill)**
- Maintenance road excavation estimated at 16' wide (construction and maintenance road only) Also, included 6" stone base for all maintenance roads. Maintenance and construction roads estimated to Southeast corner of Area B. Haul roads for Areas C and E to be used for maintenance roads after construction of these areas.
- Facilities and GC estimated from Parsons' construction company adjusted to a 3 year construction schedule (36mo.) Field management included in Home Office Support.
- Construction office estimated to be 24' x 60' with two additional 12' x 40' offices located in areas A & D.

Area A:

- Barrier wall assumed to be "Slurry Wall" construction with cement slurry mixture 25' deep full length of lake side boundary. (15,180 feet)
- Site flooding estimated with 4 each 18" feeder lines perpendicular to the lake (21,120 feet)
- 12" water lines parallel to the contours of area A spaced at 400 feet apart over a distance of 2.5 miles. (30 each @ 1,320 feet = 39,600 feet)
- Risers estimated as 12"x12" tees with valves on top to regulate water flow. Estimated at every 40" of line. (11,880 each).
- Excavation estimated at 2' deep maximum bury for flood lines.
- Collection ditch for recirculation estimate on lake side of area A boundary (13,200lf). All collector ditches estimated at 10' wide x 6' deep
- Recirculation pumps w/ pump housing estimated 2 each.
- Price used for 2500-gpm pumps is $46K for diesel operating and accessories. This cost is based on an oral vendor quote.

Area B:

- General estimate prepared same as Area A.
- All quantities adjusted to match Area B boundaries and lengths/widths.
- See above.

Area C:

- Estimated 24' wide haul road on East side of Area C for the entire length of East boundary. (7 miles long)

- Estimated 2' cut/fill for roadway excavation.
- Estimated 8" base stone fill for roadway surface for haul road.
- Added haul roads at 500' intervals perpendicular to East haul road for stone placement over lake bottom.
- Conveyor estimated from Quarry site to edge of Area C only (5 miles long). Figured loading stone onto trucks for delivery to actual placement. Loading from stockpile included in haul price of stone to lake bottom. All placement delivery by truck. Cost is estimated from Parsons' in-house data from mining projects.
- Assumed 25% salvage value for conveyor per conversations with vendor.
- Quarry site and production estimated at $7 per CY. Including reclamation of quarry, all equipment, and manufacturing of required stone. This price is for loaded gravel at the quarry. If the Keeler Fan gravel is unacceptable and another gravel source must be used, the cost for transportation of gravel may be considerably higher.
- Rock placement estimated on unit price per CY using graders with low profile tires for operation on lake playa.
- Geotextile estimated at $1.18/SY per vendor verbal quotations.

Area D:
- Estimated as dams and panels for flooding and vegetation.
- Dams estimated as 400' x 400' x 3' excavation with berms constructed around each dam. Retention of approximately 4' water anticipated. 55 dams required.
- Delivery channels estimated at 900' long X 60' wide X 6' deep typical. Channels estimated as 55 each same as dam requirements.
- Panels estimated at 3000' long X 200' wide approximately 1' deep.
- Panels estimated at 8 per each set of dams, or total of 440 each.
- Feed pipe estimated at 13,200 lf with total of 165 each 12" valves.
- Collector ditches estimated for each set of dams and panels 3000' x 8' x 4'. To collect water for recirculation.
- Added quantities and estimate for tilling and planting.
- Eight recirculation pumps estimated for recirculation to areas A, B, & F.

Area E:
- Estimated same as Area C for stone placement.
- Included haul road for transportation of stone from Area C to Area E (10 miles).
- Rock production and placement same as estimated in Area C adjusted to quantities for and additional haul Area E.

Area F:
- Estimated as flooding. Same as estimated in Areas A and B.
- Used Slurry Wall construction for Barrier Wall designated (10,560 feet)
- Also, included collection ditching and pumps for recirculation. (10,560 feet)

APPENDIX C

SUPPORTING DATA

APPENDIX C

SUPPORTING DATA

C.1 WATER TRANSMISSION LINE

The water line will serve Areas A, B, D, and F and is considered part of the overall infrastructure.

The concept for the water line is based on an annual flow of Aqueduct water at a rate of 51,000 AF/year or an average flow rate of 141 AF/day (based on a 360 day year). The flow rate in gallons per minute is approximately 32,000 gpm. Based on the data provided, 65% of the water requirement is for Areas A and B, with 35% for Areas D and F. Water consumption data is not available, but it is assumed that the design basis is double the average values. Some months will not require water. Design values are expressed in cubic feet per second (CF/S).

Design Basis Flow 102,000 AF/year = 242 AF/day = 142 CF/S
Design Basis Flow 64,000 gpm
Areas A & B = 92 CF/S
Areas D & F = 50 CF/S
Design Basis Velocity = 7.5 F/S
60 Inch Diameter pipe Area = 19.6 Sq. Ft., capacity at velocity = 147 CF/S
42 Inch Diameter pipe Area = 9.6 Sq. Ft., capacity at velocity = 72 CF/S
36 Inch Diameter pipe Area = 7 Sq. Ft., capacity at velocity = 52 CF/S
18 Inch Diameter pipe Area = 1.7 Sq. Ft., capacity at velocity = 12 CF/S

Conceptual Design

The water line would start at the Los Angeles Aqueduct west of highway 395 and approximately 5 miles south of Lone Pine. The initial 6 miles of pipe would be 60 inch diameter and would be buried. Low ground pressure construction equipment should be used for the installation of the pipe.

Water flow would split equally in two 42 inch diameter pipes both about 7 miles long. One of the two lines 42 inch diameter lines would be laid through the center of Area B and cut across part of Area C1, the other 42 inch diameter pipe would be laid on the shore side of treatment Area B. The two lines would join south of Area C1 at the eastern edge of the playa. Depending on other work in progress, normal type construction equipment could be used. The line crossing Area B may require bridges or culverts as there could be intersections with ditches and drainage channels.

The line size would be reduced to a 36 inch diameter line along the eastern edge of Area C2 and D, a distance of about 10 miles. The design basis flow in this section of pipe is about 48 CF/S.

The line size would be reduced to 18 inches in diameter for flow to Area F. The line distance is approximately 1 mile.

Draw off points will be required for each section. The number has not been established at this time, therefore an allowance must be provided.

Line Specifications and Costs

The pipe would be centrifugally cast fiberglass reinforced thermosetting resin mortar pipe, with a low pressure rating (25 psig). Hobas Pipe provided telephone quotes for this pipe, which are current and include freight from Houston, Texas. The prices are per foot , in 20 feet lengths and are based on truck load quantities. Costs would increase for a 50 psig rating, but would decrease if the smaller pipe could be nested in the larger pipe.

18 inch	$30
36 inch	$55
42 inch	$65
48 inch	$95
60 inch	$120

Distance requirements are higher than indicated in the GBUAPCD budget cost information. The change may be due to the added line across Area B. The length of 60 inch pipe has been reduced from 16 miles to about 6 miles.

Comments

Material take off is based on almost no information and using a map with a scale of about 1/2 inch equaling 1 mile.

C.2 DEVELOPMENT OF KEELER FAN DEPOSIT

The basic premise is that permitting of the site which is on public lands under the control of and managed by the Ridgecrest Resources Area Office of the Bureau of Land Management (BLM) is expected to take approximately 3 years. Once the permits are in place, the gravel operation should be ready to produce product in between 90 and 180 days.

Preliminary Information

Discussions were held with members of the Great Basin Unified District Air Pollution Control District (GBUAPCD) and their consultant Walter J. Pachucki[1] of Team Engineering & Management of Bishop, CA on February 13, 1997. Mr. Pachucki provided most of the following information:

- The Keeler Fan has the potential to deliver low cost gravel to the playa based on minimum transportation and production costs than the second site (Basalt site east of State Highway 190). Keeler Fan site should be able to deliver over 6 million yd^3 without crushing.

- The Keeler Fan site is an undeveloped alluvial material approximately 2 miles east of State Highway 136. The thickness of the material is at least 20 feet and has an expected volume of at least 50 million yd^3 (bank). The site elevation is about 4,000 feet, and the elevation at the intersection of the access road and State Highway 136 is about 3,700 feet.

- The deposit (based on preliminary evaluation by others) has a size distribution of about 50% between minus 4 inch[2] and plus 1/2 inch material. The material appears to be well cemented and amenable to simple screening for size separation.

- A bank yd^3 will expand to about 1.2 to 1.25 yd^3 when mined and processed. (At 50% recovery, the 2.8 million yd^3 will require mining of about 4.5 million yd^3, or less than 10% of the estimated 50 million bank yd^3).

Site Requirements

- Improve access road to handle large volume of heavy trucks to width of about 40 feet (This cost is included in the cost of gravel, and not in the cost of haulage).

- Clear site in preparation for gravel extraction

- Provide temporary office and maintenance shop facilities

- Evaluate and provide power requirements, probably a Diesel Generator set

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[1] Revised information was received both as Appendix C to the Draft Environmental Impact Report - Dated March 1997 (by Environmental Management Associates) and an appendix to the March 1997 of the GBUAPCD Comparative cost Estimate (by TEAM Engineering & Management).

[2] The 70% distribution value may be based on a top size of minus 6 inches. If this is correct, the distribution value may be in the range of 50 to 60%. Data is not available to make an independent analysis.

- **Provide gravel extraction equipment including rippers, dozer's, loaders, haul trucks and water trucks**

- **Provide storage area for waste rock, feedstock, and product**

- **Provide a system for screening the feedstock into product and waste, include feeders, conveyors, screens, intermediate storage. Unit capacity should be about 600 yd^3 per hour (about 1,000 tons per hour)**

- **Provide capacity for loading two trucks with double 8 yd^3 trailers at a rate of one truck every two minutes**

- **Provide service and fuel facilities for the truck fleet and parking space**

- Water tank and storage area for fuel and lubricants

- Improve intersection of State Highway 136 and access road, consider traffic signal, turning lanes, acceleration and deceleration lanes and possible an over pass for allowing car traffic to proceed without interference with truck traffic.

Probable Site Development and Operating Costs

Assume that all permitting costs are by the project and that a subcontractor supplies all of the site requirements and that the cost of gravel includes all of the subcontractor costs for ownership, operations and profit. BLM may have a charge in the lease of the site to cover depletion.

Cost data was obtained from two commercial gravel producers, one at Ridgecrest and the other at Irwindale. Costs at the site ranged from \$10 per yd^3 to \$16 per yd^3 for minus 3 inch plus 1/2 inch gravel. The Ridgecrest plant had a cost of \$11 per yd^3 and had a hourly capacity of about 500 yd^3. They extract large alluvial gravel with a significant top size of over 6 inches. They had at least a two stage crushing plant. It is believed that the Irwindale plant does not do any serious crushing.

Parsons is providing construction management for a dam site near Hemit, CA . The site has a gravel production unit capable of delivering 3,600 tons per hour of crushed rock at top size of 11/2 inches for an all inclusive cost of \$7.50 per yd^3. The unit can divert minus 6 inch material to a stockpile for \$4.40 per yd^3. The cost per unit includes some short distance hauling charges, probably less than a mile.

Under these assumptions, it does not appear likely that 'an in the truck or a conveyor' purchase cost for gravel would be much less than about \$7 per yd^3 (about \$4.40 per ton). This cost includes site development, engineering, stripping, mining, screening, loading, and reclamation. The cost does not include permitting or the permitting process.

LOS ANGELES DEPARTMENT OF WATER AND POWER
QUESTIONS REGARDING COMPARATIVE COST ESTIMATES (March 1997)

A. What is the basis (such as references, calculations, or any other substantiation) for the following assumptions stated in the report?

1. Cost of maintenance equipment for flood irrigation is 100% of the manpower cost
2. \$0.5 to \$1.5 / yd^3 for constructing lake bed soil structures
   (Is the District's estimate of 91 million dollars based on \$0.65/yd^3, \$ 1.9/yd^3, or some other figure? On what basis?)
3. \$15/yd^3 for imported aggregate base for road beds
4. Two passes with D-8 bulldozer is required to grade minor topographic obstructions
5. A man with a D-8 bulldozer costs \$150 per hour
6. A man with a D-8 bulldozer grades 40 acres per day
7. 10 Full Time Equivalent Employees (FTEE) per square mile are required for maintenance of managed vegetation during the period October to May
8. \$125,00 is the cost for construction of the pump station
9. One (FTEE) to maintain 50 miles of berm
10. Cost of installing water outlets is 40% of material price
11. \$79,200 per mile is the cost for construction of a water recirculation pipeline
12. One FTEE is necessary to maintain 50 miles of water recirculation pipeline
13. \$0.5 for constructing 1 cubic yard of berm or key
14. \$15 for constructing 1 cubic yard of road
15. Approximately \$400,000 to rebuild one mile of highway
16. Mining cost of \$1.50 to \$2.00 per ton (this item is explained, but the calculations and the source of information need to be shown also. Also, please explain the mining cost used to calculate the project cost of \$91 million. Was it \$1.50/ton, \$1.80/ton, or some other figure? What was the rationale?)

B. The March 1997 CCE report is silent about assumptions for the following cost items. What were the assumptions and basis regarding these cost items? What are the justification for not including these cost.items?

1. Water needed to control, e.g., fugitive dust on the lake and during gravel mining.
2. On-site office/maintenance facility with various furniture and equipment including the following:
   - 12 desks
   - 12 chairs
   - 12 conference room chairs
   - 12 file cabinets
   - 8 book cases

8 potable radios
5 cellular phones
4 telephones and their installation costs
Hardware for 8 computers
Software for 8 computers
Numerous office supplies
1 fax machine
1 copying machine
air conditioners

3. Extra water to leach the managed vegetation area (DSIP ES-8)
4. Easement fee (DSIP 2-5)
5. Transition structure that will divert water from the Aqueduct to the main water line.
6. Preconstruction surveys for prehistorical and archeological resources and snowy plover habitat (DEIR S-30, 31, 32, & 33)
7. Preparation of resource inventory (DEIR S-33)
8. Recovery of significant prehistorical and archeological resources (DEIR S-33)
9. Unknown number of flights to monitor compliance with the 75% area wetness requirements (DSIP 5-3 & 8-3)
10. Mosquito abatement program (DSIP 5-9)
11. A program to remove salt cedar and pest plants (DEIR 2-24)
12. Fee to the GBUAPCD for actual cost of enforcing compliance (DSIP 8-1)
13. Placement of additional safety warning signs at roads and crossings where heavy duty truck traffic is expected to increase(DEIR S-42)
14. Establishment of at least 121 acres of habitat restoration (DEIR 2-36)
15. Additional field surveys, analyses, and planning for gravel mining (DEIR 2-44)
16. Upgrading existing roads for heavy duty trucks
17. Additional water use between June 15 and July 31 for shore birds (DSIP 5-7)
18. Permitting
19. EIR
20. One year of pre- and post-construction PSD monitoring for gravel mine
21. Reclamation for mining (DEIR 2-46)
22. Insurance
23. Fees to the main contractor
24. Fees to sub contractors
25. Cost of escalation during the project duration
26. Inspection and testing
27. Design contingency
28. Preliminary engineering
29. Final engineering
30. Engineering contingency
31. Construction contingency
32. LADWP's cost of managing the contractor
33. Sales tax
34. Bond
35. Cost of electricity used for the Project

36. Replacement cost for reduction of electricity generation due to water diversion

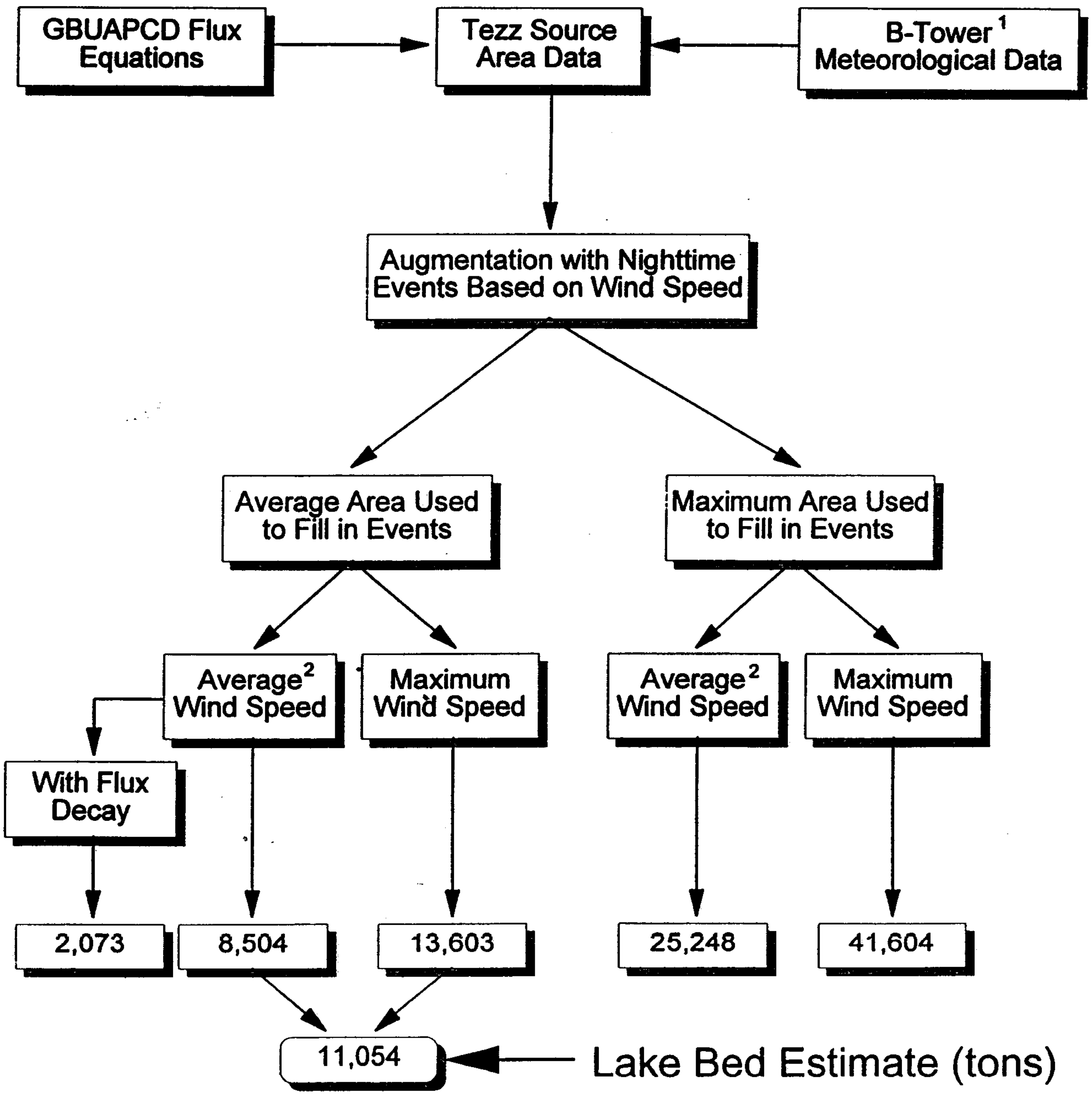
C. Questionable assumptions

The March 1997 CCE report is silent about the cost of geofabric. The January 1997 CCE report used a geofabric cost of $ 0.11 per square yard. Parsons, an LADWP consultant, contacted a vendor and the price quotation was $1.18 per square yard. This is over ten times higher than the District assumption. The CCE Report should be revised to reflect the cost of $1.18 per square yard.

D. Additional Questions

Additional questions and comments may be submitted later.

Annual PM10 Emissions Estimate Range
for
Owens Lake Bed



1. The data were used after verification with the Geomet data.
2. The average wind speed was the average of the speeds over the 7.5 m/s threshold.

AN ESTIMATE OF ANNUAL PM10 EMISSIONS FROM OWENS LAKE FROM NIEMEYER SOURCE DATA + NIGHTTIME DATA + B-TOWER WINDS [MAXIMUM AREA FILLED-IN CASE]																				
								Daytime			Nighttime			Total Event						
Tezz Event #	Date	EF	TEOM Ex K	LP	O	Total Area (m2)	(sq. mi)	Av. WS (m/s)	Max. WS (m/s)	Duration (hours)	Av. WS (m/s)	Max. WS (m/s)	Duration (hours)	Av. WS (m/s)	Max. WS (m/s)	Duration (hours)	Av. Flux (g/m2/s)	Av. Ems. (tons)	Max. Flux (g/m2/s)	Max. Ems. (tons)
1	10/7/94	1				4494821	1.74	8.5	8.5	1			0	8.5	8.5	1	1.12E-04	2.00	1.12E-04	2.00
2	10/10/94	1				407052	0.16	9.1	10.1	4	7.5	7.5	1	8.8	10.1	5	1.20E-04	0.97	1.67E-04	1.35
3	10/12/94	1				4045142	1.56	11.1	13.8	5	9.6	12.2	4	10.4	13.8	9	1.82E-04	26.26	4.22E-04	60.93
4	10/16/94	1				3914406	1.51	10.1	11.4	5	8.9	9.6	8	9.4	11.4	13	1.39E-04	28.08	2.32E-04	46.74
	10/30/94	3				21784090				0	8.1	8.1	1	8.1	8.1	1	1.02E-04	8.77	1.02E-04	8.77
5	11/1/94	4				1536005	0.59			0	7.8	7.8	1	7.8	7.8	1	9.42E-05	0.57	9.42E-05	0.57
6,7	11/01/94b	4				4994809	1.93			0	7.8	7.8	1	7.8	7.8	1	9.42E-05	1.87	9.42E-05	1.87
8	11/3/94	1				2068556	0.80	10.5	12.1	12	10.2	13.6	11	10.4	13.6	23	1.78E-04	33.66	4.02E-04	75.74
	11/4/94	3				21784090				0	9.3	9.3	1	9.3	9.3	1	1.37E-04	11.84	1.37E-04	11.84
9	11/5/94	4				1287050	0.50	5.7	5.7	1			0	5.7	5.7	1	5.57E-05	0.28	5.57E-05	0.28
	11/7/94	3				21784090				0	9.5	10.4	2	9.5	10.4	2	1.44E-04	24.89	1.80E-04	31.16
	11/8/94	3				21784090				0	10.1	11.5	2	10.1	11.5	2	1.67E-04	28.91	2.38E-04	41.03
	11/12/94	3				21784090				0	9.5	9.5	1	9.5	9.5	1	1.44E-04	12.44	1.44E-04	12.44
10	11/15/94	4				4315430	1.67	5.9	6.6	3	5.1	5.2	2	5.6	6.6	5	5.41E-05	4.63	6.98E-05	5.97
11	11/17/94	1	X			2273887	0.88	11.9	13.4	6	10.7	11.5	5	11.4	13.4	11	2.29E-04	22.71	3.82E-04	37.88
12	11/18/94	1				776885	0.30	11.6	15.1	11	11.3	12.9	6	11.5	15.1	17	2.37E-04	12.42	5.84E-04	30.59
	11/21/94	3				21784090				0	9.7	10.4	4	9.7	10.4	4	1.51E-04	52.32	1.80E-04	62.33
	11/22/94	3				21784090				0	8.2	8.2	1	8.2	8.2	1	1.04E-04	8.99	1.04E-04	8.99
13	11/25/94	1	X			16871376	6.51	9.5	10.9	10	8.7	9.7	6	9.2	10.9	16	1.34E-04	143.04	2.04E-04	218.80
14	12/3/94	1				7470723.7	2.88	10.1	11.9	3	7.8	7.8	1	9.5	11.9	4	1.45E-04	17.18	2.63E-04	31.10
15,16	12/04/94b	1	X			5420975	2.09	11.0	12.4	9	8.0	8.0	1	10.7	12.4	10	1.94E-04	41.80	2.97E-04	63.93
	12/7/94	3				21784090				0	10.0	12.4	3	10.0	12.4	3	1.63E-04	42.30	2.97E-04	77.07
17	12/8/94	1			X	854803	0.33	9.0	10.7	4	13.3	14.0	6	11.6	14.0	10	2.42E-04	8.21	4.44E-04	15.04
18	12/10/94	4				776517	0.30	7.7	8.0	2	6.5	7.6	2	7.1	8.0	4	7.91E-05	0.97	9.90E-05	1.22
	12/12/94	2	X			21784090	8.41	10.8	12.2	6	10.6	11.6	6	10.7	12.2	12	1.94E-04	201.55	2.83E-04	293.25
	12/13/94	3				21784090				0	9.9	10.6	2	9.9	10.6	2	1.59E-04	27.50	1.90E-04	32.76
19	12/14/94	4				308119	0.12	6.6	6.6	1			0	6.6	6.6	1	6.98E-05	0.09	6.98E-05	0.09
	12/23/94	3				21784090				0	7.6	7.6	1	7.6	7.6	1	8.96E-05	7.74	8.96E-05	7.74
20	12/24/94	1				4060090	1.57	11.2	12.8	5			0	11.2	12.8	5	2.20E-04	17.74	3.29E-04	26.46
21	12/25/94	1				11598133	4.48	13.3	15.8	12	13.0	15.7	6	13.2	15.8	18	3.63E-04	300.71	6.96E-04	576.03
	12/26/94	3				21784090				0	10.6	12.3	6	10.6	12.3	6	1.90E-04	98.29	2.90E-04	150.34
	12/30/94	3				21784090				0	11.0	13.1	3	11.0	13.1	3	2.10E-04	54.31	3.54E-04	91.81
	1/7/95	3				21784090				0	10.2	11.5	2	10.2	11.5	2	1.72E-04	29.64	2.38E-04	41.03
22	1/8/95	1				1004214	0.39	10.0	11.6	4	10.4	12.0	6	10.2	12.0	10	1.73E-04	6.90	2.69E-04	10.72
23	1/13/95	1				7462502	2.88	7.6	7.6	1			0	7.6	7.6	1	8.96E-05	2.65	8.96E-05	2.65

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								Daytime			Nighttime			Total Event						
Tezz Event #	Date	EF	TEOM Ex K	LP	O	Total Area (m2)	(sq. mi)	Av. WS (m/s)	Max. WS (m/s)	Duration (hours)	Av. WS (m/s)	Max. WS (m/s)	Duration (hours)	Av. WS (m/s)	Max. WS (m/s)	Duration (hours)	Av. Flux (g/m2/s)	Av. Ems. (tons)	Max. Flux (g/m2/s)	Max. Ems. (tons)
	1/15/95	3				21784090				0	9.1	11.1	3	9.1	11.1	3	1.30E-04	33.78	2.15E-04	55.69
24	2/12/95	4				943676	0.36			0	8.0	8.0	1	8.0	8.0	1	5.27E-04	1.97	5.27E-04	1.97
25	2/13/95	1	X	X		2251288	0.87	12.4	16.5	12	9.9	12.3	9	11.3	16.5	21	8.05E-04	150.98	1.56E-03	291.92
26	2/14/95	1				683151	0.26	10.0	12.8	10	9.7	11.4	6	9.9	12.8	16	6.70E-04	29.05	9.72E-04	42.11
27	2/23/95	4				337949	0.13			0	5.6	5.6	1	5.6	5.6	1	3.88E-04	0.52	3.88E-04	0.52
	2/24/95	2	X			21784090	8.41	9.4	9.4	1			0	9.4	9.4	1	6.30E-04	54.40	6.30E-04	54.40
28	2/25/95	4				618504	0.24	5.6	5.6	1			0	5.6	5.6	1	3.88E-04	0.95	3.88E-04	0.95
29	2/26/95	4				633139	0.24	5.1	5.1	1			0	5.1	5.1	1	3.64E-04	0.91	3.64E-04	0.91
	3/3/95	2	X	X		21784090	8.41	14.5	17.7	11	10.0	12.6	5	13.1	17.7	16	1.01E-03	1394.00	1.81E-03	2507.98
30	3/4/95	1				4174196	1.61	7.6	7.6	1	9.5	10.6	4	9.1	10.6	5	6.08E-04	50.29	7.34E-04	60.74
	3/6/95	3			X	21784090				0	12.8	15.9	5	12.8	15.9	5	9.72E-04	419.61	1.44E-03	623.02
31	3/7/95	4				1163401	0.45	6.3	6.8	3			0	6.3	6.8	3	4.24E-04	5.87	4.52E-04	6.26
32,33,34	3/08/95b	1				10160977	3.92	11.4	12.1	5	9.6	10.0	2	10.9	12.1	7	7.61E-04	214.67	8.89E-04	250.62
35	3/9/95	1	X	X		4821534	1.86	11.5	13.6	12	10.5	14.4	9	11.1	14.4	21	7.79E-04	312.92	1.19E-03	478.34
	3/12/95	3				21784090				0	8.1	8.1	1	8.1	8.1	1	5.34E-04	46.09	5.34E-04	46.09
	3/17/95	3				21784090				0	8.4	8.8	3	8.4	8.8	3	5.54E-04	143.67	5.83E-04	151.19
	3/18/95	3				21784090				0	7.8	7.8	1	7.8	7.8	1	5.14E-04	44.36	5.14E-04	44.36
36	3/20/95	1	X	X		2612815	1.01	11.3	13.7	8	10.7	11.3	6	11.0	13.7	14	7.77E-04	112.64	1.09E-03	158.06
37	3/21/95	1	X			2768180	1.07	11.7	15.2	12	11.8	13.7	12	11.8	15.2	24	8.50E-04	223.87	1.32E-03	347.57
38	3/22/95	1	X	X		2945333	1.14	10.4	12.4	10	11.0	13.2	8	10.7	13.2	18	7.40E-04	155.60	1.02E-03	214.93
	3/26/95	3				21784090				0	8.8	8.9	3	8.8	8.9	3	5.83E-04	151.19	5.91E-04	153.13
39	3/27/95	1			X	1584235	0.61	11.0	13.4	6	10.8	12.3	9	10.9	13.4	15	7.61E-04	71.67	1.05E-03	98.83
40	3/29/95	1				11022388	4.26	9.3	10.3	4	9.3	9.9	7	9.3	10.3	11	6.22E-04	298.95	7.06E-04	339.61
	4/1/95	3			X	21784090				0	9.9	11.7	5	9.9	11.7	5	6.71E-04	289.91	8.45E-04	364.70
	4/2/95	2				21784090		10.6	13.3	12	10.5	12.8	12	10.6	13.3	24	7.29E-04	1511.82	1.04E-03	2146.72
	4/3/95	3				21784090				0	9.0	9.8	3	9.0	9.8	3	5.99E-04	155.09	6.63E-04	171.74
	4/4/95	2				21784090		8.4	8.5	2	8.4	8.4	1	8.4	8.5	3	5.54E-04	143.67	5.62E-04	145.51
	4/5/95	2				21784090		8.8	9.6	2			0	8.8	9.6	2	5.83E-04	100.79	6.46E-04	111.61
	4/6/95	3				21784090				0	8.1	8.1	1	8.1	8.1	1	5.34E-04	46.09	5.34E-04	46.09
	4/7/95	2				21784090		8.6	8.6	1	8.9	8.9	1	8.8	8.9	2	5.80E-04	100.15	5.91E-04	102.08
	4/8/95	2	X			21784090		13.5	14.9	3	10.3	12.0	7	11.3	14.9	10	7.98E-04	689.61	1.27E-03	1096.88
	4/9/95	2	X		X	21784090		13.0	17.6	12	11.9	15.5	11	12.5	17.6	23	9.32E-04	1851.61	1.79E-03	3559.54
	4/10/95	2				21784090		7.9	8.2	2	9.5	11.2	7	9.1	11.2	9	6.10E-04	473.92	7.92E-04	615.92
	4/11/95	2				21784090		8.4	8.7	3			0	8.4	8.7	3	5.54E-04	143.67	5.76E-04	149.27
	4/12/95	2	X			21784090		10.4	11.9	8	8.9	9.9	6	9.8	11.9	14	6.59E-04	797.11	8.66E-04	1047.54

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Tezz Event #	Date	EF	TEOM Ex K	LP	O	Total Area (m2)	(sq. mi)	Av. WS (m/s)	Max. WS (m/s)	Duration (hours)	Av. WS (m/s)	Max. WS (m/s)	Duration (hours)	Av. WS (m/s)	Max. WS (m/s)	Duration (hours)	Av. Flux (g/m2/s)	Av. Ems. (tons)	Max. Flux (g/m2/s)	Max. Ems. (tons)
	4/13/95	2	X			21784090		12.8	18.1	12	8.9	9.6	4	11.8	18.1	16	8.58E-04	1185.80	1.91E-03	2639.20
	4/14/95	2				21784090		8.7	9.4	3	8.4	9.3	5	8.5	9.4	8	5.62E-04	388.65	6.30E-04	435.21
	4/15/95	2				21784090		9.2	10.3	6	10.6	11.6	12	10.1	11.6	18	6.92E-04	1075.20	8.34E-04	1296.29
	4/16/95	3				21784090				0	8.1	8.8	4	8.1	8.8	4	5.34E-04	184.37	5.83E-04	201.58
	4/19/95	2				21784090		8.7	8.7	1			0	8.7	8.7	1	5.76E-04	49.76	5.76E-04	49.76
	4/20/95	2				21784090		10.4	12.5	6	11.4	12.9	6	10.9	12.9	12	7.63E-04	790.41	9.84E-04	1019.99
	4/21/95	2				21784090		12.5	15.9	12	9.7	11.0	12	11.1	15.9	24	7.82E-04	1621.65	1.44E-03	2990.50
	4/22/95	3				21784090				0	9.3	11.3	7	9.3	11.3	7	6.22E-04	375.99	8.03E-04	485.20
	4/23/95	3				21784090				0	9.1	9.9	4	9.1	9.9	4	6.06E-04	209.44	6.71E-04	231.93
	4/25/95	3				21784090				0	7.6	7.7	3	7.6	7.7	3	5.01E-04	129.74	5.07E-04	131.40
41	4/26/95	1				4246750	1.64	9.4	9.8	5	9.1	10.0	3	9.3	10.0	8	6.21E-04	83.64	6.80E-04	91.59
42	4/27/95	1	X			5924690	2.29	10.8	12.6	7	8.6	10.4	3	10.1	12.6	10	6.92E-04	162.60	9.47E-04	222.50
43	4/28/95	1				2051217	0.79	8.2	8.9	4	9.1	9.7	2	8.5	9.7	6	5.62E-04	27.40	6.54E-04	31.93
	4/29/95	2	X			21784090		9.7	13.1	6	8.9	10.3	9	9.2	13.1	15	6.16E-04	797.51	1.01E-03	1307.92
	4/30/95	2	X			21784090		9.0	9.5	4	10.1	12.3	5	9.6	12.3	9	6.47E-04	502.97	9.12E-04	708.65
	5/1/95	2	X			21784090	8.41	11.4	12.0	2	9.8	10.5	3	10.4	12.0	5	7.19E-04	310.58	8.77E-04	378.92
	5/5/95	2	X		X	21784090	8.41	9.3	10.5	4	10.5	14.3	6	10.0	14.3	10	6.82E-04	588.77	1.18E-03	1016.10
44	5/6/95	4				21784090	8.41			0	7.7	7.7	1	7.7	7.7	1	5.07E-04	43.80	5.07E-04	43.80
45	5/7/95	4				18004687	6.95			0	7.8	7.8	1	7.8	7.8	1	5.14E-04	36.67	5.14E-04	36.67
46	5/22/95	1				4419974	1.71	11.9	14.3	6	10.0	14.3	9	10.8	14.3	15	7.49E-04	196.92	1.18E-03	309.25
47	5/25/95	1				2132957	0.82	10.0	12.3	8	9.5	11.8	4	9.8	12.3	12	6.66E-04	67.55	9.12E-04	92.52
48	6/1/95	1	X			1331286	0.51	11.1	16.0	5	11.4	15.1	6	11.3	16.0	11	7.99E-04	46.38	1.46E-03	84.84
	6/2/95	3				21784090				0	8.7	11.7	7	8.7	11.7	7	5.76E-04	348.30	8.45E-04	510.58
	6/4/95	3				21784090				0	7.7	7.7	1	7.7	7.7	1	5.07E-04	43.80	5.07E-04	43.80
	6/5/95	2	X			21784090	8.41	13.4	17.9	8	9.3	12.1	7	11.5	17.9	15	8.22E-04	1064.75	1.86E-03	2411.96
	6/6/95	2	X			21784090	8.41	13.7	13.7	1	12.9	23.8	10	13.0	23.8	11	9.93E-04	943.70	3.95E-03	3752.92
	6/7/95	3				21784090				0	8.5	10.8	6	8.5	10.8	6	5.62E-04	291.02	7.53E-04	390.20
49,50	6/14/95b	1				3742830	1.45	11.3	13.2	11	9.8	11.2	12	10.5	13.2	23	7.26E-04	247.90	1.02E-03	348.99
51	6/15/95	1				8521786	3.29	11.5	14.2	12	9.6	12.0	12	10.6	14.2	24	7.29E-04	591.42	1.16E-03	941.89
52	6/16/95	1				1917259	0.74	10.6	12.1	5	7.6	7.6	1	10.1	12.1	6	6.89E-04	31.41	8.89E-04	40.53
	6/19/95	3				21784090				0	8.2	8.5	2	8.2	8.5	2	5.41E-04	93.37	5.62E-04	97.01
	6/20/95	3				21784090				0	12.2	12.6	5	12.2	12.6	5	9.00E-04	388.71	9.47E-04	409.05
	6/21/95	3				21784090				0	10.2	12.3	4	10.2	12.3	4	6.98E-04	240.97	9.12E-04	314.96
	6/28/95	3				21784090				0	10.3	10.3	1	10.3	10.3	1	7.06E-04	61.02	7.06E-04	61.02
53	6/29/95	1				4032191	1.56	15.5	15.5	1	12.4	17.9	6	12.8	17.9	7	9.77E-04	109.33	1.86E-03	208.34

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Tezz Event #	Date	EF	TEOM Ex			Total Area		Av. WS	Max. WS	Duration	Av. WS	Max. WS	Duration	Av. WS	Max. WS	Duration	Av. Flux	Av. Ems.	Max. Flux	Max. Ems.
			K	LP	O	(m2)	(sq. mi)	(m/s)	(m/s)	(hours)	(m/s)	(m/s)	(hours)	(m/s)	(m/s)	(hours)	(g/m2/s)	(tons)	(g/m2/s)	(tons)
	7/2/95	3				21784090				0	7.7	7.9	2	7.7	7.9	2	9.19E-05	15.87	9.66E-05	16.68
	7/3/95	3				21784090				0	8.9	8.9	1	8.9	8.9	1	1.24E-04	10.71	1.24E-04	10.71
54,55,56	7/11/95a	1				10547566	4.07	11.6	13.6	11	8.7	8.9	2	11.2	13.6	13	2.18E-04	118.42	4.02E-04	218.28
57	7/12/95	1				0	0.00	10.0	11.7	11	8.4	8.9	2	9.8	11.7	13	1.54E-04	0.00	2.50E-04	0.00
58	7/13/95	1				8594410	3.32	10.9	12.6	3	9.7	10.6	6	10.1	12.6	9	1.67E-04	51.33	3.13E-04	95.90
59	7/28/95	1				1534450	0.59	12.1	12.1	1	10.3	10.3	1	11.2	12.1	2	2.20E-04	2.68	2.76E-04	3.36
60	8/7/95	1				8096189	3.13	10.0	11.8	12	8.7	10.7	5	9.6	11.8	17	1.48E-04	80.96	2.56E-04	139.71
61	8/8/95	4				2843461	1.10	6.7	6.9	2	5.5	5.5	2	6.1	6.9	4	6.16E-05	2.78	7.52E-05	3.39
62	8/11/95	1				4473017	1.73	9.0	9.4	3	9.3	9.8	2	9.1	9.8	5	1.31E-04	11.62	1.55E-04	13.77
63	8/12/95	1				1183860	0.46	8.5	9.7	5	7.6	7.6	1	8.4	9.7	6	1.08E-04	3.04	1.51E-04	4.27
64	8/28/95	1				8769081	3.39	10.3	11.9	5			0	10.3	11.9	5	1.76E-04	30.59	2.63E-04	45.63
65	9/16/95	1				611666	0.24	8.6	9.9	7			0	8.6	9.9	7	1.15E-04	1.95	1.59E-04	2.70
	9/17/95	3				21784090				0	7.7	7.8	2	7.7	7.8	2	9.19E-05	15.87	9.42E-05	16.27
	9/28/95	3				21784090				0	10.5	13.3	2	10.5	13.3	2	1.85E-04	31.95	3.73E-04	64.35
66	9/29/95	1				2321410	0.90	10.1	11.2	5	11.2	13.8	9	10.8	13.8	14	2.00E-04	25.74	4.22E-04	54.39
	10/5/95	3				21784090				0	7.7	7.7	1	7.7	7.7	1	9.19E-05	7.93	9.19E-05	7.93
67	10/6/95	4				3559972	1.37	6.0	6.6	2			0	6.0	6.6	2	6.01E-05	1.70	6.98E-05	1.97
										443			472			915	Sum	25,248	Sum	41,604

Emission 1. "Tezz Identified Days" -- Daytime high winds with possible high nighttime winds and visible emission verification.

2. High daytime winds with possible high nighttime winds and no visible emission sources observed. [Deleted except for April]

3. High nighttime winds only (no high daytime winds) with no verification of emission sources.

4. Daytime visible emission sources observed with no high winds to support wind driven fugitive sources.

[shaded] Days with lower thresholds

Average of all observed areas = 4388451 sq m

Maximum of all observed areas = 21784090 sq m

Note: Updates made /// on 11/22/96 by R. Baxter /// on 11/26/96 by R. Sahu

AN ESTIMATE OF ANNUAL PM10 EMISSIONS FROM OWENS LAKE FROM NIEMEYER SOURCE DATA + NIGHTTIME DATA + B-TOWER WINDS [AVERAGE AREA FILLED-IN CASE]																					
								Daytime			Nighttime			Total Event					Adjusted		
Tezz Event #	Date	EF	TEOM Ex			Total Area		Av. WS (m/s)	Max. WS (m/s)	Dur (hrs)	Av. WS (m/s)	Max. WS (m/s)	Dur (hrs)	Av. WS (m/s)	Max. WS (m/s)	Dur (hrs)	Av. Flux (g/m2/s)	Emissions (tons)	Emissions (tons)	Max. Flux (g/m2/s)	Emissions (tons)
			K	LP	O	(m2)	(sq. mi)														
1	10/7/94	1				4494821	1.74	8.5	8.5	1			0	8.5	8.5	1	1.12E-04	2.00	1.20	1.12E-04	2.00
2	10/10/94	1				407052	0.16	9.1	10.1	4	7.5	7.5	1	8.8	10.1	5	1.20E-04	0.97	0.27	1.67E-04	1.35
3	10/12/94	1				4045142	1.56	11.1	13.8	5	9.6	12.2	4	10.4	13.8	9	1.82E-04	26.26	6.42	4.22E-04	60.93
4	10/16/94	1				3914406	1.51	10.1	11.4	5	8.9	9.6	8	9.4	11.4	13	1.39E-04	28.08	6.48	2.32E-04	46.74
	10/30/94	3				4388451				0	8.1	8.1	1	8.1	8.1	1	1.02E-04	1.77	1.06	1.02E-04	1.77
5	11/1/94	4				1536005	0.59			0	7.8	7.8	1	7.8	7.8	1	9.42E-05	0.57	0.34	9.42E-05	0.57
6,7	11/01/94b	4				4994809	1.93			0	7.8	7.8	1	7.8	7.8	1	9.42E-05	1.87	1.12	9.42E-05	1.87
8	11/3/94	1				2068556	0.80	10.5	12.1	12	10.2	13.6	11	10.4	13.6	23	1.78E-04	33.66	7.32	4.02E-04	75.74
	11/4/94	3				4388451				0	9.3	9.3	1	9.3	9.3	1	1.37E-04	2.38	1.43	1.37E-04	2.38
9	11/5/94	4				1287050	0.50	5.7	5.7	1			0	5.7	5.7	1	5.57E-05	0.28		5.57E-05	0.28
	11/7/94	3				4388451				0	9.5	10.4	2	9.5	10.4	2	1.44E-04	5.01	2.01	1.80E-04	6.28
	11/8/94	3				4388451				0	10.1	11.5	2	10.1	11.5	2	1.67E-04	5.82	2.33	2.38E-04	8.27
	11/12/94	3				4388451				0	9.5	9.5	1	9.5	9.5	1	1.44E-04	2.51	1.50	1.44E-04	2.51
10	11/15/94	4				4315430	1.67	5.9	6.6	3	5.1	5.2	2	5.6	6.6	5	5.41E-05	4.63		6.98E-05	5.97
11	11/17/94	1	X			2273887	0.88	11.9	13.4	6	10.7	11.5	5	11.4	13.4	11	2.29E-04	22.71	5.37	3.82E-04	37.88
12	11/18/94	1				776885	0.30	11.6	15.1	11	11.3	12.9	6	11.5	15.1	17	2.37E-04	12.42	2.78	5.84E-04	30.59
	11/21/94	3				4388451				0	9.7	10.4	4	9.7	10.4	4	1.51E-04	10.54	3.16	1.80E-04	12.56
	11/22/94	3				4388451				0	8.2	8.2	1	8.2	8.2	1	1.04E-04	1.81	1.09	1.04E-04	1.81
13	11/25/94	1	X			16871376	6.51	9.5	10.9	10	8.7	9.7	6	9.2	10.9	16	1.34E-04	143.04	32.18	2.04E-04	218.80
14	12/3/94	1				7470723.7	2.88	10.1	11.9	3	7.8	7.8	1	9.5	11.9	4	1.45E-04	17.18	5.15	2.63E-04	31.10
15,16	12/04/94b	1	X			5420975	2.09	11.0	12.4	9	8.0	8.0	1	10.7	12.4	10	1.94E-04	41.80	10.03	2.97E-04	63.93
	12/7/94	3				4388451				0	10.0	12.4	3	10.0	12.4	3	1.63E-04	8.52	2.84	2.97E-04	15.53
17	12/8/94	1			X	854803	0.33	9.0	10.7	4	13.3	14.0	6	11.6	14.0	10	2.42E-04	8.21	1.97	4.44E-04	15.04
18	12/10/94	4				776517	0.30	7.7	8.6	2	6.5	7.6	2	7.1	8.6	4	7.91E-05	0.97		1.15E-04	1.42
	12/12/94	2	X			4388451	1.69	10.8	12.2	6	10.6	11.6	6	10.7	12.2	12	1.94E-04	40.60	9.47	2.83E-04	59.08
	12/13/94	3				4388451				0	9.9	10.6	2	9.9	10.6	2	1.59E-04	5.54	2.22	1.90E-04	6.60
19	12/14/94	4				308119	0.12	6.6	6.6	1			0	6.6	6.6	1	6.98E-05	0.09		6.98E-05	0.09
	12/23/94	3				4388451				0	7.6	7.6	1	7.6	7.6	1	8.96E-05	1.56	0.94	8.96E-05	1.56
20	12/24/94	1				4060090	1.57	11.2	12.8	5			0	11.2	12.8	5	2.20E-04	17.74	4.97	3.29E-04	26.46
21	12/25/94	1				11598133	4.48	13.3	15.8	12	13.0	15.7	6	13.2	15.8	18	3.63E-04	300.71	66.83	6.96E-04	576.03
	12/26/94	3				4388451				0	10.6	12.3	6	10.6	12.3	6	1.90E-04	19.80	5.28	2.90E-04	30.29
	12/30/94	3				4388451				0	11.0	13.1	3	11.0	13.1	3	2.10E-04	10.94	3.65	3.54E-04	18.50
	1/7/95	3				4388451				0	10.2	11.5	2	10.2	11.5	2	1.72E-04	5.97	2.39	2.38E-04	8.27
22	1/8/95	1				1004214	0.39	10.0	11.6	4	10.4	12.0	6	10.2	12.0	10	1.73E-04	6.90	1.66	2.69E-04	10.72
23	1/13/95	1				7462502	2.88	7.6	7.6	1			0	7.6	7.6	1	8.96E-05	2.65	1.59	8.96E-05	2.65

AN ESTIMATE OF ANNUAL PM10 EMISSIONS FROM OWENS LAKE FROM NIEMEYER SOURCE DATA + NIGHTTIME DATA + B-TOWER WINDS [AVERAGE AREA FILLED-IN CASE]

Tezz Event #	Date	EF	TEOM Ex K	LP	O	Total Area (m2)	(sq. mi)	Daytime Av. WS (m/s)	Daytime Max. WS (m/s)	Daytime Dur (hrs)	Nighttime Av. WS (m/s)	Nighttime Max. WS (m/s)	Nighttime Dur (hrs)	Total Event Av. WS (m/s)	Total Event Max. WS (m/s)	Total Event Dur (hrs)	Av. Flux (g/m2/s)	Emissions (tons)	Adjusted Emissions (tons)	Max. Flux (g/m2/s)	Emissions (tons)
	1/15/95	3				4388451				0	9.1	11.1	3	9.1	11.1	3	1.30E-04	6.80	2.27	2.15E-04	11.22
24	2/12/95	4				943676	0.36			0	8.0	8.0	1	8.0	8.0	1	5.27E-04	1.97	1.18	5.27E-04	1.97
25	2/13/95	1	X	X		2251288	0.87	12.4	16.5	12	9.9	12.3	9	11.3	16.5	21	8.05E-04	150.98	33.07	1.56E-03	291.92
26	2/14/95	1				683151	0.26	10.0	12.8	10	9.7	11.4	6	9.9	12.8	16	6.70E-04	29.05	6.54	9.72E-04	42.11
27	2/23/95	4				337949	0.13			0	5.6	5.6	1	5.6	5.6	1	3.88E-04	0.52		3.88E-04	0.52
	2/24/95	2	X			4388451	1.69	9.4	9.4	1			0	9.4	9.4	1	6.30E-04	10.96	6.58	6.30E-04	10.96
28	2/25/95	4				618504	0.24	5.6	5.6	1			0	5.6	5.6	1	3.88E-04	0.95		3.88E-04	0.95
29	2/26/95	4				633139	0.24	5.1	5.1	1			0	5.1	5.1	1	3.64E-04	0.91		3.64E-04	0.91
	3/3/95	2	X	X		4388451	1.69	14.5	17.7	11	10.0	12.6	5	13.1	17.7	16	1.01E-03	280.83	63.19	1.81E-03	505.24
30	3/4/95	1				4174196	1.61	7.6	7.6	1	9.5	10.6	4	9.1	10.6	5	6.08E-04	50.29	14.08	7.34E-04	60.74
	3/6/95	3			X	4388451				0	12.8	15.9	5	12.8	15.9	5	9.72E-04	84.53	23.67	1.44E-03	125.51
31	3/7/95	4				1163401	0.45	6.3	6.8	3			0	6.3	6.8	3	4.24E-04	5.87		4.52E-04	6.26
32,33,34	3/08/95b	1				10160977	3.92	11.4	12.1	5	9.6	10.0	2	10.9	12.1	7	7.61E-04	214.67	55.20	8.89E-04	250.62
35	3/9/95	1	X	X		4821534	1.86	11.5	13.6	12	10.5	14.4	9	11.1	14.4	21	7.79E-04	312.92	68.54	1.19E-03	478.34
	3/12/95	3				4388451				0	8.1	8.1	1	8.1	8.1	1	5.34E-04	9.29	5.57	5.34E-04	9.29
	3/17/95	3				4388451				0	8.4	8.8	3	8.4	8.8	3	5.54E-04	28.94	9.65	5.83E-04	30.46
	3/18/95	3				4388451				0	7.8	7.8	1	7.8	7.8	1	5.14E-04	8.94	5.36	5.14E-04	8.94
36	3/20/95	1	X	X		2612815	1.01	11.3	13.7	8	10.7	11.3	6	11.0	13.7	14	7.77E-04	112.64	25.75	1.09E-03	158.06
37	3/21/95	1	X			2768180	1.07	11.7	15.2	12	11.8	13.7	12	11.8	15.2	24	8.50E-04	223.87	48.51	1.32E-03	347.57
38	3/22/95	1	X	X		2945333	1.14	10.4	12.4	10	11.0	13.2	8	10.7	13.2	18	7.40E-04	155.60	34.58	1.02E-03	214.93
	3/26/95	3				4388451				0	8.8	8.9	3	8.8	8.9	3	5.83E-04	30.46	10.15	5.91E-04	30.85
39	3/27/95	1			X	1584235	0.61	11.0	13.4	6	10.8	12.3	9	10.9	13.4	15	7.61E-04	71.67	16.25	1.05E-03	98.83
40	3/29/95	1				11022388	4.26	9.3	10.3	4	9.3	9.9	7	9.3	10.3	11	6.22E-04	298.95	70.66	7.06E-04	339.61
	4/1/95	3			X	4388451				0	9.9	11.7	5	9.9	11.7	5	6.71E-04	58.40	16.35	8.45E-04	73.47
	4/2/95	2				4388451		10.6	13.3	12	10.5	12.8	12	10.6	13.3	24	7.29E-04	304.56	65.99	1.04E-03	432.46
	4/3/95	3				4388451				0	9.0	9.8	3	9.0	9.8	3	5.99E-04	31.24	10.41	6.63E-04	34.60
	4/4/95	2				4388451		8.4	8.5	2	8.4	8.4	1	8.4	8.5	3	5.54E-04	28.94	9.65	5.62E-04	29.31
	4/5/95	2				4388451		8.8	9.6	2			0	8.8	9.6	2	5.83E-04	20.30	8.12	6.46E-04	22.48
	4/6/95	3				4388451				0	8.1	8.1	1	8.1	8.1	1	5.34E-04	9.29	5.57	5.34E-04	9.29
	4/7/95	2				4388451		8.6	8.6	1	8.9	8.9	1	8.8	8.9	2	5.80E-04	20.18	8.07	5.91E-04	20.56
	4/8/95	2	X			4388451		13.5	14.9	3	10.3	12.0	7	11.3	14.9	10	7.98E-04	138.92	33.34	1.27E-03	220.97
	4/9/95	2	X		X	4388451		13.0	17.6	12	11.9	15.5	11	12.5	17.6	23	9.32E-04	373.01	81.09	1.79E-03	717.08
	4/10/95	2				4388451		7.9	8.2	2	9.5	11.2	7	9.1	11.2	9	6.10E-04	95.47	23.34	7.92E-04	124.08
	4/11/95	2				4388451		8.4	8.7	3			0	8.4	8.7	3	5.54E-04	28.94	9.65	5.76E-04	30.07
	4/12/95	2	X			4388451		10.4	11.9	8	8.9	9.9	6	9.8	11.9	14	6.59E-04	160.58	36.70	8.66E-04	211.03

AN ESTIMATE OF ANNUAL PM10 EMISSIONS FROM OWENS LAKE FROM NIEMEYER SOURCE DATA + NIGHTTIME DATA + B-TOWER WINDS [AVERAGE AREA FILLED-IN CASE]																					
								Daytime			Nighttime			Total Event					Adjusted		
Tezz Event #	Date	EF	TEOM Ex K	LP	O	Total Area (m2)	(sq. mi)	Av. WS (m/s)	Max. WS (m/s)	Dur (hrs)	Av. WS (m/s)	Max. WS (m/s)	Dur (hrs)	Av. WS (m/s)	Max. WS (m/s)	Dur (hrs)	Av. Flux (g/m2/s)	Emissions (tons)	Emissions (tons)	Max. Flux (g/m2/s)	Emissions (tons)
	4/13/95	2	X			4388451		12.8	18.1	12	8.9	9.6	4	11.8	18.1	16	8.58E-04	238.88	53.75	1.91E-03	531.67
	4/14/95	2				4388451		8.7	9.4	3	8.4	9.3	5	8.5	9.4	8	5.62E-04	78.29	19.57	6.30E-04	87.67
	4/15/95	2				4388451		9.2	10.3	6	10.6	11.6	12	10.1	11.6	18	6.92E-04	216.60	48.13	8.34E-04	261.14
	4/16/95	3				4388451				0	8.1	8.8	4	8.1	8.8	4	5.34E-04	37.14	11.14	5.83E-04	40.61
	4/19/95	2				4388451		8.7	8.7	1			0	8.7	8.7	1	5.76E-04	10.02	6.01	5.76E-04	10.02
	4/20/95	2				4388451		10.4	12.5	6	11.4	12.9	6	10.9	12.9	12	7.63E-04	159.23	37.15	9.84E-04	205.48
	4/21/95	2				4388451		12.5	15.9	12	9.7	11.0	12	11.1	15.9	24	7.82E-04	326.68	70.78	1.44E-03	602.44
	4/22/95	3				4388451				0	9.3	11.3	7	9.3	11.3	7	6.22E-04	75.74	19.48	8.03E-04	97.74
	4/23/95	3				4388451				0	9.1	9.9	4	9.1	9.9	4	6.06E-04	42.19	12.66	6.71E-04	46.72
	4/25/95	3				4388451				0	7.6	7.7	3	7.6	7.7	3	5.01E-04	26.14	8.71	5.07E-04	26.47
41	4/26/95	1				4246750	1.64	9.4	9.8	5	9.1	10.0	3	9.3	10.0	8	6.21E-04	83.64	20.91	6.80E-04	91.59
42	4/27/95	1	X			5924690	2.29	10.8	12.6	7	8.6	10.4	3	10.1	12.6	10	6.92E-04	162.60	39.02	9.47E-04	222.50
43	4/28/95	1				2051217	0.79	8.2	8.9	4	9.1	9.7	2	8.5	9.7	6	5.62E-04	27.40	7.31	6.54E-04	31.93
	4/29/95	2	X			4388451		9.7	13.1	6	8.9	10.3	9	9.2	13.1	15	6.16E-04	160.66	36.42	1.01E-03	263.48
	4/30/95	2	X			4388451		9.0	9.5	4	10.1	12.3	5	9.6	12.3	9	6.47E-04	101.32	24.77	9.12E-04	142.76
	5/1/95	2	X			4388451	1.69	11.4	12.0	2	9.8	10.5	3	10.4	12.0	5	7.19E-04	62.57	17.52	8.77E-04	76.33
	5/5/95	2	X		X	4388451	1.69	9.3	10.5	4	10.5	14.3	6	10.0	14.3	10	6.82E-04	118.61	28.47	1.18E-03	204.70
44	5/6/95	4				21784090	8.41			0	7.7	7.7	1	7.7	7.7	1	5.07E-04	43.80	26.28	5.07E-04	43.80
45	5/7/95	4				18004687	6.95			0	7.8	7.8	1	7.8	7.8	1	5.14E-04	36.67	22.00	5.14E-04	36.67
46	5/22/95	1				4419974	1.71	11.9	14.3	6	10.0	14.3	9	10.8	14.3	15	7.49E-04	196.92	44.64	1.18E-03	309.25
47	5/25/95	1				2132957	0.82	10.0	12.3	8	9.5	11.8	4	9.8	12.3	12	6.66E-04	67.55	15.76	9.12E-04	92.52
48	6/1/95	1	X			1331286	0.51	11.1	16.0	5	11.4	15.1	6	11.3	16.0	11	7.99E-04	46.38	10.96	1.46E-03	84.84
	6/2/95	3				4388451				0	8.7	11.7	7	8.7	11.7	7	5.76E-04	70.17	18.04	8.45E-04	102.86
	6/4/95	3				4388451				0	7.7	7.7	1	7.7	7.7	1	5.07E-04	8.82	5.29	5.07E-04	8.82
	6/5/95	2	X			4388451	1.69	13.4	17.9	8	9.3	12.1	7	11.5	17.9	15	8.22E-04	214.50	48.62	1.86E-03	485.89
	6/6/95	2	X			4388451	1.69	13.7	13.7	1	12.9	23.8	10	13.0	23.8	11	9.93E-04	190.11	44.94	3.95E-03	756.03
	6/7/95	3				4388451				0	8.5	10.8	6	8.5	10.8	6	5.62E-04	58.63	15.63	7.53E-04	78.61
49,50	6/14/95b	1				3742830	1.45	11.3	13.2	11	9.8	11.2	12	10.5	13.2	23	7.26E-04	247.90	53.89	1.02E-03	348.99
51	6/15/95	1				8521786	3.29	11.5	14.2	12	9.6	12.0	12	10.6	14.2	24	7.29E-04	591.42	128.14	1.16E-03	941.89
52	6/16/95	1				1917259	0.74	10.6	12.1	5	7.6	7.6	1	10.1	12.1	6	6.89E-04	31.41	8.38	8.89E-04	40.53
	6/19/95	3				4388451				0	8.2	8.5	2	8.2	8.5	2	5.41E-04	18.81	7.52	5.62E-04	19.54
	6/20/95	3				4388451				0	12.2	12.6	5	12.2	12.6	5	9.00E-04	78.31	21.93	9.47E-04	82.40
	6/21/95	3				4388451				0	10.2	12.3	4	10.2	12.3	4	6.98E-04	48.54	14.56	9.12E-04	63.45
	6/28/95	3				4388451				0	10.3	10.3	1	10.3	10.3	1	7.06E-04	12.29	7.38	7.06E-04	12.29
53	6/29/95	1				4032191	1.56	15.5	15.5	1	12.4	17.9	6	12.8	17.9	7	9.77E-04	109.33	28.11	1.86E-03	208.34

AN ESTIMATE OF ANNUAL PM10 EMISSIONS FROM OWENS LAKE FROM NIEMEYER SOURCE DATA + NIGHTTIME DATA + B-TOWER WINDS [AVERAGE AREA FILLED-IN CASE]

Tezz	Date	EF	TEOM Ex			Total Area		Daytime			Nighttime			Total Event					Adjusted		
Event #			K	LP	O	(m2)	(sq. mi)	Av. WS (m/s)	Max. WS (m/s)	Dur (hrs)	Av. WS (m/s)	Max. WS (m/s)	Dur (hrs)	Av. WS (m/s)	Max. WS (m/s)	Dur (hrs)	Av. Flux (g/m2/s)	Emissions (tons)	Emissions (tons)	Max. Flux (g/m2/s)	Emissions (tons)
	7/2/95	3				4388451				0	7.7	7.9	2	7.7	7.9	2	9.19E-05	3.20	1.28	9.66E-05	3.36
	7/3/95	3				4388451				0	8.9	8.9	1	8.9	8.9	1	1.24E-04	2.16	1.29	1.24E-04	2.16
54,55,56	7/11/95a	1				10547566	4.07	11.6	13.6	11	8.7	8.9	2	11.2	13.6	13	2.18E-04	118.42	27.33	4.02E-04	218.28
57	7/12/95	1				0	0.00	10.0	11.7	11	8.4	8.9	2	9.8	11.7	13	1.54E-04	0.00	0.00	2.50E-04	0.00
58	7/13/95	1				8594410	3.32	10.9	12.6	3	9.7	10.6	6	10.1	12.6	9	1.67E-04	51.33	12.55	3.13E-04	95.90
59	7/28/95	1				1534450	0.59	12.1	12.1	1	10.3	10.3	1	11.2	12.1	2	2.20E-04	2.68	1.07	2.76E-04	3.36
60	8/7/95	1				8096189	3.13	10.0	11.8	12	8.7	10.7	5	9.6	11.8	17	1.48E-04	80.96	18.10	2.56E-04	139.71
61	8/8/95	4				2843461	1.10	6.7	6.9	2	5.5	5.5	2	6.1	6.9	4	6.16E-05	2.78		7.52E-05	3.39
62	8/11/95	1				4473017	1.73	9.0	9.4	3	9.3	9.8	2	9.1	9.8	5	1.31E-04	11.62	3.25	1.55E-04	13.77
63	8/12/95	1				1183860	0.46	8.5	9.7	5	7.6	7.6	1	8.4	9.7	6	1.08E-04	3.04	0.81	1.51E-04	4.27
64	8/28/95	1				8769081	3.39	10.3	11.9	5			0	10.3	11.9	5	1.76E-04	30.59	8.56	2.63E-04	45.63
65	9/16/95	1				611666	0.24	8.6	9.9	7			0	8.6	9.9	7	1.15E-04	1.95	0.50	1.59E-04	2.70
	9/17/95	3				4388451				0	7.7	7.8	2	7.7	7.8	2	9.19E-05	3.20	1.28	9.42E-05	3.28
	9/28/95	3				4388451				0	10.5	13.3	2	10.5	13.3	2	1.85E-04	6.44	2.57	3.73E-04	12.96
66	9/29/95	1				2321410	0.90	10.1	11.2	5	11.2	13.8	9	10.8	13.8	14	2.00E-04	25.74	5.88	4.22E-04	54.39
	10/5/95	3				4388451				0	7.7	7.7	1	7.7	7.7	1	9.19E-05	1.60	0.96	9.19E-05	1.60
67	10/6/95	4				3559972	1.37	6.0	6.6	2			0	6.0	6.6	2	6.01E-05	1.70		6.98E-05	1.97
Sum										443			472			915		8,504	2073		13,603
Average						4388451	1.69														
Max						21784090	8.41														

Emission 1. "Tezz Identified Days" -- Daytime high winds with possible high nighttime winds and visible emission verification.

2. High daytime winds with possible high nighttime winds and no visible emission sources observed. [Deleted except for April]

3. High nighttime winds only (no high daytime winds) with no verification of emission sources.

4. Daytime visible emission sources observed with no high winds to support wind driven fugitive sources.

(shaded) Days with lower thresholds

Average of all observed areas 4388451 sq m

Maximum of all observed are 21784090 sq m

Note: Updates made /// on 11/22/96 by R. Baxter /// on 11/24/96 by R. Sahu

[IMP: Adjusted Emissions column includes decay in initial flux to 20% of its value after 30 mins of event. Further decay is not allowed.]

Normalized Bias and Normalized Gross Error 100 ug/m3 Cutoff	Lone Pine							Olancha							Keeler						
	Number of Data Points	Method 1			Method 2			Number of Data Points	Method 1			Method 2			Number of Data Points	Method 1			Method 2		
		Lone	Vect Ave	Btower	Lone	Vect Ave	Btower		Olan	Vect Ave	Btower	Olan	Vect Ave	Btower		Keel	Vect Ave	Btower	Keel	Vect Ave	Btower
Normalized Bias (%)																					
TEOM	16	115	9	-68	336	183	-19	9	423	7	-70	951	245	-17	52	100	100	102	417	462	472
0.75 * TEOM	16	150	29	-63	420	235	-5	9	523	20	-67	1071	276	-12	52	156	155	157	559	613	624
0.50 * TEOM	13	163	56	-14	404	170	38	7	742	9	-61	1332	276	15	42	220	225	229	683	757	763
SSI	2	45	83	-60	412	585	13	0	---	---	---	---	---	---	5	109	132	169	477	550	708
EPA Ozone Performance Goal	---	< +/- 15	< +/- 15	< +/- 15	< +/- 15	< +/- 15	< +/- 15	---	< +/- 15	< +/- 15	< +/- 15	< +/- 15	< +/- 15	< +/- 15	---	< +/- 15	< +/- 15	< +/- 15	< +/- 1	< +/- 15	< +/- 15
SCAQMD PM10 Performance Goal	---	< +/- 30	< +/- 30	< +/- 30	< +/- 30	< +/- 30	< +/- 30	---	< +/- 30	< +/- 30	< +/- 30	< +/- 30	< +/- 30	< +/- 30	---	< +/- 30	< +/- 30	< +/- 30	< +/- 3	< +/- 30	< +/- 30
Normalized Gross Error (%)																					
TEOM	16	149	38	68	351	194	53	9	467	74	74	969	283	101	52	115	116	118	423	469	478
0.75 * TEOM	16	176	55	63	432	244	61	9	564	79	71	1088	300	97	52	163	164	167	563	618	629
0.50 * TEOM	13	264	77	55	581	278	85	7	766	53	67	1332	285	105	42	226	232	235	688	763	766
SSI	2	63	83	60	412	585	16	0	---	---	---	---	---	---	5	109	132	171	477	550	708
EPA Ozone Performance Goal	---	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35	< 35
SCAQMD PM10 Performance Goal	---	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30	< 30

Table 1. Normalized Bias and Normalized Gross Error for Model Performance Evaluation.

Lone Pine

	Six Highest PM10 Concentrations (ug/m3) with date						Average of Six Highest (ug/m3)
	1	2	3	4	5	6	
Observed							
	3/18/94	3/9/95	1/23/94	3/3/95	2/13/95	4/21/94	
Unadjusted TEOM	499	392	307	228	228	180	305
0.75 Adjusted TEOM	374	294	230	171	171	135	229
0.50 Adjusted TEOM	250	196	154	114	114	90	153
Predicted							
MPE Receptor Network	3/18/94	5/15/94	10/4/94	3/3/95	3/10/95	2/13/95	
	699	403	398	388	376	366	438
AD Receptor Network	3/3/95	12/12/95	2/13/95	3/18/94	4/13/95	3/10/95	
	3751	2760	2103	1953	1788	1640	2333

Table 2. Comparison of predicted and observed six highest PM10 concentrations in the Lone Pine region.

Olancha

	Six Highest PM10 Concentrations (ug/m3) with date						Average of Six Highest (ug/m3)
	1	2	3	4	5	6	
Observed							
	4/9/95	4/1/95	12/8/94	3/6/95	5/5/95	4/8/95	
Unadjusted TEOM	2252	558	262	170	169	128	590
0.75 Adjusted TEOM	1689	419	197	128	126	96	442
0.50 Adjusted TEOM	1126	279	131	85	84	64	295
Predicted							
MPE Receptor Network	1/28/94 678	1/29/94 603	10/14/94 599	11/2/94 494	10/4/95 486	11/19/94 420	546
AD Receptor Network	6/6/95 5877	4/9/95 4565	3/12/94 4399	12/25/94 3296	2/12/94 3056	4/21/95 2761	3992

Table 3. Comparison of predicted and observed six highest PM10 concentrations in the Olancha region.

Keeler

	Six Highest PM10 Concentrations (ug/m3) with date						Average of Six Highest
	1	2	3	4	5	6	(ug/m3)
Observed							
	4/13/95	2/13/95	3/21/95	2/17/94	3/18/94	12/12/95	
Unadjusted TEOM	3929	3883	2204	1381	1226	1100	2287
0.75 Adjusted TEOM	2947	2913	1653	1036	919	825	1715
0.50 Adjusted TEOM	1965	1942	1102	690	613	550	1144
Predicted							
MPE Receptor Network	3/3/95	4/13/95	3/21/95	12/12/95	2/13/95	2/17/94	
	3681	2884	2528	2412	2075	1721	2550
AD Receptor Network	12/12/95	6/6/95	3/3/95	4/9/95	3/12/94	3/21/95	
	6148	5233	4681	3884	3877	3660	4580

Table 4. Comparison of predicted and observed six highest PM10 concentrations in the Keeler region.

Table 5. Comparison of OVPA SIP model unpaired peak estimation accuracy model performance measure using third highest vlaues with historical model performance evaluation goals used in other SIP attainment demonstration modeling.

	Unpaired Peak Accuracy (%)	Spatially Paired Accuracy (%)	Spatially and Temporally Paired Accuracy (%)	Observed (ug/m^3)	Predicted Unpaired (ug/m^3)	Predicted Spatially Paired (ug/m^3)	Predicted Spatially/ Temporally Paired (ug/m^3)
Historical Model Performance Goals							
EPA Ozone Goal	< ± 20	N/A	N/A				
SCAQMD PM_{10} Goal	<± 30	N/A	N/A				
Phoenix PM_{10} Goal	<± 50	N/A	N/A				
Lone Pine Subregion OVPA SIP Model							
0.50TEOM	1,2684	158	86	154	2,131	398	286
0.75 TEOM	827	73	24	230	2,131	398	286
Uncorrected TEOM	594	30	-7	307	2,131	398	286
Olancha Subregion OVPA SIP Model							
0.50TEOM	3,279	357	-24	131	4,427	599	99
0.75 TEOM	2,147	204	-50	197	4,427	599	99
Uncorrected TEOM	1,590	129	-62	262	4,427	599	99
Keeler Subregion OVPA SIP Model							
0.50TEOM	327	129	129	1,102	4,709	2,528	2,528
0.75 TEOM	185	53	53	1,653	4,709	2,528	2,528
Uncorrected TEOM	114	15	15	2,204	4,709	2,528	2,528

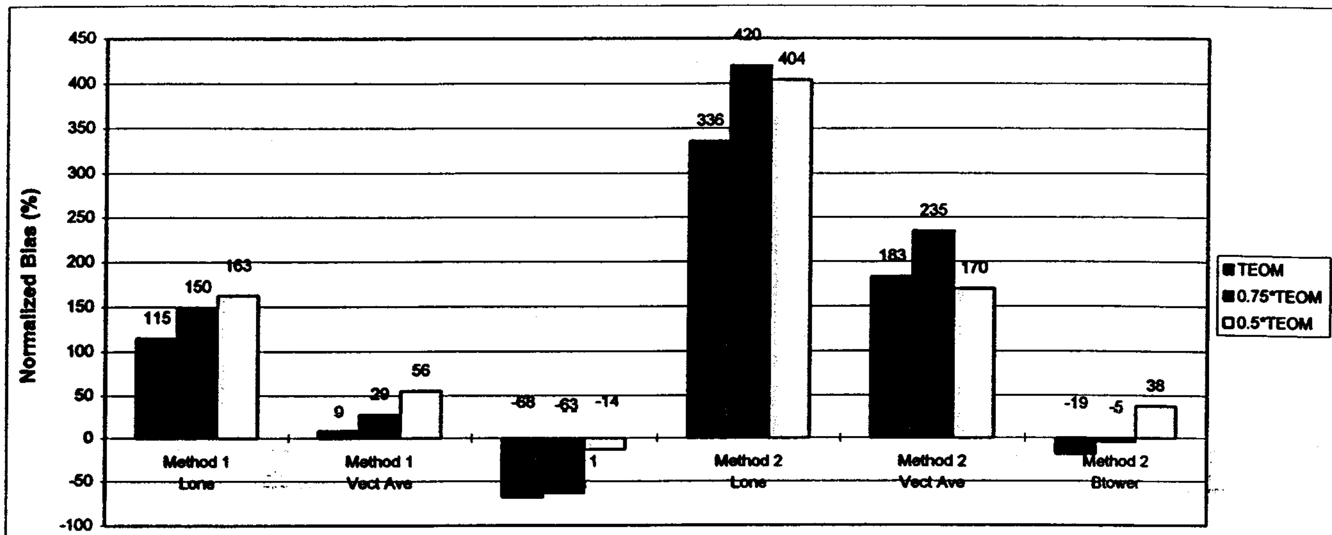

Figure 1a. Normalized Bias for ISC PM10 Model Predictions at Lone Pine
100 ug/m3 cutoff

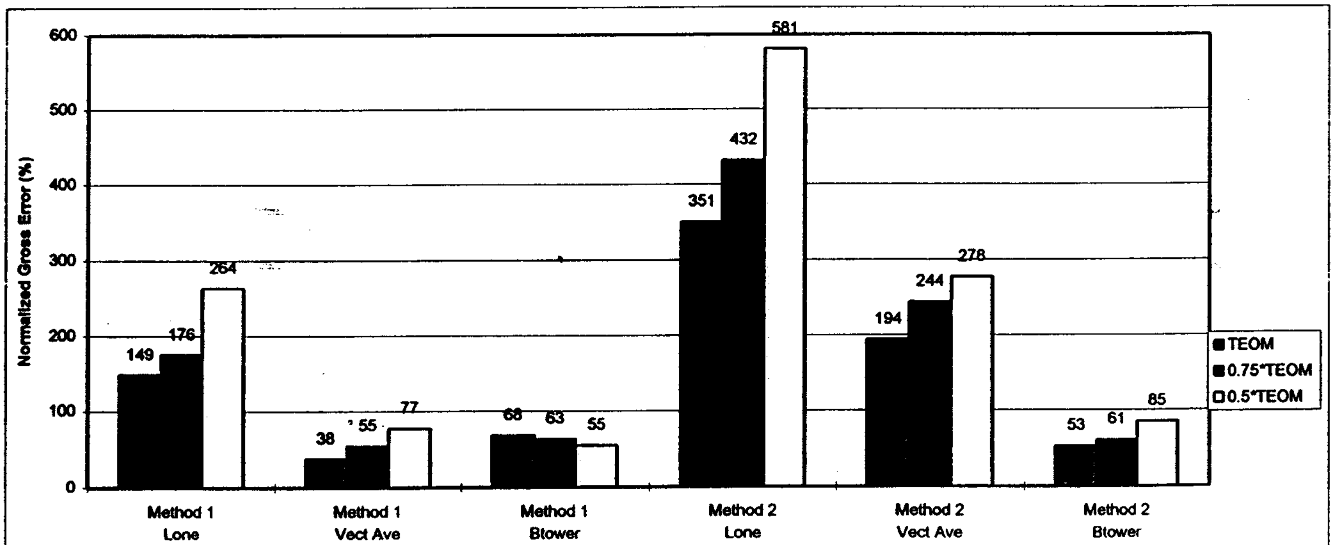

Figure 1b. Normalized Gross Error for ISC PM10 Model Predictions at Lone Pine
100 ug/m3 cutoff

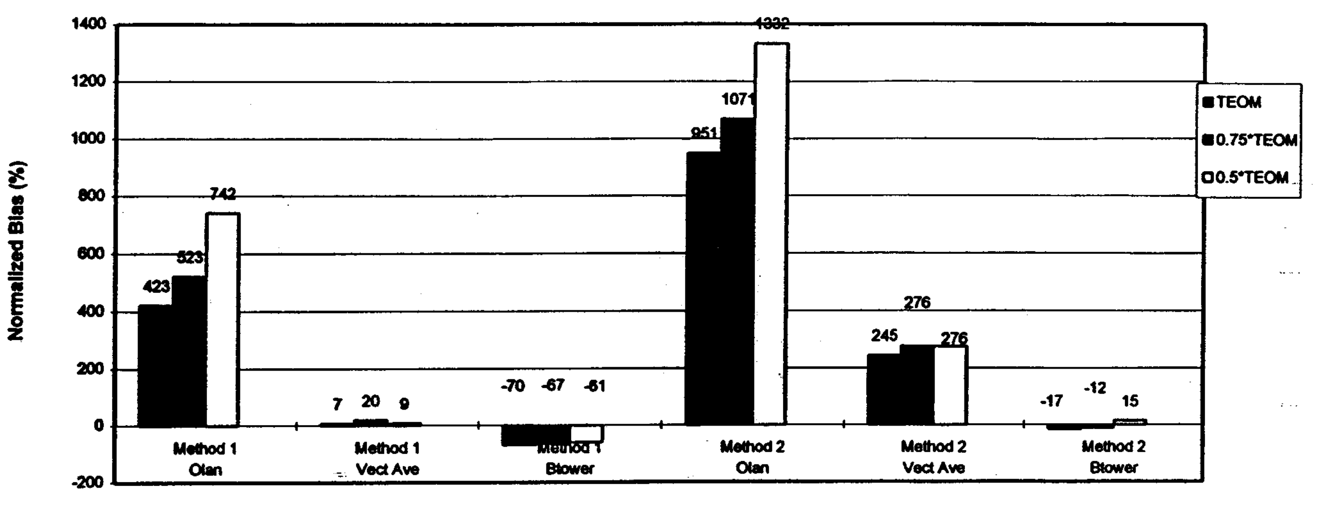

Figure 2a. Normalized Bias for ISC PM10 Model Predictions at Olancha
100 ug/m3 cutoff

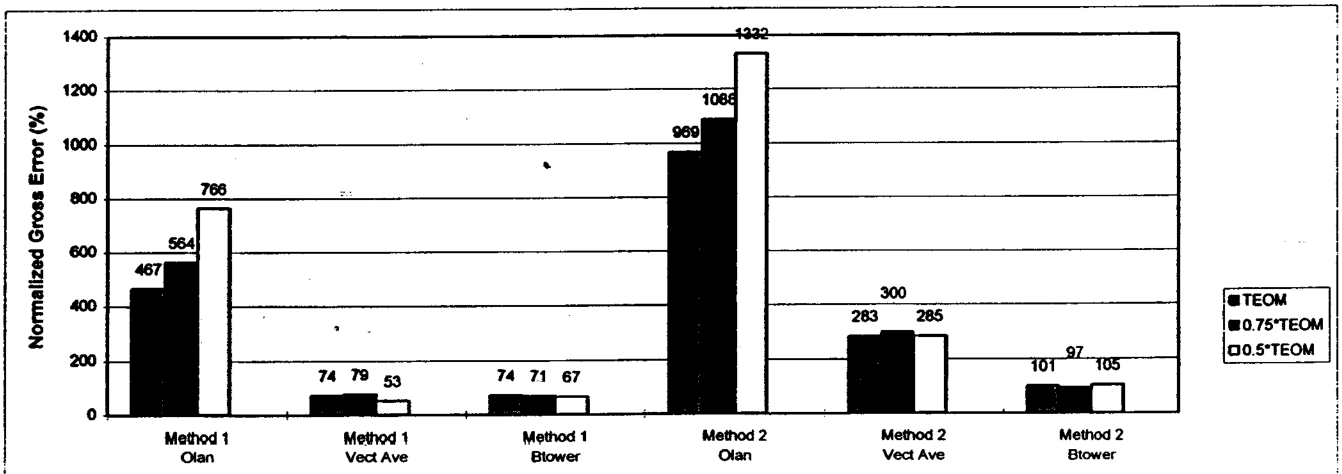

Figure 2b. Normalized Gross Error for ISC PM10 Model Predictions at Olancha
100 ug/m3 cutoff

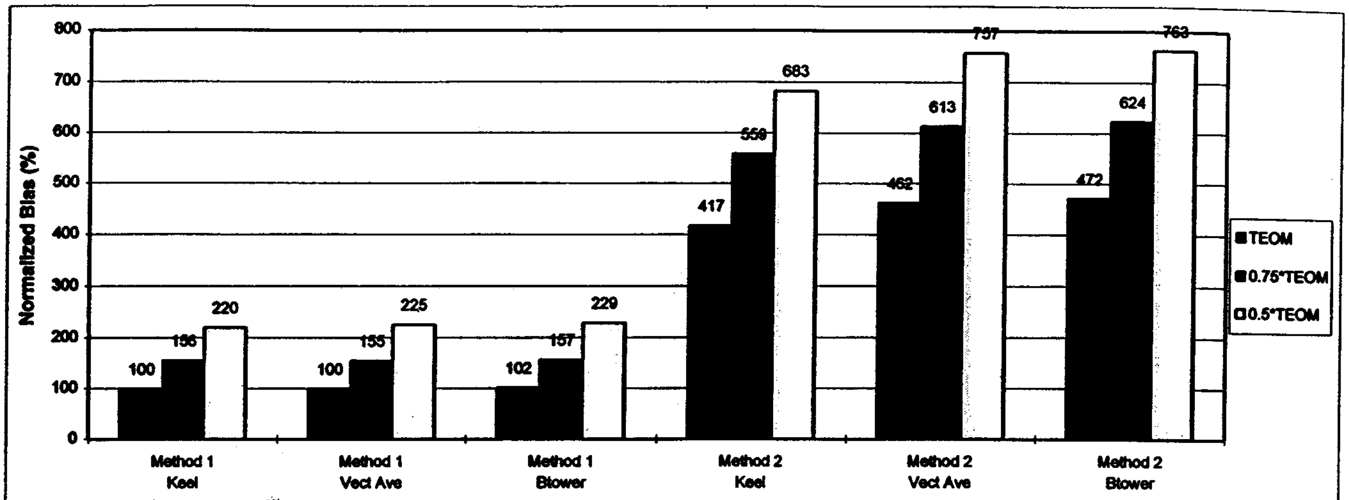

Figure 3a. Normalized Bias for ISC PM10 Model Predictions at Keeler
100 ug/m3 cutoff

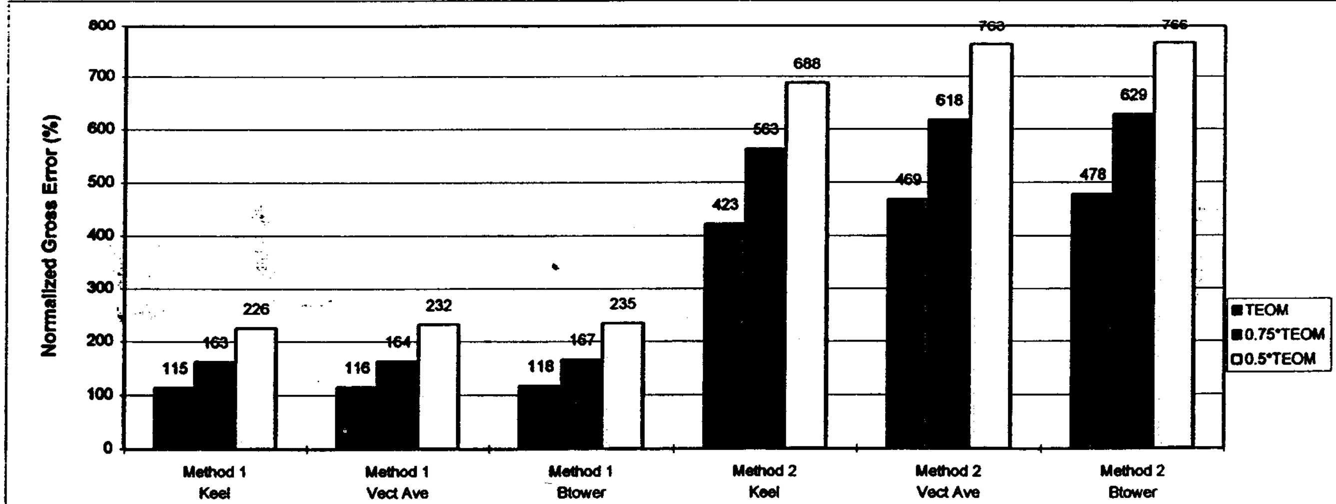

Figure 3b. Normalized Gross Error for ISC PM10 Model Predictions at Keeler
100 ug/m3 cutoff

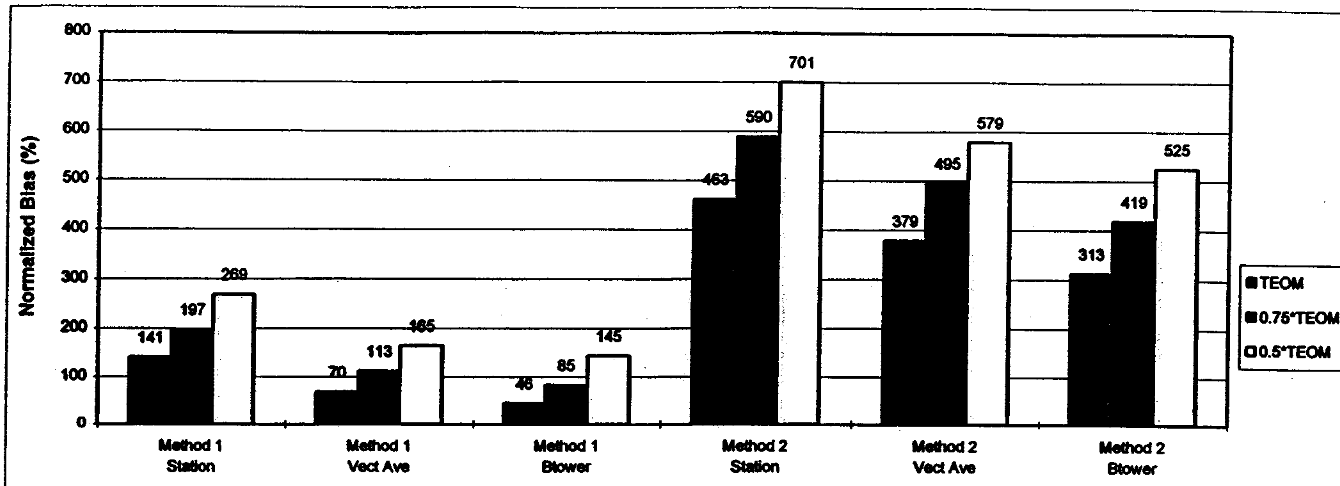

Figure 4a. Normalized Bias for ISC PM10 Model Predictions at All Three Locations 100 ug/m3 Cutoff

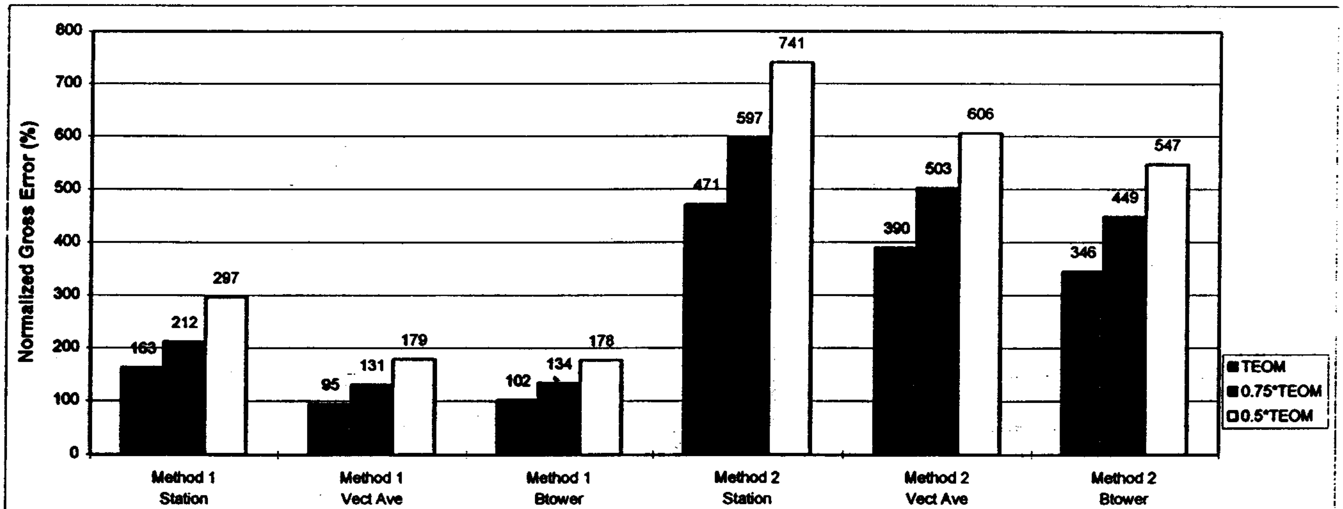

Figure 4b. Normalized Gross Error for ISC PM10 Model Predictions at All Three Locations 100 ug/m3 Cutoff

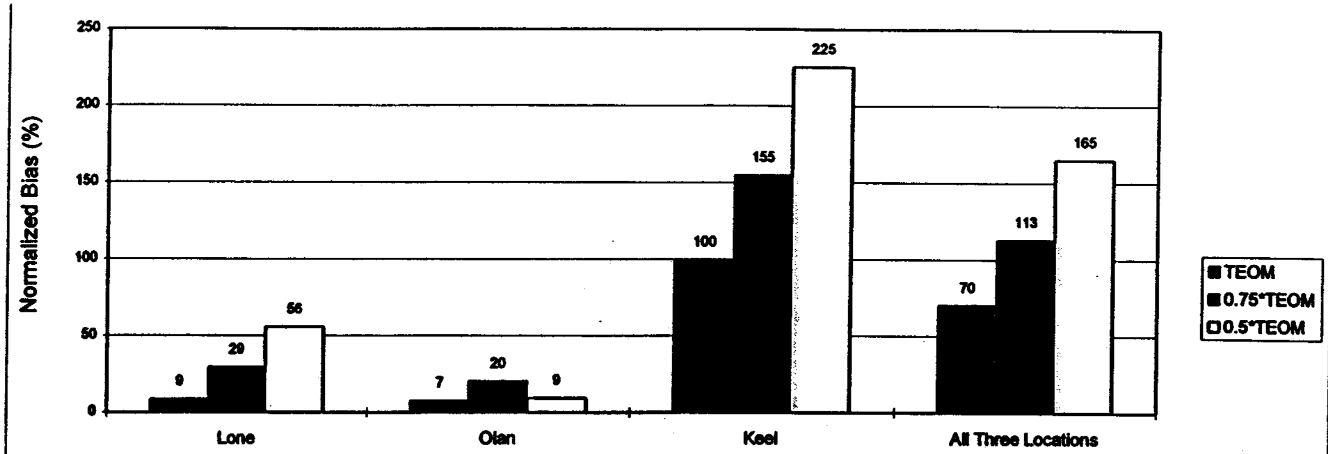

Fig 5a. Normalized Bias for ISC PM10 Model Predictions
Emissions Method 1, Vector Average Meterology Conditions
100 ug/m3 cutoff

sd

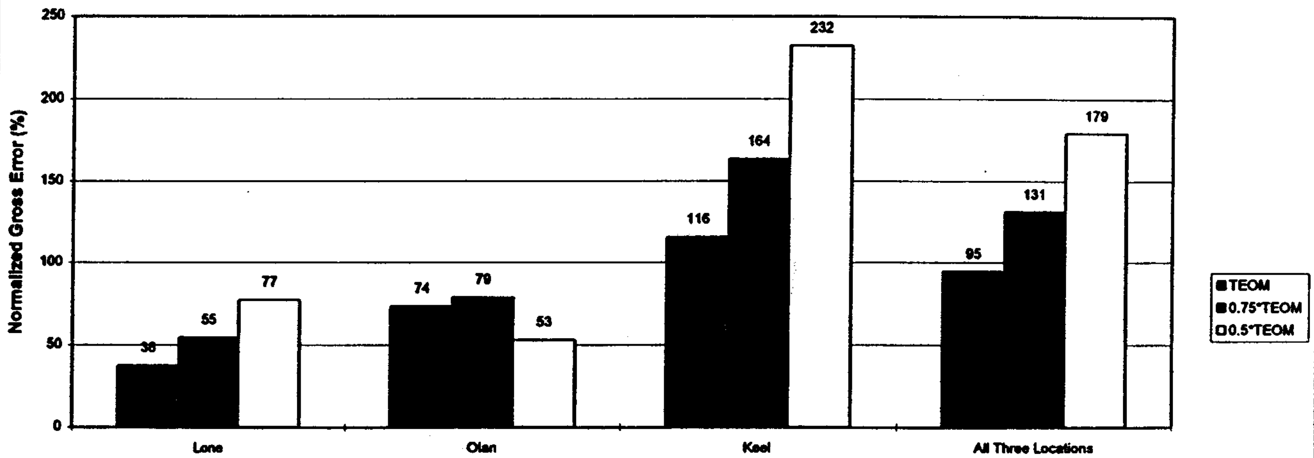

Fig 5b. Normalized Gross Error for ISC PM10 Model Predictions
Emissions Method 1, Vector Average Meterology Conditions
100 ug/m3 cutoff

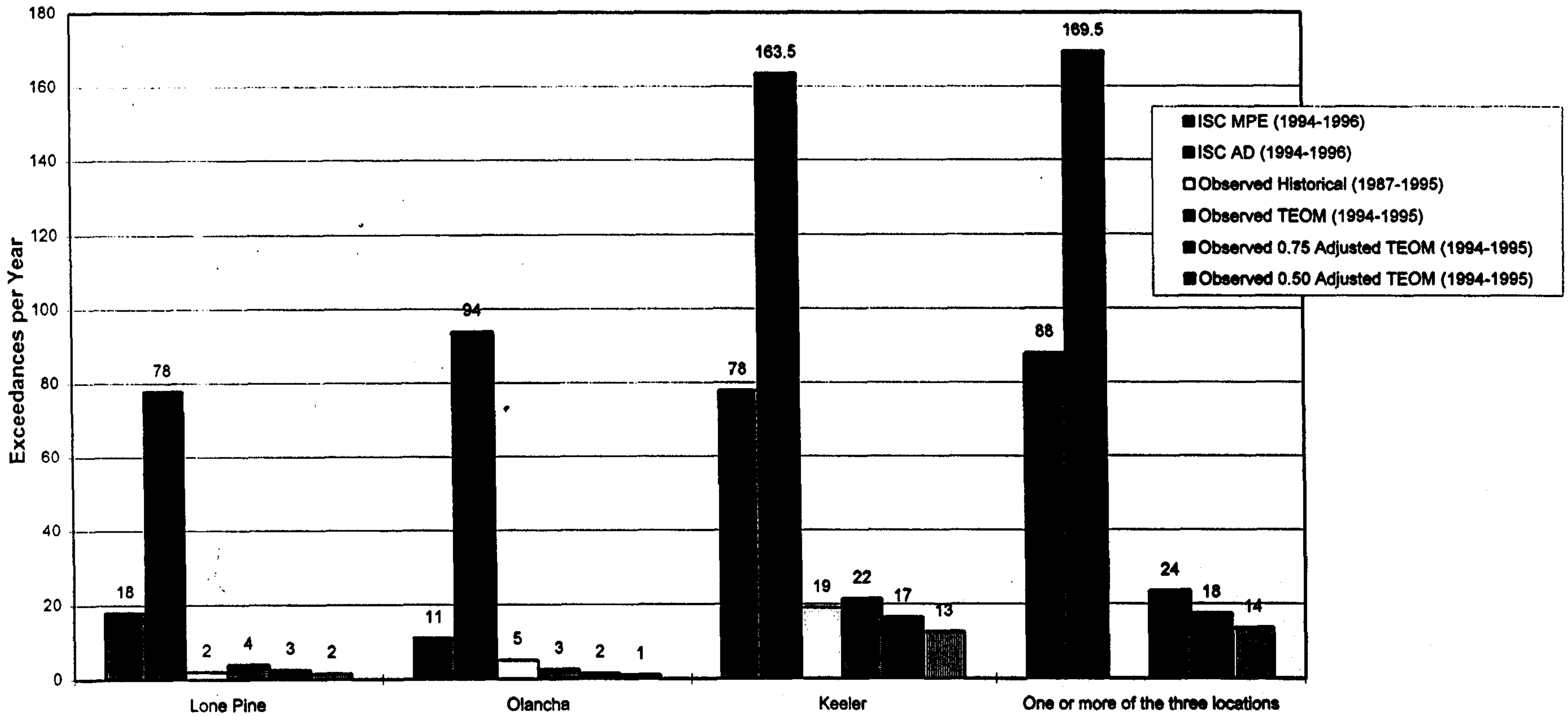

Figure 6. Number of exceedances per year (PM10>150 ug/m3) predicted by ISC using the Model Performance Evaluation (MPE) and Attainment Demonstration (AD) receptor networks, compared to historical observations (1987-1995) and TEOM measurements (1994-1995)

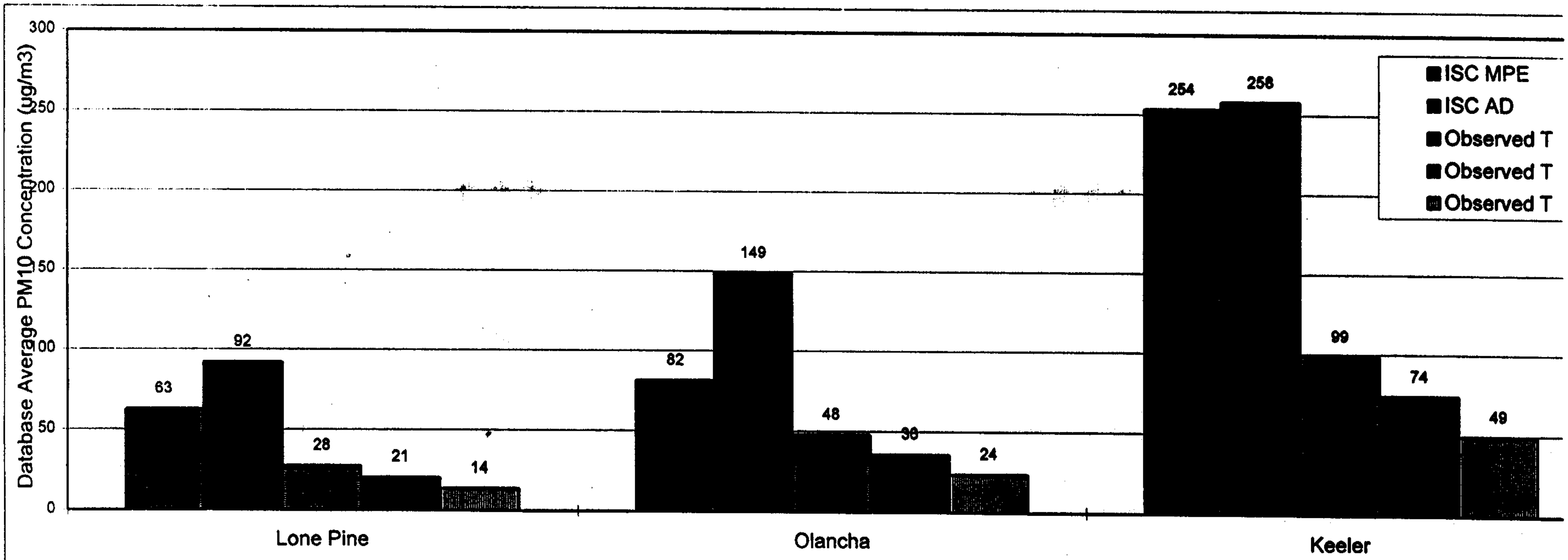

Figure 7. Database average PM10 concentrations (ug/m3) for 1994-1995 predicted by ISC using the Model Performance Evaluation (MPE) and Attainment Demonstration (AD) receptor networks, compared to observed data (TEOM, adjusted TEOM, and SSI)

District Response to LADWP's Draft SIP Comments

June 24, 1997

Note: The following District staff responses to the comments of the City of Los Angeles (City), and the Los Angeles Department of Water & Power (LADWP) respond to comments expressly addressing the draft State Implementation Plan (DSIP). The District responded to SIP related comments submitted by other parties in the response to comments on the Draft EIR supporting the SIP. The reader is directed to the Response to Comments on the Draft EIR for a complete set of responses to SIP related issues submitted by parties other than LADWP.

COMMENTS MADE BY - THE LOS ANGELES DEPARTMENT OF WATER & POWER (LADWP), HARRY M. SIZEMORE, DATED: MAY 8, 1997.

Cover Letter, Page 1 - RE: Natural Events Policy

The Draft SIP & EIR adequately discuss as a potential alternative the District petitioning the USEPA Administrator to grant a discretionary extension of the attainment deadline under Section 188(e) of the Clean Air Act Amendments of 1990. The District has concluded that the plan can be feasibly implemented in the 4.5 years between the date of adoption of the plan, and the statutory attainment deadline of December 31, 2001. Seeking an extension of the attainment deadline under Section 188(e) is not an appropriate CEQA alternative, since it does not avoid or reduce any significant effect to the environment which the Proposed Project causes, and because it is not legally feasible. A project alternative which cannot be feasibly accomplished need not be exhaustively considered. The Section 188(e) alternative is legally infeasible because all of the legal preconditions to obtaining an extension cannot be demonstrated. Those preconditions include not only a demonstration that attainment is impracticable by the statutory deadline, but also that all requirements and commitments in existing air quality plans for the area have been complied with, and that the air quality plan for the area includes "the most stringent measures that are included in the implementation plan of any State or are achieved in practice in any State, and can feasibly be implemented in the area." See Interpretative Addendum on Future Rule-Making For PM_{10} Non-Attainment Areas, 59 Federal Register 41,998 (August 16, 1994)("The consequence of receiving additional time [under a Section 188(e) extension] is that the State must demonstrate that its PM_{10} implementation plan contains the 'most stringent measures' that can feasibly be implemented in the relevant area from among those which are either included in any other SIP or have been achieved in practice in any other State."). Notably, in its comments on the plan, the City has neither proposed that the District revise its plan to include a request for an extension under Section 188(e), nor suggested how the District can demonstrate satisfaction of the statutory preconditions for such an extension. If after the City undertakes diligently and in good faith to promptly implement the plan, it appears that matters outside the City's control have rendered full implementation impracticable by the statutory deadline, the District retains its discretion to seek an extension under Section 188(e) at that time.

In any case, the City's contention that plan implementation is impracticable by the statutory deadline is irrelevant to the adequacy of the Draft SIP and EIR's discussion both of the nonavailability of a waiver under Section 188(f) of the Clean Air Act Amendments of 1990, and of the application of the USEPA's Natural Events Policy. For the reasons stated in the Draft SIP and EIR, they are not appropriate CEQA alternatives.

Cover Letter, Page 1 - RE: General Issues with DSIP
Responses specific to each DSIP issue are addressed in response to more detailed comments on specific issues.

Cover Letter, Page 2 - RE: Authority to Require Water for Air Quality Control
Based on its analysis of the cost/effectiveness of the proposed control measures, the District has concluded that, measured both by cost and by consumption of water, the proposed combination of control measures is a reasonable and effective dust control strategy. In addition, District has concluded that the proposed control strategy does not affect the City's right to produce, store, divert or convey water. The City's right to engage in those activities will be the same the day after the State Implementation Plan is adopted as the day before. The City's contrary conclusion is not supported by any analysis. The contention that any air pollution control measure that consumes water, irrespective of amount, unlawfully affects the City's water rights cannot be supported. Significantly, the City has not contested regulations of the South Coast Air Quality Management District that require the City to implement water-consumptive dust suppression measures, such as watering public works construction sites and City-owned unpaved roads, as repugnant to the City's water rights (SCAQMD, 1996a and SCAQMD, 1996b). Irrespective of whether the City chooses to fund the proposed control measures with water purchased from adjacent landowners, or from legally-developed sources of groundwater, or from its own supply, all of which would be consistent with the requirements of the proposed plan, the City's right to produce, store, divert or convey water is not prejudiced. The State's authority to affect those rights is vested exclusively in the State Water Resources Control Board, and in the California courts. The District does not assert otherwise.

Cover Letter, Page 2 - RE: Consistency with Requirements in Other Nonattainment Areas
The Owens Valley DSIP control measures are intended to mitigate the PM_{10} NAAQS violations caused by wind blown dust from Owens Lake; none of the other geographic areas mentioned have the same type of PM_{10} source.

Cover Letter, Page 2 - RE: Economic Feasibility and Funding Sources
A detailed cost estimate for implementation of the DSIP is included in Appendix G of the DSIP. Funding sources other than the LADWP have been used including: funds appropriated by the State Legislature and passed through the State Lands Commission, and Federal §105 grants that have aided the District in funding studies at Owens and Mono Lakes. The District is not opposed to working with the City to seek other funding sources for future research at Owens Lake to supplement LADWP funding. The District staff has offered to work with LADWP in the past to find other funding sources for research. However, the unavailability of other funding sources does not vitiate the City's obligations to pay the reasonable fees assessed by the District.

Cover Letter, Page 3 - RE: Establishment of a Scientific Review Panel
Scientific review panels and advisory groups have been active throughout the history of the dust control effort at Owens Lake. The Owens Lake Task Force was formed in 1979 and was active until it was replaced with the Owens Lake Advisory Group in 1991 to expand participation to all stakeholders and researchers. The LADWP has always been an active participant of these review groups. The District is not opposed to the creation of another scientific review group; however, it should be noted that funding requests (as well as results) for the work that has been done at Owens Lake were presented to these groups for their review prior to submitting the requests to LADWP for funding at annual and sometimes semi-annual meetings.

Executive Summary, Page 1 - RE: TEOM and Air Quality Data
The TEOM is a federally approved equivalent method monitor for PM_{10} and may be used to determine compliance with the NAAQS in accordance with 40 CFR 50, Appendix K (Automated equivalent method: EQPM-1090-079, Federal Register, Vol. 55, page 43406, October 29, 1990). The rate of violations is not determined by the TEOM, but by the Size-Selective Inlet samplers, which operate once every six days and have a longer record of operation to determine the rate of violations (also see DSIP). DSIP Section 3-3.4 was revised to provide a more detailed explanation of the method that was used to determine the long-term frequency of PM_{10} violations from 1987 through 1995.

Staff believes that the term "frequently violated" in reference to the number of PM_{10} NAAQS violation days per year at Owens Lake is properly used.

The DSIP does not dwell on the number of days when the air quality complies with the NAAQS because the focus of the plan is to provide a strategy to improve air quality for days like those that presently violate the NAAQS. The reader should refer to the graphs in Figures 3.4, 3.5 and 3.6 to see a graphical representation of the frequency of good and bad air quality days and may also want to refer to Appendix A to see the entire listing of PM_{10} air quality data.

Executive Summary, Page 1 - RE: Consideration of Meteorological Trends
The number of PM_{10} violations at Keeler in 1995, 22, is not much higher than the nine year average of 19 per year. The observations of the surface conditions at Owens Lake show that weather conditions affect the erodibility of the surface, with wet cool weather causing more erodible conditions in the spring, fall and winter. Surface condition changes may take place within a week and will be independent of the overall seasonal trend. For instance, one rain followed by cool weather could cause dust storms for weeks, although it may be in an overall warm and dry year or season. Although the City may take advantage of meteorological changes when implementing the control measures they should not be relied upon in estimating the necessary level of control needed to meet the NAAQS. Also see response to Cover Letter, Page 1, RE: Natural Events Policy.

Executive Summary, Page 2 - RE: Dust Transport from Owens Lake
The projected area of Owens Lake dust impact in Figure 2 in the Executive Summary and Figure 3.3, is the District's projection of the ground level concentrations based on the monitor data and projections for areas where monitors are not operated. These figures were revised to exclude Bishop as an area that the staff projects to have PM_{10} violations, since exceedances have not been measured at the site. However, it should be noted that samples in Bishop are taken on a fixed schedule, once every six days, so there is only a 17% chance that if an exceedance occurred on a given day that it would be measured. Visible observations by staff confirm that the dust from Owens Lake impacts Bishop.

The off-lake data collected on April 8, 1995, taken for the 24-hour period from 15:00 to 15:00 hours, which showed Ridgecrest with a 24-hour average concentration of 235 $\mu g/m^3$, is not consistent with compliance monitoring requirements for the NAAQS which uses a midnight to midnight time for sampling. The list of exceedance days with concentrations over 150 $\mu g/m^3$ only includes data taken on the midnight to midnight schedule. Also see response to Executive Summary, Page 1 - RE: Consideration of Meteorological Trends. The District is not aware of any evidence to indicate that the poor air quality in Ridgecrest on April 8, 1995 was caused by any source other than Owens Lake. Monitoring data indicates that every operating off-lake monitor south of Owens Lake, including Olancha, Coso Junction, Pearsonville and Ridgecrest, was impacted by the Owens Lake dust plume on that day.

Executive Summary, Page 2 - RE: Exceedance Measured at Coso Junction
District staff spoke with Mr. Charles Chang, LADWP (months prior to submission of LADWP's comments) about the April 23, 1990 violation at Coso Junction, which was caused by a fallow agricultural field near the monitor site. This violation day was the design day for the Coso Junction area of the Searles Valley SIP. Staff have pictures showing the field blowing on that day. Staff further explained that the field is now stable and has not caused a violation since then. Even when it existed, there is no indication that this source caused or contributed to violations in the Owens Valley Planning Area. In light of the facts that were given to LADWP, it is not clear why this violation at Coso Junction was raised as an issue regarding the adequacy of the DSIP.

Executive Summary, Page 2 - RE: Visitors to the Manzanar National Historic Site
It is difficult to relate the frequency of poor air quality days at the Manzanar National Historic Site to the frequency of violations measured in Lone Pine. Southerly winds often cause the dust plume to pass to the east of Lone Pine and may have a higher impact at sites north of Lone Pine, such as the Manzanar NHS and Independence. Days on which violations occur are not "extreme" wind speed days, as LADWP contends. Peak hourly wind speeds on violation days may range from 20 to 40 mph, and often don't exceed 30 mph. The District does not believe that the Owens Lake health advisory program should be used in place of the need to control the dust problem. Stage 1 health advisories are issued when hourly PM_{10} concentrations exceed 400 $\mu g/m^3$. This concentration is a fair indicator for a probable exceedance of the 24-hour average concentration of 150 $\mu g/m^3$.

Executive Summary, Page 3 - RE: Figures 2 and 3.3
See response to Executive Summary, Page 2 - RE: Dust Transport from Owens Lake.

Section 2, Page 3 - RE: LADWP Ownership/Lease of Control Equipment and Property for Control Measures.
The District has the authority to require sources of air pollution to comply with regulations to limit emissions. Facilities normally purchase or lease control equipment, such as water trucks and scrubbers to comply with air pollution regulations.

Section 2, Page 3 - RE: Large Scale Testing
The District is confident that the 600-acre shallow flooding project and the 40-acre managed vegetation project that were performed to test these control measures were large enough to engineer the implementation of these measures on the lake bed. Two full-size managed vegetation panels, each 3/4 of a mile long, were also constructed to improve confidence in the large scale conversion. A small-scale test of the gravel to determine if salts would migrate through the material was sufficient to show that it would stop capillary salt rise as theorized. A

large scale test of the gravel measure was not necessary to determine if this control measure could be applied on the lake bed.

Section 2, Page 3 - RE: CAA Deadlines, Section 188(f) and the Natural Events Policy
See response to Cover Letter, Page 1 - RE: Natural Events Policy.

Section 2, Page 4 - RE: The Natural Events Policy and BACM Determination
The District has proposed the adoption of a District Natural Events Policy. The proposal includes a BACM determination for Owens Lake. The reader is referred to the document, *Proposed Natural Events Policy for PM_{10} Air Quality Exceedances at Owens Lake*, (GBUAPCD, 1997) for a detailed response this comment, and the BACM SIP (GBUAPCD, 1994).

The following is a summary taken from the memorandum which proposes the District Natural Events policy. It should be noted that the BACM analysis for the DSIP control measures that is included in this document supports gravel, shallow flooding, and managed vegetation as acceptable BACM for wind blown dust from Owens Lake.

For purposes of flagging PM_{10} air quality exceedance data for consideration as a natural event under the US Environmental Protection Agency's Natural Events Policy, the District will consider an hourly average wind speed greater than 40 miles per hour, measured at one of the Owens Lake PM_{10} monitoring sites, as an unusually high wind for the Owens Lake area. Events considered for flagging as a natural event will be publicly reviewed to ensure that the District-approved SIP control measures were in place, and properly operated and maintained during the event, but were overwhelmed by unusually high winds. Upon Board approval, evidence supporting the natural event and a request to flag the data will be submitted to the California Air Resources Board and the USEPA for their concurrence. A Natural Event Action Plan will be developed and implemented in accordance with the USEPA's Natural Events Policy and any related subsequent guidance.

In May 1996, the US Environmental Protection Agency issued a policy to clarify the federal Clean Air Act Amendments of 1990 (CAAA) with regard to areas that would be in compliance with the PM_{10} National Ambient Air Quality Standard (NAAQS) but for impacts caused by natural events. The policy allows the USEPA Administrator to exclude PM_{10} monitoring data affected by natural events, such as wildfires, volcanic and seismic activities, and unusually high wind, in designating or re-designating an area as attainment or non-attainment, including the moderate and serious area designations for PM_{10} non-attainment.

The policy requires a Natural Event Action Plan (NEAP) to be developed in certain circumstances. A NEAP would include a public health advisory program to alert the public when PM_{10} levels are affected by natural events, a commitment to implement Best Available Control Measures (BACM) if anthropogenic sources of PM_{10} are the cause of the exceedance, and other specific provisions. For a high wind event from an anthropogenic source to qualify as a "natural event" it must be shown that BACM for wind erosion was in place at the time of the event and that unusually high winds overwhelmed the BACM strategy.

In Congress' Clean Air Act Reports discussing attainment date waivers for serious PM_{10} nonattainment areas (CAAA §188(f)), Congress explicitly considered wind blown dust from Owens Lake to be an anthropogenic source of PM_{10} because it is anthropogenic in origin, since the dust storms are a result of the diversion of water that would normally flow into Owens Lake. Because Owens Lake is considered an anthropogenic source of PM_{10}, the Natural Events Policy would apply only after BACM has been implemented. In this case, the District considers the 1997 SIP control measures to be BACM for PM_{10} at Owens Lake.

Because conditions that create high wind events vary from area to area, the USEPA's Natural Events Policy requires the State to determine the wind conditions for unusually high winds that will overcome BACM in each planning area. In California, local air pollution control districts have the authority to regulate local stationary sources. That authority includes the authority to determine, for areas within a local district, what conditions constitute unusually high winds for purposes of the application of the USEPA's Natural Events Policy.

An air quality modeling analysis of PM_{10} emissions after the implementation of the 1997 SIP control measures shows that the PM_{10} NAAQS will be attained at Owens Lake. The model used historical meteorological conditions from 1994 and 1995, which included one day with hourly average winds over 40 miles per hour at Olancha. However, higher wind speeds than the modeled wind conditions are possible. Higher winds will increase the PM_{10} emissions from some of the control areas, and under extreme conditions could cause a PM_{10} exceedance to occur, despite the application of BACM, thus prompting a natural event flag on the data.

It is possible that the shallow flooding control measure may not be as effective in reducing PM_{10} as predicted if wind speeds exceed 40 mph. Because field testing and wind tunnel testing for the shallow flooding control measure were not able to be done at sustained winds greater than 40 mph, the expected control effectiveness of around 99% control cannot be assured at wind speeds above those tested. However, it is reasonable to believe that even at winds greater than 40 mph that PM_{10} emissions will be significantly reduced in shallow flood areas. For the gravel and vegetation management control measures, the projected emission reductions are not expected to be significantly affected by winds greater than 40 mph.

Through a review of the historic wind speed data (1992-1995) at the PM_{10} monitoring sites, the hourly average wind speed is expected to exceed 40 mph about once every two years at the Owens Lake PM_{10} monitoring sites. It is anticipated that the 1997 DSIP control measures will be capable of maintaining their expected level of control up to an hourly average of 40 miles per hour. However, compliance cannot be assured if unusually high winds above 40 mph are sustained over many hours in a day.

Section 2, Page 5 - RE: Authority to Require Water for Air Quality Control
See response to Cover Letter, Page 2 - RE: Authority to Require Water for Air Quality Control.

Section 2, Page 5 - RE: Consideration of Meteorological Trends
See response to Executive Summary, Page 1 - RE: Consideration of Meteorological Trends.

Section 2, Page 5 - RE: Storm Locations by Tezz Niemeyer
The area proposed for control was reduced from 46 square miles as shown in the 1994 BACM SIP to 35 square miles in the 1997 DSIP based on observations of the source areas on the lake bed. Further refinements of this area may jeopardize attainment with the standard if uncontrolled areas become sources of dust. The source areas are not always in the same place and hot spots may move from season to season within the entire 35 square mile area that is intended for control. Niemeyer's observations were taken over two years and are not a complete record of all the dust storms and sources that existed during that period.

Section 2, Page 5 - RE: Emissions Inventory
The Coso Junction fallow field is no longer an emission source as stated in the response to Executive Summary, Page 2 - RE: Exceedance Measured at Coso Junction. In addition, this source is not in the Owens Valley PM_{10} nonattainment area, but is in the Searles Valley PM_{10} nonattainment area and would be incorporated in background monitoring concentrations if there were an impact in the Owens Lake area.

The range of emission estimates for wind blown PM_{10} from Owens Lake can be attributed to the variability of emission rates that can change from day to day. Even if different methods are used to estimate the emissions, measurements taken at different times would likely yield different emission estimates even if all the methods were accurate. The range of emission rates is largely affected by when the measurements were taken. The District's portable wind tunnel was operated in a side-by-side test with a large wind tunnel at Owens Lake in a test that showed the two tunnels to agree on the PM_{10} emission rate (Nickling, *et al.*, 1997).

The District disagrees with LADWP's statements that the emissions inventory for the wind blown dust is overestimated, that there significant missing sources of PM_{10}, and that proper modeling shows violations after application of the proposed control strategy.

Section 2, Page 5 & 6 - RE: Control Option Research, BACM Analysis & Cost
See response to comment Section 2, Page 4 - RE: The Natural Events Policy and BACM Determination. The BACM analysis contained in this document supports the technical and economic feasibility of the proposed SIP control strategy.

Section 2, Page 6 - RE: Revision to the PM NAAQS.
It appears that LADWP's comment about a "casual" association between PM levels and the number of premature deaths may be because LADWP misread the source of this statement. Discussions regarding the revision of the PM NAAQS pertain to the "causal" link between PM levels and health effects or the number of premature deaths. There is little doubt among epidemiologists studying the issue that particulate matter has a causal effect on human health. In the case of Owens Lake dust impacts where hourly PM_{10} concentrations frequently exceed 1,000 $\mu g/m^3$ and may go up to 30,000 $\mu g/m^3$, some studies suggest that short-term high hourly PM concentrations may be more significantly linked to health effects than the 24-hour average exposure (Michaels and Kleinman, 1997).

Section 3, Page 6 - RE: TEOM and Air Quality Data and Consideration of Meteorological Trends
See responses to Executive Summary, Page 1 - RE: TEOM and Air Quality Data, and Executive Summary, Page 1 - RE: Consideration of Meteorological Trends.

Section 3, Page 7 - RE: Dust Transport from Owens Lake
See responses to Executive Summary, Page 2 - RE: Dust Transport from Owens Lake and Executive Summary, Page 2 - RE: Exceedance Measured at Coso Junction.

Section 3, Page 7 - RE: Cancer Risk
The cancer risk at Owens Lake is based on a 70-year lifetime risk for a resident in Keeler. The long term average of 50 $\mu g/m^3$ for Keeler is appropriate.

Cancer risk is a chronic (long-term) health effect. Acute (or short-term, like one hour) risk from arsenic and other toxics is not significant at Owens Lake. The CAPCOA risk assessment guidelines were used for the cancer risk assessment which do not include reducing exposure to compensate for indoor air and to incorporate the effect of the Owens Lake Health Advisory Program. As stated before, the health advisory program is not intended to replace the need to control the dust problem at Owens Lake, but is an interim program to help protect sensitive individuals.

The District's Toxic Risk Policy applies to any air pollution source and provides a guide to define a significant toxic risk. The goal of the policy is to reduce additional cancer risks and does not compare itself to existing risks that the public is exposed to.

Section 3, Page 7 & 8 - RE: Dust Loads & Toxic Risk During Construction
Stradling reported "high on-site dust loads during construction." It is important to note that these dust loads were confined to the actual construction site, which in the case of the managed vegetation, will be far removed from the shoreline or from any inhabited areas or even from roadways. The only people exposed to these dust loads will be the construction personnel, who can and will be provided with appropriate dust filter devices.

A screening assessment of the toxic risk due to the gravel operation was done using the CAPCOA Risk Assessment Guidelines (CAPCOA, 1993). Based on a 400 cubic yard per hour maximum throughput and an annual throughput of 1.4 million cubic yards, the cancer and non-cancer scores for the facility are 0.11 and 0.09, respectively. The District uses a prioritization score of 10 or greater to determine if a risk assessment beyond the screening analysis is needed. A cancer risk prioritization score of 0.11, in this case, shows that the cancer risk to residents is less than 1 in a million due to toxic emissions from the gravel operation. (Ono, 1997a)

Section 3, Page 8 - RE: Visibility Impact at China Lake Naval Weapons Station
See response to Executive Summary, Page 2 - RE: Dust Transport from Owens Lake. The visibility impact caused by Owens Lake dust on the R2508 airspace is discussed in the RESOLVE project study as cited in the DSIP and in US Navy photographs showing 11 Owens Lake dust events impacting the R-2508 air space and Ridgecrest in one year from April 1996 to April 1997 (Douglass, 1997).

Section 4, Page 8 - RE: Future Emissions
With regard to construction dust impacts, all construction activities must meet District Rules 400 and 401 that limit visible emissions from any source to 20% opacity and require best available control measures for fugitive dust to prevent visible dust caused by the operation from leaving the property boundaries. Projects associated with the gravel mining and gravel delivery to the lake bed will have fugitive dust control conditions in the permit to operate. Fugitive dust control

measures have been used successfully on similar large operations such as the Briggs Gold Mine to control fugitive dust from mining operations, open areas and unpaved roads. Monitoring at the Briggs gold mine shows that fence line PM_{10} impacts are safely below the federal PM_{10} standard. The ambient air quality impacts caused by the activities related to the implementation of the DSIP control measures, such as dust from the gravel operation, are not required to be offset. Although additional emissions will temporarily be emitted in the planning area, District Rule 209-A.B.4.f, exempts from the emission offset requirement, emissions that are due to the installation of air pollution control equipment on existing sources. Inclusion of these emissions in the future inventory is not necessary since it will not affect the attainment demonstration after controls are implemented.

Section 4, Page 8 - RE: Table 4.1 Emissions Inventory
The following explanation of the use of the two emission equations was added to Section 4-3.2 of the DSIP:

"Because more than twice as many emission runs were used to characterize the 1993 to 1995 emissions equation (n = 102), and because they represent three years of sampling instead of one, equations 4-1 and 4-2, may provide a better estimate for the PM_{10} emission potential for any given year and are used for the Owens Lake primary and secondary wind erosion estimates in Table 4.1. The model validation equations, 4-3 and 4-4, used emission data from fall 1994 and spring 1995, so it is more appropriate for use in predicting the ambient impacts in the model validation analysis which was also done for 1994 and 1995."

Section 4, Page 8 - RE: Road Dust Emissions
See response to Section 4, Page 8 - RE: Future Emissions.

Section 4, Page 8 - RE: Non-lake Wind Erosion Emissions
Non-lake wind erosion sources are assumed to be incorporated in the background PM_{10} concentration of 28 $\mu g/m^3$ that is used for the modeling analysis. This is based on the average PM_{10} concentration at sites upwind of Owens Lake on days that violated the NAAQS. The District is not aware of any significant sources of off-lake wind blown dust in the area other than those that are shown in Table 4.1 as Owens Lake Secondary Wind Erosion.

Section 4, Page 8 & 9 - RE: Sahu's Annual PM_{10} Emissions Estimate Method Using Niemeyer's Observations
Dr. Niemeyer mapped the source area locations and boundaries by observing dust storms from Cerro Gordo, 10 to 15 miles from the lake bed. From this location distinct high emitting dust plumes can be easily spotted, however, lower emitting dust sources are not easily seen.

Niemeyer's source area size and mapped observations correspond to the high emitting sources, low emitting sources are undetectable from that vantage point. Dr. Niemeyer's PM_{10} emission flux readings using the sun photometer determined a range of values from $2.7x10^{-3}$ to $7.62x10^{-2}$ g/m^2-s, which is an order of magnitude higher than the average range of PM_{10} flux rates estimated with the portable wind tunnel. Staff believes this order of magnitude difference between the two methods is caused by the visual observer focusing on the highest emitting areas -- which is what a person can reasonably see and map. However, this does not make Niemeyer's emission estimate method incorrect, because the sun photometer method produces a total emission estimate for the dust producing area.

Sahu's methodology for estimating annual emissions is not reasonable because of its use of the wind tunnel generated emission factors which do not correspond to the source areas identified by Niemeyer. Sahu's PM_{10} flux estimates are 80 times lower than measurements taken by Niemeyer for the same storms and source areas. A better estimate is made by using Niemeyer's PM_{10} flux rate measurements with Niemeyer's identified source areas. Using Niemeyer's flux rates shown below, an average PM_{10} flux of $2.64x10^{-2}$ g/m^2-s is determined for the nine storms that were measured during the period of Sahu's inventory (Niemeyer, 1995). Note that these flux rates are different from the range LADWP attributes to Niemeyer of $9.35x10^{-5}$ to $4.62x10^{-2}$ Further, LADWP's contention that the District wind tunnel flux rates are much higher than Niemeyer's measurements is not true (LADWP comment letter, Page 12). DSIP Figure 4.2 shows the District's range as $9x10^{-4}$ to $2x10^{-3}$ g/m^2-s which is lower than Niemeyer's data shown below, not higher as LADWP contends.

Niemeyer's Sun Photometer Based PM_{10} Flux

Observation Date	PM_{10} Flux g/m^2-s
12/25/94	$2.7x10^{-3}$
1/13/95	$4.39x10^{-3}$
2/13/95	$1.77x10^{-2}$
3/22/95	$5.34x10^{-3}$
7/11/95	$2.12x10^{-2}$
7/13/95	$3.11x10^{-2}$
8/7/95	$2.68x10^{-2}$
8/11/95	$7.62x10^{-2}$
8/28/95	$5.25x10^{-2}$
Average	$2.64x10^{-2}$

Using Sahu's hours of events (915 hours/yr) and average source area size as modified by Sahu (4,388,451 m^2), the annual PM_{10} emissions are 420,672 tons per year.

The text of the DSIP in Section 4-3.3 was revised to more clearly separate Sahu from this estimate or 420,672. The District understood Niemeyer's comment regarding the use of her observations, is that more observations should be made over the duration of storm and that her flux rates should be adjusted to account for storm variations, since the one or two observations she made during the storm were snapshots that did not necessarily represent the average emission rate during the duration of the storm. She believes that using her average flux rate that resulted in the 420,672 ton estimate, may yield a high estimate for the total emissions. The District agrees that adjusting for variations during the storm would improve the estimation of total emissions, however, it is not clear if more observations would increase or decrease the total emissions (from 420,672 tons), since it is not known if her current study measurements represent above average of below average emission rates during the storm period. Although there is no information available to make adjustments to Niemeyer's observations and measurements, LADWP's comment indicates they believe the total emission estimate would decrease. This may bring it more in agreement with the District's estimate of between 130,000 and 291,100 tons per year.

Section 4, Pages 9-12 - RE: LADWP's Revised Emission Inventory Using Niemeyer's Sources Area Observations and the District's Flux Rates
See response to Section 4, Page 8 & 9 - RE: Sahu's Annual PM_{10} Emissions Estimate Method Using Niemeyer's Observations. In the District's view, the problem with LADWP's method is that it mixes source area data and emissions data that are not related. LADWP's method is similar to estimating the population of Inyo County by taking the county-wide population density of 1 person per square mile and multiplying it by the number of square miles in Bishop, Lone Pine, Big Pine and Independence, which are the areas where we see many people — this yields 4 people in Inyo County, instead of a population that is closer to 19,000. LADWP's method is a poor method for estimating emissions.

The District staff disagrees with the use of an 80% decay of the emission rate after 30 minutes. LADWP attributes this to a reduction of available particles. The District showed through continuous sampling using Sensits in the field that during a storm the sand flux rate does not decay during the storm, but is sustained during the entire duration of high winds. The decay rate that is observed in wind tunnel testing is an artifact of the wind tunnel method, 1) because saltation particles are not introduced into the test section and 2) because the test method will cause an initially high entrainment rate due to the movement of all the particles on the exposed surface that have thresholds below the wind tunnel speed. Without saltation particle introduction there is a depletion of the available erodible material in the wind tunnel. During dust storms, decay is not observed because saltation particles are abundant and continuously scour the surface to expose more erodible particles. (Hardebeck, 1997a)

The District used the wind tunnel generated emissions estimation method for the entire 35 square mile source area that has been identified as the frequent dust source area. This yielded annual emissions of 279,900 tons per year in 1995 for wind erosion from the lake bed. Although this method yields a single emission rate for a large area, it is not correct to assume that dust plumes and emissions within the area are homogenous. Like the visual observations made by Niemeyer, some areas may have very visible dust plumes and should have high emission rates, while other areas appear to emit nothing. As shown by the graph of wind tunnel data for spring emission rates, at 35 mile per hour, the (geometric best fit curve) "average" is composed of runs that have emission rates that are an order of magnitude higher and lower than the average (see DSIP Figure 4.3). It is likely that this entire range of emission rates is occurring simultaneously from different locations within a large source area. A large source area may have subareas that are emitting in the order of 10^{-2} g/m^2-s, another area at 10^{-3}, other areas at 10^{-4}, and some areas are not emitting at all. The wind tunnel generated emissions algorithm incorporates this heterogenous source mix into an average emission rate as a function of wind speed and applies it over a large area. So, although the District's methodology yields a single emission rate for a large area, it also reflects the heterogeneity in dust plumes (and no plumes) that we observe.

Section 5, Pages 12 - RE: Control Measure Analysis and Inconsistency with State and Nationwide BACM.

See response to Section 2, Page 5 & 6 - RE: Control Option Research, BACM Analysis & Cost. The proposed DSIP control measures are consistent with measures that have been used in other areas to control open area wind erosion. In fact, the USEPA recommends controls for "water mining activities" which are identical to the control measures proposed for the DSIP (USEPA, 1992). This USEPA BACM recommendation for water mining activities is also discussed in the *Proposed Natural Events Policy for PM-10 Air Quality Exceedances at Owens Lake*, which includes an analysis of BACM for wind blown dust from Owens Lake (GBUAPCD, 1997).

Section 5, Pages 12 & 13 - RE: Combination of Three Control Measures

The DSIP accounts for the coordination required to implement the three control measures at Owens Lake. Installation of the gravel areas is the only measure that could be significantly affected by dust from uncontrolled areas. To prevent dust from uncontrolled areas from settling into the gravel, the gravel areas will be installed last. In addition, interim protection of gravel could be accomplished through such measures as perimeter flooding, sand fences or "moat and row" soil barriers. These measures have been successfully used on the lake bed for the temporary protection of test areas.

Regarding assumptions about costs associated with composite construction or implementation: Costs associated with combinations of measures will go down, as infrastructure elements will be shared and water will be recycled. The District was charged with determining effectiveness and feasibility, not with maximizing efficiency. There is no basis for the argument that research aimed at maximizing efficiency and water conservation would result in increased project costs.

Section 5, Page 13 - RE: Selection of Control Measures and Areas for Implementation. The selection of control measures for the final DSIP strategy was primarily a process of elimination. First, the District eliminated those measures that were not technically feasible or that could provide the necessary level of control to attain the standard. A simple roll-back analysis of the Keeler PM_{10} data showed that better than 90% reduction is required to meet the standard. This left sand fences, fill the lake, gravel, shallow flooding, and managed vegetation as the technically feasible control measures. The modeling run performed for the Project Alternatives Analysis document showed that sand fences would not work on a large scale. Refill the lake is very costly, but the BACM analysis shows that at $528 per ton it is well within the BACM cost effectiveness limit of $5,817 per ton based on the Mono Basin SIP cost effectiveness to raise the lake level at Mono Lake to attain the NAAQS. With the focus on the managed vegetation, shallow flooding and gravel control methods, further refinement of the control measures was based on a soil survey of the lake bed. To minimize costs the managed vegetation was proposed in the clay areas, where the infrastructure could be built with clay, and the shallow flooding was proposed for the sandy areas where the water table was already high and would reduce water resource requirements. Areas that were mixed clay and sand were proposed to have gravel to reduce overall water requirements. It should be noted that although gravel could be applied on all areas of the lake bed, the State Lands Commission advised the District that it would not be consistent with the public trust at Owens Lake, and recommended only limited application of gravel be considered.

The methodology used to determine the emissions for each of the control measures after they are implemented was based on different methods suited for that control measure. The best unified approach is discussed in the analysis of the flood irrigation project (Hardebeck *et al.*, 1996).

Section 5, Page 13 - RE: Authority to Require Water for Air Quality Control
See response to Cover Letter, Page 2 - RE: Authority to Require Water for Air Quality Control.

Section 5, Page 13 - RE: Control Efficiencies of 99 and 100%
The District believes that the information contained in the DSIP and the detailed information provided in the reference control effectiveness documents for shallow flooding, managed vegetation and gravel all support these control effectiveness values (Hardebeck, et al., 1996,

Scheidlinger, 1997, and Ono and Keisler, 1996). Although these appear to be high effectiveness numbers, the controlled emissions are being compared to an extremely high value for uncontrolled emissions from Owens Lake. It may be helpful to note that the emissions that will come off the controlled surfaces will likely be nearly equivalent to the emissions that come off of normal surfaces in the Owens Valley, which as observed by District staff, do not cause PM_{10} violations. To help put things in perspective, one way to look at the emissions change is that the control measures will make the lake bed an almost normally emitting surface.

Section 5, Page 13 - RE: Feasibility of Maintaining Control Measures
All of the anticipated requirements for operating the control measures are discussed in the DSIP, DEIR and specific documents related to each control measure. The District does not foresee any feasibility problems in maintaining the control measures on the lake bed.

The District is not opposed to continued research to develop more cost effective solutions, but believes that proposed control strategy should be implemented on schedule and replaced with new measures if they are more cost effective. The District has included commitments in the DSIP that are intended to help reduce implementation costs and to develop more cost effective solutions (see DSIP Section 7-8). Also see response to Cover Letter, Page 1 - RE: Natural Events Policy.

Section 5, Page 14 - RE: Off- Lake Soil Deposition and Sand Sheet Movement
The primary direction for sand movement is for material to move off the lake and deposit in lower wind speed areas, that typically have rougher terrain than the lake bed. The shallow flooding project is not expected to be adversely affected by moving sand, which would likely deposit in the wet areas, which are low. This will help to keep the wet surface level and prevent large islands from forming.

Section 5, Page 14 - RE: Surface Cracks in the Shallow Flood Areas
The shallow flooding has deliberately been sited to avoid clay soils with surface cracking. Each measure has been located on the playa to match the control measures with the limitations and opportunities presented by the soil surface. Managed vegetation, which will be located on clay soils with surface cracks, has been designed with surface treatments that both defeat the cracks and maximize leaching efficiency.

Section 5, Page 14 - RE: Control Effectiveness Method
The control efficiency determination was calculated from the simple equation E = 1 - wet/dry, or, Efficiency = 1 - (Emissions from wetted areas)/(Emissions from uncontrolled areas). If there are no emissions from the wet area, there is 100% control.

Section 5, Page 14 & 15 - RE: Salt Efflorescence in the Shallow Flood Areas
The District included emissions from the 1% of the area that had efflorescent salts in shallow flood wind tunnel test to determine the overall emissions and control effectiveness.

Section 5, Page 15 - RE: Wind Tunnel Problems
There were no wind tunnel problems. The wind tunnel tests showed that the threshold wind speed for PM_{10} on the shallow flood test surface was usually higher than 45 miles per hour. Tests that did show emissions were few and had threshold wind speeds scattered from 25 to 45 mph. This meant that one part of the test area may erode at 25 mph and another area might erode at 45 mph and both could have the same emission rate, so overall the area didn't have a strong relationship to increasing emissions with wind speed. Many tests showed thresholds above 45 mph, the limit for the wind tunnel, with no detectable emissions. This shows the stability of the surface and should not be considered a problem, in fact, it should be expected if the control measure is working well.

Section 5, Page 16 - RE: Wind Tunnel Locations on the Shallow Flood Project Site
The locations of wind tunnel tests can be found in the summary report on the wind tunnel tests from 1993 through 1995 (Ono, 1997b). The distances from the water range from 8 to 25 meters and included all the different surface types that existed on the test area. The report includes a short description of each test location. The flood acreages for the gridded sand flux results were determined using area B, such as that shown in Figures 3.1-7. The flood acreage for the wind tunnel emissions rate estimation is not required, since it was assumed that if the surface was covered with water it didn't emit PM_{10} and the areas that were exposed emitted at the average rate of all the wind tunnel runs including those with no detectable PM_{10} emissions.

Section 5, Page 16 - RE: Drying of Soils
As shown by the sprinkler test at Owens Lake the soils will dry quickly, however, the saturated soil on the shallow flood project didn't dry and lose stability. The use of Sensits and sand transport samplers during the storm periods showed that the surface maintained the high level of control throughout the storms. Tests showed this level of control was related to the overall surface water cover provided during the storm (see DSIP Appendix D, Figure 3.1-10).

Section 5, Page 16 - RE: Longer Wind Tunnel Testing
LADWP suggests that a longer period than 10 minutes should be used on the transitional wet/dry surface to allow for drying. Each test for these areas was run for 30 minutes, for the reason LADWP stated and to try to collect enough mass in the sample to have detectable emissions if the surface was eroding at low rates. Also see response to Section 5, Page 16 - RE: Drying of Soils.

Section 5, Pages 16 & 17 - RE: Shallow Flood Emission Rate and the Detection Limit
The detection limit for the District's wind tunnel runs is based on a valid filter sample of 1.0 mg, which will yield an emission rate of 1.5×10^{-5} g/m²/s for the lowest measurable level (Ono, 1997b). DSIP Figure 4.5 explains, "The average PM_{10} emission rate was 1.6E-05 g/m2/s, including 21 non-detectable runs. The average emission rate from the flood irrigation project was 4.1E-06 g/m2/s, considering that 75% of the control areas was covered with water." This average emission rate represents the emission rate for the entire flood area, and not just the exposed areas that are emitting above the detection limit.

Section 5, Page 17 - RE: Mosquito Fish
As stated in the DSIP (page 5-9), a mandatory element of the project includes the detailed design of site infrastructure which incorporates specific measures to minimize water depths ranging from 2 to 20 inches and to prevent still-water areas from forming. If this mandatory element does not adequately prevent the development of a mosquito breeding and/or swarming hazard, the mosquito abatement program that would be implemented would utilize a *combination* of measures to control mosquito populations. The use of mosquitofish (*Gambusia affinis*) is one of several biological controls that could be implemented for reducing the population of mosquitoes that may develop. Mosquitofish are currently present at several locations at Owens Lake including Dirty Socks, Swede's Pasture, and the Owens River Delta. The water temperature and salinity at each of these sites differs. Therefore, if mosquitofish were to be used for mosquito abatement in the shallow flooded areas, they would be expected to survive despite the range of salinity and temperatures that could exist. In fact, mosquitofish have become "the chosen mosquito control species because of...their wide spectrum of tolerances to a variety of unfavorable water conditions (McGinnis 1984)."

The mosquito abatement program that will be developed will meet requirements set by the Inyo County Agricultural Commissioner and the State of California Environmental Protection Agency regarding biological, cultural, and mechanical methods for mosquito control, including pesticide application. As stated in the DSIP (page 5-9), the abatement program also "shall be designed to minimize the potential impacts on the breeding success of western snowy plovers and other birds that use the playa)." The types of wildlife that utilize shallow flooded areas are primarily limited to shorebirds, waterfowl, invertebrates, and foraging bats. Therefore, the biological impacts from mosquito abatement measures are expected to be accordingly limited in scope.

Section 5, Page 17 - RE: WESTEC Study and Managed Vegetation
The species used in the WESTEC study (WESTEC Services, Inc., 1984) were *Distichlis spicata* (saltgrass), *Atriplex parryi* (Parry saltbush, *Sarcobatus vermiculatus* (greasewood), and *Sporobolus airoides* (alkali sacaton). Of these, only the Parry saltbush could be considered a

truly "drought tolerant" plant in that it does not root in shallow groundwater. Saltgrass is probably the most drought-resistant of the remaining species. The conclusions of the WESTEC report are summarized by the UCD Owens Lake Task Force as follows:

> "Even on the dunes, blasting effects of blowing sand, blowout of dunes, and saline substrates made survival of all species very low, with the largest survival rates found on one plot of *Distichlis spicata* (saltgrass) plants. If revegetation is to be accomplished, *D. spicata* appears to be the best candidate species for large scale use."

It would appear that we have followed the recommendations of this report closely.

Comments regarding the WESTEC study reveal some misconceptions regarding the nature of the described study. The report states throughout that the species studied on the lake for this project were selected for **salt tolerance**, not for **drought tolerance.** In spite of it being possibly the most drought-tolerant species, parry saltbush (*Atriplex parryi*) did not survive the first season. District projects, however, had this species establish as a volunteer associated with our saltgrass plots on the north sand sheet, and it is common at the run-off areas for spring mounds.

The WESTEC study got best survivorship in the saltgrass, but in their work saltgrass did not survive at all on clay soils . Our results have been different. The WESTEC study indicates that saltgrass "grew on all three plots through the spring and summer of 1983 without irrigation" (pg. 4-1).

Regarding greasewood (*Sarcobatus vermiculatus*), the WESTEC study showed it to grow well in sandy soils only, a finding consistent with the UCD work at Mono Lake. The report states that the greasewood were also "still actively growing without irrigation" at the end of the study in July 1983 (pg. 4-3).

There is very little in this study to suggest that "drought-tolerant" plants were studied and that there were superior candidates to saltgrass. In fact, saltgrass is extremely and demonstrably "able to withstand variable meteorological conditions (i.e. drought).

The dune-stabilization scenario that is presumably referred to as "colonization of drought resistant plants" was presented in the WESTEC report in a single sentence, stating that vegetation is "too water- and labor-intensive" to be practical on the lake bed, but that there may be some "limited potential for stabilization of formed dune sands with vegetation" (pg. 4-36). It is hard to interpret this conclusion as "generally positive results." As there are no further data in the Cahill communication, the District concludes that this study does not have sufficiently convincing evidence of success to constitute a serious contender as an alternative control measure.

Section 5, Pages 17-19 - RE: Critique of Managed Vegetation
Although saltgrass has not achieved the desired coverage on the Agrarian Test Site, it is well established by now both from the fall 1996 plantings and the recent spring 1997 plantings. In addition, we have grown saltgrass on clay soils in Control Area D on the South Flood Irrigation Project (SFIP) location. These plants were planted in 4 plots on 29 May 1996. By 18 October 1996, cover on these plots was over 30%. Other plantings on the SFIP soils also grew very vigorously during that season. By 8 May 1997, plants on all SFIP sites show vigorous new growth, and are expanding rapidly after the intervening winter. These results allow us to conclude with confidence that minimally leached clay soils (soil EC at the time of planting ranged from 35 to 83 dS/m, which is higher than we had initially proposed for saltgrass introduction) readily support saltgrass establishment and growth. There are 4 saltgrass plots on the SFIP site, as well as the saltgrass plants in the channel environment and those in the small initial test plot in clay soils near the Sulfate Well Road (planted in August 1994) that have been observed over at least one full growing season.

In addition, saltgrass plants growing on other test plots on the Owens Lake have been maintained on minimum water (less than 1 acft/ac/yr) for three years. This exceeds the recommendation in the WESTEC (1984) report.

Saltgrass on managed vegetation plots HAS been tested over full growing seasons, as noted above. Furthermore, water use on these plots has been well documented for leaching, establishment, and survivorship.

The "leaching and irrigation" water needed for maintaining a downward gradient of salts in the soil is NOT "independent of water needs for survival purposes." This water IS the irrigation water. The high irrigation schedule described in the Agrarian Test Area Construction Cost Summary Report assumes full cover of live saltgrass with a high transpiration rate and a narrow rooting zone. In fact, we were able to maintain a stable cover of over 50% during the summer months of 1996 with NO irrigation, since the majority of the cover was dormant and non-transpiring. A deeper rooting zone, as described by Stradling (1997, pg. 19) would greatly reduce the irrigation interval. How low the irrigation requirements can actually go remains yet to be determined, but the 2.5 af/ac of planted soil is an extremely conservative estimate. This control measure cannot be accurately described as "water intensive", and it does not result in any unmitigable adverse environmental impacts.

In spite of high levels of salt and sodium in the soil, these soils present no leaching problems that are unique to the playa. Leaching is accomplished by passing water through the soil in sufficient quantities to put the soluble materials into solution so that they can be removed from the surface soils by downward movement. Leaching extremely salty soils is a matter of how much water is needed, not whether it can be done. We have always acknowledged that the shallow water table will need to be managed to prevent its intrusion into the rooting zone. Drainage will accomplish this, as it has with shallow water table soils elsewhere in the world. As nearby as California's Central Valley, maintenance of high-value agricultural crops using drainage and shallow water table management is commonplace, and permits the cropping of land that would otherwise be much too saline for profitability.

The infrastructure "failures" documented in the Agrarian Test Area Report were temporary, and all of the problems have been solved. The failures were indeed due to the fact that this site was a "test project". The on-going monthly reports to Los Angeles regarding the Agrarian project have clearly documented the solutions to these initial problems, such as the introduction of head ditches, moat and row arrays to protect from blowing sand, and slurry keying of reservoirs (which was necessary only on old designs, as the newer constructions did not leak). We have clearly demonstrated that these projects can be successfully managed. In addition, Stradling (1997, pg. 5 and 12) cites the effectiveness and longevity of similar projects elsewhere in the region.

The additional study suggested by the Agrarian Test Area Report clearly identifies future needs regarding "efficiencies", not effectiveness or feasibility. We support efforts to make these projects more efficient, but the DSIP and DEIR are written analyzing CURRENT estimated water requirements. More efficient projects would use LESS water, not more. The information gaps suggested here are clearly not critical to the implementation of the project as described.

The data on the managed vegetation are in fact very good. Infrastructure failures have all been corrected, saltgrass viability has been amply demonstrated, and water needs have been assessed in conservative fashion using both published data and practical experience. The fact that the projects could become more efficient with experience is not sufficient reason to delay their initiation.

Section 5, Pages 19 & 20 , RE: Critique of Gravel

Due to concerns raised by LADWP regarding the use of geofabric, the District retained the services of Law/Crandall Engineering to analyze the use of gravel and the need for geofabric. They have prepared a report which concludes that except under areas used as access roads, geofabric is not required under the gravel blanket (Law/Crandall, 1997). However, even if the fabric was used, it would not be subject to ultraviolet deterioration, as it would be protected from solar radiation by the gravel layer.

The project schedule allows time for additional testing of gravel. If the LADWP wishes to show that the Standard can be attained with alternatives to the proposed gravel measure, the District would very likely be willing to cooperate with the Department.

As stated in the Law/Crandall report, gravel blankets are commonly used throughout the world to control fugitive dust. The concept of armoring the surface with a wind resistant material is basic and Owens Lake is not so unique as to give rise to any suspicions that it would not work in this environment. The LADWP has provided no real data of any kind to demonstrate that gravel would not work as a control measure. "Large scale testing over a several year period" is not necessary. The testing has already been performed all over the world, including on Owens Lake.

The District has investigated the feasibility of a number of gravel sites in the Owens lake area. Three alternative sites are analyzed in the DEIR and the Keeler fan site appears to be the most suitable. Nothing about this site would seem to eliminate it as a source of gravel. It is close to the lake bed areas designated for gravel, it is removed from residential areas, it occurs in sufficient quantities, it is the proper color and durability and the preliminary environmental analysis has identified no environmental or land use constraints. The LADWP has provided no real data of any kind to demonstrate that feasible sources of gravel do not exist.

The District has seen no evidence that the gravel blanket will not work. As stated above, if the LADWP wishes to refine the measure in the time available, the District is willing to cooperate.

Section 5, Page 20, RE: Investigation of Cahill Proposal and Deadline Extension
LADWP does not cite a reference for the "proposal" by Dr. Cahill that has been rejected. The December letter from Flocchini is not detailed enough to be considered as a "proposal" separate from the UC Davis proposal of 1991, and the District has not seen another one. See responses to Section 5, Page 17 - RE: WESTEC Study and Managed Vegetation, Section 5, Pages 17-19 - RE: Critique of Managed Vegetation, and Section 5, Page 13 - RE: CAAA Section 188(f), and the District's memorandum regarding Dr. Cahill's proposal (Hardebeck, 1997b).

Section 5, Page 20 - RE: DSIP Overcontrols Emissions
See responses to Section 2, Page 5 - RE: Storm Locations by Tezz Niemeyer and Section 4, Page 8 - RE: Non-lake Wind Erosion Emissions.

Chapter 6, Page 21-36 - RE: Air Quality Modeling
Many of the comments regarding the model performance are either misleading or not relevant. The District strongly disagrees with LADWP's comments that the air quality modeling used to develop the control plan was "highly irregular and inconsistent with procedures used, and approved by EPA" and that biases in the modeling overstate the level of control necessary to demonstrate attainment of the PM_{10} NAAQS. The model applied is the USEPA Guideline model, the modeling procedures are based on the USEPA *Guideline on Air Quality Models*, and the model evaluation techniques are from USEPA guidance documents for assessing model performance. Specific comments on these issues and others follow.

Chapter 6, Page 24 - RE: Bullets 1-3
Item 1 states the attainment demonstration is overly conservative resulting in significant overestimation of the level of controls required to achieve attainment of the NAAQS. Item 2 suggests the control measures are unproven and may not be as successful as assumed in the control plan. These mutually contradictory statements are repeated several times throughout the text of the comments.

Chapter 6, Page 25 and elsewhere - RE: TEOM PM_{10} measurement bias.
The District agrees comparisons between the paired TEOM and SSI PM_{10} observations suggest the TEOM inlet may capture more mass than the SSI at Owens Lake; however, the District disagrees that the SSI is any more correct than the TEOM, is more health protective, or is less representative of particles less than 10 µm. The TEOM is an equivalent method for PM_{10} measurement and data should not be artificially lowered, unless LADWP can demonstrate the TEOM sampling characteristics result in significant over collection of particles greater than 10µm. See response to Executive Summary, Page 1 - RE: TEOM and Air Quality Data. It should be noted TEOM data was not evaluated in LADWP's cited references supporting documented problems with the TEOM (Thankus (sic), *et al.*, 1996, and MRI, 1996). [The District believes the correct citations for these references is Thanukos, *et al.*, 1992, and Cowherd and Kuykendal, 1997, see reference list].

Chapter 6, Page 26 - RE: Emissive Areas.
This comment argues only portions of the potential emitting area should be simulated during any one event.

Two alternatives were considered during the development of the modeling approach:

- simulate the location of source areas for each storm and use emission rates representative of these high emitting areas. Simulate the remaining playa with a lower emission rate or assume negligible emissions

- simulate the entire potential emitting area with a more moderate emission algorithm

The problem implementing the first alternative is identifying the source areas for each event. The heterogenous surface conditions of the Owens Lake playa are not predictable and it is not possible to forecast the areas of highest windblown emissions from event-to-event, season-to-season, and year-to-year. The model performance evaluation suggests the Method 1 emission algorithm combined with the assumed 35 mi^2 emitting area result in realistic downwind concentrations for the more severe episodes. The wind tunnel data suggest emission rates can be much higher than predicted by the Method 1 emission algorithm. The District does agree assumptions combining the large source area with the highest emission rates from the wind tunnel data result in over-prediction of even the larger episodes; however, these higher emissions rates were not used in model simulations supporting development of the proposed control plan.

Chapter 6, Page 26 - RE: Wind Tunnel Emission Flux Decay
The decay rate that is observed in wind tunnel testing is an artifact of the wind tunnel method, 1) because saltation particles are not introduced into the test section and 2) because the test method will cause an initially high entrainment rate due to the movement of all the particles on the exposed surface that have thresholds below the wind tunnel speed. Without saltation particle introduction there is a depletion of the available erodible material in the wind tunnel. During dust storms, decay is not observed because saltation particles are abundant and continuously scour the surface to expose more erodible particles. (Hardebeck, 1997a)

Chapter 6, Page 26- RE: Tower B Wind Data.
The District agrees that A-Tower winds are more appropriate for both emission estimates and dispersion calculations near the location of A-Tower; however, these data are less complete than those from the B-Tower and it is a more difficult task to construct a representative data set. For emission estimates the differences between these locations is not significant because the wind velocity statistics observed at A-Tower are very similar to those at B-Tower. For example, during 1994 average wind speeds were 4.38 m/s and 4.34 m/s; and the number of hours exceeding 7.5 m/s were 17.8% and 18.6%, at A-Tower and B-tower, respectively. Wind direction differences are significant between the sites potentially biasing the predicted path of plumes from the source areas near A-Tower. However, the vector average wind direction data set constructed from the Lone Pine and B-Tower data compensates for the lack of A-Tower data in the model simulations.

The District believes the use of the A-Tower data would not significantly improve model performance or affect the results of the attainment demonstration.

The same comment suggests B-Tower wind speed data overstate speeds for source areas closest to the historical shoreline due to frictional effects of the non-lake surfaces. Surface winds would decrease within the internal boundary layer that forms after an increase in surface roughness in the downwind direction of the flow. When source areas near the historical shoreline affect receptor areas outside the lake, the flow is in the reverse direction and they are upstream from the change in surface roughness. In these instances, winds over the source areas are not modified by the change in surface roughness. The District does not believe the B-Tower wind speed data should be reduced before emissions are calculated for these source areas.

Chapter 6, Page 26 - RE: Off-Lake Sources.
The comment states because the background value of 28 $\mu g/m^3$ is 40% of the final design value, controlling non-lake sources may be more cost-effective than controlling on-lake sources. The background contribution is 40% because the contributing on-lake sources have been controlled by an assumed 99% control. For the same episode at the historical shoreline in the Olancha modeling region, the background contribution is less than 1% of the total prediction before the assumed controls.

Chapter 6, Page 27 - RE: Receptor Network.
In this comment and elsewhere throughout the text, the LADWP suggests the attainment demonstration should be based solely on predictions at the three PM_{10} monitoring sites. Without the benefit of downwind dispersion, PM_{10} concentrations close to the source areas are expected to be higher than at the monitoring sites, especially the Lone Pine and Olancha sites. The public has unrestricted access to the historical shoreline receptors used in the attainment demonstration. The USEPA definition of "ambient air" is based on public access, not exposure. Because it is not practical to monitor all potential locations accessible to the public, dispersion modeling is applied to provide quantitative estimates at locations and for periods when monitoring data are unavailable.

Chapter 6, Page 27 -RE: Mixing Heights.
The District agrees that a mixing height of 100m is too low for windy conditions in the Owens Valley airshed. The District constructed the meteorological data set according to regulatory guidance. The mixing height interpolation routines used by the USEPA sometime result in unrealistically low mixing heights in the hour after sunrise when the preceding hours were stable (low winds). This problem does not occur during prolonged periods of high winds because the nocturnal hours are neutral. Hence, the minimum mixing height rule is not usually an issue for

important episodes of interest. McCulley, Frick and Gilman, Inc. (MFG), the District's modeling consultant, has confirmed this by scanning the meteorological data sets for the more important episodes of interest. The District does not expect that simulations with a higher minimum mixing height would significantly influence the results of our modeling studies.

Chapter 6, Page 27 - RE: Final Design Concentration.
In this comment and in other places, the comments refer to a target of 154 $\mu g/m^3$ for attainment of the NAAQS. The District is not aware of any modeling guidance suggesting predictions should be rounded to two significant figures as is sometimes the practice with the interpretation of monitoring data. The Executive Summary and the Chapter 6-4.2 of the DSIP were revised to include an estimate of the control area change to bring the model demonstration up to 150 $\mu g/m^3$. The estimate shows that only a 1.2% reduction in the proposed control area or the emission reductions could be made.

Chapter 6, Page 28 - RE: Model Performance Evaluation.
In this comment, the LADWP expresses concern regarding the "use of insufficient statistical measures, displays, and analysis" in the model performance evaluation, but does not explain why the techniques are insufficient.

The District believes the statistical performance measures employed and the methods used to assess the uncertainty are sufficient to judge model performance. The model performance evaluation techniques were taken directly from USEPA guidance documents, were approved by the CARB following their review of the Modeling Plan, and were the same as those employed in the most relevant recent PM_{10} SIP at Mono Lake. The District's modeling consultant, MFG has provided modeling support to USEPA Region 10 where the same model evaluation techniques were employed in Power-Bannock Counties PM_{10} SIP in Pocatello, Idaho. The Robust Highest Concentration (RHC) statistical measure used in the evaluation was proposed by the USEPA and has been used throughout the country in assessing model performance. It has been criticized when applied to small data sets and has the short-comings of any "unpaired" statistic. However in the present application the data sets are large and MFG presented other paired statistics (e.g. correlation coefficients) to supplement the RHC measure.

The District agrees performance goals contained in the Modeling Plan, agreed to by all interested stakeholders prior to the modeling would have been the preferred. However, in practice it is difficult to reach consensus among all parties regarding performance goals. Further, performance goals are usually relaxed, strengthened, or not adhered to by one or more of the parities in their interpretation of the analysis. The District originally proposed performance goals based on the fractional bias of the RHC and solicited input from the ARB concerning acceptable goals. The

ARB was reluctant to specify a set of goals and indicated goals used in ozone modeling performance evaluations are not relevant to the Owens Valley Planning Area PM_{10} SIP.

Chapter 6, Page 28-29 - RE: Historical Model Performance Goals for Attainment Demonstration Modeling.
In this section of the comments, an alternative set of performance measures and performance goals are presented. The statistics and goals are taken from studies within the South Coast Air Basin (SCAB) and Phoenix. The District questions whether the statistical methods used in these studies are relevant to the Owens Valley. The urban airshed nature of the modeling in the SCAB and Phoenix studies is more episodic, and the focus is placed on one or a small set of episodes with a large number of spatial monitoring stations. Performance goals are more often achieved because the modeling is more refined, the meteorological data bases are better, the modeled concentrations are less sensitive to the emission inventory, and the concentration gradients are smaller.

These concerns aside, in the following discussion the District applies the statistical measures proposed by the LADWP. However, the District targets the more relevant high end of the frequency distribution in our analysis and we do not reduce the TEOM observations.

Normalized bias and normalized gross error are applied by the LADWP to assess model performance. The District agrees these paired statistics can provide insight into model performance, but doesn't agree they are any more relevant than the measures used in the model performance evaluation. In our opinion, the LADWP applied the measures using arbitrary subsets of the frequency distribution. The subsets selected are based on a threshold of 100 $\mu g/m^3$. Using this threshold results in the inclusion of data pairs much less than the design concentration, especially at the Keeler site. For example, 52 observations or 15% of the paired samples exceed this threshold at the Keeler site. The District based the model performance evaluation on the top 2% of the frequency distribution, closer to the design concentration frequency of 0.4% (third highest 24-hour prediction in two years).

Table A contrasts model performance by meteorological data set using the normalized bias and error statistics. The statistics are calculated using increasingly smaller subsets of the total sample population. With the exception of Olancha, the model performance improves as the statistics target the higher observations. For example, using the comment authors criteria the normalized bias and error for the Keeler vector average meteorological data set are 100% and 116%, respectively. Calculating these statistics based on a higher end of the frequency distribution results in model performance (-19% and 29%, for bias and error, respectively) meeting goals suggested in the comments. In summary, when the statistical measures proposed in the comments

Table A. Model Performance by Meteorological Data Set and Modeling Region

Monitoring Station	Stat Measure	Number Samples	Freq. Based No. Pairs	Freq Based No. Obs	Local Met	Vector Met	B-Tower Met
Lone Pine 416 data pairs 710 obs.	Norm Bias	16*	3.8%	2.3%	115%	9%	-68%
		10	2.4%	1.4%	83%	19%	-71%
		3	0.7%	0.4%	-11%	-6%	-73%
		1	0.2%	0.1%	-45%	40%	-90%
	Norm Error	16*	3.8%	2.3%	149%	38%	68%
		10	2.4%	1.4%	111%	38%	71%
		3	0.7%	0.4%	45%	33%	73%
		1	0.2%	0.1%	45%	40%	90%
Olancha 127 data pairs 244 obs.	Norm Bias	9*	7.1%	3.7%	423%	7%	-70%
		5	3.9%	2.0%	441%	-31%	-87%
		3	2.4%	1.2%	549%	-76%	-90%
		1	0.8%	0.4%	20%	-83%	-98%
	Norm Error	9*	7.1%	3.7%	467%	74%	74%
		5	3.9%	2.0%	501%	89%	87%
		3	2.4%	1.2%	594%	76%	90%
		1	0.8%	0.4%	20%	83%	98%
Keeler 352 data pairs 605 obs.	Norm Bias	52*	14.8%	8.6%	100%	100%	102%
		10	2.8%	1.7%	42%	51%	64%
		3	0.9%	0.5%	-13%	-19%	-26%
		1	0.3%	0.2%	-22%	-27%	-29%
	Norm Error	52*	14.8%	8.6%	115%	116%	118%
		10	2.8%	1.7%	69%	85%	96%
		3	0.9%	0.5%	28%	29%	27%
		1	0.3%	0.2%	22%	27%	29%

Notes: Number of data pairs based on days with valid observations, valid B-Tower wind data (needed for emission estimates in all regions), and B-Tower winds greater wind suspension threshold.

* Denotes pairs where the observations were greater than 100 μg/m^3.

und Indicates frequency closest to the "design concentration" frequency.

are applied to the same portion of the frequency distribution, we find good agreement in the evaluation of model performance.

Chapter 6, Page 29 - RE: Model Performance for the OVPA SIP Model Options.
The District disagrees with LADWP's comment stating the B-Tower wind data are the most appropriate for the purposes of dispersion modeling. The improved performance suggested in the comment is an artifact of the subset selected for the statistics and/or the reducing of the TEOM data. B-Tower wind direction are clearly less appropriate for transport calculations than the local data or vector average data. Our results suggest the vector average meteorological data sets when combined with the Method 1 emission algorithm and source areas better represent the design concentrations at the TEOM monitoring sites. If future modeling objectives target concentrations from the less severe events, then the emission algorithms and source areas should be modified, not the meteorological data set.

Chapter 6, Page 30, RE: Paired Comparisons of Bias and Gross Error.
We agree the modeling approach tends to over-predict the subset of the concentration distribution selected by the LADWP, especially near Keeler where concentrations exceeding 100 $\mu g/m^3$ occur more often; however, the control plan must address the much more severe design episodes. As shown in Table A, model performance is improved for these larger episodes and meets several of the "historical performance goals" proposed in the comments.

Chapter 6, Page 30-31, RE: Tables 2-4 and Table 5, Accuracy of Peak Concentration Statistical Measures.
The District's modeling consultant, MFG, could not reproduce the results contained in these tables using data sets and model predictions we have. We suspect model predictions were obtained during periods when no observations were available or at locations other than the monitoring sites. For example, in Table 3 the five highest predictions for Olancha are taken from periods when no observations at Olancha were available. This is an error. When calculating unpaired statistics, there must always be the same number of observations as predictions. The database should contain only model predictions and observations from the same locations and periods. Once this database has been assembled, the data are sorted, then the unpaired statistics can be calculated for comparison. In summary, we believe the unpaired statistics in these tables are not relevant. The paired statistics support the model performance evaluation and suggest the modeling approach can be applied to assess peak or design concentration episodes in all three modeling regions.

Tables 2-4 compare model predictions at receptors used in the attainment demonstration with observations at the three monitoring sites. This comparison is irrelevant for the purpose of assessing model performance, because many of the attainment demonstration receptors are not near the three monitoring sites.

Chapter 6, Page 31-32 - RE: Additional Checks of the Draft OVPA SIP Model Performance. In this section of the comments, database average concentrations and the predicted number of days above 150 $\mu g/m^3$ are compared with observations. The source configuration and emission algorithms are appropriate for the large episodes and for the purposes of designing control plans to bring these episodes under the 24-hour NAAQS.

Chapter 6, Page 32 - RE: Inconsistencies in the MPE and AD Modeling.
The District agrees the model was not tested for the receptors used in the attainment demonstration. One of the purposes of dispersion modeling is to obtain predictions at receptors and for periods for which monitoring data are unavailable. These attainment demonstration receptors represent areas of public access closer to the sources areas than the monitoring stations, especially the Olancha and Lone Pine sites. Because these receptors are closer than these two monitoring sites, spatial variations in the wind regime between source and receptor are less important. Model performance may actually be better in these areas because predictions are less dependent on meteorological data assumptions. We believe the better model performance at Keeler can be attributed to the site's proximity to the source areas and expect similar model performance at the receptors used in the attainment demonstration.

Chapter 6, Page 32 - RE: Final Design Concentration
See response to Chapter 6, Page 27 - RE: Final Design Concentration.

Chapter 6, Page 33 - RE: Control Measures
See response to Section 2, Page 4 - RE: The Natural Events Policy and BACM Determination.

Chapter 6, Page 33 - RE: Consistency with the Objectives of the PM_{10} NAAQS and CAA.
The District and MFG are unaware of any USEPA precedent or guidance suggesting areas accessible to the public should not be considered ambient air for the purposes of attainment demonstration.

LADWP is correct that adding 100 workers to the lake bed area could potentially increase the exposure of these workers to elevated PM_{10} concentrations. The level of risk associated with this project would be similar to the risk associated with typical construction projects. All project-related activities would be performed in compliance with state and federal regulations to minimize the potential risk. Lake bed construction activities would be carried out in a manner that minimizes the creation of fugitive dust. In addition, state and federal regulations require that workers who could potentially be exposed to elevated PM_{10} concentrations from construction activities and from dust events carry breathing apparatus, such as respirators, to prevent the inhalation of excessive PM_{10} concentrations.

With regard to construction dust impacts, all construction activities must meet District Rules 400 and 401 that limit visible emissions from any source to 20% opacity and require best available control measures for fugitive dust to prevent visible dust caused by the operation from leaving the property boundaries. Projects associated with the gravel mining and gravel delivery to the lake bed will have fugitive dust control conditions in the permit to operate. Fugitive dust control measures have been used successfully on similar large operations such as the Briggs Gold Mine to control fugitive dust from mining operations, open areas and unpaved roads. Monitoring at the Briggs gold mine shows that fence line PM_{10} impacts are safely below the federal PM_{10} standard.

Chapter 6, Page 34 - RE: Quantitative Estimate of Overestimation Bias of the Draft OVPA SIP Model.
The comment indicates a design value of 4709 $\mu g/m^3$ was predicted within the Keeler Modeling Domain for March 3, 1995. This prediction is then compared with the observed value of 2204 $\mu g/m^3$ at the Keeler TEOM site on March 21, 1995. The model-predicted design value at the Keeler TEOM site is 2528 $\mu g/m^3$, not 4709 $\mu g/m^3$. Not only is the prediction within 15% of the observation, it was predicted for the same day March 21, 1995.

The District disagrees the modeling over-predicts the level of control by 550% for the design episode. First there is no convincing evidence the modeling approach over-predicts concentrations for the design episode. Second we disagree the TEOM data should be adjusted without understanding why the TEOM data seem to be higher.

Chapter 6, Page 34 & 35 - RE: Comparisons with Other PM_{10} Attainment Demonstrations
See responses to Chapter 6, Page 27 - RE: Final Design Concentration, Chapter 6, Page 28 - RE: Model Performance Evaluation, Chapter 6, Page 28-29 - RE: Historical Model Performance Goals for Attainment Demonstration Modeling, Chapter 6, Page 29 - RE: Model Performance for the OVPA SIP Model Options, and Chapter 6, Page 33 - RE: Consistency with the Objectives of the PM_{10} NAAQS and CAA. The District has worked with the City since 1979 in the development of the control plan.

Chapter 6, Page 35 - RE: Off-lake PM_{10} Contributions
The District believes that the off-lake areas that are secondary sources of lake bed dust will be controlled after the lake bed source areas are controlled and stop depositing new material in these areas. These areas currently emit at a lower emission rate than the lake bed, and are exposed to

lower wind speeds. Emissions from these areas will decline after controls are in place. Exactly how long it will take before the dunes no longer emit significant amounts of PM_{10} is not known, but because of the finite amount of PM_{10} on the surface, if it takes a long time, then the emission rate will be lower than if it takes a short time.

Chapter 7, Page 36 - RE: Investigation of Controls that Use Less Water
See responses to Section 2, Page 4 - RE: The Natural Events Policy and BACM Determination and Section 5, Page 13 - RE: Selection of Control Measures and Areas for Implementation.

Chapter 7, Page 36 - RE: Control Measures not Documented and Inappropriate Modeling
The District believes the technical reports and related documentation on each of the proposed control measures is sufficient to proceed with implementation at Owens Lake in accordance with the proposed plan. Many of the comments regarding the model performance are either misleading or not relevant. The District strongly disagrees with LADWP's comments that the air quality modeling used to develop the control plan was "highly irregular and inconsistent with procedures used, and approved by EPA" and that biases in the modeling overstate the level of control necessary to demonstrate attainment of the PM_{10} NAAQS. The model applied is the USEPA Guideline model, the modeling procedures are based on the USEPA *Guideline on Air Quality Models*, and the model evaluation techniques are from USEPA guidance documents for assessing model performance.

Chapter 7, Page 36- RE: Health & Safety Code §42316
See responses to Cover Letter, Page 1 - RE: Natural Events Policy, Cover Letter, Page 2 - RE: Authority to Require Water for Air Quality Control. Water, gravel and vegetation are not "future technologies."

Chapter 7, Page 36 - RE: Minimize Natural Resource Consumption and Water Use.
See response to Section 5, Page 13 - RE: Selection of Control Measures and Areas for Implementation, Section 5, Page 13 - RE: CAAA Section 188(f), and Section 5, Page 17 - RE: WESTEC Study and Managed Vegetation.

Chapter 7, Page 37 - RE: Minimization of Cost.
See responses to Section 2, Page 4 - RE: The Natural Events Policy and BACM Determination and Section 5, Page 13 - RE: Selection of Control Measures and Areas for Implementation.

Chapter 7, Page 37 - RE: Water Use and Fugitive Dust
Table 7.1 indicates the amount of water required after construction of all the control measures is complete. During construction of the control measures, the control measures will not be

operational. Demand for water for construction of infrastructure elements will be a very small percentage for the water required for operational purposes, certainly less than 51,000 ac-ft per year. Therefore, during the 5-year construction period, total water demands will certainly not be "substantial," but rather will be well below the full operational demands indicated in Table 7.1.

The District has encountered no difficulties or health threats using water to maintain dust-free conditions during lake bed construction of District managed projects. District projects use traditional dust control methods such as site watering and low vehicle speed limits. Lake bed employees are required to carry respirators to protect themselves from unanticipated dust storms. Cahill used no dust abatement during construction of the UC Davis dune array, that is most likely why "substantial fugitive dust emissions were created."

The minimal flows required on the Keeler/Swansea flood area for the 6-week period from mid-June through July are accounted for in the 51,000 ac-ft total. The total quantity of water delivered to the shallow flood areas during this 6-week period is approximately 1,000 ac-ft, or 2% of the total amount of water required.

The City seems to have some misunderstanding as to the operation of the managed vegetation site and the need to "leach the managed vegetation area every September." The near-surface soils designated for planting will be leached once. Once the salt levels are lowered to levels that allow saltgrass to be planted, the deep drains will prevent the salt levels from rising into the plant root zone.

Chapter 7, Page 37 - RE: Authority to Require Water for Air Quality Control
See response to Cover Letter, Page 2 - RE: Authority to Require Water for Air Quality Control.

Chapter 7, Pages 38-39 - RE: Implementation Schedule
After a careful review of the DSIP implementation schedule revisions were made to the PM_{10} emission reduction trend in DSIP Figure 7.2 to reflect the implementation schedule and resource limitations. The implementation schedule, however, was not changed and the District staff believes that it is possible to implement the control measures on the proposed schedule to meet the CAAA deadline of December 31, 2001 for implementation.

Regarding schedule of gravel: SLC will investigate land trades with BLM to expedite permitting.

Regarding schedule of managed vegetation: Although it will take several years for 50% cover of saltgrass to become established on managed vegetation plots, recent on-site wind tunnel work reveals that substantial dust control is achieved by the leaching process alone, even in the absence of plant cover. Leached soils partially covered with saltgrass will therefore greatly reduce PM_{10} emissions from the managed vegetation area even before the full amount of cover has developed.

Chapter 7, Page 39 - RE: Costs, Parsons Engineering Science Report and Attachment with Cost Questions.

The cost estimate prepared by Parsons Engineering Science for the LADWP, while apparently very thorough, indicates an incomplete understanding of both the proposed control measures and the Owens Lake bed environment. The LADWP accuses the District of preparing a cost estimate based upon "numerous unsubstantiated assumptions." One could argue that the LADWP's estimate is based on the same. One 2-day site visit by the LADWP's consultants is far too little time to understand the environment of the lake bed. This understanding is necessary before even preliminary cost estimates can be prepared. The District has developed a good understanding of the actual effort required to construct lake bed improvements and has incorporated this understanding into its cost estimate. Where possible actual costs have been used. No actual Owens Lake costs were apparently used to prepare the LADWP's estimate. It is unfortunate that Parsons did not communicate with District staff during the preparation of the estimate; the result would have been a cost estimate that was detailed and accurate. It could then have been useful to both the District and the LADWP.

The Parsons' cost estimate does include details not included in the District's estimate. However, the Parsons' cost estimate, in addition to being based on misunderstandings of the control measures and the Owens Lake bed environment, is based on predicted costs. Wherever possible, the District's cost estimate is based on actual costs incurred while constructing improvements on the lake bed. A more realistic approach to estimating costs at this pre-design stage would be to correct the inaccuracies in the Parsons' budget, using actual costs whenever possible and then use the range of costs reflected by the District estimate at the low end and the Parsons' estimate at the high end. More detailed comments on the Parsons' estimate will be provided below.

The LADWP adds $6 million per year to the annual cost of the project to reflect on-going studies. It is inappropriate to add the cost of measure refinements conducted during implementation as an annual cost. It would be more appropriate to annualize these costs and add them. The LADWP seems to be confusing annual costs with annualized costs. In addition, no credit is given for cost savings brought about by the results of the additional research. This work could reduce both construction and operational costs substantially. These savings are not included in the LADWP's grossly over-estimated annual cost of $67 million per year. In addition, $6 million per year has never been spent in the past during measure development. There is no reason to expect that this level of spending would occur once implementation begins.

On page 39 the comment is made that environmental mitigation costs "would be very expensive." If the City reviews the proposed mitigation measures, it will find that of the 14 significant or potentially significant impacts for which mitigation measures are proposed, only 3 measures will require ongoing costs once the project is constructed: (1) the creation and maintenance of 121 acres of transmontane alkaline meadow, (2) an exotic plant elimination program and (3) snowy plover habitat restoration. The cost of these measures is insignificant in comparison to the construction and long-term annual costs.

The LADWP states on page 39 of their comments that "accurate and comprehensive cost data is necessary to appropriately assess the reasonableness of the proposed control strategy." If the obvious errors in Parsons' estimate are corrected, their annualized cost drops from $60 million to about $50 million. If this is taken as an upper limit cost and the District's annualized cost of $38 million is taken as a lower limit, the cost of control per ton of PM_{10} ranges from $130 to $170. This is between 2.5 to 3.5% of the $5,300 per ton limit deemed reasonable by the South Coast AQMD in their November 1996 Air Quality Management Plan for fugitive dust BACMs. Thus, even under the highest estimate of cost, the cost of control is more than reasonable.

Comments on Attachment titled: "Engineering Cost Estimate..." Prepared by Parsons Engineering Science, May 6, 1997

As stated above, the cost estimate prepared by Parsons Engineering Science for the LADWP appears to be very thorough. It was refreshing to finally see an attempt to back up statements with numbers. However, some significant, and costly, errors in the estimate indicate incomplete understanding of both the proposed control measures and the Owens Lake bed environment. One site visit is far too little time to understand the environment of the lake bed and this understanding is necessary before meaningful cost predictions can be made. It is unfortunate that Parsons did not communicate with District staff during the preparation of the estimate; the result may have been a document that could have been useful both to the District and the LADWP.

On page 1-1 Parsons states that "because of the large area, the cost for PM_{10} abatement is high." This statement has no context. What is the cost high compared to? The total cost of the Owens Lake control strategy is roughly comparable to the cost of the current Los Angeles City Hall remodeling project. Even if we take Parsons' admittedly high annualized cost of approximately $60 million over 25 years, the cost per ton of PM_{10} controlled is $206 per ton. This is less than 4% of the $5,300 per ton limit deemed reasonable by the South Coast AQMD in its 1997 Air Quality Management Plan for fugitive dust BACMs.

It should be noted that on page 1-2 of the estimate, Parsons states that the estimate provided is conservatively high. Therefore, it can be assumed that their costs represent an upper limit of the total project costs.

The sentence on page 2-2 regarding surface soil types is incorrect. The surface soil types are indicated correctly in Figure 3.3 (page 3-9) of the Draft EIR. An understanding of the surface and subsurface soil types present on Owens Lake is vital to the preparation of preliminary engineering and cost analyses. Discussions with District technical staff would help resolve these misunderstandings.

Parsons indicated that additional geotechnical analysis may indicate a reduced requirement or alternative to underlaying the gravel blanket with a geotextile fabric. The District agrees and retained the soil engineering firm of Law/Crandall Engineering to provide additional analysis of the need for geofabric under the gravel. A report dated May 21, 1997 prepared for the District by Law/Crandall Engineering indicates that, except under certain limited conditions, it is unlikely that geofabric will be required under the gravel. The DSIP and DEIR should be revised to reflect the elimination of this requirement. Therefore, the approximately $43 million cost of geofabric included in the Parsons estimate should be removed.

Parsons has apparently provided for far more infrastructure on the shallow flooding areas than would ever be required. They have divided the flood areas into 1/4-mile square grids with a 12-inch pipeline along the upper edge of each grid area. This is far more pipeline than will be necessary to provide the 75% water coverage necessary to reach attainment of the Standard in these areas. The 600-acre North Shallow Flooding Test Area controlled emissions from the test area with only one up-hill outlet pipeline. In order to provide a factor of safety and allow the water to be spread more efficiently, two parallel pipelines approximately 1-mile apart, are proposed for the Keeler/Swansea flood area. The Owens Lake bed is an extremely flat, uniform environment. Water discharged onto the surface spreads laterally very readily and frequent winds help to spread the waters across the control surfaces. In addition, by eliminating most of the 12-inch outlet lines, most of the 18-inch headers are also eliminated.

Another cost estimate error regarding shallow flooding infrastructure is the placement of water outlet valves every 40 inches along their already too numerous outlet lines. District tests on both the north and south shallow flood test sites indicated that discharging the water every 40 to 80 feet was more than enough to ensure uniform spreading.

The construction of a 25 foot cut-off wall along the lower edge of the shallow flood areas, as proposed by Parsons, would cause significant detrimental impacts to both the project area and the brine pool. Natural shallow groundwaters make their way from the historic shoreline area toward the brine pool. The District's proposed measures would not interfere with this natural flow. However, the construction of a 25-foot deep cut-off wall along the lower edge of the control area would prevent natural waters from reaching the brine pool and would force the water to the surface at the lower edge of the project area. Lower edge berms should only be keyed deep enough to capture waters added to the lake bed surface. In the north sand sheet this is on the order of a few feet deep, as indicated in the District's cost estimate.

On page 4-2 of Parsons' report in Section 4.2.1 "Labor Costs," it is stated that field crews would be working 24 hours per day, 7 day per week when water is flowing. This is excessive. There is no need to have full crews working 24 hours per day. The water spreads itself with very little need for human intervention. It may be wise to have a night or weekend "skeleton crew" but full-time manning of the site is not necessary.

It is difficult to revise the Parsons cost estimate without access to the detailed spread sheets they have prepared for the project. However, it appears that by removing the requirement for geofabric, constructing the shallow flooding system as intended and eliminating the need for the 25-foot cut-off wall, that their construction cost would be lowered by $65 to $70 million to about $240 to $250 million. By revising manpower requirements and scaling back on the unnecessarily high reserve fund requirements, Parsons' annual cost should be able to be reduced to below $30 million. If the City finds a source of replacement water that cost less than $450 per ac-ft, additional, significant cost savings could be realized. The District uses $450 per ac-ft because this is a conservative, upper-limit, value.

Using Parsons' revised costs, annualized costs would be on the order of $50 million. This would represent an upper limit project cost.

Comments on Attachment titled "Los Angeles Department of Water and Power Questions Regarding Comparative Cost Estimates (March 1997)."

A.1. Interviews with District field maintenance personnel. Actual cost of equipment was much lower. 100% of manpower cost is very conservative.

A.2. Actual cost to move earth on various projects constructed on the lake bed. The cost per yard varies with the earth structure being built. The details in the estimate indicate the cost per yard for each structure.

A.3. Actual cost for the District's earthwork contractor, the Lake Minerals Corporation, to purchase base material from Dolomite, haul and spread on lake bed roads.

A.4. Estimate based on Agrarian project surface ripping with D-8.

A.5. Actual cost charged by Claire Construction on District jobs.

A.6. Conservative rate based on operation of D-8 on Agrarian project.

A.7 Estimate provided by Agrarian Research and Management, based on many similar projects that they have been involved with.

A.8 Actual cost of two District pump stations was approximately $100,000 (Deep River and Shallow River Stations). Cost inflated to $125,000 to be conservative.

A.9. Assume 1 ftee can maintain 25 feet of berm per hour (this is very conservative). 1 ftee can repair 50,000 feet per year. Assume 20% of all berms require maintenance in any year. Therefore, 1 ftee can maintain 250,000 feet or 47 miles per year. Round to 50 miles.

A.10. Conservative estimate based on the District's assembly of many miles of above ground pipeline.

A.11. Based on actual cost of pipeline installation for North FIP test site waterline.

A.12. See A.9. The calculation for pipeline maintenance is similar to that for berm maintenance.

A.13. Actual cost on Agrarian project for constructing similar structures.

A.14. See A.3.

A.15. The District's consulting mining engineer contacted a local CalTrans employee and developed this value based on the type of highway to be repaired and the type and amount of damage that could be expected.

A.16 This range of values was developed based of the experience of the District's consulting mining engineer, the characteristics of the site and confirmation with several gravel producers.

As indicated on page 14 of the cost estimate, the range of total gravel costs were from $11.39 to $15.07 per cubic yard. A mid-range value of $13.23 was used to calculate the cost per acre used for the total cost estimate.

B. Many of the District's costs were intentionally conservative at this feasibility stage in order to include minor associated project costs. In addition, the District's cost estimate included 10% for annual contingencies, 15% for engineering, an annual overhead of 50% for all non-water costs and $2 million per year for enforcement. Many of the "Item B" costs should be included in the above amounts. It was not the intention, nor is it the responsibility, of the District to prepare detailed project cost estimates. In fact, it is not appropriate at this feasibility stage to include such items as "12 conference room chairs" or "8 potable [*sic*] radios." What is the basis for asking for these details at this time? How could anyone speculate that 12 conference room chairs would be required? The District's estimates are intended to demonstrate the magnitude of control measure costs and to allow an approximate cost per ton of PM_{10} controlled to be calculated. It will be the City of Los Angeles' responsibility to prepare detailed final engineering plans and associated cost estimates for the project, including, if they wish, funds for conference room chairs.

As stated above in the comments on Parsons' cost estimate, if the City wishes it can view the District's estimate as a lower limit of project costs and the adjusted Parsons' estimate can be viewed as an upper limit. The range of annualized costs are therefore approximately $38 to $50 million.

C. See response to Section 5, Pages 19 & 20 , RE: Critique of Gravel regarding the use of geofabric under gravel blanket. Based on a report prepared by Law/Crandall Engineering (1997), the District is revising the gravel blanket control measure to eliminate the requirement for using geofabric. The $1.18 per square yard should not be added to the cost estimate.

Section 8, Page 39-42, RE: Enabling Legislation to Implement SIP & Conclusions
LADWP reiterates points made in their cover letter to the DSIP comments. The reader is referred back to the relevant responses provided to those comments: Cover Letter, Page 1 - RE: Natural Events Policy, Cover Letter, Page 2 - RE: Authority to Require Water for Air Quality Control, Cover Letter, Page 2 - RE: Economic Feasibility and Funding Sources, Cover Letter, Page 3 - RE: Establishment of a Scientific Review Panel, Section 2, Page 4 - RE: The Natural Events Policy and BACM Determination, and Chapter 7, Pages 38-39 - RE: Implementation Schedule.

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June 6, 1997

RECEIVED
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GREAT BASIN
UNIFIED APCD

Dr. Ellen Hardebeck, APCO
Great Basin Unified APCD
157 Short Street
Bishop, CA 93514

SUBJECT: Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan

Dear Dr. Hardebeck:

On behalf of over 50,000 residents of Eastern Kern County living downwind of Owens Lake, and especially the 30,000 residents of the Indian Wells Valley, I would like to take this opportunity to encourage your Board to adopt the proposed Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan (Plan). This Plan, when implemented, will result in the protection of public health and visibility in East Kern and communities as far south as Lancaster and Palmdale in Los Angeles County. This Plan is well-conceived, feasible, and cost-effective and is the result of ten years of District staff efforts.

The proposed Plan requires the City of Los Angeles to control particulate emissions from the dry Owens Lake bed by means of a combination of shallow flooding, managed vegetation, and application of gravel. These control measures have been shown to work and will be cost-effective. Cost of dust control is estimated at $325 per ton. By means of comparison, it has cost the Naval Air Weapons Station, China Lake, $342 per ton to comply with Kern County APCD Rule 402 (Fugitive Dust). Furthermore, up to about $6000 per ton is considered cost-effective by most California Air Districts for controlling particulates from industrial sources.

The Los Angeles Department of Water and Power (LADWP) has an obligation to provide the City of Los Angeles with potable water, but it also has the responsibility to protect the environment which provides that water. The Plan proposed by GBUAPCD staff will simply require LADWP to fulfill that responsibility.

Thank you for the opportunity to comment on your Plan. I plan to attend your Board's July 2nd public hearing and present these comments.

Sincerely,

Thomas Paxson, P.E.
Air Pollution Control Officer

TP:bjm
TOM051

Staff Response to June 6, 1997 Comments on Draft SIP submitted by Kern County Air Pollution Control District

Great Basin appreciates Kern County's support of the proposed SIP. District staff also believes that the control measures proposed are cost-effective. District staff also believes that parties responsible for air polluting activities have a responsibility to protect the environment.

9706232

Department of Water and Power the City of Los Angeles

June 18, 1997

Dr. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street, Suite 6
Bishop, California 93514

Dear Dr. Hardebeck:

<u>Owens Valley PM-10 Planning Area Demonstration of Attainment
Revised Draft State Implementation Plan (RDSIP)</u>

The City of Los Angeles Department of Water and Power (LADWP) has reviewed the Revised Draft Owens Valley PM-10 Planning Area Demonstration of Attainment State Implementation Plan released May 30, 1997 (RDSIP). The RDSIP in many instances represents large-scale changes to the proposed control strategy and policies presented in the previous Great Basin Unified Air Pollution Control District (GBUAPCD) documents, including the previously released Draft SIP. The LADWP continues to oppose the DSIP with its proposed control measures at this time.

The LADWP submitted comments on the Draft SIP on May 8, 1997, which are herein incorporated by reference, and which are of equal applicability to the RDSIP inasmuch as the issues raised in those comments have not been addressed by the GBUAPCD's additional revisions to that document. The RDSIP, in fact raises a number of additional and new issues which are commented upon and discussed in the attached detailed comments, as well as additional comments submitted by the LADWP on the Draft Environmental Impact Report, which are herein incorporated by reference.

Control measures as complex, potentially environmental damaging, and as costly as those proposed by the GBUAPCD for use on the Owens Lake bed require thorough development and planning. In light of the significant uncertainties regarding control strategy success, technological feasibility on the lake bed, air quality modeling data, emission inventory issues, monitoring data discrepancies, lack of clarity of the plan, inconsistencies with existing laws and court orders, etc., it is premature to adopt the RDSIP and proposed Board Order. Federal Clean Air Act Section 188 (f) provides the regulatory flexibility and time necessary for resolving such important and fundamental air quality planning information. Therefore, the LADWP recommends that the GBUAPCD utilize Section 188 (f), in an effort to continue necessary research on the Owens Lake bed to allow the Owens Valley Planning Area to move forward with reasonable solutions to its air quality problems.

Furthermore, the inclusion of new research results, which present significant new information and conflicting results, further highlight the experimental nature of the proposed control strategy. Control strategies and associated implementation regulations (i.e., Board Orders or rules) must be technologically proven in practice in the proposed application, have control efficiency clearly demonstrated, and associated environmental impacts adequately assessed. This is necessary both to insure that decision making is informed, and that the expenditures of both financial and natural resources necessary to implement control strategies are valid and will result in documented benefits.

The GBUAPCD has continually failed to consider economic feasibility in development of the proposed control strategy. Economic feasibility cannot be evaluated solely by cost-effectiveness; funding availability and overall public health benefit must be considered as well. Local government resources, particularly fiscal, are increasingly constrained, and the ability to generate additional revenues is increasingly restricted. The U.S. Environmental Protection Agency recognized the significant constraints on local government funding ability, and therefore provided special provisions for local governments in its guidance regarding PM-10 State Implementation Plans. As a reference point (the LADWP is not solely responsible for the costs of the proposed control strategy), the LADWP calculated the water rate increase necessary for delivery of water to City of Los Angeles residents, an essential public service, as 17% for GBUAPCD estimated costs and 21.3% for Parsons Engineering Science estimated costs. Clearly such increases are unreasonable, and would not be publicly acceptable.

As previously commented, the LADWP is unaware of any water sources large enough to provide the 51,000 acre feet of water annually required by the proposed control strategy. The proposed Board Order and RDSIP remain unclear and vague as to the proposed source of the water, while significantly changing the GBUAPCD policy to accommodate use of water resources that result in significant impacts. State law (Section 42316 of the Health and Safety Code) specifically precludes the GBUAPCD from specifying dust control measures for the Owens Valley which require City of Los Angeles water.

The RDSIP now incorporates a Board Order (i.e., a rule) for control strategy implementation. The requirements of the RDSIP and proposed Board Order exceed the jurisdiction and authority of the GBUAPCD, and are inconsistent with existing statutes and judicial precedent. In addition, the RDSIP and proposed Board Order lack clarity.

The LADWP has been a partner with the GBUAPCD in addressing the air quality issues of the Owens Valley Planning Area for 14 years. We look forward to continuing these efforts and hope to extend the air quality planning partnership to include all stake holders (including the State Lands Commission and the California Air Resources Board).

Sincerely,

HARRY M. SIZEMORE
General Manager

Enclosure

c: Mr. Dean Saito, California Air Resources Board
Mr. Gerald A. Gewe

City of Los Angeles Department of Water and Power
Comments on the Revised (May 30, 1997) Draft Owens Valley
PM-10 Planning Area Demonstration of Attainment
State Implementation Plan (RDSIP)

The revisions to the Draft SIP in many instances represent large-scale changes to the project described in the previous draft and analyzed in the Environmental Impact Report (EIR). At the same time, these changes are often made without explanation or detail and leave the reader to speculate as to the true nature of the project as presently contemplated by the Great Basin Unified Air Control District (GBUAPCD). Without an EIR which details the impacts of the present rendition of the project, the ambiguity and lack of detail present in the revised SIP is all the more troublesome. LADWP has previously submitted comments to the initial draft SIP which it hereby incorporates by reference, and which are of equal applicability to the revised draft inasmuch as the issues raised in those comments have not been addressed by the GBUAPCD's revisions. Moreover, the revisions raise a number of additional issues as addressed below. The continued evolution of the proposed control strategy impedes the public review and informed decision making process.

In previous comments on the DSIP and DEIR, the LADWP has noted that the control measures contained in the DSIP are predicated upon faulty modeling techniques, are legally and technologically infeasible, and are unproven in their capability to reduce PM-10 to a level of attainment with the National Ambient Air Quality Standard (NAAQS). Despite these consistent comments, the GBUAPCD until recently has maintained an unsupported confidence in the efficacy of the SIP's control measures. The most recent revisions to the DSIP and other actions of the GBUAPCD demonstrate that the GBUAPCD itself is now subject to doubts about the SIP measures, all of which make adoption of the RDSIP more unreasonable than ever.

EXECUTIVE SUMMARY

On page ES-1, the discussion of statutory extensions of time to comply with the NAAQS available at the discretion of the EPA, has been eliminated without justification or support. The SIP should provide for informed decision making, providing an overview of all possible regulatory tools available to address the PM-10 problems of the Owens Valley in the most responsible, reasonable, and scientifically valid manner available. Deletion of the discussion of Clean Air Act Section 188(e) and the further omission of Section 188(f), and the EPA's Natural Events Policy result in a document that fails to adequately address and consider the most appropriate control options and associated implementation time frames available.

As commented previously, best available control measures (BACM) has not been determined for Owens Lake, the proposed control strategies are unproved and cost prohibitive, the emission inventory for the Owens Valley region is greatly overestimated, and the demonstration attainment modeling is flawed. Therefore, additional time is necessary to obtain the fundamental data necessary to establish BACM and to develop an attainment strategy.

There are a number of methods under the Clean Air Act for the GBUAPCD to extend the SIP process until BACM is developed. As previously commented, the LADWP recommends the use of Section 188(f) which provides for a waiver of a specific attainment date where it is determined that naturally occurring sources of PM-10 contribute significantly to violation of the NAAQS.

On page ES-2, the text is corrected to indicate that Ridgecrest experienced an exceedance of the federal standard rather than a violation. Although the LADWP appreciates the correction, the text continues to present a biased representation of the air quality of the region, and continues to fail to substantiate the claims made with actual air quality data. The air quality data indicates that a single exceedance, monitored with a focused effort to obtain data for anticipated exceedance days, was observed in Ridgecrest during a three year period. Furthermore, this single exceedance day was observed in 1995, which could be characterized as one of the worst air quality years in the vicinity of Owens Lake since 1987. The air quality monitoring data therefore, clearly indicates that the exceedance observed at Ridgecrest and discussed on page ES-2 is indeed a rare event. To provide for informed decision making, the public needs to understand the true air quality of the region overall in order to balance the benefits which may be achieved by the plan with the financial and environmental costs of the plan.

On page ES-3, the use of high altitude photography and salt efflorescence were removed without explanation from the list of methodologies used to determine the Owens Lake playa emission inventory. The reasons why these methods were determined to inaccurately estimate emissions should be presented. This would assist in evaluating the methods currently employed by the GBUAPCD.

On page ES-6, the text has been modified to indicate that "3 1/2 to 6 feet of water will be necessary to *permanently* reclaim a two-foot deep soil profile." This is inconsistent with the result presented in the Ayars report on reclamation studies, dated May 2, 1997. The report clearly states that "accumulation of salt on the surface will continue as long as there is a net upward flow of water to the soil surface." The report then goes on to detail three separate methods of reversing the upward flow of water, all of which include long-term requirements. The report identifies the promising solution as continued water use. Furthermore, the Ayars report clearly indicates that "the estimated time to stabilize reclamation in the current test plots is a minimum of two years," this is in addition to the nearly nine months of work completed upon release on the May report. The RDSIP needs to be factually correct and present the data regarding additional leaching requirements, additional water needs, and additional time for implementation, in an unbiased fashion.

On page ES-6, the GBUAPCD modifies the amount of vegetation necessary to attain the required PM-10 control efficiency from "at least" 50% to "no more than" 50%. In fact, the new studies, with data being presented for the first time in the RDSIP, indicate that no vegetation is necessary to achieve the desired control efficiency (see RDSIP page ES-7). The new data presented in the RDSIP clearly warrants careful review and consideration. Section 188(f) of the federal Clean Air Act provides the time necessary to consider these potentially significant results, and analyze and consider potential associated environmental impacts indicated by these results.

On page ES-6, the RDSIP modifies the estimate of water necessary to maintain salt grass at 2.5 acre feet per year for each acre of planted salt grass, rather than the previous estimate of 2 acre feet per year. Although the GBUAPCD indicates that this is not a change in water use, the calculations for both scenarios are not presented for review. The new data which resulted in this change must be identified. In addition, it appears that the 2.5 acre feet estimate per acre of salt grass planted does not include consideration of irrigation needs required to maintain downward movement of the water in the upper soil profile to minimize salt infiltration from the upward artesian movement (see Ayars report).

On page ES-7, significant new data, information, and conclusions are introduced regarding the efficacy of managed vegetation as a control measure for the first time. The inclusion of new research results, which present significant new information, with conflicting data, further highlights the experimental nature of the proposed managed vegetation control strategy. Control strategies must be technologically proven in the proposed application, and control efficiency clearly documented, before they can be considered as potential control strategies. Although the LADWP has requested the studies on which the new data introduced into the RDSIP are based, they have not been received, so comments are necessarily constrained to the limited information (17 lines) presented in the RDSIP. More focused comments can only be made by the LADWP, public, and stakeholders upon review of the actual studies and data.

The research results regarding managed vegetation effectiveness vary tremendously: 23% cover in sandy soils resulting in 90% control effectiveness, with a higher effectiveness anticipated in clay soils; 54% cover resulting in 99.2% efficiency in laboratory studies; and 11% cover in field studies on clay resulting in 99.5% control efficiency. With such significant variations in data, it is impossible to arrive at a scientifically valid conclusion as to the control effectiveness of the proposed managed vegetation control measure. Additional study is clearly warranted and necessary to determine the control effectiveness of managed vegetation and the necessary cover to achieve such effectiveness.

Additionally, it is a fundamental goal of the Clean Air Act and the California Environmental Quality Act (CEQA) to minimize costs and environmental damage to the greatest extent feasible. Clearly, the new research results presented in the RDSIP on page ES-7 indicate that reduced areas of vegetation, with reduced water needs may be adequate to control dust from the lake bed. In fact, the results indicate that leached soil areas with no vegetation achieve the same control effectiveness as vegetated areas. The use of non-vegetated leached areas could then potentially be utilized to reduce emissions, eliminating the need for long-term water requirements. This possibility is not investigated by the GBUAPCD, with the vegetation requirement in the RDSIP and draft Order being maintained at 50% cover.

The discussion on ES-7 indicates that the emissions from non-vegetated leached soils would increase "after the initial protection provided by watering decreases." It is unclear what additional protection is provided by leaching, and why the degradation of that protection would be a phenomenon limited to only to non-vegetated leached soils, and not equally impact vegetated areas. No scientific data validating this difference is presented.

The idea that non-vegetated leached soils are as effective at reducing fugitive emissions as vegetation, implies that emissions are tied to salt directly, as this is the only reported alteration created by leaching activity. This raises the interesting and pressing question as to the emissivity of areas to which the leached salts are transported and allowed to percolate into the groundwater. Before making conclusions as to the effectiveness of leached soils and managed vegetation, which incorporates leaching activity, the impacts of leached salts and potential increased emissivity of other areas of the lake bed need to be thoroughly investigated.

To assure the implementation of an effective control strategy, with the least amount of cost and environmental damage, it is incumbent upon the GBUAPCD to take the time necessary to complete the addition research required to address the numerous issues raised via the recent research results. Section 188(f) of the federal Clean Air Act provides the time necessary to complete such studies, to ensure implementation of effective, cost-efficient, and environmentally responsible solutions to fugitive dust emissions.

On page ES-8, the RDSIP indicates that 25% of the managed vegetation area would consist of unvegetated areas such as roads, berms, etc.). If this is the case, then greater than 50% plant cover would be required on vegetated areas to achieve a 50% cover requirement. In addition, roads tend to be more emissive than inactive areas. It is unclear how these differences are accommodated in the effectiveness of the proposed managed vegetation control strategy.

On page ES-8, the RDSIP indicates that a " total water use for the first year of implementation will be seven ft/ac. After the first year, water use will be reduced to at or below 2.5 ft/ac/yr." This is in direct contrast to the results and recommendations of the Ayars report on reclamation studies of the Owens Lake bed, May 2, 1997. The report states that "results of the leaching trials indicate that approximately 4-6 feet of water will be needed to reclaim 24 inches of soil to an *average* EC of 30 dS/M" (emphasis added). The Ayars report goes on to indicate that additional work in necessary to reduce salinity to the range where halophytes can be established, in the 20-30 dS/m range. The report also documents significant sodicity problems which require sulfur amendment with water. The report also identifies high boron content found in leach soils as a hazard for plants. The Ayars report indicates that leaching of boron to the level appropriate for plants would require at a minimum twice the water required for the leaching of salts. Depending upon the boron tolerance of salt grass and soil characteristics, significantly more than twice as much water may be necessary for leaching.

In addition, the Ayars report clearly indicates that additional research in necessary to accurately quantify water needs for both leaching and plant maintenance. The report specifically states: "Studies need to be conducted to determine what the water requirements and management necessary to achieve this depth of reclamation [minimum 2 foot depth required for vegetation]." The report goes on to state: "Studies are needed to determine the minimum water requirement needed to sustain the plant [salt grass] and provide adequate cover to prevent dust." In light of the results and recommendations of the Ayars report, the assertions and water requirement volumes presented in the RDSIP are inaccurate, unsubstantiated, and significantly underestimate the water needs of the proposed managed vegetation control strategy. Data and information presented in the RDSIP needs to be accurate and based upon the best scientific information available.

On page ES-9, the RDSIP introduces yet another permutation to the proposed gravel control measure. When gravel was first proposed as a control measure by the GBUAPCD in the Project Alternatives Section Document, LADWP made comments regarding the load-bearing capacity of the lake bed and the likely possibility that gravel would sink. In response to those comments, in the DSIP the GBUAPCD introduced a requirement to require that geotextile fabric be placed between the soil and gravel. This very expensive addition to the proposed gravel control measure was introduced without any additional research. Now, in the RDSIP, the requirement has been reduced to require geotextile fabric in limited areas. However no data is presented to illustrate the method of determining areas where such placement will be "necessary."

The RDSIP modifies the soil type of concern for gravel-treated areas identified in the DSIP, from areas high in clay and silt, to areas containing sandy soils. This is a fundamental change in the soil types of concern for gravel placement, with no data presented. In addition, this fails to address the impacts of the anticipated changes in groundwater levels associated with the proposed flood irrigation and managed vegetation control measures. Impacts of precipitation also remain unaddressed.

Clearly, significant research is needed to determine if geotextile fabric will perform as anticipated, as well as to determine the appropriate areas for its application. Furthermore, as previously commented, the RDSIP continues to evaluate proposed control measures independently and fails to recognize the potential problems and difficulties associated with integrated implementation, such as a substantial increase in groundwater levels, that could impact gravel placement. Section 188(f) of the Clean Air Act provides the flexibility and time necessary to address the several issues associated with placement of gravel on the lake bed as a potential control option.

The preliminary economic review of gravel presented in Appendix G highlights that a "number of technical challenges to designing a bulk gravel placement method." remain. In light of the problem discussed and evaluated in the report, "no one option that met all requirements for successful bulk spreading of a 4 inch lift of gravel on Owens Lake playa" were identified. The report recommends that "pilot tests" be conducted on the playa. Clearly, the technical feasibility of the gravel control measure has not been demonstrated in any fashion. Section 188(f) of the federal Clean Air Act provides the time necessary to evaluate the appropriateness and feasibility of the proposed control strategy.

It is imprudent to move forward with significant expenditures to initiate implementation of the gravel measure and incur the significant environmental impacts associated with gravel mining, in light of the substantial uncertainty regarding the ability to place and maintain gravel on the lake bed.

On page ES-11, the sentence establishing the policy position of the GBUAPCD, which stated "although the District has chosen at this time not to specify the source of water to be used in the water based control measures, it reserves its authority under both state law (in determining which control measures are reasonable) and under federal law (in determining which control measures are the "best available") to prohibit the use of water resources which cannot be tapped without causing significant adverse environmental consequences," is eliminated This is a significant change in policy and requires substantial discussion with, and adequate notice to, potentially impacted water agencies, their customers, and groundwater users.

Clearly, as documented in the comments submitted by the LADWP, the Metropolitan Water District, and a number of other water agencies, the loss of 51,000 acre feet of water resources to the Southern California region is considered a significant loss. With the identification of the significance of water loss, the threat to water resources was thought to be removed, due to the above-referenced policy established by the GBUAPCD. However, with release of the RDSIP with a limited review period, that policy is now reversed by simply striking five lines of the over-100 page document.

Furthermore, the GBUAPCD Governing Board adopted a policy which precludes the use of groundwater if significant impacts are identified. It is unclear whether the RDSIP policy change would now repeal and overturn the Governing Board policy regarding groundwater, or if the RDSIP policy modification is focused solely on Los Angeles Aqueduct diversions. It is inappropriate to establish two different water resources policies for different areas, unless substantial evidence warrants such differences. No such differences have been identified by the GBUAPCD to date.

If the GBUAPCD is considering using groundwater or Los Angeles Aqueduct water, the recirculation of the Draft Environmental Impact Report (DEIR) is required. Significant new information will have been added to the project, with the utilization of water resources despite significant adverse environmental consequences, and the identification of required mitigation measures.

With the change in policy documented in the RDSIP, page ES-11, the GBUAPCD has raised the issue of the possibility of adopting a Statement of Overriding Considerations under CEQA for water resources. Informed decision making regarding the RDSIP dictates and CEQA requires that the GBUAPCD's intention to adopt a Statement of Overriding Considerations regarding water use be circulated to all Responsible Agencies. CEQA Guidelines Section 15043 (agency must make a "fully informed and publicly disclosed" decision that "[s]pecifically identified expected benefits outweigh the policy of reducing or avoiding significant impacts of the project.") If the District is considering the use of groundwater (as is seemingly indicated by the GBUAPCD budget), the RDSIP should disclose this fact to the public.

The District's 1997-98 budget further states that the hydrologic model currently being refined with ongoing and future budgeted research will be used to evaluate alternative water sources for dust mitigation. This is not clearly disclosed in the RSDIP or adequately addressed in the DEIR.

On pages ES-11 and ES-12, the RDSIP asserts the level of control required in the RDSIP and the draft Order is appropriate and that the increased level of control required to achieve the proposed PM-10 ambient air concentration of 67 ug/m3, rather than the required 150 ug/m3 standard, would not make a material difference in the amount of control required. These assertions illustrate a complete lack of understanding of the comments previously submitted by the LADWP, and are contrary to the new information presented in the RDSIP. As an example, the study results presented on page ES-7 indicates that non-vegetated, leached soils have the same emissivity as vegetated plots. This indicates that 50% cover for managed vegetation, in and of itself, is over-control.

The discussion justifying the appropriateness of modeling results with a targeted ambient air concentration of 67 ug/m3 when the required standard is 150ug/m3 is based upon several false premises. First, on page ES-11 the RDSIP states, "ambient concentrations are proportional to emissions." This is inaccurate. Emissions impacts on ambient concentration are not linear as indicated, but depend greatly on proximity to the emission source. Furthermore, the air quality modeling performed by the GBUAPCD incorporates overestimation of emission by utilizing TEOM data (demonstrated to overestimate ambient concentration in Owens Valley by an average of 50%) and an inflated emission inventory based on 35 square miles of the lake bed generating emissions on days that exceed a wind threshold of 7.5 meters/second.

By providing for a level of PM-10 control to reduce emissions to nearly three times below what is required to satisfy the federal Clean Air Act, the RDSIP violates state law which expressly prohibits such over-regulation. In 1987, the US EPA established, pursuant to the federal Clean Air Act, a NAAQS for PM-10 of 150 ug/m3 (24 hour average). The Clean Air Act provides for states to exercise their responsibility for attainment and maintenance of the NAAQS through a SIP, of which the GBUAPCD's RDSIP is a component part. Though the Clean Air Act allows states to adopt SIP provisions which are more stringent than the federal Act, in California this discretion is constrained by Health and Safety Code Section 39602, which provides that "the state implementation plan shall only include those provisions necessary to meet the requirements of the Clean Air Act."

The restriction of Section 39602 is directly violated by the GBUAPCD's RDSIP, which establishes a planned reduction in PM-10 emissions to a 24-hour standard of 67 ug/m3 -- a level far below the federal NAAQS standard of 150 ug/m3. The RDSIP offers no adequate explanation, and fails to address the issues previously raised by the LADWP, as to why such an over-reduction in PM-10 is necessary to assure attainment of the NAAQS standard, much less permissible under state law.

On pages ES-13 of the RDSIP a new implementation schedule is presented. The implementation schedule for the entire project, as well as portions of it, fluctuates dramatically from one document to another. The inability of the GBUAPCD to provide a firm, coherent and accurate implementation schedule adds another element of instability to the project description.

The RDSIP states that the project will be implemented over a four and a half year period to meet the federal attainment deadline of December 31, 2001. The time frame presented in the RDSIP, which appears predicated upon expedited construction, is at variance with project mitigation measures in the DEIR which dictate less-intensive construction schedules to minimize impacts. For example, the RDSIP concludes that gravel placement will occur over a two-year period. Though the RDSIP provides no further detail, the two-year period is explained in the Preliminary Economic Review for the gravel cover control measure incorporated as part of Appendix "G." In that report, the two-year period is calculated based upon a transportation schedule of 24 hours per day, 350 days per year. While the report qualifies this estimate on account of potential reductions "as a result of operating permit conditions," the two-year deadline in the RDSIP is not similarly qualified, and the reader is left to determine, through extensive review of supplemental material, the expected length of time gravel placement will occur.

In the DEIR, it is concluded that the estimated 48 truck trips per day (2 per hour/24 hours per day) and the conveyor which will be operated 24 hours a day will not create a significant impact on the residents of Keeler. As this finding is unsupportable, it is likely that the "permit conditions" anticipated in the Preliminary Economic Review will be imposed, restricting truck trips and/or the conveyor usage to less than 24 hours per day/350 days per year and lengthening gravel placement considerably. The RDSIP must address this potential restriction.

Furthermore, in various portions of the RDSIP, DEIR, and RDSIP appendices, the concept of reducing costs and water use through additional research is discussed. It is unclear how initiation of expeditious implementation of multi-million dollar control measures, requiring immediate initiation of construction of infrastructure, permitting activities, and required environmental documentation could accommodate wholesale changes due to new research results. Therefore, the schedule is incompatible with project modifications discussed in other RDSIP sections, the GBUAPCD budget, and the DEIR. The schedule inconsistencies must to be rectified, and as the inconsistencies affect several other RDSIP sections, the RDSIP needs to be recirculated for review.

On page ES-13, the cost estimates for project construction are increased by 174% in the RDSIP, with an increase in annualized costs of 31%. These estimates reflect substantial changes in the assumptions previously presented and used by the GBUAPCD, as well as substantial modifications to the cost estimate prepared by Parsons Engineering Science submitted by the LADWP on May 9, 1997; however, no substantiating data is presented in the RDSIP for review and comment. In addition, the uncertainty associated with both control strategy costs and the emissions inventory precludes the calculation of meaningful cost-effectiveness estimates.

Since the Parsons Engineering Science cost estimate of $313 million was based on the project as described in the draft SIP, the various changes and new information included in the RDSIP, and discussed in the newly presented studies, will result in increased costs over the $313 million.

As identified in the Agrarian and Ayars reports, significant new cost items were identified, but are not included in the GBUAPCD or the Parsons Engineering Science cost estimates. A minimum of twice as much water will be required for leaching activity associated with boron. It should be noted that the cost of leaching water was not included in construction costs of managed vegetation or in the annual maintenance costs. Substantial changes to vegetation infrastructure requirements were identified in the Agrarian and Ayars reports, such as: 30 diesel pumps rather than the 10 previously identified, with increases in associated operation and maintenance costs; the potential need to use piping rather than earthen infrastructure due to water loss; the need for infrastructure to potentially recycle water to mix with "pre-leached" water to achieve the appropriate conductivity/salinity for leaching to prevent sealing of the soil; etc. These increased costs need to be included in the cost-effectiveness calculations.

The RDSIP presents a cost per ton estimate range of $130 -- $175. The cost per ton estimates are flawed in that they are based upon an inaccurate emissions inventory and cost estimate. The 130,000 ton/yr. emission inventory utilized by the GBUAPCD in the attainment demonstration plan assumes that 35 square miles of the lake bed produce PM-10 emissions for winds in excess of 7.5 meters/second. The Tezz Niemeyer data clearly documents that only discrete areas of the lake bed emit on any one given day. Generation of emissions utilizing the daily emissive area data collected by Niemeyer produces a substantially lower emission inventory (estimated at 11,100 tons by the LADWP). The substantially lower emission inventory significantly increases the cost per ton of PM-10 emissions reduced.

In addition, as commented previously and throughout this comment submittal, the effectiveness and success of the proposed control strategy is highly questionable, impacting both the cost of the proposed measures as well as the emission reduction benefits. Furthermore, the GBUAPCD has failed to address the increase in emissions associated with implementation of the proposed control strategy. Due to daily disturbances of the lake bed associated with construction and gravel mining operations, annual PM-10 emissions for the lake will increase, thereby minimizing the benefits of the proposed control strategy.

The wildly shifting cost and emission inventory estimates call into question the ability of the GBUAPCD to make any sort of accurate cost/benefit analysis as required by law. Health and Safety Code Section 40703 provides that "in adopting any regulation, the District shall consider, pursuant to Section 40922, and make public, its findings related to the cost effectiveness of a control measure." Section 40922 requires among other things, an assessment of the cost effectiveness of available and proposed control measures.

The RDSIP cites the South Coast Air Basin BACM cost-feasibility limit of $5,300 per/ton, along with the actual cost of BACM implemented in South Coast Air Basin costs as a comparison for Owens Valley. The LADWP asserts that comparison with South Coast Air Basin BACM cost-feasibility is inappropriate, as the South Coast Air Basin experiences chronic PM-10 exceedances and encompasses a population in excess of 14 million (see additional discussion below). However, the selective use of South Coast Air Basin BACM feasibility criteria by the GBUAPCD is of specific concern. The South Coast Air Quality Management District (SCAQMD) Governing Board employs three additional criteria in its deliberations regarding adoption of various BACM proposals, which the GBUAPCD fails to discuss or evaluate.

The South Coast Air Basin BACM feasibility criteria include technological feasibility, environmental impacts (with significant impacts generally resulting in elimination of measures from BACM consideration), and funding availability. The numerous recently released technical study results substantiate, as does the RDSIP itself, that many significant questions regarding the technical feasibility of the proposed control strategy remain unanswered or addressed. Clearly, the technology proposed to control emissions from Owens Lake has not been demonstrated in practice on the lake bed. Therefore, the control measures proposed in the RDSIP would fail to meet the technological feasibility criteria established by the SCAQMD.

The control strategy proposed in the RDSIP would result in numerous potentially significant environmental impacts, as illustrated in the DEIR. The modifications made to the basic BACM policy included on page ES-11, which allows BACM that would result in significant water resources impacts, is contrary to the policy of the South Coast Air Basin. Therefore, the control strategy proposed in the RDSIP would not meet the environmental BACM feasibility criteria of the SCAQMD.

Finally, the SCAQMD Board considers funding availability of local governments in determining BACM. Local government resources, particularly fiscal resources, are increasingly strained and the ability to generate additional revenues has been further restricted by the recent passage of Proposition 218 and other federal and state legislation. The determination of feasibility of BACM cannot, therefore, be based solely upon technological availability and costs, but must also address funding availability, competing environmental mandates, and other societal concerns which must be addressed by local governments. In fact, the EPA recognized such considerations in its guidance regarding State Implementation Plans for Serious Nonattainment Areas and stated: "Where economic feasibility of a measure depends upon public funding, EPA will consider past funding of similar activities as well as availability of funding sources to determine whether or not a good faith effort is being made to expeditiously implement the available control measure." The GBUAPCD fails to identify the funding sources required for the GBUAPCD estimated costs of $250 million for control strategy construction and implementation and $30 million for annual operation and maintenance. Clearly this in excess of what could be achieved via acceptable water rate increases in the City of Los Angeles.

The use of the South Coast Air Basin BACM cost-effectiveness and technological feasibility criteria is inappropriate in the Owens Valley. The cost-effectiveness criteria, which is now $4,900 per ton of PM-10 and not the $5,300 figure cited in the RDSIP, is based on a complex methodology. The GBUAPCD inappropriately relies upon the bottom- line cost figure of the SCAQMD, rather than utilize the methodology established by the SCAQMD to determine the cost-effectiveness level. The SCAQMD methodology fails to recognize the limited number of non-exceedance days experienced in the Owens Valley compared to the chronic exposure experienced in the South Coast Air Basin, making its application limited. The SCAQMD methodology includes evaluation of costs of all other control measures in place, as well as proposed in the air quality management plan, with the highest cost strategies being eliminated from the equation and incremental cost being provided special consideration. Therefore, emphasizing the South Coast Air Basin methodology in the Owens Valley would basically result in cost-feasibility per ton numbers equivalent to the cost of dust controls at construction/mining sites in the Owens Valley, which is minimal, and far less that the cost effectiveness figure of $130/ton (this figure represents a substantial miscalculation of cost-effectiveness; see comment above) presented in the RDSIP.

Technological feasibility in the South Coast Air Basin is generally defined as proven in practice, in the application proposed, for a one year period. This criterion was established for technology-based control strategies for stationary sources. Due not only to the difficulty of implementing control measures for a source as unique as Owens Lake, but also the extreme variability of weather conditions, and the unknown success of vegetation for a long-term period, "proven in practice" in Owens Valley would require several years of success and considerably more substantiating data than currently exists. As indicated in the Ayars report, a minimum of two additional years would be required to stabilize reclamation of the current test plots. The 1984 WESTEC research consisted of two years of vegetation studies and concluded that several years of research would be necessary to assure long-term viability. Therefore, the proven application for a one year period utilized in the South Coast Air Basin, and which the control strategy currently proposed by GBUAPCD for the Owens Valley fails to meet, would need to be extended to require several years of proven application to accurately assess the technological feasibility of the proposed control strategy for Owens Lake.

Both the environmental and local government funding availability criteria used in the South Coast Air Basin are directly applicable in the Owens Valley region.

Although not explicitly stated in the SCAQMD BACM feasibility criteria, the SCAQMD, as well as other regional, state, and federal air quality regulatory agencies provide special considerations for essential public services, such as water delivery, wastewater treatment, and solid waste management facilities. Most notably, the EPA is contemplating providing special consideration for power generating facilities in its New Source Review Guidance document. Essential public services are necessary to maintain public and environmental health, and therefore should be, and generally are, granted special consideration. Cost of such services are generally minimized to assure equal access for all income levels. The GBUAPC has failed to address the essential public service nature of the Los Angeles Aqueduct, and appears to place greater value on non-potable groundwater resources available in the region than on the essential water resources of the Southern California region. This is inconsistent with the practices of regional, state, and federal air quality regulatory agencies and needs to be justified by the GBUAPCD.

Figure 2 has been modified, but continues to present biased and inaccurate information. As recognized in the RDSIP (page ES-2), there is no documented PM-10 violation at Ridgecrest. Furthermore, no PM-10 violations are documented north of Lone Pine. The designations of "possible PM-10 violations" and "air quality reduction" are not defined, nor substantiated with scientific data, and are therefore meaningless, serving only to confuse the public and stakeholders. As commented previously, to provide for informed decision making, factual data needs to be presented in a clear and unbiased manner. Figure 2 should be modified to accurately represent air quality monitoring data or be deleted.

Figure 3 includes a footnote stating "off-lake source areas are due to deposition of lake bed material and subsequent resuspension." This assertion is unsubstantiated. The LADWP is unaware of any scientific data validating this statement.

SECTION 1 - INTRODUCTION

Page 1-1: see comments on page ES-1 regarding Clean Air Act requirements and flexibility.

SECTION 2 - OWENS VALLEY PLANNING AREA

On page 2-5, the RDSIP indicates that all proposed control measures and infrastructure will be owned by the LADWP. As commented previously, the LADWP is not solely responsible for funding and implementing the proposed control strategy, and is not responsible or liable for any environmental mitigation measures. The LADWP would own only the infrastructure which it funds. GBUAPCD would own infrastructure related to environmental mitigation.

Page 2-9: see comments on page ES-1 regarding Clean Air Act requirements and flexibility.

On page 2-10, the discussion regarding PM-2.5 has been deleted. As commented by the LADWP, much of the information presented in the section was inaccurate; however, it seems imprudent for the GBUAPCD to delete discussion of the proposed PM-2.5 standard and proposed revision to the form of the PM-10 standard when proposing a $250 million PM-10 control strategy.

SECTION 3 - AIR QUALITY SETTING

On page 3-5 the RDSIP indicates that 40,000 residents between Ridgecrest and Bishop are annually affected by dust from Owens Lake. The LADWP appreciates the correction, eliminating the assertion that these residents experience ambient air quality above the federal PM-10 standards, but the new statement fails define the impact. The goal of the RDSIP is to reduce health impacts, but since health based federal PM-10 standards are not exceeded, it is unclear what health impacts are experienced by the 40,000 residents discussed. The RDSIP need to present accurate and factual information in order to provide for informed decision making.

Figure 3.3: see comments on Figure 2.

On page 3-8, the RDSIP discusses the use of SSI monitoring data to determine the number of 24-hour violations, while using the TEOM monitoring data to determine peak PM-10 concentrations. Consistent monitoring data should be used in establishing the status of the Owens Valley Planning Area.

The LADWP has submitted data to the GBUAPCD demonstrating that TEOM monitors overestimate PM-10 concentrations by an average of 50%. Although the GBUAPCD concurs that substantial differences exist between TEOM and SSI (reference method) PM-10 ambient concentration measurements, the GBUAPCD has responded that TEOM monitoring is an EPA approved equivalent monitoring method. The EPA equivalency determination is limited to a maximum concentration of 500 ug/m3. In addition, in light of the substantial evidence provided by the LADWP, and the GBUAPCD's responsibility to protect public health at the least possible cost, it is imprudent for the GBUAPCD not to investigate the SSI and TEOM monitor discrepancies.

In other areas of the State and nation, TEOM monitors are not used in areas where secondary PM-10 pollutants are of concern, despite its equivalency designation by EPA, because secondary PM-10 were determined not to be captured by the monitor. The EPA equivalency determination for TEOM data does not relieve the GBUAPACD's responsibility to assure equivalency when discrepancies are recognized and documented.

On page 3-14, the revised DSIP incorporates a statement indicating that local man-made sources of PM-10 emissions have an insignificant impact on visibility. There is no empirical data to substantiate this conjecture.

SECTION 4 - PM-10 EMISSION INVENTORY

In Table 4.1, the RDSIP replaces on-lake with "primary" and off-lake with "secondary." This implies that all off-lake emissions are from the lake bed. This assertion is unsubstantiated. The LADWP is unaware of any scientific data validating this assertion. The information included in the RDSIP needs to be factual.

On page 4-5, the RDSIP removes from the text two methods of estimating PM-10 emissions from Owens Lake dust storms. The fact that two of the methods which the GBUAPCD indicates were used to measure emissions are now being eliminated seems to undermine the credibility of the entire emissions analysis. See comments on page ES-3.

On page 4-13, the RDSIP incorporates clarifications to the sun photometry PM-10 emission calculations employed by the GBUAPCD. However, the clarifying language fails to correct the misconception created by the discussion: that the PM-10 emissions inventory presented in the paragraph were generated by Parsons Engineering Science (Sahu). Sahu estimated annual emission at 11,100 tons, which is significantly lower than the 420,672 tons calculated by the GBUAPCD and presented in the paragraph. To insure an accurate portrayal of Sahu's annual emission inventory calculations discussed in the RDSIP, his inventory estimate of 11,100 must be presented.

Although the RDSIP clarifies that the GBUAPCD utilized "Niemeyer's average flux," it fails to justify the use of the average flux. Niemeyer submitted a memo to the GBUAPCD in February, 1997, indicating that using the average vertical flux is likely to overestimate PM-10 emissions. Despite Niemeyer's comments, the RDSIP retained use of the average flux. GBUAPCD needs to justify its continued use of the average flux in estimating the emissions inventory.

SECTION 5 - CONTROL MEASURES

On page 5-10, the RDSIP includes a single statement which incorporates a new report, "Vegetation as a Control Strategy: Updated Report." The report incorporated into the RDSIP includes substantial new information, and potential control strategies, such as tree rows, that are not discussed in the RDSIP itself. It is vague and unclear if the potential control strategies introduced in the report are considered part of the proposed control strategy. It is therefore difficult to discern what exactly the proposed control strategy encompasses. The RDSIP needs to clarify the applicability of the information included in the new report. If the potential control strategies included in the report are not applicable to the RDSIP, then the GBUAPCD needs to justify its elimination from control measure consideration, especially those that would minimize environmental impacts. See comments on Appendix G.

Page 5-12: see comments on page ES-6.

On pages 5-14 and 5-15, significant new data, information, and conclusions regarding the efficacy of managed vegetation as a control measure is introduced for the first time. The inclusion of new research results, which present significant new information, with conflicting data, further highlights the experimental nature of the proposed managed vegetation control strategy. Control strategies must be technologically proven in the proposed application, and control efficiency clearly documented, before they can be considered as potential control strategies. See addition comments on page ES-7. Most notably, the discussion of managed vegetation omits the discussion of the inability to leach four of the eight parcels originally identified in the managed vegetation pilot studies (Ayars, May, 1997). Four panels were eliminated from the pilot study "because of problems during construction and differences in soil types across the site." It is questionable whether the leaching of the test pilot parcels necessary to sustain vegetation for the long-term (i.e., boron and sodicity issues are yet to be resolved), let alone successfully leach the four parcels which were eliminated from the pilot due to difficulties, is possible. Therefore, the actual effectiveness of the control measure over the entire area proposed for application is highly questionable. As commented numerous times previously, the RDSIP assesses limited discrete elements of the proposed control strategy, but fails to evaluate the potential for success in the scale of application proposed in the RDSIP and in this case ignores the possibility that approximately 50% of the area proposed for managed vegetation may be eliminated due to soil differences. To provide for informed decision making, factual, comprehensive, and accurate information needs to be included in the RDSIP.

Table 5.1 fails to include the data discussed on page 5-15 regarding the effectiveness of leached, non-vegetated plots. In addition, the Table fails to include the data presented in the WESTEC, 1984 report which indicates that the crust of the lake bed is at times less emissive than vegetated areas. This information is especially important in developing a control strategy that minimizes costs and areas impacted.

If thoroughly evaluated and investigated, is it possible that a control strategy focusing on emissive areas that impact the normally non-emissive areas (i.e., areas where surface crusts form) could be developed, minimizing costs and environmental impacts. The GBUAPCD has not investigated this potential control option, and has failed to recognize the data presented in the WESTEC, 1984 study.

Much information has been removed and/or added to the document, further raising questions concerning the reliability of the information that has been thus far collected by the GBUAPCD. The LADWP has consistently questioned the effectiveness of the control measures and the insufficient evidence utilized by the GBUAPCD to support its estimate of effectiveness. The substantial changes in information in this portion of the RDSIP further substantiate the LADWP's position.

Page 5-17: see comments on page ES- 6.

Page 5-18: see comments on page ES-9.

SECTION 6 - AIR QUALITY MODELING

Page 6-14: see comments on pages ES-11 and 12.

SECTION 7 - CONTROL STRATEGY AND ATTAINMENT DEMONSTRATION

Page 7-3: see comments on page ES- 11.

Pages 7-6 through 7-11: see comments on page ES-13. It should be noted that the numerous comments submitted on the DSIP by the LADWP on the implementation schedule, as with all of the comments submitted by the LADWP on the DSIP, remain unaddressed. However, the LADWP's previous comments become even more significant in light of the compressed implementation schedule proposed in the RDSIP. Both Sections 188(e) and (f) of the federal Clean Air Act provide the flexibility and time needed to accommodate development and implementation of reasonable control measures for fugitive dust emissions.

On page 7-10, the RDSIP indicates that electricity will be required at the proposed shallow flooding site. The Agrarian report indicates that diesel engine pumps are preferable to electrical pumps, due to the ability to move the pumps on an as-needed basis to maximize operations. The RDSIP fails to evaluate the need for similar flexibility for flood irrigation operations.

On page 7-11, the RDSIP discusses the implementation schedule for managed vegetation. The proposed schedule fails to recognize and incorporate the many difficulties identified in the Agrarian and Ayars reports. The solutions to the problems highlighted in those reports, if feasible, will require substantial additional time to accomplish than the time provided in the RDSIP. This fact underscores the need for the flexibility provided in the federal Clean Air Act in Sections 188(e) and (f) and the need for the GBUAPCD to incorporate the use of such extensions into the planning process.

On page 7-11, the RDSIP designates that gravel for the project will come from the Keeler site. As indicated in the LADWP's previous comments on the use of Keeler gravel, there are a number of problems which could preclude use of that site. If it has been determined to be an integral part of the control measures, a much more in-depth analysis of the viability of that site must be made and the environmental consequences and appropriate alternatives examined.

Gravel mining operation will require environmental assessment under both the National Environmental Protection Act (NEPA) and CEQA. The objective of both these environmental statutes is to avoid or minimize environmental impacts. Therefore, locating mining operations in close proximity to a residential area, Keeler, may prove to be undesirable and precluded under NEPA and CEQA due to the potential availability of alternative sites. This then would result in increased costs, impacts to the implementation schedule, and perhaps result in environmental impacts not currently identified, depending upon the gravel site ultimately selected. In light of the existence of such significant variables, the accurate assessment of project costs, implementation time frames and environmental consequences is precluded.

The ability of the gravel extracted from the Keeler site to conform to the various requirements of the DEIR, including but not limted to color, has not been investigated. Therefore, the appropriateness of the Keeler site for gravel mining operations has not been documented.

Table 7.3 reflects the substantial changes made in the implementation schedule, and illustrate the compressed phasing of the project. Normally, construction projects are phased to the maximum extent possible to reduce noise and air quality impacts. The impacts of the compressed schedule and its consistency with DEIR mitigation requirements and environmental evaluation assumptions need to be verified. As commented previously, the schedule included in the RDSIP needs to incorporate the mitigation requirements, implementation of environmental mitigations, and construction time-frame constraints (i.e., bird nesting seasons, etc.). Without such an analyses, the appropriateness and accuracy of the schedule cannot be assessed.

Page 7-14: see comments on page ES- 13. The increase in water rates necessary to accommodate the annualized cost of $50 million estimated by the GBUAPCD would be 17%. The socio-economic impacts of such significant water rate increases (additional costs for essential public service) must be evaluated by the GBUAPCD in the context of cumulative water rate increases necessary to comply with the revised Clean Drinking Water Act mandates, and the conservation infrastructure needs (i.e., reclaimed water and conservation program funding).

Section 40728.5 of the California Public Resources Code requires that a socio-ecominic impact analysis be prepared for all rules in air pollution control district with greater than 500,000 population. Although the GBUPACD does not include such a population, the rule making currently being considered by the GBUAPCD would impact the 3.7 million residents of the City of Los Angeles, and therefore a socio-economic impact report is clearly warranted.

In addition, in assessing the appropriateness of control measures, it is necessary for the GBUAPCD to evaluate public acceptability of the measures. The control strategy proposed by the GBUAPCD would impact the essential public service of water delivery of City of Los Angeles residents and businesses through significant increased water rates. In addition, all of the Southern California region water agencies would be impacted by the significant loss of water resources to the region proposed by the GBUAPCD. Despite these significant impacts to Southern California, there has been no notification to the Southern California region water agencies of the RDSIP. By failing to engage a significantly large portion of the population directly impacted by the proposed RDSIP, the GBUAPCD has failed to adequately evaluate the public acceptability of the proposed control strategy.

California Health and Safety Code Section 40703 provides that "in adopting any regulation, the District shall consider, pursuant to section 40922, and make public, its findings..." Section 40922 requires the GBUAPCD to assess the public acceptability of its proposed control measures, among other things. To date, the GBUAPCD has not made a proper assessment of the public acceptability of the provisions of the RDSIP and proposed Board Order, and as a result, any finding made by the GBUAPCD relative to public acceptability would not be supported by substantial evidence, as required by law. Moreover, given the demonstrable flaws in the analysis contained in both the RDSIP and the DEIR, as well as the looming uncertainties surrounding the SIP's ability to demonstrate PM10 attainment, public acceptability is far from certain.

Though Section 40922 does not clarify the term "public acceptability," it is logical to conclude that the "public" as referenced in the statute is the public affected by the measures proposed by the GBUAPCD. As the impacts of the RDSIP extend beyond the boundaries of the Owens Valley Planning Area, so too does the affected public to whom the proposed measures must be "acceptable."

On page 7-14, the RDSIP asserts that "adjustments to the Parsons costs were necessary due to incorrect project design assumptions." The GBUAPCD asserts that the professional engineers of both Parsons Engineering Science and LADWP staff misunderstood the design requirements set out via the proposed Board Order. With proposed adoption of the Board Order and RDSIP, it is necessary to revise the documents so that their meaning and requirements can be easily understood by those directly affected by it.

As commented previously by the LADWP, the RDSIP and proposed Board order are ambiguous throughout, and implementation requirements are unclear. Such ambiguity is unacceptable and does meet the statutory requirements for rulemaking activities.

On page 7-18, the RDSIP adds a section regarding authority and resources. Section 7-12 asserts that the GBUAPCD has "concluded that the required control measures do not affect the right of the City to produce, divert, store, or convey water." It is unclear how the GBUAPCD has determined that a requirement mandated by the GBUAPCD to divert 51,000 acre feet of water from the Los Angeles Aqueduct to Owens Lake bed would not impact and infringe upon the water rights held by the City, as well as the City's right to produce, divert, store, or convey water.

The LADWP has submitted numerous comments on this issue on several different occasions. The GBUAPCD fails to address these issues in the RDSIP and does not explain or support the conclusions reached on page 7-18. The failure of the GBUAPCD to disclose its reasoning and information used to reach such a critical conclusion deprives the LADWP, stakeholders, the public, and the decision makers of the opportunity to analyze necessary information to reach a reasoned decision. The omission of such fundamental information therefore precludes informed decision making by the GBUAPCD Governing Board.

On page 7-19, the RDSIP states that the LADWP, pursuant to SB 270, is liable for the legal costs associated with "challenges to the plan and its adoption." As commented by the LADWP previously, the inclusion of attorney fees for defense of the RDSIP from legal challenge is unreasonable and therefore not required pursuant to SB 270. Furthermore, to assure an unbiased presentation of the enforcement discussion, the GBUAPCD must disclose that the LADWP has appealed the GBUAPCD budget which includes such legal fees.

In addition, the GBUAPCD asserts that the "appeal does not stay the City's obligation to pay the fees on time." As commented in response to the GBUAPCD letter asserting the same point, the Los Angeles City Attorney feels this is an inaccurate interpretation of California Health and Safety Code Section 42316. To assure an unbiased presentation of the enforcement discussion, the GBUAPCD must disclose that the LADWP has appealed the GBUAPCD budget, and disagrees with the GBUAPCD legal analysis as to the requirement to pay fees under appeal.

The requirements of the proposed control strategy and proposed Board Order exceed the authority and jurisdiction of the GBUAPCD. Therefore, the GBUPACD is unable to enforce the requirements of the RDSIP, or legally adopt the proposed Board Order.

SECTION 8 - ENABLING LEGISLATION TO IMPLEMENT CONTROL STRATEGY

Page 8-1 makes the significant policy change from a proposed Board Order not being approved as part of the SIP, to a Board Order being approved as part of the SIP. This basically changes the adoption of the RDSIP from Plan adoption to rulemaking, which is held to a much higher burden of proof than planning efforts.

With the release of the RDSIP on May 30, 1997, which incorporated this significant change in policy, the time provided for the review of the proposed Board Order (Rule) is wholly inadequate and fails to provide adequate time for review and comment on the proposed rulemaking. The rule would have tremendous impacts, including an implementation cost estimated by the GBUAPCD at $250 million dollars and an annual operation and maintenance cost estimated at $30 million, and a requirement for the diversion of 51,000 acre feet of water annually from the Los Angeles Aqueduct to Owens Lake bed. The lack of an appropriate comment period for such a significant rulemaking, with such far-reaching impacts and policies, unnecessarily constrains a reasoned decision making process by the GBUAPCD Governing Board.

The proposed Board Order exceeds the jurisdiction and authority of the GBUAPCD and is inconsistent with existing statutes and court decisions. The proposed control strategy incorporated into the Board Order impacts several statutes, including the Endangered Species Act, Clean Water Act, SB 270, CEQA, NEPA, etc. The GBUAPCD incorporates mitigation requirements for wetlands and species of concern, without going through the regulatory process designed to evaluate impacts and establish requirements. This creates a significant potential that the requirements of the GBUAPCD Board Order are in direct conflict with the requirement that will be designed by the appropriate resource agency legally mandated to establish appropriate conditions for such impacts.

The GBUAPCD has clearly exceeded its authority and jurisdiction in designating Keeler as the required gravel mining site in the RDSIP, as well as designating three potential mining sites in the DSIP. The federal Bureau of Land Management is the resource agency responsible for overseeing mining of public property, and has the sole authority over designation of appropriate mining sites. This was made clear in the comment letter submitted by BLM on the project alternatives document.

The proposed Board Order requires the implementation of control measures that require 51,000 acre feet of water annually to be released on the Owens Lake bed. While the proposed Board Order is unclear as to the source of the water, only two sources exist: groundwater, whose use is limited by a specific policy adopted by the GBUAPCD Governing Board, and Los Angeles Aqueduct water, whose use is precluded under Health and Safety Code Section 42316. Thus, the fundamental premise of the RDSIP and proposed Board Order are inconsistent with existing law and GBUAPCD Governing Board policy. In addition, the proposed Board Order is inconsistent with the requirements of the injunction which precludes the placement of water on the lake bed.

On pages 8-4 and 8-5, the RDSIP is modified to discuss "natural floods." The construction and maintenance of infrastructure designed to minimize impacts from natural flood events on the proposed control strategy, is proposed to be the responsibility of the LADWP. The justification for requiring the LADWP to pay for infrastructure to protect the lake bed is not presented. This cost is unreasonable, and it is not the responsibility of the LADWP to protect the lake bed from natural floods. The development and funding of proposed infrastructure to address natural floods is not justifiable or required pursuant to Health and Safety Code 42316. Alternative funding needs to be identified by the GBUAPCD.

On page 8-5, the RDSIP indicates that the LADWP must meet the implementation schedule established in the RDSIP. As clearly experienced by the GBUAPCD in implementing the Agrarian research, significant construction problems will be associated with the proposed control measures on the lake bed. In addition, the proposed Board Order includes significant schedule restrictions associated with mitigation requirements (see page 8-5). Furthermore, as recognized by the GBUAPCD, many different local, regional, state, and federal agencies have discretionary approval over the project. The time required by each agency to evaluate the proposed RDSIP elements over which it has jurisdiction, comply with all applicable statutory requirements, provide for public disclosure and noticing requirements, and thoroughly consider the information presented, cannot be committed to by the GBUAPCD or the LADWP. Despite the complex issues presented by the proposed control strategy, the schedule included in the proposed Board Order provides no flexibility. Therefore, the Order is unrealistic in its nature and subjects the implementing entity to potential civil penalties and judicial action for non-compliance issues that are clearly outside its control. See previous comments on schedule issues.

On page 8-5, the RDSIP asserts that the "City shall comply with any applicable requirements of the mitigation monitoring program adopted by the District concurrently with its certification of the Final EIR." The GBUAPCD has prepared a DEIR which indicates that the implementation of the RDSIP would result in several environmental impacts, requiring long-term mitigation and monitoring. In drafting the SIP and Board Order, it is the regulatory agency that must take responsibility for the environmental damage and mitigation measures incurred by the project. The GBUAPCD asserts that LADWP water diversion has created the environmental air quality problems in the Owens Valley, and proposes that LADWP address the air quality problems via strategies that impact other environmental resources and essential public services, such as water delivery. The LADWP will not accept the long-term liability of environmental damage created by a Board Order mandated by the GBUAPCD. Furthermore, Health and Safety Code Section 42316 requires the LADWP to assist in funding reasonable air quality mitigation, not open-ended and all-inclusive environmental mitigation. The proposed Board Order requirement that the LADWP fund and implement mitigation measures and monitoring exceeds the jurisdiction and authority of the GBUAPCD.

In reviewing the DSIP, RDSIP, and DEIR, the LADWP does not believe that the environmental damage created by the RDSIP is overridden by the proposed air quality benefits. Rather, as stated in the DSIP, RDSIP, and DEIR comments, control strategies should focus on realistic and reasonable control measures that avoid environmental impacts. Since the GBUAPCD Governing Board is the decision making authority for the Board Order and SIP, and will ultimately be responsible for adopting the Order and certifying and adopting the EIR, it, not LADWP, must take responsibility and liability for its actions.

As noted by the LADWP in its comments on the DEIR, that document is so fundamentally flawed that the GBUAPCD cannot legally approve the SIP based upon the EIR as it presently exists.

SECTION 9 - SUMMARY OF REFERENCES

The RDSIP deletes references. This is highly inappropriate. Most notably, the Ayars January 1997 report Owens Lake Reclamation Study is deleted. This January report is referenced in several other reports, as well as in the DSIP. The Agrarian report dated January 1997, heavily relies upon and refers to the Ayars January report. As the GBUAPCD is aware, the LADWP would like a copy of the Ayars January 1997 report, but has been unable to acquire one.

APPENDIX D - FEASIBILITY AND COST EFFECTIVENESS OF FLOOD IRRIGATION

Comments submitted on this document by LADWP on November 27, 1996 are herein incorporated by reference.

APPENDIX E - VEGITATION AS A CONTROL MEASURE

The GBUAPCD has incorporated an additional report entitled Vegetation as a Control Measure, dated May 1997, as Appendix "E" to the RDSIP. Comments presented on Appendix E are preliminary. The report incorporates information from a number of reports and new studies which the LADWP has not yet acquired. Additional comments will be submitted. Those areas where the RDSIP modifications seem to be most impacted are highlighted here:

Page 3 indicates that experimentation on saltgrass was done at Lake Texcoco in Mexico. There is no indication in this report that the conditions at Lake Texcoco are comparable to Owens Lake, and if so, in what respect. The report clearly indicates the importance of such information and data in determining applicability to the Owens Lake bed.

Page 5. There are three issues that seem to be problematic with respect to vegetation. Those include the water delivery method, drainage, and sand abrasion. As indicated in this report, further analysis must be done on these issues before the control measures can be determined to be effective.

Page 7 indicates that different soils on the lake require different amounts of water to leach out the materials which harm plant growth. There is no indication in the document that calculations have been made for different sorts of soil with respect to water use, and in the absence of this information, a critical assessment of the District's plan is impossible.

Page 9. Tree rows now seem to be part of the control measure. If it has been determined that tree rows are more effective than managed vegetation, some substantial evidence must be put forward by the District in order to substantiate that decision. In addition, the cost effectiveness as well as the use of water and environmental impacts concerning tree rows must be examined. It is difficult to believe that the District, only a few weeks prior to the proposed adoption of the SIP is suggesting substantial changes in the control measures. This further underscores the Department's position that the District has not proven the effectiveness and is still tinkering with the control measures.

APPENDIX F - GRAVEL AS A DUST MITIGATION

Comments submitted on this document by LADWP on November 27, 1996 are herein incorporated by reference.

APPENDIX G - COMPARATIVE COSTS

Comments on this appendix will be submitted at a later date.

Environmental Impact Report Comments
Received After the Close of the Comment Period

Department of Water and Power the City of Los Angeles

RICHARD J. RIORDAN
Mayor

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THOMAS M. McCLOSKEY, *Assistant General Manager – Marketing & Customer Service*
M. FAYE WASHINGTON, *Assistant General Manager/Chief Administrative Officer*
PHYLLIS E. CURRIE, *Chief Financial Officer*

June 18, 1997

Dr. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street, Suite 6
Bishop, California 93514

Dear Dr. Hardebeck:

Additional Comments on Owens Valley PM10 Planning Area Demonstration of Attainment State Implementation Plan (SIP) Draft Environmental Impact Report (DEIR)

The City of Los Angeles Department of Water & Power (LADWP) submits the enclosed additional comments on the DEIR. On May 30, 1997, the Great Basin Unified Air Pollution Control District (GPUAPCD) issued a revised Draft SIP which contains numerous and substantial changes to the project as depicted in the earlier Draft SIP and DEIR circulated for public comment. These changes to the Draft SIP not only create a situation where the Draft EIR no longer addresses the project in its latest incarnation, but defeat the public comment provisions of the California Environmental Quality Act (CEQA) inasmuch as the comments submitted during the public comment period address a project that no longer exists.

Pursuant to *Public Resources Code* Section 21177, the LADWP formally objects to the adoption of the revised Draft SIP and certification of the DEIR. The LADWP has previously submitted detailed comments on the DEIR and the Draft SIP which are hereby incorporated by reference, and which remain applicable. Moreover, the revisions to the Draft SIP raise a host of additional issues as detailed in the attached comments. Some of the more serious deficiencies include:

The GBUAPCD has failed to provide an accurate, stable and finite project description. From the outset of the SIP process, the project description has remained subject to constant change and has thus been a 'shifting target' with respect to public comment. The latest revisions to the Draft SIP are only the most recent example of this. The more significant revisions to the Draft SIP, as well as additional attached documents and referenced material, have included changes in the designated water source and amount of water potentially required, potential additional control measures such as tilling and tree rows, determination of the designated site for gravel mining, leacheate disposal and additional water reclamation measures. In the absence of proper revision of the Draft EIR to reflect the most recent and substantial amendments to the project, this circumstance constitutes a glaring violation of CEQA.

The revisions to the Draft SIP require revisions to the DEIR. CEQA requires that where a substantial change to the project occurs after the close of the public comment period, the DEIR must be revised to address those project changes and their impacts on the environment. It is axiomatic that the EIR must address the specifics of the project under consideration for approval by the GBUAPCD, not a previous rendition.

Once revised to address the project in its present state, the EIR must be recirculated for renewed public comment. *Public Resources Code* § 21092.1 requires that if, subsequent to the commencement of public review but prior to final EIR certification, the lead agency adds "significant new information," the agency must recirculate the revised EIR for additional public comment. When the DEIR is revised to reflect the project changes which have been made subsequent to public comment, the revisions will constitute "significant new information" requiring recirculation.

Additional reports released by the GBUAPCD and incorporated into the Draft SIP constitute additional "new information" Subsequent to the close of the public comment period on the DEIR, the GBUAPCD released four additional reports which constitute new information requiring revision and recirculation of the DEIR. These documents raise issues which call into question the analysis in the DEIR and indicate that further environmental review is necessary.

In light of the above discussion of a few of the DEIR's more serious defects under CEQA, and the more detailed Comments attached, the DEIR must be revised and recirculated. Failure to do so would deprive the public of a meaningful opportunity to comment on the project as it is currently being proposed for adoption by the GBUAPCD.

Pursuant to *Public Resources Code* Section 21092.5, the GBUAPCD is required to provide a written response to comments made by a public agency at least 10 days prior to certifying the DEIR. The LADWP requests that the GBUAPCD issue a written response to the Comments submitted herewith concurrently with its response to the LADWP's previous comments on the DEIR and Draft SIP previous incorporated.

Sincerely,

HARRY M. SIZEMORE
General Manager

Enclosure

c: Mr. Dean Saito, California Air Resources Board
Mr. Gerald A. Gewe

City of Los Angeles Department of Water and Power

Supplemental Comments on the Draft Owens Valley PM-10 Planning Area Demonstration of Attainment Revised State Implementation Plan

Supplemental Draft Environmental Impact Report (DEIR) Comments

I. New Information Provided by the District, plus the District's Revisions to the Draft SIP, Necessitate Revision and Recirculation of the Draft EIR For Further Public Comment.

The revisions and additions to the Draft SIP (DSIP) require the District to grant further opportunity for public comment on those changes, many of which represent changes in District policy or in the project itself. Moreover, those revisions and additions, taken together with new reports provided by the District, implicate new environmental issues which under CEQA necessitate the revision of the Draft EIR (DEIR) *to accurately portray and analyze the project in its most recent incarnation.* Sierra Club v. City of Gilroy, 222 Cal.App.3d 30 (1990) (significant environmental impacts revealed following close of public comment period necessitate revision of EIR); Stevens v. City of Glendale, 125 Cal.App.3d 986 (1981) (revision of EIR and recirculation for public comment required for a significant change in the project which occurred following the expiration of the public comment period.)

Following revision of the DEIR, the District is required under CEQA to recirculate the DEIR for public comment. Public Resources Code § 21092.1 provides that if, subsequent to the commencement of public review and interagency consultation but prior to final EIR certification, the lead agency adds "significant new information," the agency must issue new notice and recirculate the revised version for additional public commentary and consultation. Laurel Heights Improvement Ass'n v. Regents of University of California, 6 Cal.4th 1112 (1993). CEQA Guidelines Section 15088.5 further provides that:

> "A lead agency is required to recirculate an EIR when significant new information is added to an EIR after public notice is given of the availability of the draft EIR for public

> review under Section 15087 but before certification. . . . the term information can include changes in the project or environmental setting as well as additional data or other information."

New information is considered "significant" if it changes the EIR in a way that deprives the public of a meaningful opportunity to comment upon a substantial adverse environmental effect of the project or a feasible way to mitigate or avoid such an effect. CEQA requires that the revised environmental document must be subjected to the same "critical evaluation that occurs in the draft stage," so that the public is not denied "an opportunity to test, assess, and evaluate the data and make an informed judgment as to the validity of the conclusions to be drawn therefrom." <u>Sutter Sensible Planning, Inc. v. Board of Supervisors</u>, 122 Cal.App.3d 813 (1981). As noted throughout these comments, specific revisions to the EIR are required by CEQA to make that document legally valid. Once made, these changes constitute "new information" which under CEQA requires recirculation for public comment.

II. The District Has Failed to Provide an Accurate, Stable and Finite Project Description as Required Under CEQA, and Has Precluded Effective Public Comment by Constant Project Modification.

From the outset of the SIP process, the project description has remained subject to constant change and has thus been a 'shifting target' with respect to public comment. The more significant changes have included changes in the designated water source and amount used, additional control measures such as tilling and tree rows, determination of the designated site for gravel mining, and additional water reclamation measures. In the absence of proper revision of the DEIR to reflect the most recent and substantial amendments to the project, this circumstance constitutes a glaring violation of CEQA. "An accurate, stable and finite project description is the *sine qua non* of an informative and legally sufficient EIR." <u>Kings County Farm Bureau v. City of Hanford</u>, 221 Cal. App.3d 692 (1990). As noted by previous comments, the project description contained in the DEIR was grossly inadequate even <u>before</u> the latest round of changes to the project. Following these changes, the project described in the DEIR is further divergent from the project actually anticipated by the District, and the violation of CEQA that much more demonstrable. Because of the shifting nature of the project description, it has become impossible for the LADWP or any party to comment precisely on the nature and extent of the project impacts at the level necessary to satisfy the requirements of CEQA. With the substantial changes made to the DSIP, it remains quite likely that full compliance with CEQA would ultimately be achieved only with the preparation of a supplemental or subsequent EIR pursuant to Public Resources Code § 21166. See Concerned Citizens of Costa Mesa, Inc. v. 32nd. District Agricultural Ass'n, 42 Cal.3d 929 (1986) (agency had no authority to proceed with project dramatically different than the version addressed in the EIR).

In the Concerned Citizens of Costa Mesa case, the lead agency prepared, circulated and certified an EIR for an outdoor amphitheater. After noticing in the construction process that the project being built was different in substantial respect from the project described in the EIR, the petitioners sought to require the preparation of a supplemental EIR. In requiring further environmental review, the California Supreme Court noted that where an agency makes significant changes to a project after certification of the EIR the public is deprived of any meaningful assessment of the actual project chosen by the agency. "Indeed, the commencement of a project in [these] circumstances is more misleading than if the agency had prepared no EIR, since the public might justifiably but erroneously assume that the project being built is the one discussed in the EIR" Concerned Citizens of Costa Mesa, 42 Cal.3d at 938. Much as in the Concerned Citizens case, the amendments to the DSIP and recent additional reports indicate fundamental changes in the project depicted in the EIR. CEQA requires that the public be able to comment on the project as presently, not formerly, proposed.

In many cases it is difficult to discern the exact changes which have been made in the control measures examined in the original SIP for which the DEIR was prepared. Because the District failed to describe the changes in the components of the control measures in detail, it is difficult to precisely pinpoint the areas where impacts will occur for purposes of these comments. However, with respect to the issues noted in this comment letter (as well as is likely with many other issues), it is obvious that a complete analysis has not been made and that the DEIR fails to examine the actual project as it is presently conceived by the District. In each of the instances where there is a difference between the original control measures and policies and the changed control measures and policies that are currently being proposed by the District in the SIP documents, the EIR is not only inadequate and incomplete, but it also appears to describe a project no longer under consideration. Though these comments attempt to identify some of the more salient inadequacies, it remains the District's burden under CEQA to identify the changes it has made to the project and revise the EIR as CEQA requires. Every change in the control measures raises potential environmental impacts which require analysis. See Concerned Citizens of Costa Mesa, 42 Cal.3d at 939. ("It is up to the agency, not the public, to ensure compliance with CEQA in the first instance"). Moreover, many of the changes to the DSIP represent large-scale policy changes by the District which are described in one or two sentences and which leave the reader to speculate as to the details and environmental impacts. CEQA further requires that these policy changes be addressed in the DEIR, as significant environmental impacts will invariably occur if the District's revised plans become reality.

Subsequent to the public comment period on the DEIR, the District released four additional and separate documents:

(A) Vegetation as a Control Measure, Carla Schiedlinger, May 1997 (Appendix "E" to the Revised DSIP (RDSIP));

(B) Reclamation Studies on Owens Lake Bed Soil Using Controlled Flood Irrigation, Dr. James Ayars, Agrarian Research and Management Company Limited, May 2, 1997;

(C) Preliminary Economic Review, Owens Lake Gravel Cover PM_{10} Control Measure, TEAM Engineering & Management, March 12, 1997 (Appendix "G" to the RDSIP); and

(D) Great Basin Unified Air Pollution Control District 1997-98 Annual Budget

While a fifth report, Agrarian Test Area, Construction Cost Summary was available during the public comment, this report was heavily relied upon by the District in the course of its revisions to the SIP and the formation of the budget. As a result further comments on that report and its conclusions are appropriate.

These documents raise issues which call into question the analysis in the DEIR and indicate that further environmental review is necessary. For either event, CEQA requires a revision of the DEIR document and recirculation. A non-exhaustive selection of the issues which trigger a further duty under CEQA follows:

A. Vegetation as a Control Measure

1. Page 4. This report states: "The unvegetated portions of the playa need only to be narrow enough to be shielded from the wind by the vegetated strips, or treated with another effective control measure such as tilling". Tilling was eliminated as a control measure and is neither analyzed as a component part of the project nor sufficiently analyzed in the project alternatives section of the DEIR. If the District is now including tilling as part of one of the control measures, it must analyze that measure consistent with CEQA. Tilling raises noise, traffic and operational impacts such as air pollution, which have not been adequately examined in the DEIR.

2. Page 6. The report indicates that there are problems with high volume water delivery to the control measures site. The delivery of water affects the construction and operation of the delivery infrastructure and the DEIR analysis must be augmented to include a greater volume delivery system if that is determined to be necessary.

3. Page 7. The issue of leaching of the soil and removal of the saline drainwater from the site is here discussed. As indicated in the LADWP's previous DEIR comments, the DEIR does not adequately analyze the disposal problem and its impacts with respect to the water used to leach salts from the soil underlying the vegetation. In addition, if an increased amount of water is necessary (as seems to be suggested in this report), there will also be an increase in the water and waste produced at the site requiring disposal. An EIR-level analysis must be made of the increase in water and waste, as well as their impacts on the disposal site. In addition, if this water is to be left on the lakebed, impacts on groundwater resources must be discussed and analyzed as well. Moreover, the report's finding that "managed water use and controlled water distribution provide a viable alternative for establishing vegetation on the playa" suggests that the District is again shifting the project description.

4. Page 9. The report proposes planting tree rows as a dust control measure. This option has not been analyzed in the DEIR. If this measure is now to be adopted, it constitutes significant new information under CEQA and the impact ramifications of such a measure must be analyzed in the DEIR.

Again, as with many of the issues mentioned concerning the DEIR, the project seems to be a "moving target" which is impermissible under the Concerned Citizens of Costa Mesa case. An accurate, stable and finite project description must be conclusively established, the impacts analyzed and the DEIR recirculated for more informed public comment.

B. Reclamation Studies on Owens Lake Bed Soil Using Controlled Flood Irrigation.

1. Page 17. It is indicated that keeping the water in the panel and developing a watertight dike around a panel were the most difficult problems regarding vegetation. The modifications in the control measure infrastructure and operation that are required as a result of the pilot research project detailed in this report must be examined in the DEIR.

2. Page 26. The report indicates "the leaching efficiency data and the water application data support the idea that a surface treatment (tillage) such as discing [sic] or ripping would be needed on this project to reduce the water requirements to as low a level as possible while getting the maximum effective leaching. Tillage should also help reduce the rate of evaporation of water from the water table since it creates a mulch layer of soil with larger pore spaces than the underlying material". As discussed in the Vegetation as a Control Measure report, and again in this report it now appears that tilling has become part of the control measures for Owens Lake. This being the case, an EIR-level analysis of all of the environmental impacts of tilling must be presented to the decisionmakers and the public. This has not yet been done and until a finite, stable project description is established, the limited analysis done of tilling (as an alternative) in the DEIR does not approach compliance with CEQA.

3. Page 28. There is discussion concerning transmission losses from the water delivered to the site. The report indicates that "The loss from the reservoir and laterals can be reduced by changes in construction techniques which were identified during construction". Although it is unclear the nature of the environmental impacts that could result from such "changes in construction techniques", they must be identified and discussed in the DEIR prior to any

decision by the District to approve the SIP. The District is required to present to the public the precise parameters of the control measures and thoroughly examine each measure in the DEIR. The public should not have to engage in speculation as to the changes that have been made since the DEIR was circulated for comment or what impacts could result from those changes.

4. Page 30. The report indicates "If high irrigation efficiencies are not achieved there will be a significant problem in managing the drainage water". However, there was no indication in the DEIR that such a problem exists and it has not been analyzed as required by CEQA. Such a problem definitely presents a worse-case scenario and presents significant new information which must be discussed and analyzed under CEQA and the information recirculated to the public.

In the same paragraph the report indicates that "The most efficient way to operate the system would be to achieve as high a level of irrigation efficiency as possible in a single application", yet there is no real solution given for how that goal will be accomplished. Until the actual control measure operation is defined in the SIP, it is impossible to adequately analyze the environmental impacts.

5. Page 30. The report indicates "Besides the problem of managing the volume and the salinity of the water, the drainage water contains high levels of boron as well as several other elements which have to be managed to prevent phytotoxic effects". Nowhere in the DEIR are the "high levels of boron" described, discussed or analyzed, or their effect on groundwater, wildlife, proposed introduction of mosquito fish, water quality or the nature of the impacts of this water or the resultant waste on the project area, the public, or any disposal site. Such

impacts must be addressed and included in the DEIR and the report then recirculated. This is definitely significant new information requiring further analysis and public review under CEQA.

6. Page 31. The report indicates that the boron levels "will have to be reduced to insure that vegetation will be sustained". This indicates that there will be wastewater containing boron which will require disposal. As indicated in the Department's earlier comments, there is no EIR-level analysis of the impacts of disposal of waste such as boron from the site. This information must be presented in the DEIR, including analysis of where and how the leached water and boron will be disposed and the impacts of that activity. If water is allowed to percolate into lakebed soils, the DEIR must evaluate potential impacts to groundwater resources.

7. Page 34. The report states "Drains would be needed to carry away the excess water since the artesian pressure precludes downward movement of water into the deep saturated aquifer system under the lake bed". There is no analysis of the environmental impacts of constructing such drains. Finally, also on page 34, the report indicates "solution to the drainage design problem will have to be done on an empirical basis with field experiments" because of varying soil conditions and cracking. The information gleaned from such field experiments, which will dictate the nature of the drains, will then be used to design the drainage system. Only when that is accomplished and the system actually designed can adequate environmental analysis take place. It also appears that it may be necessary to use increased amounts of water in order to accomplish the leaching. Increased amounts of water will result in environmental impacts concerning water use as well as construction of the operational system and

additional drainage infrastructure that may be needed. These are all significant environmental impacts raised by the new information in this report.

8. The Section entitled Recommendations for Future Research presents numerous suggested changes in the project. Each of these changes constitutes new information which must be examined to determine whether it is significant in terms of CEQA. Most notable are the recommendations to add sulfur to the lake bed to reduce sodicity, and the requirement for a minimum of twice as much leaching water to reduce boron to a level tolerable for vegetation. If that information is in fact significant new information, it must be analyzed in the DEIR and the document recirculated to the public and the decisionmakers.

The project as described in the SIP is still a "moving target". No DEIR prepared by the District can be considered to be adequate under either the CEQA guidelines or the case law until a finite, stable project is determined by the District and environmental analysis made of that particular project. While experimentation and analysis is still continuing and changes are being made to the SIP, the environmental analysis will continue to require updating and will remain inadequate.

C. Preliminary Economic Review, Owens Lake Gravel Cover PM_{10} Control Measure.

This report, incorporated as part of Appendix "G" to the RDSIP, injects further confusion as to the exact nature of the control measures and their impacts:

1. On page 1, the report states that "[t]he components of the gravel dust control measure are conceptual and formative at this time." This frank admission by the District's consultant means the proposal of control measures is premature at best, and further indicates that the District has no basis upon which to adopt the RDSIP and Order, which would require the immediate implementation of these

"conceptual" and "formative" measures. Further research is required to determine whether gravel cover as a control measure would result in attainment of the NAAQS. As the District is still undertaking such research, adoption of an admittedly "conceptual" and "formative" plan is premature.

2. On page 3, the report states that the Keeler Fan site is the "theoretical" source for gravel production. This statement conflicts with the revised draft SIP, which categorically identifies the Keeler Fan site as the gravel source. Neither of these documents or the conflicting positions, are supported or discussed by the DEIR, which fails to address the impacts from gravel extraction at the Keeler Fan site. If the Keeler Fan site has now been definitively selected, the RDSIP and its appendices should be revised further to be consistent one way or the other, and the DEIR must fully discuss and analyze the impacts from gravel extraction from the site the District ultimately selects.

3. On page 6, the report sets out a two-year target for completion of gravel transport and placement, which is based upon a 24 hour/350 day per year schedule. The report recognizes that this schedule may be subject to operating permit conditions which could be imposed to mitigate the impacts a 24 hour, daily trucking and conveyor operation would have on the adjacent residents of Keeler. The DEIR fails to classify these impacts as significant - a conclusion which the District itself recognizes is erroneous in light of its expectation of permit conditions. The DEIR must be modified to reflect the reality of the gravel operation's impacts and to set forth mitigation measures as required under CEQA.

D. The District's 1997-98 Budget.

The District's 1997-98 budget contains itemized entries for vegetation analysis, the development of a hydrology management program for Owens Lake, and a study to determine the soil properties of the lakebed. The budget further states that the hydrologic model currently being refined with ongoing and future budgeted research will be used to evaluate alternative water sources for dust mitigation - efforts which are at variance with the RDSIP, which seems to only consider the use of Aqueduct water. The soil analysis is proposed for the stated purpose of collecting data "critical to assist in the design of mitigation measures in the proposed dust mitigation project." The budget further includes funding for a tree row project for control on the lake bed, which the District believes "has promise as a replacement measure if it should prove to be more water-efficient than shallow flooding, and sufficiently effective for dust control."

These budget items provide strong substantiation of the LADWP's position (now apparently confirmed by the District) that further research is required before specific control measures can be reasonably implemented. Moreover, to the extent that this further analysis progresses, the data obtained would constitute new information which would either require inclusion in the DEIR and subsequent recirculation, or the preparation of a subsequent or supplemental EIR pursuant to Public Resources Code § 21166.

Along with a line-item description of proposed expenditures, the District's budget contains a number of associated reports which present additional new information on the proposed control measures. Taken at face value, the District's budgetary requests and proposed research detail a number of significant changes (and substantial flaws) in the project previously presented for public comment.

1. Page 7 of the report entitled "Monitoring Program," which is an attachment to the District budget, states that "the data collected as part of monitoring before dust mitigation will be used to establish a baseline of the existing conditions on the lake bed." Such a baseline is required under CEQA as a part of the project

description and must be included in the DEIR prior to certification in order to give the public and decisionmakers the ability to analyze the impacts of the project. See CEQA Guidelines § 15125 - "A DEIR must include a description of the environment in the vicinity of the project, as it exists before the commencement of the project, from both a local and regional perspective."

2. Page 7 of the Monitoring Program further states that "this effort will continue and complete the GBS delineation of wetlands on the Owens Lake playa and its margins". Again, for purposes of CEQA, baseline delineation of wetlands must be completed prior to project approval, not at some point in time after project approval. In order for the DEIR to be adequate, it must list the existing wetlands and their extent in order to determine whether removal of, or impacts to, such wetlands is significant requiring mitigation under CEQA.

3. This report further states, at page 7, that "This is a monitoring study that will establish baseline data on the water chemistry and water flows from springs, abandoned artesian holes, and sieve complexes on or at the margins of the Owens Lake playa." Similar to the above issues, this data must be collected and analyzed now rather than after the project is approved and the EIR certified. As indicated by the LADWP in numerous comments on the DEIR, that document is completely deficient in the "environmental setting" section where the District is required to give the existing situation in the Owens Lake area. If baseline data on water flows from springs, artesian holes and sieve complexes have not yet been completed, it is impossible to determine the impacts that the project will have upon those natural conditions. The fact that the District is seeking additional funding to complete these studies merely underscores the LADWP's previous comments on the DEIR indicating that this information was missing

from the DEIR and that it was deficient on this basis.

4. Page 8 of the Monitoring Program states that "Continuation of Wildlife surveys in the 1997-1998 seasons is important to determine the natural variation present in the existing environment and to allow for more complete aerial data coverage". The LADWP commented extensively on the DEIR's absence of information on existing wildlife in the area and the fact that the District is asking for additional funding for monitoring at this point in the EIR process further highlights the inadequacy of the existing environmental document. Complete wildlife surveys must be conducted and the cataloging of wildlife on the site must be determined prior to any analysis of the impacts that could occur as a result of the project. The DEIR analysis is incomplete without this information.

5. Page 1 of the report entitled "Owens Lake Managed Vegetation Operation, Design, and Efficiency Refinements" states that "the data collected to date on water use, transmission efficiencies, leaching effectiveness, and opportunities for vegetation establishment, however, must be considered as preliminary." For purposes of both the SIP and the EIR, if such information is only now preliminary, there is extensive work that must be done prior to the adoption of the SIP or the certification of the EIR. Water use, water transmission efficiencies, leaching effectiveness and vegetation viability are critical components of the control measures and raise extremely significant issues with respect to possible environmental impacts. If water use data are only preliminary, it is impossible for the District to indicate that only 51,000 acre feet of water will be used per year. The absence of final data on this issue as well as the transmission efficiencies for the water renders these components of the control measures, as

well as a number of other issues in the SIP and the EIR, completely indefinite and speculative. As stated numerous times previously by the Department, it is impossible for the District to adopt a SIP and Order with such "preliminary information". When the SIP control measures constitute a "moving target" no adequate environmental analysis can be considered complete until they are firmly established.

6. The "Owens Lake Managed Vegetation Operation, Design, and Efficiency Refinements," attached as part of the budget, states at page 1 that an effort must be made in FY 1997-1998 to "allow for the full operation of the existing agrarian project during an entire year." This is consistent with previous comments made by the LADWP with respect to the DSIP and DEIR. It is also at variance with the control measures proposed by the District in the RDSIP, which would implement managed vegetation as a control measure in the absence of long-term testing. The short length of time allowed for the agrarian project renders it completely unusable until further and longer experimentation is conducted. It is inappropriate for the District to consider adopting a vegetation-based control measure that will cost millions of dollars and use precious California water when its effectiveness and viability has been tested for less than a year and not throughout an entire growing season. The District's recognition that more testing of the agrarian project is necessary, and therefore has not been demonstrated in practice, must be presented in the DSIP and DEIR.

7. The "Owens Lake Managed Vegetation Operation, Design, and Efficiency Refinements" at page 1 states that one of the objectives of the project is to "generate a complete yearlong set of data on water use for both leaching and consumptive use of the saltgrass vegetation, irrigation intervals and schedules

for all soil types encountered, and water delivery efficiencies." Again, it is premature of the District to adopt SIP control measures where these extremely critical components have not been firmly established.

8. The same report at page 2 states that "the end product of this effort will be detailed data on water use efficiency, minimum water requirements of saltgrass at various percentages of live cover, improved methods for reducing transmission and storage losses of water, cost effective methods for saltgrass introduction and establishment and refinements of all aspects of the soil data generated this year that will allow for more exact predictions of water use for the entire area specified for managed vegetation in the project area".

For the reasons cited above as well as throughout the LADWP's previous comments, it is premature to adopt the control measures and Order. With such a degree of uncertainty regarding implementation issues and natural resources demands of the proposed control measures, an appropriate environmental analysis cannot be performed, nor can an informed decisionmaking process take place. Such information is needed in order to establish a finite project description and thus allow for an adequate analysis of the project environmental impacts. So long as these facts are not known and the control measures remain in a state of flux, an adequate CEQA analysis is impossible.

9. Page 2 of the report further states that "because the managed vegetation research project was developed at such a small scale, further effort in design refinement is required to bring the managed vegetation concept to the point of full- scale implementation." If the managed vegetation component of the control measures is not to "the point of full-scale implementation", it cannot be adopted as part of the SIP and has not been adequately analyzed in the DEIR.

E. Agrarian Test Area, Construction Cost Summary.

In addition, an earlier report, Agrarian Test Area, Construction Cost Summary, is heavily relied upon in the revised RDSIP and its Appendices, and is thus susceptible to the following comments in light of the project's revisions:

1. Page 4. The consultant indicates "The time and money constraints of the 1996 effort did not afford full development and evaluation of the secondary and tertiary issues". As described in the report, the secondary component of the controlled flood irrigation project will involve colonization of the vegetation. The tertiary component of the flood control project addresses operation and maintenance issues as they relate to the system as a whole. If operation and maintenance for the control measures have not been fully developed and evaluated, it is unlikely that the DEIR can be considered adequate when these very important components of the project have not been finalized. The report then lists various components of the infrastructure where such "full development" did not take place. Each of these components, if modified (which the report seems to suggest may be necessary) raise numerous environmental impact issues related to construction, noise, transportation, etc. that must be reexamined in a revised DEIR.

2. Page 7. The report includes a list of work items that remain "to be done in order to fully implement a maximally effective operation". Examining and further developing each of these components of the control measures will raise numerous environmental issues including impacts concerning leaching, amount of water needed, use of groundwater, disposal of the leached water, construction of the operating system, and evaluation of the discharge salts and trace minerals in discharge water as well as the location of disposal areas for

these wastes and the water. The Department of Water and Power has previously commented on the inadequacy of the analysis in the DEIR concerning many of these issues and the District's admission here that further examination of these components must be made highlights the incompleteness of the existing DEIR.

3. Page 12. It is indicated that "To get the best numbers regarding water loss and resulting efficiency applicable to this project, however, will require operation of a pilot for a year or two". If such a pilot is necessary to analyze the water loss of the project, it is obvious that it is not now possible to analyze the amount of water needed for this project. A determination must first be made as to the amount of water required by this portion of the control measures and then a complete analysis of the impacts of the modified water use must be made in the DEIR.

4. Page 14. The report states: "At this time we are seeing unacceptable levels of failure on small ditches that had been constructed on the south FIP (Flood Irrigation Project) and the reservoir constructed on that site was leaking excessively. It was becoming apparent that the earthen berm requirements for all systems needed to be beefed up. One general calculation yielded positive results if the design submitted prior to this construction were [sic] bulked up by an astounding 400%".

This increase in the earthen berm requirements was not addressed in the DEIR with respect to construction, noise, transportation or other impacts. Page 16 of the report also indicates that such larger berms will be necessary and there is no information given as to the extent and amount of construction necessary for the project dikes and berms. Such new information requires additional environmental analysis under CEQA once the particular specifications are determined.

5. Page 19. The report states that "This means that we will use more water and reclamation, and that it will take longer than previously planned". Both of these issues require re-analysis and recirculation of the DEIR. More water and reclamation indicates that there will be additional significant impacts on the water needs of the people of California and Los Angeles. If the project will take longer than previously planned, it is unclear how the implementation of the control measures will be completed within the shortened time schedule in the RDSIP. Reducing the time for project completion raises issues with a number of the mitigation measures which were formulated to decrease impacts by lengthening the construction period for the project. The fact that the consultant indicates that the construction of the control measures will now take longer than previously planned seems to be in direct conflict with the District's reduction of the timeframe of the project. Moreover, the DEIR fails to address the environmental impacts from water reclamation, most notably the construction of required infrastructure including pumps, pipelines, and trenches.

III. Changes and Additions to the Draft SIP Require Revision and Recirculation of the DEIR.

Moreover, the following changes and additions to the DSIP appear to constitute significant new information requiring revision and recirculation of the DEIR pursuant to CEQA:

A. Timeframe. The RDSIP includes a project implementation timeframe that has been shortened considerably. This raises various issues, such as calling into doubt the ability to implement certain mitigation measures. For example, the DEIR proposed reducing the hours and days for conducting gravel operations in order to mitigate noise impacts. From the information provided, we cannot know whether the new timeframe takes this mitigation measure into account, or if the measure will have to be eliminated, thus significantly increasing noise impacts.

B. Use of Groundwater. The DEIR focuses on the use of Los Angeles Aqueduct water for the project (the environmental impact of which was not adequately analyzed in the DEIR). If the District is considering Aqueduct water, it is critical to know if the District has determined that it will issue a Statement of Overriding Considerations under CEQA if (which is likely) the annual loss of 51,000 acre feet of water is considered to be a significant unmitigable environmental impact. Moreover, CEQA requires that the District's intention to adopt a Statement of Overriding Considerations regarding water use be circulated to all Responsible Agencies, including all affected water districts. CEQA Guidelines § 15043 (agency must make a "fully informed and publicly disclosed" decision that "[s]pecifically identified expected benefits outweigh the policy of reducing or avoiding significant impacts of the project.")

The RDSIP and Order are non-committal on the source of project water, and it now appears that the focus may be on the use of groundwater since the new budget for the District requests a considerable amount of money to research its availability. If, in fact, groundwater will be used as a source of water for the project, its use may result in new impacts, and this information must be included in the DEIR and the document recirculated so these new impacts can be assessed by the public. As water is an integral component of the project, its source must be identified and the impacts addressed. Without this critical project information, meaningful public comment is impossible and an informed decision cannot be made.

C. Use of a Greater Amount of Water. It appears from new information in the RDSIP that water use for the first year of implementation will be seven ac-ft/ac. Discussion in the vegetation study (Appendix E to the RDSIP) states that unvegetated wetted surfaces can reduce PM_{10} emissions, thereby implying that this might become part of the project, and that the project may require more water than previously indicated in the DSIP and DEIR. Since the RDSIP is unclear with respect to the amount of water needed, additional research and time is necessary for the District to determine such vital information. In addition, if more water will be required, the impacts of using that additional amount must be identified and discussed in the DEIR and the revised document recirculated.

D. Keeler Fan Site as Source of Gravel. The District has now apparently determined that gravel from the project will come from the Keeler Fan site. As the LADWP and others have indicated in previous comments, the Keeler Fan site might be subject to conflicting mine claims and hence potentially unavailable. If the Keeler Fan site is available as the source of gravel, the DEIR must be revised to clarify this fact and to provide a thorough analysis of the gravel-mining operation and its impacts. This has not been done to date.

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June 19, 1997

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RE: Comments to the Draft Environmental Impact Report

Dear Ms. Hardebeck;

The Tribes of the Owens Valley (hereinafter "Tribes") submit the following comments to the Great Basin Unified Air Pollution Control District (hereinafter "Great Basin") on the Draft Environmental Impact Report (hereinafter "EIR") prepared on the Owens Valley Dry Lake (hereinafter "Dry Lake"). In order to gain a better understanding of the technical aspects of the EIR, the consulting firm of Radian International LLC (hereinafter "Radian") was retained by the Fort Independence Tribe to provide technical and regulatory review of the EIR. In light of Radian's review and that of the Tribes' attorney, the Tribes' find the EIR to be a sound environmental document and that the control measures, as presented and analyzed in the EIR, can be implemented with either no substantial environmental impacts or impacts that can be effectively mitigated. The Tribes find that the EIR clearly sets forth the pollution control measure strategy and provides a comprehensive look at all the environmental components required under the California Environmental Quality Act. Because Great Basin has chosen a "tiered" EIR process for evaluating the Dry Lake control measures, the Tribes' reserve the right to evaluate and comment on the future Site Specific EIR (Tier II) which will provide the information most critical to the Tribes; namely, from what sources will Los Angles Department of Water and Power (hereinafter "DWP") obtain the water and gravel necessary to implement the control measures so ordered by the California Air Resources Board.

A. Shallow Flooding and Managed Vegetation:

Reviewing the use of DWP aqueduct water as the source of water to implement the shallow flooding and managed vegetation measure as compared to other water sources discussed in Chapter 7, Project Alternatives, it is clear that DWP aqueduct water presents the least environmental impacts and is the best water source to be used at the Dry Lake. Great Basin's discussion in Chapter 4 clearly demonstrates, through sound methodology and modeling, that shallow flooding and managed vegetation are feasible control measures that can be implemented at the Dry Lake without creating a substantial environmental impact, at least if aqueduct water is used. The only potential impacts associated with the use of aqueduct water appear to be those economic or social impacts to DWP's domestic water supply. However, based on Great Basin's analysis these impacts do not appear to be substantial and can be mitigated without severe cost to DWP.

In particular, the Tribes' would like to highlight the Reclamation Water discussion found at page 4-53 of the EIR as an important source of water replacement for DWP and supplement this discussion with information from the Mono Lake Committee. Before the Mono Lake injunction, DWP was diverting roughly 83,000 acre-feet from the Mono Lake Basin. After the Mono Lake case, DWP will be allowed to divert only 30,000 acre-feet once the Lake level reaches 6,392 feet above sea level. To protect the Mono Lake ecosystem and to offset DWP's loss of water (roughly 53,000), two reclamation bills, AB 444 in 1989 and Western Water Bill H.R. 429 in 1992, cumulatively provided DWP with 135,000 acre-feet of a water a year through reclamation facilities. Taking the 53,000 acre-feet of water from the 135,000 reclamation water supply, DWP is left with at least 82,000 acre-feet of surplus water. The surplus water from just two (2) of DWP's reclamation projects would more than meet the water needs at the Dry Lake.

As an additional note, the Tribes' have learned that DWP may have an estimated 20,000 acre-feet of water a year available through the Lower Owens River Project which could be used at the Dry Lake. Although EIR describes the Lower Owens Valley River Project in Chapter 6, Cumulative Impacts, p. 6-7, the Tribes believe the development of this project as a water source for DWP to use at the Dry Lake should have been more appropriately discussed in the mitigation section of Chapter 5.

The only technical comment the Tribes have is that a Dust Control Plan should be submitted as part of any construction/operation permit for construction of roadways, pipelines, and berms. This way, failure to implement "Best Air Control Measure" can be readily enforced.

In sum, the Tribes' find that managed vegetation and shallow flooding are effective air pollution control measures for the Dry Lake and that they can be implemented without substantial environmental impacts by using an estimated 51,000 acre-feet of water from the DWP aqueduct. However, the Tribes' reiterate that its environmental conclusion is limited to the use of DWP aqueduct water and reserve their right to review and comment on the future Tier II EIR which will discuss in detail the source of water DWP intends to use for implementing the Dry Lake control measures.

B. Gravel as a Control Measure:

The Tribes find Great Basin's environmental assessment of the proposed gravel mining, transportation, and distribution adequate to support its finding that the gravel control measure can be implemented without creating substantial environmental impacts. Again, however, the Tribes' environmental review of the gravel control measure was based on the assumption that the needed gravel would come from the Keeler fan. Should DWP choose an alternative gravel mine site the Tribes reserve their right to review and comment on the new proposed mine location as well as the means of transporting and distributing the gravel onto the lake bed.

The only technical comment the Tribes have is that to ensure that air quality is not degraded during the construction and operation of the gravel mine, the Tribes recommend that the following be added to section 2-3.1.1, <u>Other Mandatory Project Elements</u>: Ambient air quality modeling should be conducted to demonstrate that insignificant air quality impacts will result from gravel extraction operations after controls are implemented. Modeling results would be submitted along with permits to construct/operate. Great Basin will need to develop modeling guidelines and establish threshold concentrations for determining significance.

Although the Tribes' find that the gravel control measure can be environmentally implemented, they strongly object as a matter of policy to the use of the gravel control measure at the Dry Lake. The Tribes' incorporate their objections to the use of gravel as set forth in their November 26, 1996 comment letter to Great Basin (Attachment A, November 26th which presented the Tribes' Preferred Control Measures for the Dry Lake). The Tribes' are cognizant of the fact that the less water based control measures presented to DWP , the more likely DWP will be to support the measure (the Tribes' also recognize the effectiveness of gravel as a control measure). Nonetheless, the Tribes' would like the record to reflect that they find the use of gravel to be costly, time consuming to develop, transport and distribute on the lake bed, and could cause delay in implementing the State Implementation Plan if the Site Specific Tier II EIR reveals unforeseen environmental impacts. The Tribes further object to the use of gravel as it will create "irreversible environmental changes". As the EIR recognizes the "placement of gravel on the surface of the lake bed will impede the use of these lake beds for other beneficial uses such as agriculture, grazing, or recreation.". EIR , Chapter 6, p. 6-10

Based on rough calculations, it is the Tribes' opinion that it would take relatively minor additional water to control the 5, 305 acres currently slated for gravel. Using Great Basin figures, it will take 4 acre-feet of water to implement shallow flooding on 8,395 designated acres of sandy soils. It is estimated that it will take between 2 and 2.5 acre feet of water to implement managed vegetation on 8,700 designated acres of clay soil. The soil type found in the gravel area is a combination of sandy and clay soil. Using an average of 3 acre-feet, it would require approximately 20,000 acre-feet of water a year to implement a combination of shallow flooding and managed vegetation on the designated gravel area. A water based control measure, instead of gravel on the 5, 305 acres described in the EIR, would certainly elevate the massive development (the mine, roads, conveyerbelt, etc.) associated with the use of gravel, the extensive permitting process the use of gravel will require and could ultimately be more cost effective. Indeed, should the Lower Owens River Project mentioned above become viable, DWP could utilize this water source and see no impact in its domestic water use.

C. Conclusion

Overall the Tribes find the EIR to be a sound environmental document and encourage the Great Basin Board of Directors to adopt it with the minor technical comments offered above. The Tribes' environmental assessment and support of the EIR in no way waives its right to future review and comment on the tier II EIR that will be prepared by DWP and set forth the specifics of the implementation of control measures ordered by the California Air Resource Board. Although the Tribes are supportive of Great Basin's overall pollution control strategy for the Dry Lake, they do not endorse the use of gravel on the designated 5, 305 acres discussed in the EIR. It would take relatively little additional water to implement a water based control measure for the gravel area and cause no substantial impact to DWP's domestic water use. The Tribes would like to see the Board order a water based control measure for the area now slated for gravel cover.

The Tribes' thank Great Basin for this opportunity to comment on the EIR and look forward to working with your staff in the near future to control a pollution problem that threatens not only health of the tribal communities but all persons in the Owens Valley and surrounding areas.

Sincerely yours,

DOROTHY ALTHER

ATTACHMENT

cc: Merv Hess, Bishop Tribal Chairman
Donna Duckey, Big Pine Tribal Chairwoman
Richard Wilder, Fort Independence Chairman
Sandra Jefferson Yonge, Lone Pine Tribal Chairwoman

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November 26, 1996

Ms. Helen Hardebeck
Air Pollution Control Officer
157 Short Street
Bishop, CA 93514

RE: Written Comments to "Project Alternative Analysis Summary"

Dear Ms. Hardebeck

The Lone Pine and Fort Independence Tribes would like to thank the Great Basin Unified Air Pollution Control District (Great Basin) for this opportunity to comment on its *Project Alternatives Analysis Summary* (PAAS). The Tribes are optimistic that the PAAS signifies that Great Basin and other involved agencies are finally prepared to take critical and long overdue PM-10 control action at the Owens Dry Lake (Dry Lake). Given the limited time for review and comments on the PAAS the Tribes have been unable to give it and supporting documents thorough technical review. Nonetheless, the Tribes are prepared to offer their comments on what PM-10 control options they consider acceptable, unacceptable and the criteria they believed to be the most important in making their selection.

In evaluating Great Basin's control measures, the Tribes relied on criteria not that dissimilar to Great Basin's own objectives in developing the PAAS:

1. What effect will ground water pumping have on local ground water tables and surrounding wildlife;

2. Will the proposed option restore the Lake's natural characteristics such as scenic and aesthetic beauty, wildlife and habitat, or said another way will the control measure restore "public trust values";

3. Will the option create more environmental problems than it is designed to elevate;

4. Will the control measure meet the Clean Air Act Amendment (CAAA) attainment deadline of December, 2001; and

5. Is the option based on sound, supportable, scientific data.

In light of the above the Tribes find Alternative F--"No Project" neither legally nor environmentally

In light of the above the Tribes find Alternative F--"No Project" neither legally nor environmentally viable and is thus unacceptable. Similarly, the Tribes have dismissed Alternative E-- "High Volume Water Use" as a viable option. Although the Tribes recognize that refilling the Lake would satisfy most of the Tribes' criteria, Alternative E appears to carry with it numerous legal entanglements, and will most assuredly draw a legal challenge from DWP, thereby preventing attainment by 2001. As such, although extremely attractive, Alternative E does not appear to be an acceptable control Alternative. However, the Tribes would like the recor to reflect that should DWP's current legal posturing change or should Great Basin decide to adopt Alternative E, the Tribes would strongly support this Alternative as an acceptable control measure.

The Tribes also find Alternative C--"No Water Use" unacceptable. Even though Great Basin's data appears to suggest that use of gravel as a control may be very effective, it is an expensive measure that provides no flexibility for future change should the measure prove ineffective after long term use. Additionally, and most importantly, the use of gravel does not lend itself to restoring some of the most important public trust values the State Land Commission is charged with ensuring. Since the Dry Lake has long lost the most traditional public trust uses and values --navigation, commerce and fisheries-- the Land Commission, and Great Basin's as its surrogate, should make every effort to select an Alternative that can at least restore some of the more contemporary public trust values enumerated by the courts.

The California Supreme Court has on several occasions expounded upon the public trust doctrines as protecting and ensuring that public resources remain "in their natural state, so that they may serve as ecological units for scientific study, as open space, and as environments that provide food and habitat for birds and marine life, and which favorably affects the scenery and climate of the area." Marks v. Whitney, (1971) 6 Cal.3d 251,259-260, National Audubon Society v. Superior Court (1983) 33 Cal.3d 419, 435. While Alternative C may prove to be an effective air control measure, so do other Alternatives and the latter offer greater potential for restoring recreational and ecological trust values.

Alternatives A, B, and D are also unacceptable as each contemplates the use of ground water pumping which will have an adverse impact on local ground water tables and will undoubtedly have significant environmental impacts to wildlife as clearly demonstrated throughout Great Basin's "Summary of Potential Environmental Effects, Mitigation Measures, and Significance After Mitigation". While these Alternatives do meet the other Tribal criteria outlined above, the same can be achieved under Alternatives A1, B1, and D1 and no ground water will be used. As such the Tribes have focused their attention on those Alternatives that rely exclusively on the use of Los Angles aqueduct (DWP) water.

Alternatives A1, B1, and D1 all appear to satisfy the Tribes' criteria, however B1 and D1 utilize only water based measures which are more appealing to the Tribes than gravel and sand fences. Between B1 and D1, the Tribes tend to favor Alternative D1 because less tilling and shallow flooding are used. Although tilling and shallow flooding are effective control measures (Table Summary on p. 9, section 2-2.1), vegetation measures, both moderately and intensively managed, are likewise effective and much more aesthetic and environmentally pleasing. Thus, Alternative D1's heavy reliance on vegetation and hybrid poplar tree rows is much more acceptable to the Tribes than extensive use of tilling and shallow flooding. Alternative D1 offers less use of DWP water, provides the greatest amount of future flexibility in trying new measures should an old one fail to perform as anticipated, and as discussed below has no significant impacts after mitigation measures are implemented.

Great Basin reports that there will be significant economic and social impacts associated with Alternative D1; namely, a decrease in portable water to Los Angles, however, these impacts can be mitigated. After close review of Great Basin's PAAS supporting document it appears that DWP may have at its disposal

Valley and Terminal Island Projects (50,000 ac-ft/yr). These new water supplies coupled with new conservation programs, and other mitigation measures presented by Great Basin should more than adequately make up the loss of DWP aqueduct water (D1 calls for the use of only 30,000 ac-ft/yr). Additionally, the Tribe has learned that the Lower Owens River Project might produce as much as 50,000 ac-ft/yr of usable water on the Dry Lake.

The Tribes are aware that DWP is prepared to challenge the use of any aqueduct water in light of Health and Safety Code § 42316. The Tribes have carefully reviewed § 42316 and related documents and believe DWP's interpretation of the section is misguided. The Tribes are extremely hopeful that DWP will not use § 42316 as an obstacle that stands in the way of accomplishing and executing the full purpose and objectives of the CAAA. Given the hazardous air pollutants as defined by 42 U.S.C. § 7412 and PM-10 pollution found at the Dry Lake, attainment must be achieved by the 2001.

Again the Tribes wish to thank Great Basin for this opportunity to comment on its PAAS and look forward to working with your agency during the implementation of the selected Alternative.

Sincerely yours,

Dorothy Alther

DOROTHY ALTHER

Appendix I

1998 SIP Revision Comments and Responses

Draft 1998 SIP Revisions Comment Letters

Letter No.	Agency	Name	Date Received
1		Donald W. Odell	10/7/98
2	Department of the Navy	R. A. Stables	10/20/98
3	Calif. State Lands Commission	Robert C. Hight	10/26/98
4	National Park Service	John J. Reynolds	10/26/98
5	Los Angeles Dept. of Water & Power	S. David Freeman	10/26/98
6	Calif. Dept. of Fish and Game	Curt Taucher	10/26/98
7		Martha Gilchrist	10/26/98
8	California Indian Legal Services	Dorothy Alther	10/27/98
9		Stephen Kalish	10/28/98
10	U.S. Environmental Protection Agency	David P. Howekamp	10/29/98

DONALD W. ODELL
Post Office Box 128, Lone Pine, CA 93545
Telephone: 760-876-5829

October 6, 1998

OCT 07 1998
GREAT BASIN UNIFIED APCD

GREAT BASIN UNIFIED AIR
POLLUTION CONTROL DISTRICT
157 Short Street
Bishop, California 93514

Attention: Dr. Ellen Hardebeck,
Control Officer

SUBJECT: COMMENT ON THE PROPOSED REVISION OF THE OWENS VALLEY PM-10 PLANNING AREA DEMONSTATION OF ATTAINMENT STATE IMPLEMENTATION PLAN (SIP)

Dear Ellen:

I submit herewith my written comments for the meeting of the District scheduled for Monday, November 16, 1998 at Bishop, California. It is in the form of this letter and an open letter, dated October 6, 1998, addressed to the California State Lands Commission and other State agencies and subdivisions, including GBUAPCD.

1-1 While I appreciate your agency's efforts to attain federal air quality standards at Owens Lake, and the indifference of other agencies with whom you must work, the subject SIP and the proposed revision are inconsistent with the Public Trust Doctrine. Simply stated, the SIP is an avoidance of the only relevant method for the repair of the damage to Owens Lake, which is providing for the restoration of the public trust uses to the lake, required by the Public Trust Doctrine. The public trust process must be exercised and is the appropriate procedure for attaining ambient air quality standards in accordance with the laws, protecting Owens Lake, the Owens River and its tributaries.

I will appreciate receiving a copy of the written responses to my comments, prepared by the District Staff.

Thank you for your kind attention to this letter and enclosed open letter, which are submitted as my comments to the proposed SIP revision.

Very truly yours,

Don

DONALD W. ODELL

THE PUBLIC TRUST DOCTRINE IN CALIFORNIA
AND ITS APPLICATION TO OWENS LAKE, INYO COUNTY, CALIFORNIA

AN OPEN LETTER TO THE CALIFORNIA STATE LANDS COMMISSION
100 HOWE AVENUE, SUITE 100-SOUTH, SACRAMENTO, CALIFORNIA
95825-8202 AND OTHER STATE AGENCIES AND SUBDIVISIONS

REQUEST

It is the purpose of this letter to request that the California State Lands Commission take an active part to abate the dust nuisance at Owens Lake, Inyo County, California and enforce the Public Trust Doctrine, to restore Owens Lake, the Owens River and its tributaries to their natural state and to provide the public unfettered access to these public resources. Also, in this connection, it is requested that the California State Lands Commission address and answer the following questions.

QUESTIONS

I

May one city of the State of California, go 200 from its boundaries, divert a river and its tributaries from a natural lake of the State and destroy its public use as a navigable body of water, without violating the Public Trust Doctrine?

II

If not, who has the obligation to stop the diversion of water to Owens Lake and restore it to its natural state?

III

Does the Public Trust Doctrine apply to Owens Lake as it has been held to apply to Mono Lake?

IV

Is it true that the California State Lands Commission has statutory authority over the uses of Owens Lake, Owens River and its tributaries and is the administrator of the Public Trust Doctrine over Owens Lake, Owens River and its tributaries?

V

Is it true that public trust uses have traditionally included water recreation (fishing, hunting, swimming and boating) and that the California Supreme Court ruled that the public trust uses include preservation of lands in their natural state to provide open space, habitats for bird and marine life, and scenic landscape?

APPLICATION OF THE PUBLIC TRUST DOCTRINE TO OWENS LAKE

It seems conclusive, under the California Supreme Court decision in National Audubon Society v. Superior Court, (Feb.1983) 33 Cal.3d 419, 189 Cal.Rptr. 346, 658 P.2d 709, that the public trust doctrine applies to Owens Lake, a sister lake to Mono Lake. It also appears that the State Lands Commission has not only woefully failed to assert the public trust doctrine at Owens Lake but is currently, as the Administrator of the public trust doctrine, permitting violations of the public trust at Owens Lake, including the continuous maintenance of a hazardous dust nuisance at the lake, which is significantly affecting the lives of the general public.

1. Any member of the general public has standing to raise a claim of harm to the public trust. The State of California, however, is the title holder to the lands of the lake and its waterways, river and tributaries and is obligated to protect such public resources.

2. The State of California has the power and <u>duty</u> to exercise continued supervision over the public trust and it has an affirmative <u>duty</u> to take the public trust into account in planning and allocating water resources and to protect public trust uses whenever feasible. The State of California has the duty to preserve the uses protected by the public trust.

3. The judicial decisions of the State of California recognize and enforce the public trust obligation of the state.

THE STATE LANDS COMMISSION

There is a State Lands Commission in the Resources Agency, consisting of the Controller, the Lieutenant Governor, and the Director of Finance. (Section 6101, California Public Resources Code).

The State Lands Commission has exclusive jurisdiction over all of California's tide and submerged lands and the beds of naturally navigable rivers and lakes, which lands are sovereign lands, and swamp and overflow lands and State School Lands (proprietary lands). The Commission has authority to approve appropriate uses of state lands under its jurisdiction and is the administrator of the Public Trust Doctrine over sovereign lands.

THE FACTS ABOUT OWENS LAKE

Owens Lake is a navigable lake to which the public trust is applicable. The lake was traversed by steamships during the 1870's, carrying ore from the north to the lakes southern shores. The Public Trust Doctrine, as recognized and developed in California decisions, protects navigable waters from harm caused by diversion of nonnavigable tributaries. (National Audubon Society v. Superior Court, (Feb.1983) supra., 33 Cal.3d 419, 434-437.

Parties, such as the City, acquiring rights to trust property, generally hold those rights subject to the trust and "can assert no vested right in a manner harmful to the trust." (National Audubon Society v. Superior Court, (Feb.1983) supra., 33 Cal.3d 419, at page 437).

In 1913, the Los Angeles Department of Water and Power, constructed an aqueduct to carry water from the Owens River some 200 miles over the Antelope-Mojave plateau to the coastal plain and thirsty city. Virtually all the waters of the Owens River and its tributaries flowed south to Los Angeles. Owens Lake was transformed into an alkali flat. (National Audubon Society v. Superior Court, (Feb.1983) supra., 33 Cal.3d 419, at page 437)

Owens Lake, as a dry lake bed, is one of the worst, if not the worst health hazard in the United States of America. (United States Environmental Protection Agency (EPA) Green Book, as of August 10, 1998) It produces PM 10, an EPA term, describing dangerous particulate matter measuring from 0 to 10 on an electronic microscope. The particulate matter blowing on and above Owens Lake is much like asbestos. It is small in size and shape, and when ingested, cannot be expelled. PM 10 can cause lung cancer and other respiratory diseases. Winds convey this hazardous material from the bed of Owens Lake to the north, to Nevada and to the south as far as San Diego County, and to wherever these winds may blow.

The lake was once a source of water vapor and humidity for the Owens Valley. In its natural condition, and before the diversion of its navigable and nonnavigable tributaries, Owens Lake had values other than navigation, including scenic views of the lake and its shores, purer air, economic and scientific uses, a flyway and natural habitat for nesting of birds, and as an avian resource, provided food for such wildlife. With water restored to the lake, public access to its waters for boating, swimming, camping and other recreational activities would also be restored. (footnote 17,National Audubon Society v. Superior Court,.(1983) supra.,33 Cal.3d 419, at 435).

A waterway usable only for pleasure boating is nevertheless a navigable waterway and protected by the public trust. (National Audubon Society v. Superior Court, (Feb.1983) supra., 33 Cal.3d 419, at page 435). There is a growing public recognition that one of the most important uses of tidelands -- a use encompassed within the tideland trust -- is the preservation of those lands in their natural state, so that they may serve as ecological units for scientific study, as open space, and as environments which provide food and habitat for birds and marine life, and which favorably affect the scenery and climate of the area. (National Audubon Society v. Superior Court, (Feb.1983) supra., 33 Cal.3d 419, at pages 434-435).

ENFORCEMENT OF THE PUBLIC TRUST

The continuing power of the State (and the State Lands Commission) as Administrator of the public trust, is a power which extends to the revocation of previously granted rights and to the enforcement of the trust against lands long thought to be free of the trust. No one can claim a vested right to bar recognition of the trust or state action to carry out its purpose. (National Audubon Society v. Superior Court, (Feb.1993) supra., 33 Cal.3d 419, at pages 440).

The State has an affirmative duty to take the public trust into account in the planning and allocation of water resources and to protect public trust uses whenever feasible. The State is not confined to past decisions and has the power to reconsider allocation decisions, even though such decisions were made after due consideration of their effect on the public trust. Decisions which failed to weigh and consider public trust uses present an even stronger case for reconsideration. (National Audubon Society v. Superior Court, (Feb.1993) supra., 33 Cal.3d 419, at pages 419). In its decision in the Audubon Case, supra., the California Supreme Court held that the water allocation decision at issue was entitled to reconsideration, particularly since no responsible body had ever determined the impact of the diversion of water or whether some lesser taking would better balance the diverse interests involved. (idid., page 419).

The human and environmental uses of Owens Lake, protected by the public trust doctrine, deserve to be taken into account. Such uses should not be destroyed because the State has not previously acted to protect them. It is time to move forward. The State Lands Commission, on its own motion and initiative, has a duty to act in the best interests of the public trust, without the courts being petitioned to exercise concurrent jurisdiction in this matter.

CONCLUSION

The public is being deprived of access to Owens Lake in its natural state. Any effort that impedes restoration of such public access is inconsistent with the public trust doctrine. It is requested that the California State Lands Commission enforce the public trust doctrine at Owens Lake and as Administrator of the public trust over the sovereign lands of the state, immediately abate the hazardous dust nuisance at Owens Lake. The State Lands Commission, in exercising its jurisdiction, can now act to forbid the diversion of the Owens River and its tributaries from Owens Lake and thus restore the natural flow of water to the lake.

DATED: October 6, 1998

Respectively submitted,

DONALD W. ODELL
3420 South State Highway 395
Post Office Box 128,
Lone Pine, California 93545

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cc:

CALIFORNIA STATE LANDS COMMISSIONERS

The Honorable Gray Davis
Lieutenant Governor
State Capitol, Room 1114
Sacramento, California 95814

The Honorable Kathleen Connell
State Controller
300 Capitol Mall, Suite 1850
Sacramento, California 95814

Craig L. Brown
Director of Finance
State of California
915 L Street
Sacramento, California 95814

(1)

Letter 1 – Donald W. Odell

1-1 The issues raised by Mr. Odell are more properly addressed by the staff of the California State Lands Commission (SLC), as the attached letter is addressed to the SLC. See the attached response dated October 29, 1998 from Michael Valentine, the Senior Staff Counsel of the SLC.

During the adoption processes for the SIP and its accompanying EIR, a number of comment and guidance letters were submitted to the District by the SLC staff. These letters are contained in Appendix B of the Final EIR and at EIR Comment Letter 21. In particular, the SLC's September 25, 1996 letter to the District (Appendix B) states that:

> … wildlife and habitat values, scenic and aesthetic concerns, the mineral resources of the lake bed, and ***air quality*** are all public trust values which have been recognized at Owens Lake. Likewise, surface water and groundwater are public trust resources the use of which can benefit or harm a variety of the foregoing public trust values or activities.[emphasis added]

It is the primary responsibility of the SLC to determine and protect the public trust resources of Owens Lake. The final determination of consistency with public trust values will be performed by the SLC after the SIP is adopted and an application is presented to the SLC by the City for authorization to implement controls on the lake bed. In fact, the same letter goes on to say "choosing or balancing between competing public trust uses is, of course, a responsibility of the State Lands Commission." However, the District believes that the elimination of the PM_{10} pollution from Owens Lake will be a significant enhancement to the lake's existing condition, that no other values will be adversely impacted by the proposed plan and that implementation of the plan will result in restoration of at least some of Owens Lake's public trust resources.

The SLC staff has cooperated with the District throughout the control measure development process to ensure that the SIP will be compatible with public trust values. Measures that the SLC staff determined did not maintain or enhance values have been eliminated from further consideration. In addition, the above referenced September 25, 1996 letter states: "the Commission recognizes that the primary legal authority, responsibility and expertise for preparation of a plan for reduction of PM_{10} in the vicinity of Owens Lake rest with the District." It is not the intent of the District's SIP, or the responsibility of the District, to repair all previous damage to Owens Lake or its associated public trust values. It is the District's responsibility to develop a plan to control the PM_{10} air pollution in the southern Owens Valley that minimizes associated environmental impacts. The District considered the impact of its plan on the public trust resources of Owens Lake as part of its extensive environmental review conducted pursuant to the

California Environmental Quality Act. The District's Final EIR concluded that the plan and its implementation would not result in any significant environmental impacts. The District adheres to that conclusion for the proposed SIP revisions.

For additional discussion of the public trust issue as it relates to the proposed SIP revisions, see the responses to letters 3 (California State Lands Commission) and 6 (Calif. Dept. of Fish and Game).

STATE OF CALIFORNIA PETE WILSON, *Governor*

CALIFORNIA STATE LANDS COMMISSION
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RECEIVED
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GREAT BASIN
UNIFIED APCD

October 29, 1998

File Ref: W24777

Donald W. Odell
P.O. Box 128
Lone Pine, California 93545

Re: Public Trust Considerations at Owens Lake

Dear Mr. Odell:

This letter is in response to your October 6 "open letter" to the State Lands Commission in which you raise several issues involving the public trust doctrine and the responsibilities of the Commission. Your attention is also directed to our letters dated December 16, 1993 and May 24, 1994, copies of which are enclosed, in which we responded to a series of similar questions which you had posed. Your specific questions from the October 6 letter will first be addressed, followed by a more general discussion of the public trust doctrine.

As you know from our previous correspondence, we agree with you that: 1) in a natural condition Owens Lake was a navigable lake, ownership of which was transferred to the State as sovereign lands upon the entry of California into the Union; 2) jurisdiction and management of these sovereign lands have been granted by the Legislature to the State Lands Commission; 3) as sovereign lands, the bed of Owens Lake is subject to the public trust doctrine. It is also true that the courts have ruled that included among public trust uses, in addition to commerce, navigation and fisheries, are recreational activities such as boating, bathing, and hunting, as well as preservation of the lands in their natural state.

You have asked whether a city in California "may...go 200 miles from its boundaries, divert a river...from a natural lake" thereby destroying "its public use as a navigable body of water" without violating the public trust doctrine. However this question is answered, the fact remains that the City of Los Angeles has diverted the Owens River and since 1913 has been conveying its waters to the City via the Los Angeles Aqueduct. The impacts of these diversions on the lake and on the Owens River are obvious; their impacts on public trust resources have been dramatic and, for the most part, negative. Whether the diversions violate the public trust doctrine is a question which can ultimately be decided in a judicial forum or in proceedings before the State Water Resources Control Board. That is, there exists an established body of law
Donald W. Odell

①

and procedure for consideration of past and future water allocations. The State Lands Commission, whatever its views on the diversions, cannot unilaterally curtail or modify any rights Los Angeles may have to Owens Valley water. The Commission would be a vitally interested party to any such proceedings, to be sure, but the public trust doctrine, in itself, grants the Commission no supreme powers over the modification of existing water rights.

While the Commission has no intention or legal basis to unilaterally halt diversions from the Owens River, as you seem to suggest it should, it has and will continue to assert the public interest in protecting and, where feasible, restoring the public trust resources of Owens Lake and the Owens River. We believe, for example, that public trust factors should be placed in the balance when weighing various air pollution control options for implementation on the lakebed. The Commission will be required to consider applications for control activities on the bed of the lake and will take these factors into account when doing so. In the meantime, we will attempt to cooperate with other interested parties and agencies to achieve compliance with air quality standards in ways that preserve and restore public trust resources.

Thank you for your continued interest in these important issues. We will continue to be involved in the ongoing decisions affecting Owens Lake and will look forward to discussing these matters with you as we go along.

Sincerely,

Michael R. Valentine
Senior Staff Counsel

cc: Ellen Hardebeck,
Air Pollution Control Officer
Great Basin Unified Air Pollution
Control District

Robin Dezember,
Chief Deputy Director for Policy
Department of Finance

1

DEPARTMENT OF THE NAVY
NAVAL AIR WEAPONS STATION
1 ADMINISTRATION CIRCLE
CHINA LAKE, CALIFORNIA 93555-6100

IN REPLY REFER TO:
5090
Ser 8G0000D/ 5582
October 20, 1998

Dr. Ellen Hardebeck
Great Basin Unified Air Pollution Control District
157 Short Street
Bishop, CA 93514

Dear Dr. Hardebeck:

I am writing in response to the District's Proposed Revision to the Owens Valley PM10 Planning Area Demonstration of Attainment State Implementation Plan (the "SIP revision") dated September 25, 1998. We have reviewed this document, and wish to provide the following comments.

2-1 In reviewing the proposed SIP revision, we first compared it to the July 1998 Memorandum of Agreement (MOA) between the District and the City of Los Angeles (the City). Based on our understanding of the MOA, the SIP revision is consistent with the agreed upon requirements and schedules. Our primary concern, however, is that the required level of effectiveness for the unspecified measures to be implemented in the Dirty Socks area is implied, but is not explicitly stated as a requirement. Specifically, it is our understanding that the Dirty Socks area was set aside as an opportunity for the City to develop and demonstrate the effectiveness of new control measures. It is also our understanding that in the event one of the unspecified control measures failed to perform to a minimum standard, the area to which it had been applied would have to be re-treated in a manner that would achieve the required level of control. In order to clarify the nature of the requirements in the Dirty Socks area, we recommend the following changes:

a. Page S-7, end of third paragraph: "... but, in order to be considered "successful", must achieve the controlled emission rate specified in section 5-5."

b. Page 5-4 end of page: Add to end of last paragraph: "Alternative control measures that fail to achieve the allowed emission limit must be reapplied or replaced with other control measure(s)."

c. Page 7-3 end of third paragraph: add "... but they must achieve the controlled emission rate specified in section 5-5."

2-2 Also, the SIP revision contains several references to requirements to "replace, modify, improve or rework" control measures on areas that have already been controlled. However, we were unable to find any indication of the time period within which these actions must be taken. For example, if an untested control measure is applied in the Dirty Socks area and proves to be ineffective, how long does the City have to re-treat that area with another control measure? If specific, uniform time limits are not seen to be appropriate for this project, we suggest that the SIP revision include a discussion of the process by which case-by-case time limits will be set.

Our editorial comments are as follows:

2-3 a. Page 5-1 last paragraph, 7th line: delete the phrase "proposed form of the" in order to make this paragraph consistent with the changes made in section 1-3.

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL # of pages ▸ 2

To Ellen Hardebeck	From Brenda Mohr
Dept./Agency GBUAPCD	Phone # 760-927-1513

(2)

b. Page 7-3 last paragraph: modify last sentence to read "Increment 2, as modified by the 2003 SIP, may require..."

2-3 c. Table 7.1: Wording of the last item "additional phases" implies that the timeline for implementation extends beyond December 31, 2006. Perhaps this could be changed to "additional acreage, phases 4-6" to clarify that these areas would be treated in 2004 through 2006 as parts of phases 4 through 6.

d. Page 7-5, second paragraph: modify last sentence to read "The City will be required to continuously operate..."

Thank you for the opportunity to review and comment on these this document. My point of contact in this matter is Ms. Brenda Mohn. She can be reached at (760) 927-1513.

Sincerely,
RA Stables

R. A. STABLES
Acting

Letter 2 – Department of the Navy, China Lake Naval Air Weapons Station

2-1 The requirement in the Revised SIP for the Dirty Socks area is that it be controlled sufficiently so that the National Ambient Air Quality Standards for PM-10 (PM-10 NAAQS) are attained and maintained. No specific control measure is prescribed for that area, nor is any specific control measure effectiveness required for the measure(s) placed here by the City. However, since the City is required to continue to control additional area until the District determines that the NAAQS have been attained, it is in their interest that controls in all areas of the lake bed, including Dirty Socks, are sufficiently effective to attain the NAAQS.

2-2 Paragraph 10 of the Board Order (page 8-5) states that "replacing, modifying, improving or reworking control measures on areas previously counted as controlled" does not count towards the City's obligation to control additional area every year until the District determines that the NAAQS have been attained. If an area already controlled must be reworked to reduce emissions sufficiently to attain the NAAQS, this work must be done in addition to controls on the new area. It is in the City's best interest to implement effective controls initially, and if they fail, to rework them in a timely manner. Otherwise, the failure of the controls on the Dirty Socks area could subject the City to a requirement to control two additional square miles of lake bed for every year they delay their reworking at Dirty Socks.

2-3 All the suggested editorial comments will be made, except for "d." By this SIP, the City <u>is</u> required to operate and maintain the controls.

CALIFORNIA STATE LANDS COMMISSION

GRAY DAVIS, *Lieutenant Governor*
KATHLEEN CONNELL, *Controller*
CRAIG L. BROWN, *Director of Finance*

EXECUTIVE OFFICE
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

ROBERT C. HIGHT, *Executive Officer*
(916) 574-1800 Fax (916) 574-1810
California Relay Service from TDD Phone 1-800-735-2922
from Voice Phone 1-800-735-2929

October 26, 1998

File Ref: W24777

Dr. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution
Control District
157 Short Street
Bishop, California 93514

RECEIVED
OCT 26 1998
DONNA LEAVITT
GBUAPCD, CLERK
(FAXed)

Re: Proposed Revision to the Owens Valley PM-10 Planning Area Demonstration Attainment State Implementation Plan

Dear Dr. Hardebeck:

Thank you for this opportunity to comment on your proposed revision of the above document. Staff of the State Lands Commission supports the proposed amendment as well as the agreement between the District and the City of Los Angeles upon which it is based. We do, however, have one brief comment. While this comment is not unfamiliar to you or your staff, it seems to us that the matter is of sufficient importance to bear repeating.

3-1

We have on numerous occasions expressed our concern that the required efforts to control PM-10 in the Owens Valley could have serious and ultimately unnecessary impacts on other public trust resources on or adjacent to the bed of Owens Lake. We have also observed that the State Lands Commission will be required to take such impacts into account and, where feasible, to preserve the public trust resources of the lake when acting on applications to engage in control activities on the lakebed. As you know, these resources include, in addition to air quality, water quality and quantity, plant and animal habitat, scenic qualities and public access considerations.

We believe that other agencies are likewise required to consider these public trust resources when making air pollution control decisions for implementation at Owens Lake. We therefore request that the District adopt the following policy directives as a part of the current revision of the PM-10 SIP.

3-1 First, the District and the City should, prior to on-the-ground implementation, take into account the impacts of proposed control measures on any existing public trust resources on or adjacent to the bed of Owens Lake. Second, any existing public trust resources of the lake should not be diminished by control measures proposed for location on the lakebed. Third, when the District or the City select any new control measures in the future, preference should be given to those measures which have the potential to restore the public trust resources at the lake which have been so seriously degraded by diversions.

We believe these general policy statements are within the existing authority and responsibilities of the District and would enhance the revised SIP. Thanks again for this opportunity to comment and for your continued attention to our concerns.

Sincerely,

Robert C. Hight

ROBERT C. HIGHT
Executive Officer

cc: Michael P. Kenny
Executive Officer
Air Resources Board

Gerald Gewe
Director of Water Resources,
LADWP

3

Letter 3 – California State Lands Commission

3-1 Since most of the emissive lake bed is owned by the State of California, it is the responsibility of the State Lands Commission, as a trustee agency, to define and protect the public trust values of Owens Lake. Prior to the implementation of any control measures on state lands, the City has the responsibility to secure authorization from the state for its proposed activities. Therefore, the State Lands Commission will have the opportunity to determine consistency of those proposed activities with the public trust values and to grant or deny permits based upon the impacts of the proposed control measures on any existing public trust resources on or adjacent to Owens Lake.

As Michael Valentine, Senior Staff Counsel for the SLC, states in his October 29, 1998 letter to Donald Odell (see Response to Comments 1-1), the SLC will take these public trust factors into account in its permitting decisions. Since the SLC has the duty, authority, expertise, and opportunity to define, protect and enhance the public trust values at Owens Lake, it is not necessary in the circumstances for the District to formulate an independent policy in that area.

For additional discussion of the public trust issue as it relates to the proposed SIP revisions, see the response to letter 6 (California Department of Fish and Game).

United States Department of the Interior

NATIONAL PARK SERVICE
Pacific West Field Area
600 Harrison Street, Suite 600
San Francisco, California 94107-1372

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OCT 26 1998
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IN REPLY REFER TO:
N3716 (PGSO-PN)

OCT 22 1998

Ellen Hardebeck, Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street
Bishop, CA 93514

Dear Ms. Hardebeck:

Thank you for the opportunity to comment on the proposed revisions to the Owens Valley PM-10 Planning Area Demonstration of Attainment State Implementation Plan (SIP) and associated Environmental Impact Report. Owens Lake is the largest particulate matter source in the country, emitting over 300,000 tons of PM10 per year. The National Park Service continues to be concerned about the potentially serious local and regional human health and resource impacts, including visibility, at nearby Death Valley National Park, and Manzanar National Historic Site, as stated in our letter dated May 21, 1998.

4-1 The proposed SIP revisions include a five-year delay for the City of Los Angeles to implement dust controls on Owens Lake bed, which is supposed to bring the area into attainment with the National Ambient Air Quality Standard (NAAQS) for particulate matter by December 31, 2006 rather than 2001. The proposed revisions call for treatment of only 22.5 square miles, of the worst 35 square miles of particulate source area on Owens Lake by the end of 2006. However, if the NAAQS has not been met at that time, the plan proposes to continue to treat two square miles per year until Owens Valley reaches attainment, which may not occur for several years following 2006. Is this delay necessary?

The proposed mitigation measures set forth in the SIP have been estimated to cost only \$300-\$500 per ton. South Coast Air Quality Management District has determined clean up efforts costing \$5,000 per ton are deemed reasonable. Therefore, the cost of Owens Lake clean-up should not be a significant obstacle and does not warrant further delay in implementation, given the potential serious impacts from elevated particulate matter.

The NPS is mandated by Congress to preserve and protect nationally significant natural and cultural resources and provide visitors, today and from future generations, with opportunities to experience them. We depend on the support of regulatory agencies to fulfill this mandate. We support the mitigation measures spelled out in the existing SIP and urge Great Basin Unified Air Pollution Control District and the City of Los Angeles to begin mitigation of Owen's Lake particulate matter without further delay.

(4)

If you have any questions regarding our comments, please contact Environmental Specialist Richard Anderson, at Death Valley National Park at 760-786-3251, or Regional Air Quality Coordinator Judy Rocchio, at 415-427-1431.

Sincerely,

for John J. Reynolds
Regional Director, Pacific West Region

cc:
John Kennedy, EPA R-9
Richard Martin, Superintendent, Death Valley National Park
Ross Hopkins, Superintendent, Manzanar National Historic Site

4

Letter 4 – U.S. Department of the Interior, National Parks Service

4-1 The purpose of this SIP revision is to insure that the NAAQS will be met around the lake bed by December 31, 2006. The 2003 SIP revision will require the City to control whatever additional area must be controlled to meet those standards. This requirement is outlined in paragraph 11 of the Order on page 8-5.

The 22.5 square miles is a backstop in case state approval of the District's 2003 SIP revision is delayed. The additional two square miles a year contingency measure automatically continues the controls if for some reason the 2003 SIP strategy fails to attain the standards.

The District anticipates that the standards will be met by December 31, 2006. A discussion of the 5-year extension of the attainment date can be found in response to comments 8-1.

Department of Water and Power the City of Los Angeles

RICHARD J. RIORDAN
Mayor

Commission
RICK J. CARUSO, *President*
MARCIA F. VOLPERT, *Vice President*
KENNETH T. LOMBARD
JUDY M. MILLER
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IRENE N. KISHI, *Secretary*

S. DAVID FREEMAN, *General Manager*

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October 23, 1998

Dr. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Unified Air Pollution
Control District
157 Short Street, Suite 6
Bishop, California 93514

Dear Dr. Hardebeck:

Proposed Revision to the Owens Valley PM-10 Planning Area Demonstration of Attainment State Implementation Plan (SIP)

This is in response to your September 25, 1998 Notice of Public Hearing on the SIP.

The Los Angeles Department of Water and Power (Department) has reviewed the SIP. We would like to congratulate the staff of the Great Basin Unified Air Pollution Control District (District) for the thorough and careful way they revised the July 1997 SIP to bring it into conformance with the Memorandum of Agreement between the City of Los Angeles and the District.

We look forward to working with the District to see that the measures that are contained in the SIP are implemented and that the area is brought into conformance with the standards of the Clean Air Act.

The Department supports the adoption of the SIP with the following minor change which has been generally agreed upon between our staffs to clarify storm water management criteria. The Department requests the District to delete the second paragraph on page 5-3 of the SIP dealing with storm water flows in its entirety and replace it with the following paragraph:

5-1

> Because the lake bed is subject to storm water runoff flows, alluvial deposits, and fluctuating brine pool levels, flood and siltation control facilities shall be designed to provide levels of protection appropriate for the PM-10 control measures being protected. For example, lake bed areas controlled with managed vegetation or gravel control would require a higher level of flood

5-1 protection than areas controlled with shallow flooding. Food and siltation control facilities shall be integrated into the design and operation of the PM-10 control measures. All flood and siltation control facilities and PM-10 control measures damaged by storm water runoff or flooding shall be promptly repaired and restored to their designed level of protection and effectiveness.

5-2 The Department continues to have concern over the modeling methodology that has been used by the District. However, since the current state of particulate monitoring is still very crude and since only limited data is currently available for calibration of any model, the Department accepts the model for the SIP. The Department requests the District continue to work with the Department in reviewing modeling methodology and reserves the right to advance an alternative model for consideration at the time the 2003 State Implementation Plan (referred to in the SIP) is prepared.

Please feel free to call me or Mr. Gerald A. Gewe at (213) 367-1022 if you have any questions or concerns about the above comments.

Sincerely,

S. DAVID FREEMAN
General Manager

c: Mr. Gerald A. Gewe

5

Letter 5 – Los Angeles Department of Water and Power

5-1 The District agrees with the City's request to clarify the requirements for stormwater management. However, instead of inserting stormwater management language applicable to all the control measures into the discussion of managed vegetation, the District proposes the deletion of the referenced second paragraph on page 5-3 and insertion of a new section after Section 5-4 "Gravel Cover":

5-5 Stormwater Management

The bed of Owens Lake is subject to flooding, alluvial deposits and fluctuating brine pool levels caused by stormwater runoff flows. In order to protect the PM_{10} control measures installed on the lake bed, the City shall design, install, operate and maintain flood and siltation control facilities. Flood and siltation control facilities shall be designed to provide levels of protection appropriate for the PM_{10} control measures being protected. For example, lake bed areas controlled with managed vegetation or gravel would require a higher level of flood protection than areas controlled with shallow flooding. Flood and siltation control facilities shall be integrated into the design and operation of the PM_{10} control measures. All flood and siltation control facilities shall be continually operated and maintained to provide their designed level of protection. All flood and siltation control facilities and PM_{10} control measures damaged by stormwater runoff or flooding shall be promptly repaired and restored to their designed level of protection and effectiveness.

5-2 The District is pleased that the City accepts the current air quality model.

STATE OF CALIFORNIA-THE RESOURCES AGENCY PETE WILSON, *Governor*

DEPARTMENT OF FISH AND GAME
Habitat Conservation Program
330 Golden Shore, Suite 50
Long Beach, California 93514
(562) 590-5113

RECEIVED
OCT 26 1998
GREAT BASIN
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October 23, 1998

via facsimile no. (760) 872-6109 and hand-delivered

Dr. Ellen Hardebeck, Air Pollution Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street
Bishop, California 93514

RE: Draft 1998 Revision to the Owens Valley PM-10 Planning Area Demonstration of Attainment State Implementation Plan

Dear Ms. Hardebeck:

Thank you for providing the Department of Fish and Game (Department) with the opportunity to review the subject document which outlines the proposed revision to the Owens Valley PM-10 Planning Area Demonstration of Attainment State Implementation (SIP) previously adopted by the Governing Board of the Great Basin Unified Air Pollution Control District (District) on July 2, 1997. The SIP describes how the District plans to attain the federal standards for particulate matter pollution in the region surrounding Owens Lake in southern Inyo County, California. The Draft 1998 Revision to the SIP (Revision) now allows the City to use any combination of the three identified control measures, shallow flooding, managed vegetation, or gravel, or another control measure agreed to by the District on a predetermined schedule to achieve attainment of air quality standards. The Revision also includes a five-year extension of time for the City of Los Angeles (City) to implement controls on the Owens lake bed to bring the area into attainment with the National Ambient Air Quality Standards (NAAQS) by December 31, 2006.

The Department has reviewed the proposed revisions to the SIP and has been
unable to determine what actual "project" the SIP now describes. As stated on page 8-
6-1 1 of the revisions, "The order requires the City to implement shallow flooding, managed
vegetation, gravel **or other unspecified control measures** within the areas shown in
and described ..." (emphasis added). The revisions also give sole discretion to the City
to use any combination of those measures, in addition to allowing the City to use any
unapproved measure in the Dirty Socks Zone (Zone 4). This not only represents a
6-2 substantial change from the proposed project provided in the certified FEIR, but with
this apparent lack of any actual project description, may substantially change the
project objectives. At minimum, the FEIR can no longer claim to be consistent with the
State of California's obligation of land and resource stewardship and of public trust
6-3 values with respect to the Owens Lake bed, which is supported by the deletion of this
commitment on page S-8 of the Revision.

It is difficult for the Department to understand the District's proposal to allow
adoption of the proposed SIP revision by "addendum" to the FEIR with such a
substantial change in the proposed project and no readily identifiable new project
6-4 description. Therefore, the Department, pursuant to CEQA Section 15164 (e),
respectfully requests to be provided an explanation of the District's decision not to
prepare a subsequent EIR (or at minimum a supplemental EIR), including the
substantial evidence used in support of this decision.

It has been a challenge to track the use of the FEIR as a "first-tier EIR" and, now
with the proposed revisions and without any real District project to review, any
information and/or explanation you could provide which would minimize our concerns
regarding the additional CEQA analysis still remaining to be completed prior to actual
implementation of any control measures would be greatly appreciated. Especially
disturbing to the Department is the statement on page 8-1 of the Revision that claims,
6-5 "Implementation under the Board's order also ensures compliance with the California
Environmental Quality Act." "Additional environmental documents to the SIP Final
Environmental Impact Report (EIR) and EIR Addendum Number 1 **may be** [emphasis
added] needed for complete implementation of the proposed control strategy." Other
than having the City fully adopt the project proposed by the District in the FEIR, does
the District believe this addendum, assuming this is Addendum Number 1, actually
includes a project description for which CEQA analysis has been completed and the
City **may be** able to go forth with implementing the revised proposed control strategy
6-6 without further CEQA review? What is the Board actually going to "order"? What new
information, scientific data, and/or environmental analysis has the City provided to
6-7 warrant the District abandoning the proposed project it identified in completing the first-
tier of this EIR and, can you provide the information and reasoning you utilized in this
decision to the Department for review? What information was used by the District to
justify discarding your commitment to ensure the FEIR was "consistent with the State of
6-8 California's obligation to preserve and enhance the public trust values associated with
Owens Lake"?

The Department is further concerned that the environmental analysis and
identified mitigation requirements in the FEIR may be compromised by the proposed
revisions based upon a Memorandum of Agreement between the District and City. In
letters to the District dated November 26, 1996 and May 9, 1997 pertaining to the SIP
Project Alternatives Analysis and Draft EIR respectively, the Department expressed its
concerns, comments, and recommendations regarding the proposed project. The
6-9 efforts of the District and their consultants to identify and disclose potential
environmental impacts to fish and wildlife resources, and the identification of mitigation
for these impacts, have been exemplary. The Department supported numerous
mitigation measures identified in the EIR, and supported an alternative that maximized
wet and moist habitat types which are best provided by shallow flooding and managed
vegetation. We further requested the use of gravel to be minimized. The concerns and
recommendations expressed in these two letters remain valid as they pertain to these
proposed revisions and are hereby incorporated by reference into these comments. 6

The proposed revisions appear to compromise the thorough evaluation of the proposed project impacts and mitigation measures for fish and wildlife resources identified in the Final EIR. The proposed project described in the Final EIR included specific measures to be conducted in specific areas. Based upon the extensive studies conducted, this project was designed to minimize adverse impacts to fish and wildlife resources and preserve and enhance public trust values while achieving attainment objectives. The Revision, by allowing the City to utilize any combination of the three control methods (shallow flooding, managed vegetation, or gravel) along with
6-10 unspecified measures to attempt to achieve attainment objectives, essentially gives the City the leeway to implement any of the alternatives identified in the Final EIR which were rejected by the District for numerous reasons. For example, Alternative A (Low Volume Water Use: Groundwater) was rejected in part, because groundwater pumping "has the potential to alter surface drainage of waters in the affected areas which could adversely impact existing vegetative and wildlife communities, and the amount and quality of water reaching The Owens Lake brine pool. This impact is considered significant" (FEIR p. 7-20). What control, if any, does the District have regarding the selection of alternative control measures under the proposed revisions?

Further, although the first-tier of the FEIR identified that additional environmental analysis would be required regarding the "final engineering detail" and "specific manner in which water is delivered to the water-based control measures", the issue of use of ground water was to have been "ripe for decision" at the time of the first-tier FEIR and should not need further analysis based on the Districts finding in the certified FEIR.
6-11 Now it appears, based on the proposed revisions, the City may have the ability to re-evaluate the use of ground water for the water-based control measures. If this is so, was the District wrong in its finding that the use of ground water would result in significant impacts? Although these concerns may be resolved with clarification from the District, the Department remains concerned that such an apparent change to the FEIR can be made between the City and District without supplemental environmental review and document circulation.

The Department believes both the City and the District remain responsible to review the potential environmental consequences of any alternatives identified to control emissions from Owens Lake pursuant to CEQA. Any revisions and associated alternatives proposed by either the City or the District should be held to the same
6-12 objectives as those identified in the certified FEIR, should ensure there is neither damage to nor diminishment of public trust resources of the lake, should serve to restore the public trust values and resources of the lake previously impacted by actions or activities of the City, and may be subject to further Department review pursuant to Fish and Game Code 1600 et seq.

6

Thank you for your continued consultation with the Department and providing us the opportunity to review the Draft 1998 Revision to the Owens Valley PM-10 Planning Area Demonstration of Attainment State Implementation Plan. I am looking forward to your response to our concerns and continuing a cooperative approach to resolving this complex issue. If you have any questions, or desire clarification of these comments, please contact Mr. Bruce Kinney, Environmental Specialist, at our Bishop Office address: Department of Fish and Game, 407 W. Line Street, Bishop, California 93514; telephone (760) 872-1129, fax (760) 872-1284.

Sincerely,

Curt Taucher
Regional Manager
Region 6

cc: Mr. Alan Pickard, CDFG, Bishop
Mr. Bruce Kinney, CDFG, Bishop

6

Letter 6 – California Department of Fish and Game

6-1 The "project" described by the 1998 SIP revisions is the same project described by the July 1997 SIP. At this time, the District does not have any substantial basis for concluding that the control measures and their location on the lake bed when implemented by the City are likely to materially differ from the proposed project evaluated in the 1997 SIP and Final EIR. The 1998 SIP revisions simply change the method and time allowed for implementing the proposed control measures and makes provisions for new or revised control measures, if appropriate. However, if the City makes any substantive changes to project set forth in the 1997 SIP or if the location or nature of any of the control measures materially changes, the City will be required to prepare appropriate environmental documentation and secure all necessary permits and authorizations before construction begins.

6-2 The SIP revisions do give the City discretion as to what controls to implement in the Dirty Socks Zone on the lake bed. At this time the City has not indicated what they intend to propose for the Dirty Socks Zone. However, if the City decides to implement any controls other than the 225 acres of shallow flooding and the 1,940 acres of gravel analyzed by the District in the Final EIR, they will be required to revisit the Final EIR and prepare the appropriate revision (e.g., an addendum, a supplement or a subsequent EIR). As such, it is not possible for the City to change the project objectives (see Final EIR Section 1-3).

6-3 As the 1998 SIP revisions will not change the project description set forth in the Final EIR and the City cannot implement control measures that do not conform to the approved SIP and EIR, the Addended Final EIR will continue to be consistent with the state's public trust obligations. For additional discussions of the public trust issue, see the District's responses to letters 1 (Donald W. Odell) and 3 (California State Lands Commission).

6-4 A detailed explanation of the District's decision to prepare an addendum to the Final EIR is set forth in Section 1-4 "CEQA Compliance" of the EIR addendum. As discussed above, at this time, the District has no substantial basis for concluding that the control measures and their location on the lake bed when implemented by the City will materially differ from the proposed project evaluated in the 1997 SIP and Final EIR. Therefore, the adoption of the 1998 SIP revisions do not raise important new issues about significant effects to the environment, no new or more severe significant environmental effects have been identified and no proposed mitigation measures will be affected. Preparation of an addendum to the EIR is therefore appropriate.

6-5 If the City implements the PM_{10} controls analyzed in the Final EIR in the manner and location set forth in the Final EIR, then the City may be able to begin implementation without additional CEQA review. However, if the City decides to substantively change the manner or location of the controls, additional environmental documents will be required. The scope of any additional environmental documents will depend on the scope of any proposed changes. If the City proposes changes to the measures analyzed in the Final EIR, the City (or other lead agency) will be obligated by CEQA to conduct an initial study to investigate whether the proposed changes may have a significant environmental effect. Based on the results of the initial study, the City (or other lead agency) will then decide what further level of environmental review is required. The District intends to participate in such subsequent environmental review as a responsible or trustee agency. The District's participation in that CEQA process may be limited to an analysis of the air quality impacts of the work proposed by the City.

6-6 The actual Board Order is contained in Chapter 8 of the SIP revisions. No further action by the District is required.

6-7 The City (or any other entity) has provided no new information, scientific data or environmental analysis. As discussed above, the project described and analyzed in the 1997 SIP and Final EIR has not changed as a result of the 1998 SIP revisions.

6-8 As discussed in our responses to Letters 1 (Donald W. Odell) and 3 (California State Lands Commission), it is the primary responsibility of the SLC, as a trustee agency, to define and protect the public trust values of Owens Lake. The final determination of consistency with public trust values will be performed by the SLC after the SIP is adopted and an application is presented to the SLC by the City for authorization to implement controls on the lake bed. However, one of the project objectives stated in Section 1-3 of the Final EIR is to "ensure that implementation of the Attainment SIP is consistent with the State of California's obligation to preserve and enhance the public trust values associated with Owens Lake." Based on the comments received from the SLC during the SIP adoption process, the District has every reason to believe that this objective has been accomplished. As the SIP itself is a document prepared pursuant to federal Clean Air Act requirements, the District did not feel it was appropriate to discuss state issues such as public trust obligations in that document.

6-9 The District, along with the Department of Fish and Game and many other public agencies and individuals, worked very hard to prepare a Final EIR that will protect the environment of Owens Lake. We are also proud that the finished product withstood legal challenges by the City of Los Angeles. We have no substantial basis for concluding that the control measures and their location on the lake bed will materially differ from the proposed project evaluated in the 1997 SIP and Final EIR. Therefore, the required project elements and mandatory mitigation measures contained in the Final EIR will not be affected by the SIP revisions.

6-10 As stated above, the District has no substantial basis for concluding that the control measures and their location on the lake bed will materially differ from the proposed project evaluated in the 1997 SIP and Final EIR. Activities proposed by the City and not included in the Final EIR analysis, such as groundwater pumping, would have to be analyzed as subsequent tiers to the existing first-tier document. CEQA then sets forth the procedures and requirements for such proposed activities. Section 5-5 "Alternative Control Measures" of the SIP revisions sets forth the procedures and controls that the District will have regarding the selection of alternative control measures. In addition, Section 7-3 "Implementation Monitoring and Enforcement" of the SIP revisions states that "all necessary environmental analysis, leases, easements and permit approvals required to implement control measures are the sole responsibility of the City."

6-11 The District's Final EIR concluded that the range of groundwater pumping amounts analyzed during the EIR process (33,000 to 56,000 acre-feet per year) would result in significant environmental impacts. For this reason the proposed project in the Final EIR assumes that the City would secure the water required for the project from the Los Angeles Aqueduct. Using aqueduct water was not projected to have a significant impact on the Owens Valley, the City of Los Angeles or any other area. However, neither the 1997 SIP and implementation order nor the SIP revisions and new order prescribe the source(s) of water for the project. It will be the City's responsibility to decide on the source of water for the project and, if the source is not the Los Angeles Aqueduct, analyze the environmental impacts of their decision. The District will participate in any subsequent CEQA process as a responsible or trustee agency.

6-12 The District believes that the City or possibly the State of California, as much of the control measures will be placed on state property, will be the CEQA lead agency responsible for reviewing the potential environmental consequences of any alternative PM_{10} control measures or alternative measure locations that materially differ from the measures and locations analyzed in the Final EIR. The District will act to enforce the requirements of the SIP and all local, state and federal air quality regulations. In addition, the District will continue to lend technical assistance to all interested parties and will act as a responsible or trustee agency during subsequent CEQA activities.

RECEIVED

OCT 26 1998

DONNA LEAVITT
GBUAPCD, CLERK

October, 20, 1998
Rte. 2, Box 89
Lone Pine, CA 93545

Great Basin Air Pollution Control District
127 Short St.
Bishop, CA, 93514

Re: Proposed Revision to the Owens Valley PM-10 Planning Area Demonstration of Attainment of the State Implementation Plan.

Rather than more years of litigation between DWP and the GBUAPCD, allowing this compromise settlement to go forward seems to be the obvious solution to the on-going problem of dust control on the Owens Dry Lake. Ellen Hardebeck and her staff are to be commended for bringing this about.

The unresolved question of the source of the water to be used for lake flooding remains the major source of concern.

7-1 Aqueduct water rather than any more pumping from the underground aquifer should be used for mitigation.

Consideration of the use of water from the Lower Owens River Project and a pumpback station that works both directions is an encouraging new proposal.

7-2 In any event the process needs to be closely monitored and begun as soon as possible.

Sincerely,

Martha Gilchrist

Martha Gilchrist

Letter 7 – Martha Gilchrist

7-1 The District does not prescribe the source(s) of water from which the City must supply water for the project. However, the Final EIR assumes that the City will secure the water required for the project from the Los Angeles Aqueduct. Using up to 50,000 acre-feet per year of water from the Aqueduct was not projected to have a significant impact on the Owens Valley, the City of Los Angeles or any other area.

7-2 The District intends to closely monitor the City's implementation and operation of the ordered PM_{10} control measures. Section 7-10 "Implementation Monitoring and Enforcement" of the SIP revisions explains the air quality, control measure and environmental impact monitoring the District is committing to during the control measure implementation process.

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RECEIVED
OCT 27 1998
GREAT BASIN
UNIFIED APCD

October 27, 1998

Ms. Ellen Hardebeck
Air Pollution Control Officer
Great Basin Air Pollution Control District
157 Short Street
Bishop, CA 93514

RE: Comments on Proposed Draft 1998 Revision to the Owens Valley PM-10 Planning Area Demonstration of Attainment State Implementation Plan (SIP)

Dear Ms. Hardebeck,

The Lone Pine Paiute/Shoshone Tribe and Timbisha Shoshone Tribes ("Tribes") would like to thank Great Basin Unified Air Pollution Control District (Great Basin) for this opportunity to comment on its Proposed Draft 1998 Revision to the Owens Valley PM-10 Planning Area Demonstration of Attainment State Implementation Plan (herein "SIP Revision"). The Tribes have reviewed the SIP Revision and make the following comments:

8-1

1. On page 7-1 of Chapter 7, it states that in order to implement the proposed control strategy under the SIP Revision it will be necessary to seek a five (5) year extension of the attainment date (December 31, 2001) from the Environmental Protection Agency (EPA) under 42 U.S.C.§ 7513(e) of the Clean Air Act Amendments of 1990 (CAA). The Tribes object to the development and submission of a SIP that pre-supposes the granting of a § 7513(e) extension. The CAA makes clear that attainment is to be reached by December 31, 2001. *See* 42 U.S.C. § 7513(c)(2). An extension of this date is within the discretion of the Administrator and cannot be granted until the State has submitted an attainment demonstration project for the area in question. Further, an extension is warranted only upon a showing that:

a. attainment by December 31, 2001 is "impracticable";
b. the State has complied with all the requirements and commitments pertaining to the area in the implementation plan;
c. the State demonstrates to the satisfaction of the Administrator that the plan for that area includes the most stringent measures that are included in the implementation plan of any State or are achieved in practice in any State; and,
d. can feasiblely be implemented in the area.

The Tribes do not believe that the State has met the criteria warranting an extension under §7513(e) and should not prepare a SIP based on an extended deadline currently not approved by the EPA.

(8)

2. The Tribes object to the requirements of Increment 2 set forth in subsection 7-2.2, Chapter 7, page 7-3. Placing two (2) miles of controls on the Dry Lake in 2004, 2005, and 2006 does not ensure that attainment will be achieved by December 31, 2006 and thus the proposed SIP does not meet the mandate of the CAA. Although the Tribes do not oppose a strategy of increment controls during the years of 2004 through 2006, the final increment must result in attainment on December 31, 2006.

An alternative to the current SIP Revision, is to amend the Implementation Milestones found at page 7-4 to provide for two (2) miles of controls during 2004 and 2005 and eight point five (8.5) miles of control implementation in the year 2006. Under the Tribes' proposal, the total area of control by 2006 will be twenty-nine (29) miles. Twenty-nine (29) miles of control was the recommended area of control set forth in the May 1998 staff report of the California Air Resources Board. While short of the thirty-five (35) miles recommended by Great Basin in its earlier studies, the Tribes believe twenty-nine (29) miles would result in attainment by 2006.

8-2

The Tribes' proposed amendment is an attempt to address the Los Angles Department of Water and Power's (DWP) concern regarding the possibility of facing a federal and state order proscribing control measures at the Dry Lake which are beyond those that may be determined necessary by Great Basin in 2003. Under the Tribes' proposed SIP amendment, DWP will be agreeing to no more than it has already agreed to under its July 1998 Memorandum of Understanding (MOU) with Great Basin. Currently DWP has agreed to twenty-two point five (22.5) miles of control on the Dry Lake by 2006. Under the Tribes' proposed amendment, if Great Basin determines in 2003 that only six (6) additional miles are needed to reach attainment (a total of 22.5 miles), a successful SIP revision can be obtained before DWP would be required to implement the eight point five (8.5) mile increment as §7410(k) of the CAA requires EPA to approve SIP revisions within eighteen months (18) from submission.

The Tribes' proposed amendment to the SIP Revision is reasonable and meets the concerns of all interested parties. First, it ensures attainment by 2006 and thus protects the State's SIP from a legal challenge of noncompliance with the CAA. Secondly, if in 2003 Great Basin determines that less than twenty-nine (29) miles of controls is needed, a timely SIP revision will prevent DWP from proceeding with unnecessary control measures. Finally, the Tribes' concern with certainty for the future is satisfied, as twenty- nine (29) miles of control in 2006 should ensure that attainment is reached at the Owens Dry Lake.

3. The Tribes take issue with the Contingency Control Measure Provision set forth on page 7-5, section 7-5, Chapter 7. The proposed contingency measure provides that if attainment is not achieved by 2006, DWP will be required to continue to place two (2) miles of controls on the Dry Lake every year until attainment is met. This contingency measures offers too little too late. If attainment is not met in 2006, the State will be unable to request an extension of the attainment deadline and will be in noncompliance with the CAA. Such non-compliance with the CAA will subject the State to sanctions and could force EPA to implement the final controls necessary to reach attainment at the Dry Lake. The Tribes would like to see a contingency measure developed that will ensure that we do not arrive at 2006 and find that we are in noncompliance with the CAA.

8-3

Finally, if Great Basin were to determine in 2003 that thirty five (35) miles of controls were needed at the Dry Lake the contingency measure as written will require control implementation at the Lake reaching as far into the future as 2012. This is unacceptable. Ideally a contingency measure should be developed that would be triggered before December 31, 2006, thus avoiding delay in reaching attainment. If a contingency plan is made effective after 2006, it should mandate attainment within twelve (12) months if not sooner.

The Tribes are hopeful that their comments will be addressed and incorporated in the draft SIP. The Tribes commend Great Basin and DWP for their joint effort in moving the SIP process to the stage where, with

minor changes, the Tribes and all interested parties can support the SIP and the long over due clean up at the Dry Lake can begin. Thank you.

Sincerely yours,

Dorothy Alther

DOROTHY ALTHER

cc: Pauline Esteves, Timbisha Shoshone Tribal Chairwoman
Sandra Jefferson Yonge, Lone Pine Paiute Shoshone Tribal Chairwoman
Felicia Marcus, EPA Region IX

8

Letter 8 – California Indian Legal Services

8-1 Section 188(e) of the Clean Air Act Amendments of 1990 [42 U.S.C. § 7513(e)] provides for one extension of the attainment date for serious PM_{10} nonattainment areas from the date of December 31, 2001 established in Section 188(c) [42 U.S.C. § 7513(c)(2)]. The single extension may be for a period of no more than five years. In Section 7-1 of the SIP revisions, the District requests that the EPA Administrator grant one five-year extension of the attainment date for the OVPA to December 31, 2006. Section 188(e) allows the EPA Administrator to grant the extension if four conditions are met:

1. <u>Attainment by December 31, 2001 would be impracticable.</u>

It is estimated that control measures will need to be installed on up to 22,400 acres of the Owens Lake bed in order for the OVPA to meet the PM_{10} NAAQS. The extent of the control measures, the remoteness of Owens Lake from infrastructure supply sources and the difficult working conditions will make rapid implementation of the proposed control measures very challenging. In addition to implementation of control measures, the City will also be responsible for and require sufficient time to obtain the necessary permits, leases and authorizations required to construct the control measures on lands owned and managed by the State of California. These constraints make attainment of the PM_{10} NAAQS in three years impracticable.

2. <u>The State has complied with all requirements and commitments pertaining to the area in the implementation plan.</u>

As there is currently no federally approved implementation plan for the OVPA, there are no requirements or commitments pertaining to the area. The SIP presented herein would be the first plan that imposed date specific requirements for the implementation of PM_{10} control measures and attainment of the PM_{10} NAAQS.

3. <u>The State demonstrates to the satisfaction of the Administrator that the plan for the area includes the most stringent measures that are included in the implementation plan of any State or are achieved in practice in any State and can feasibly be implemented in the area.</u>

The District has developed three feasible and effective control measures for use on the Owens Lake playa: shallow flooding, managed vegetation and gravel. Currently, these three measures are the only feasible control measures that have been determined to be effective enough to allow the OVPA to meet the PM_{10} NAAQS. The SIP requires the use of one or more of these control measures. In addition, in order to provide for technological advances, the SIP also provides for the implementation of alternative control measures, if they can be proved to the

District to be effective enough to allow the PM_{10} NAAQS to be met by the statutory deadline of December 31, 2006. Therefore, the OVPA SIP contains the most stringent feasible and effective control measures that have ever been developed for the control of aeolian PM_{10} emissions from playa surfaces.

4. The State must submit a revision to the implementation plan that includes a demonstration of attainment by the most expeditious alternative date practicable.

The control strategy presented here in Chapter 7 is a performance-based strategy that assures the OVPA will attain the PM_{10} NAAQS by no later that the statutory deadline of December 31, 2006. The air quality model presented in Chapter 6 demonstrates that by implementing the proposed strategy, lake bed PM_{10} emissions will be reduced such that the 24-hour PM_{10} NAAQS of 150 $\mu g/m^3$ will be attained prior to December 31, 2006. Due to the practical and logistical constraints discussed above, the proposed strategy provides for the most expeditious practicable attainment date.

8-2 The requirement for an additional two square miles of controls in 2004, 2005 and 2006 is merely a backstop in case there is a delay in state approval of the 2003 SIP Revision. Paragraph 11 of the Order requires a SIP Revision in 2003 that "will provide for attainment in the OVPA of the PM-10 NAAQS by December 31, 2006." The two square miles in Increment 2 will happen only if the City challenges the 2003 SIP. Within one year of State of California approval the 2003 SIP, the City will make up any shortfall between the SIP requirements and the two square miles required by Increment 2. Only if the State approval of the 2003 SIP is delayed for more than two years will attainment be delayed beyond December 31, 2006.

8-3 Section 172(c)(9) of the Clean Air Act [42 U.S.C. 7502(c)(9)] requires that the SIP contain an automatic contingency measure that will be triggered if the standards are not attained by December 31, 2006. The 2003 SIP Revision, and not the contingency measure, is the vehicle to ensure attainment by December 31, 2006.

Stephen Kalish
8574 Rimrock Place
Bishop, CA 93514
387.2782
kaljar@qnet.com

28 October 1998

RECEIVED
OCT 28 1998
GREAT BASIN
UNIFIED APCD

Mr. Ted Schade
Project Manager
Great Basin Unified Air Pollution Control District
157 Short Street
Bishop, CA 93514

Re: *Draft 1998 Revision to the Owens Valley PM10 Planning Area Demonstration of Attainment State Implementation Plan.*

Dear Ted:

First, let me congratulate you and the District on reaching a settlement with Los Angeles that will *hopefully* facilitate timely attainment of PM10 clean air standards for the Owens Lake basin.

I have reviewed the draft revised State Implementation Plan (SIP) for Owens Lake, and offer the following comments to you and the District Board.

While it is understood at the outset that the proposed SIP revisions follow directly from the the MOA with Los Angeles, the SIP still represents the District's—not the polluter's—attainment strategy, time lines, goals and commitments. It is supposed to reflect what the District—not the city of Los Angeles—intends to accomplish to satisfy EPA requirements within a fixed and presumably finite period of time. It is meant to inform rather than mislead the ARB, the EPA, and the air-consuming public of what is to be done, and when, so that this terrible source of PM10 dust will blow no more.

9-1 With that by way of preface, I am challenged by Figure 7.2 at page 7-7, "Estimated Design Day Emission Trend with the Proposed Control Strategy." Specifically, I find the dashed line on the chart to be, while not misrepresentation, at least misleading. It may accurately reflect the position of the City, but it does not reflect the scientific work done by the District, given that the District will only be able to compel an additional two square miles of controls in 2004, 2005, and 2006. If the City challenges the District's 2003 SIP—practically a given, based on their track record,—then, under the MOA, the City will only be required to control an additional two square miles per year beginning in 2004, and a plotted trend based on the MOA would extend out to 2013 before attainment is reached.

Irrespective of the MOA, the SIP is supposed to ensure EPA mandated compliance well prior to 2013. I would suggest that now is the time to line up support with the ARB and EPA to ensure compliance by 2006, since neither the MOA nor this draft SIP can realistically ensure compliance by 2006 (and not forgetting that 2001 was the compliance deadline under the previously adopted SIP). To me, this means being forthright in the revised SIP about the difficulties the District may have in
9-2 achieving compliance by 2006. The ARB and EPA should be forewarned now, and encouraged to insist on timely compliance by the City of Los Angeles. I think those agencies, and the public, should be informed and alerted—in the text of this revised SIP,—to the precariousness of the "Estimated Design Day Emission Trend with the Proposed Control Strategy" as plotted in Figure 7.2. Nothwithstanding the MOA between the District and the City, the EPA should, and hopefully will, insist on full compliance no later than 2006.

Very truly yours,

Stephen Kalish

9

Letter 9 – Stephen Kalish

9-1 The District does not agree that Figure 7.2 on page 7-7 is misleading. The dashed line does not represent what the District predicts from implementation of two square miles a year between 2004 and 2006, but what the District will accomplish with the 2003 SIP Revision (See paragraph 11 of the Order on page 8-5). The District has expressly retained its authority to revise this SIP to require the City to control whatever area is necessary attain the NAAQS by 2006, and the City has agreed in the MOA to attain and maintain the PM-10 standards by the statutory deadline.

If the City challenges the 2003 SIP Revision, the MOA and the present Order require them to control two square miles a year until the State of California approves the 2003 SIP Revision. Then the City has one year to make up any difference between the 2003 SIP requirements and the two square miles a year. Only if the State of California delays its approval more than two years, will the standards not be attained by the federal statutory deadline.

9-2 The ARB and the EPA, having followed and participated in the difficulties surrounding the adoption of the 1997 Owens Valley SIP, are aware that a similar situation could arise in 2003. As described above, the State of California, by approving the 2003 SIP revision by December 31, 2005, can ensure timely attainment of the standards. If EPA is not satisfied with the enforceability of this SIP revision, they will not approve it, the MOA will become void and a Federal Plan will ensure attainment by 2006.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Ellen Hardebeck
Air pollution Control Officer
Great Basin Unified Air pollution Control District
157 Short Street
Bishop, CA 93514

RE: Comments on Proposed Draft 1998 Revision to the Owens Valley PM_{10} Planning Area-Demonstration of Attainment- State Implementation Plan

Dear Ellen:

10-1 We have given a preliminary review on your Proposed Draft 1998 Revision to the Owens Valley PM_{10} Planning Area, Demonstration of Attainment, State Implementation Plan. On page 7-1 of Chapter 7, the District formally requests from EPA a 5 year extension to the year 2006 for the Owens Valley to reach attainment of the PM_{10} National Ambient Air Quality Standards. We ask that the District address the criteria in 42 U.S.C. § 7513 (e) of the Clean Air Act Amendments of 1990, regarding the requirements for an extension of the attainment date.

Sincerely

David P. Howekamp
Director
Air Division

(10)

OPTIONAL FORM 99 (7-90)

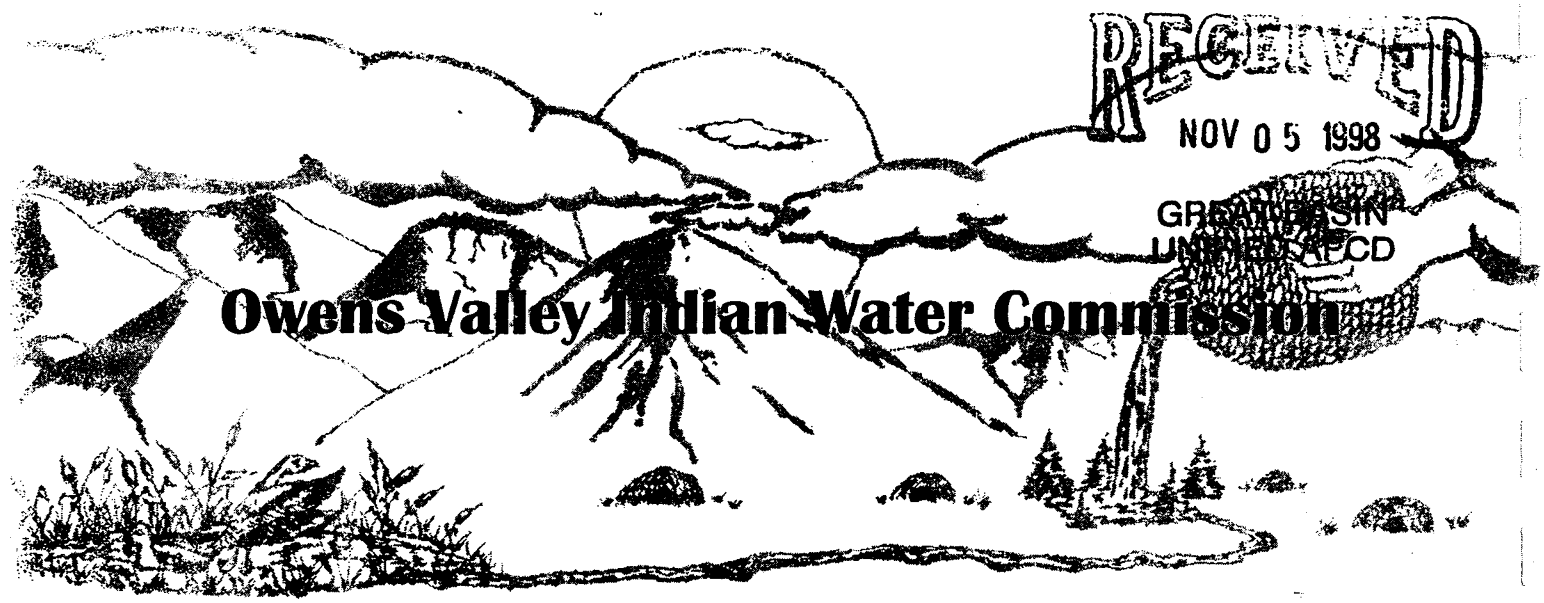
FAX TRANSMITTAL # of pages ▶ 1

To Ellen Hardebeck	From LARRY BILAND
Dept./Agency	Phone # 415-744-1227
Fax # 760-872-6107	Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

Letter 10 – U.S. Environmental Protection Agency, Region 9

10-1 The District's revision to the Owens Valley Planning Area SIP requests the Administrator to grant the five-year attainment extension authorized by 42 U.S.C. § 7513(e). The attainment demonstration presented in the SIP revisions is based on an assumption that the extension will be granted. The Clean Air Act does not require that all the facts supporting the requested extension appear in the SIP. The District has concluded the requested extension is justified under the criteria set out in the Clean Air Act. Some of those criteria are discussed in the District's response to Letter 8, Comment 1 (California Indian Legal Services). The District intends to work closely with the Administrator to insure that she has all the factual information she needs to decide whether to grant the request for an extension.



November 2, 1998

Ms. Ellen Hardebeck, Air Pollution Control Officer
Great Basin Unified Air Pollution Control District
157 Short Street
Bishop, CA 93514

Re.: Comments on Draft 1998 Revision to the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan (SIP)

Dear Ms. Hardebeck:

The Owens Valley Indian Water Commission (Commission) is a tribal entity which serves five tribes - the U-tu Utu Gwaitu Paiute Tribe, Bishop Paiute Tribe, Big Pine Paiute Tribe of the Owens Valley, Fort Independence Paiute Tribe, and the Lone Pine Paiute-Shoshone Reservation. The latter two have reservations located within the designated serious non-attainment area for particulate matter. The Commission hereby submits the following comments on the Draft 1998 Revision to the Owens Valley PM_{10} Planning Area Demonstration of Attainment State Implementation Plan (1998 SIP Revision):

1. On page S-1 of the Summary, the document states the following deadlines:
   - February 8, 1997 - submission of Attainment SIP for serious nonattainment areas to US Environmental Protection Agency.
   - December 31, 2001 - attainment of NAAQS for PM_{10}.
   - December 31, 2006 - latest possible date for attainment of the NAAQS PM_{10} given a discretionary extension by the EPA Administrator.

   As you know, the State of California did not submit an approved SIP on or before the February 8, 1997 deadline. The EPA issued a Notice of Finding to that effect in August 1997. It is also very likely that the NAAQS for PM_{10} will not be met by December 31, 2001, the statutory requirement. The 1998 SIP Revision presupposes that the Administrator will grant a five-year extension for attainment as described in §188 (e) of the Clean Air Act Amendments of 1990 (CAAA). It should be noted that an implementation plan must have been submitted prior to the request for the extension, that the extension is for a period of up to five years, and that demonstration of attainment must indicate the most expeditious alternative date practicable.

11

101 S. Barlow Lane - Bishop, CA 93514 - 760-873-3300 - FAX 760-873-3320

The Commission objects to the request for an extension given that no approved SIP was submitted by the required deadline (nor has one been submitted to date) and given that there is no certainty that the NAAQS for PM_{10} will be attained by December 31, 2006 using the methods in the 1998 SIP Revision.

2. The proposed control strategy in Chapter 7 of the 1998 SIP Revision indicates that control measures may be necessary on up to 22,400 acres (35 mi^2) by December 31, 2006. The implementation phasing summary and mandatory project milestones (Tables 7.1 and 7.2), however, show guaranteed controls on only 14,400 acres by December 31, 2006. Although provisions are made for a SIP revision in 2003 (2003 SIP) and for continuing controls on an additional 1,280 acres per year should the City of Los Angeles appeal the 2003 SIP, there exists the very real possibility that the NAAQS for PM_{10} will not be met even by the extended deadline of December 31, 2006. For this reason, the Commission endorses the proposal put forth by the Lone Pine Paiute-Shoshone Tribe and Timbisha Shoshone Tribe in a letter dated October 27, 1998 (attached).

   This proposal only modifies the area of control that could be required during the final year of the attainment process. Rather than require dust control measures on a minimum of 1,280 acres (2 mi^2) during 2006, the proposal would set the increment at 5,440 acres (8.5 mi^2) for that year. Maximum cumulative controls would total 18,560 acres (29 mi^2) as opposed to the 14,400 acres (22.5 mi^2) currently set forth in the 1998 SIP Revision (page 7-4). There are two key benefits to this plan:

   - An increased mandatory milestone for the year 2006 enhances the likelihood of attainment by the extended deadline even if Los Angeles appeals the 2003 SIP revision.
   - The 2006 increment area can be reduced if Great Basin determines in the 2003 SIP revision that the entire final year increment is not necessary for attainment. Los Angeles is thus assured that control beyond that needed for attainment will not be required.

The Commission commends the Great Basin Unified Air Pollution Control District and the City of Los Angeles for cooperatively working towards attainment of the NAAQS for PM_{10} in the Owens Valley Planning Area. The modification to the 1998 SIP Revision described in this letter only furthers the goal of attainment by the statutory deadline. Thank you for the opportunity to comment.

Sincerely,

Rachel A. Joseph

Rachel A. Joseph, Chairperson

Cc: U-tu Utu Gwaitu Paiute Tribe
Bishop Paiute Tribe
Big Pine Paiute Tribe of the Owens Valley
Fort Independence Paiute Tribe
Lone Pine Paiute-Shoshone Reservation

11

Letter 11 – Owens Valley Indian Water Commission

This letter was received well after the October 26, 1998 deadline for written responses, however, the issues raised are very similar to those raised in Letter 8 (California Indian Legal Services) and are addressed there.

Appendix J

Letters Regarding the EPA Natural Events Policy

Appendix K

Control Measure Estimated Costs per Acre and per Ton of PM_{10} Controlled

Letter from Great Basin APCD to EPA Region IX Regarding Natural Events Policy

Ellen Hardebeck
Control Officer

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

157 Short Street - Bishop, CA 93514
(760) 872-8211 * Fax (760) 872-8109

May 15, 1998

Ms. Felicia Marcus
Regional Administrator
EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105

Dear Ms. Marcus:

During our discussions with the City of Los Angeles over the Owens Valley Planning Area PM-10 Demonstration of Attainment State Implementation Plan, we have discovered a disagreement over the interpretation of EPA's Natural Events Policy as it relates to high winds and anthropogenic sources. For anthropogenic sources, such as Owens Lake, the policy says "Ambient PM-10 concentrations due to dust raised by unusually high winds will be treated as due to uncontrollable natural events under the following conditions: ... (2) the dust originated from anthropogenic sources controlled with best available control measures (BACM)." (Pages 4 and 5)

The District interprets this section to mean that, to be eligible for exclusion under the Natural Events Policy, two separate and independent tests must be met. First, the concentrations must be "due to dust raised by unusually high winds" and second, the anthropogenic source must be controlled with BACM. The definition of "usually high winds" is completely independent of what has been determined to be BACM.

The City interprets this section to mean that, if an anthropogenic source is controlled with BACM, all winds that overcome BACM are "unusually high winds". Only one test then needs to be met - that the source is controlled with BACM. Under this interpretation, all exceedances of the standard caused by dust raised from anthropogenic sources controlled with BACM are eligible for exclusion under the Natural Events Policy, irrespective of the wind speed or frequency.

The District is requesting a formal legal opinion from EPA on which interpretation of the Natural Events Policy is correct. Please let me know as soon as possible so that this question will not continue to be a barrier to a settlement of litigation over the Owens Valley Plan. Thank you.

Sincerely,

Ellen Hardebeck

Ellen Hardebeck
Air Pollution Control Officer

Letter from USEPA Region IX to Great Basin APCD regarding Natural Events Policy

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

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JUL - 6 1998
GREAT BASIN
UNIFIED APCD

JUN 11 1998

Ellen Hardebeck
Air pollution Control Officer
Great Basin Unified Air pollution Control District
157 Short Street
Bishop, CA 93514

Dear Ellen:

Thank you for your recent letter to our Regional Administrator Felicia Marcus concerning EPA's May 30, 1996 Natural Events Policy. I have been asked to respond to your request. We agree with your interpretation of the policy that two separate and independent tests must be met before an exceedance of the PM-10 standard can be excluded as due an uncontrollable natural event. The first test is that anthropogenic sources must be controlled with best available control measures (BACM). The second test is that the unusually high winds were the cause of the exceedance. The definition and determination of "unusually high winds" are completely independent of what has been determined to be BACM.

If we can be of further assistance, please contact Larry Biland of my staff at (415) 744-1227.

Sincerely

David P. Howekamp
Director
Air Division

Printed on Recycled Paper

Appendix K

Control Measure Estimated Costs per Acre and per Ton of PM_{10} Controlled

APPENDIX K – Control measure estimated costs per acre and per ton of PM_{10} controlled.

Item	Construction ($)	Maintenance ($)	Annualized*($)
Shallow Flooding (8,400 acres assumed)			
Flood area	503,700	319,010	
Recirculation pumps	300,000	53,750	
Water transmission	8,827,236	13,860	
Water outlets	2,073,500	17,160	
Water recirculation	613,008	9,288	
Berms	653,267	19,120	
Roads	50,920	3,040	
Electric power	297,000	5,940	
Engineering/Contingencies	1,997,795	44,117	
Purchased water		15,111,000	
Subtotal	15,316,426	15,596,285	17,902,630
Cost per acre	**1,824**	**1,858**	**2,133**
Cost per ton PM_{10} controlled**			**164**
Managed Vegetation (8,700 acres assumed)			
Vegetation area	16,303,800	2,001,000	
Recirculation pumps	240,000	43,000	
Water transmission	8,827,236	13,860	
Water recirculation	408,672	6,192	
Berms	653,267	19,120	
Roads	50,920	3,040	
Flood channel	473,154	8,844	
Electric power	297,000	5,940	
Engineering/Contingencies	4,088,107	210,100	
Purchased water		7,830,000	
Subtotal	31,342,156	10,141,096	14,762,587
Cost per acre	**3,603**	**1,166**	**1,697**
Cost per ton PM_{10} controlled**			**131**
Gravel (5,300 acres in Proposed Project)			
Gravel area	57,028,000	768,500	
Berms	653,266	19,120	
Roads	50,920	3,040	
Flood channel	233,046	4,356	
Engineering/Contingencies	8,694,785	79,502	
Subtotal	66,660,017	874,518	7,504,867
Cost per acre	**12,566**	**165**	**1,415**
Cost per ton PM_{10} controlled**			**109**
EMISSION AREA (22,400 acres)			
TOTAL	113,318,599	26,611,898	40,170,084
COST PER ACRE	**5,059**	**1,188**	**1,793**
Cost per ton PM_{10} controlled**			**138**

*Annualized using EPA BACM methodology

**Annual emissions = 291,100 tons (from Table 4.2)
= 13 ton per acre