STATE IMPLIMENTATION PLAN

AND NEGATIVE DECLARATION / INITIAL STUDY

FOR

OWENS VALLEY PM-10 PLANNING AREA

PREPARED BY

GREAT BASIN UNIFIED

AIR POLLUTION CONTROL DISTRICT

157 Short Street, Suite 6

Bishop, CA 93514

December 1988

Ellen Hardebeck
Control Officer

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

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

December 14, 1988

Mr. James Boyd
Executive Office
Air Resources Board
P.O. Box 2815
Sacramento, CA 95812

Dear Mr. Boyd:

Attached please find the State Implementation Plan and Negative Declaration for the Owens Valley PM-10 Planning Area. This Plan was approved by the Great Basin Unified Air Pollution Control District Board on December 14, 1988.

The major source of the Federal PM-10 Ambient Air Quality Standard violations is Owens Lake, a 110 square-mile dry lake. Our District is developing and testing control measures for this source, but they will not be available soon enough to allow compliance with the standards within three years. Please request the Governor to ask the EPA Administrator for a two-year extension of the compliance date.

Thank you.

Sincerely,

HB Irwin

H. B. Irwin
Board Chairman

RESOLUTION OF THE GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT BOARD MAKING CERTAIN FINDINGS AND ADOPTING THE STATE IMPLEMENTATION PLAN FOR THE OWENS VALLEY PM-10 PLANNING AREA

WHEREAS, the United States Environmental Protection Agency (EPA) promulgated a new ambient air quality standard in July, 1987 for particulate matter less than ten (10) microns in diameter (PM-10); and

WHEREAS, on August 7, 1987, the EPA identified the portion of the Owens Valley between Tinnemaha Reservoir and Haiwee Reservoir as an area where the PM-10 standard was being violated; and

WHEREAS, Section 110 (a)(1) of the federal Clean Air Act mandates that the State of California, after reasonable notice and public hearings, adopt and submit to the EPA within nine (9) months after the promulgation of the new PM-10 standard, a revision of the State Implementation Plan (SIP) which provides for the implementation, maintenance and enforcement of the PM-10 standard within the southern Owens Valley; and

WHEREAS, under California law, the Great Basin Unified Air Pollution Control District (GBUAPCD) is the governmental entity charged with the responsibility of developing and of adopting such a SIP, and with timely submitting such an adopted SIP to the State of California Air Resources Board; and

WHEREAS, the staff of the GBUAPCD has developed and circulated for public review, and received and considered public comment upon, a draft SIP for the southern Owens Valley; and

WHEREAS, the SIP is now before this Board for consideration of final adoption.

THEREFORE, BE IT RESOLVED that following review by this Board of the SIP prepared by the GBUAPCD staff, after consideration of written public comments received on the draft SIP, and of oral public and staff comment on the draft SIP received at a public hearing held this date, this Board hereby finds as follows:

1. The single major source causing violations of the federal PM-10 standard in the area of the Owens Valley between Tinnemaha Reservoir and Haiwee Reservoir is Owens Dry Lake.

2. Wind blown dust from Owens Dry Lake causes violations of the federal PM-10 standard at distances greater than 25 miles downwind from the Lake.

3. Of the Owens Dry Lake total area of 110 square miles, there is 46.5 square miles of area that produces wind blown dust that contributes to violations of the federal PM-10 standard.

4. The necessary technology or other alternatives for controlling wind blown dust from sources such as Owens Lake has not yet been developed.

5. The SIP provides for the development of measures necessary to insure the attainment and maintenance of the federal PM-10 standard in the southern Owens Valley as expeditiously as practicable given the current lack of proven measures for controlling the wind blown dust from Owens Dry Lake.

6. THE SIP assures that through the implementation of the provisions of California Health and Safety Code section 42316 for study and mitigation of the air quality impacts on Owens Dry Lake caused by the production, diversion, storage or conveyance of water by the City of Los Angeles, and for annual funding of the GBUAPCD by the City of Los Angeles for the costs of the GBUAPCD associated with the development of mitigation measures with respect to these water gathering activities of the City of Los Angeles, as well as through the development and adoption by the GBUAPCD of regulations as necessary to provide for the implementation of reasonably available control measures not capable of implementation under section 42316, the GBUAPCD will have adequate personnel, authority and funding to carry out the provisions of the SIP.

7. The SIP includes provisions for the establishment and operation of appropriate devices, methods, systems and procedures necessary to monitor, compile and analyze data on ambient air quality in the southern Owens Valley.

BE IT FURTHER RESOLVED that in consideration of each of the foregoing findings, statements and legal requirements, this Board hereby approves and adopts, as modified by staff, the draft SIP as the State Implementation Plan for the Owens Valley PM-10 Planning Area.

BE IT FURTHER RESOLVED that the adopted SIP be forwarded for appropriate review to the California Air Resources Board.

Passed and Approved this 14th day of December, 1988.

AYES: 6

NOES: 0

ABSENT: 0

N B Irwin

Chairman

ATTEST:

Donna Leavitt

Clerk of the Board

STATE IMPLEMENTATION PLAN

AND NEGATIVE DECLARATION / INITIAL STUDY

FOR

OWENS VALLEY PM-10 PLANNING AREA

PREPARED BY

GREAT BASIN UNIFIED

AIR POLLUTION CONTROL DISTRICT

157 Short Street, Suite 6

Bishop, CA 93514

DECEMBER 1988

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0.0 EXECUTIVE SUMMARY

0.1 Background

The United States Environmental Protection Agency (EPA) promulgated a new ambient air quality standard in July 1987 for particulate matter less than 10 microns in diameter. This new standard, called PM-10, replaced the old Total Suspended Particulate (TSP) standard that had existed since 1971. TSP included all airborne particulates without regard to particle size or ability to be inhaled into the human respiratory system. The PM-10 standard can be more easily associated with health impacts.

On August 7, 1987 EPA identified those regions of the country where the new standard was being violated. The Owens Valley between Tinemaha Reservoir and Haiwee Reservoir was one such area. Each identified area is required by the Federal Clean Air Act to produce a State Implementation Plan Revision that verifies the violations, identifies the sources of PM-10 contributing to the violations, and show how those sources will be controlled within three to five years so that violations will no longer occur. This is the required Plan.

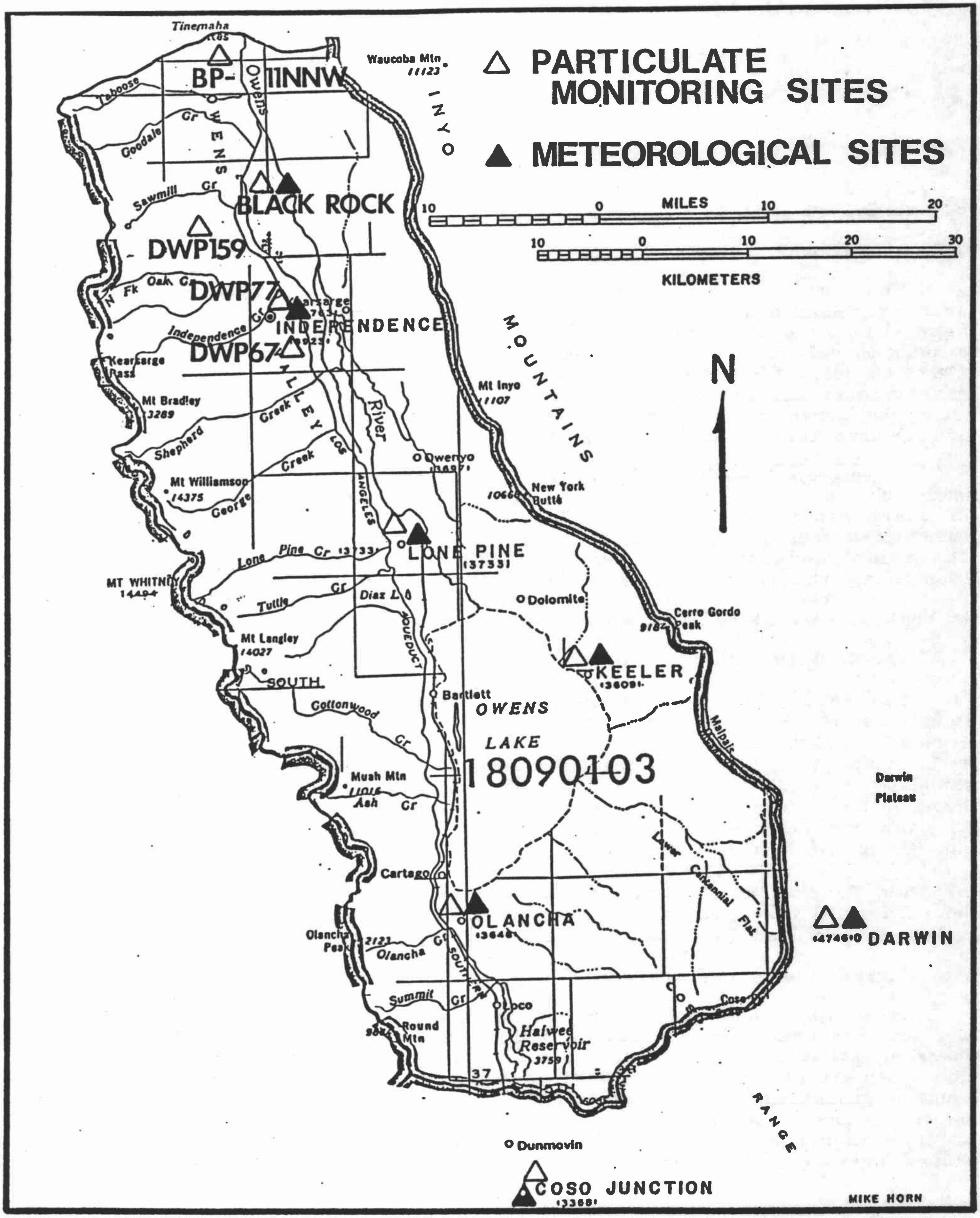
0.2 Air Quality Data

The boundaries of the Owens Valley Planning Area, and the locations of PM-10 and meteorological monitoring sites are shown in Figure 1. Eight sites were located within the planning area, and two sites outside of the area were also used to identify sources. Most of the data used was TSP, but the Lone Pine site has three years of PM-10 data, and the Coso and Darwin sites are PM-10. Co-located TSP and PM-10 samplers were run at Keeler for a year, so a site-specific conversion factor is available.

The Federal PM-10 standard was observed to be exceeded 4 times at Lone Pine, 15 times at Keeler (converted TSP), twice at Darwin, and 4 times at Coso Junction from March 1985 through March 1988.

0.3 Source Identification

Since there are only a few major potential sources of PM-10 in the area, source identification was done on the basis of upwind-downwind comparisons. An analysis of wind direction and speed on the days when PM-10 levels were high shows that the single major source causing violations of the federal PM-10 standard within this area is Owens Dry Lake. Owens Lake covers 110 square miles near the south end of the planning area; about 60 square miles are dry. Large dust plumes have been observed coming off of this lake on windy days.



Air Monitoring Locations

Figure 1

Other identified sources of PM-10 include an area east of the Owens River from Mazourka Canyon to Lone Pine, Tinemaha Reservoir, and an area east of Independence. These sources contribute to, but do not individually cause, violations. The one point source with emissions over 100 tons per year was modeled, and shown not to be a significant contributor. There are no other point sources in the area large enough to cause or contribute to violations.

0.4 Air Quality Impacts

Owens Lake has been shown to cause concentrations over the significant harm to health level at distances greater than 25 miles downwind. Standard violations could occur more than 60 miles downwind, and visibility reduction has been observed more than 150 miles from this source. Figure 2 shows the extent of observed dust plumes from Owens Lake. These plumes sometimes contain enough sulfate to violate the California standard at Keeler. Because of the extent of the plumes, the health of an estimated 40,000 people may be affected by this one source.

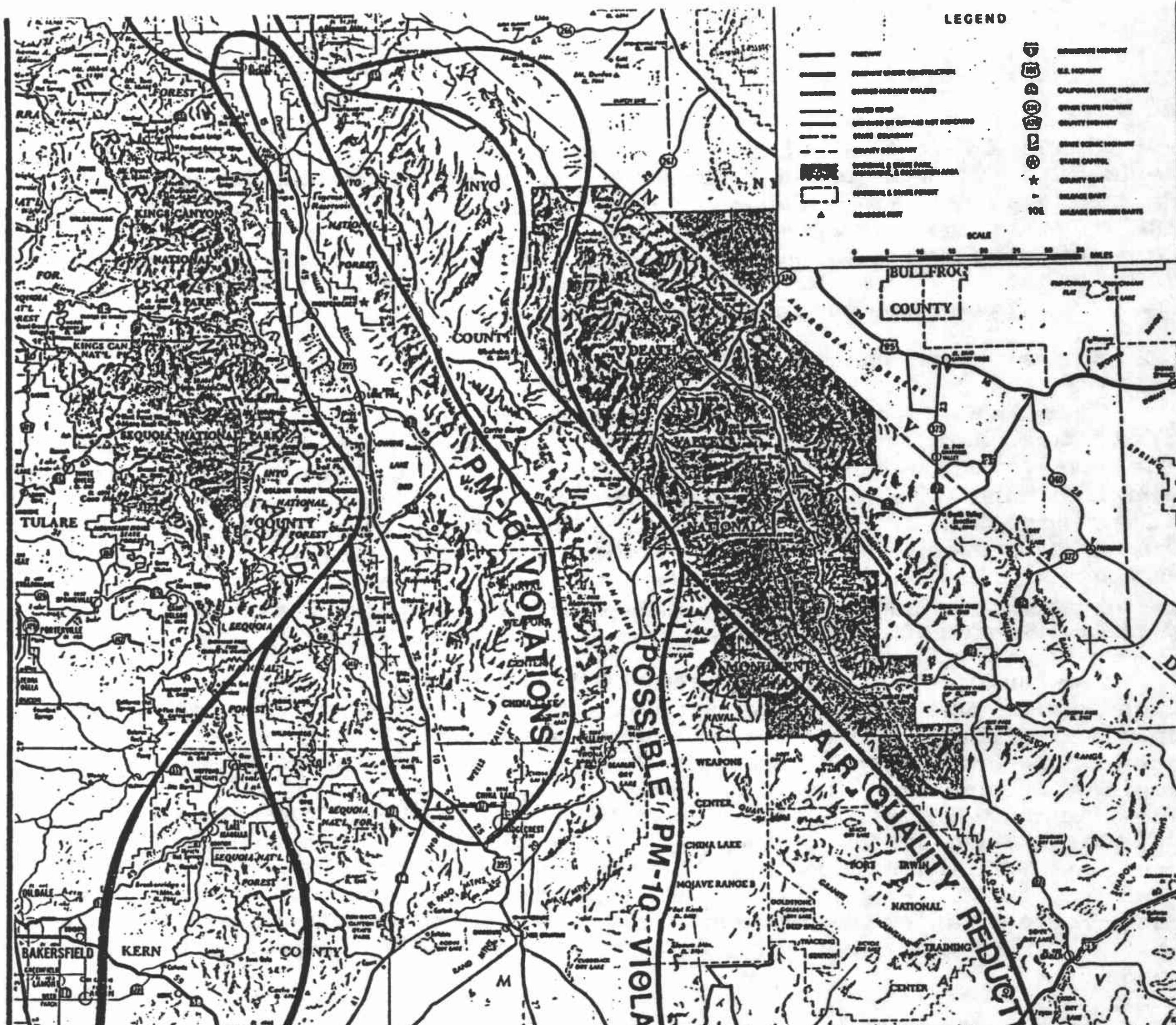
A calculation using the frequency of violations at all monitoring sites shows that Owens Lake causes more than 90% of the violations measured at Lone Pine, Keeler, Darwin and Coso; an average of 48 federal 24-hour PM-10 violations per year if corrected for the sampling frequency. There are several areas in the vicinity of Owens Lake where visibility should be protected: the John Muir Wilderness , a Class I area on the northwest boundary of the planning area; the Dome Land Wilderness, a Class I area 24 miles south-southwest of the boundary; the Golden Trout Wilderness on the southwest boundary; the Death Valley National Monument, 15 miles east of the planning area; and the China Lake Naval Weapons Center, partially located within the boundaries.

0.5 Control Measures

Every wind storm does not cause dust from Owens Lake. The salt, sand and silt that make up the lake surface form under some conditions a hard crust that will not blow. Under other conditions the crust at the same place may be soft and fluffy, and easily lofted. Control measures must be designed to alter the natural conditions so that the soft crust does not form.

Not all of the 100 square miles must be controlled. There is a body of brine at the center of the lake, and the areas near this water stay too wet and crusted to blow. Figure 3 shows the areas of concern, and suggested control measures for each area.

The mitigation that seems most promising at this time for the sand-dominated areas is sprinkling with locally-produced ground water when a wind-storm is predicted and crust conditions are poor. The District plans to test this mitigation on a one-square mile area



Area of Owens (Dry) Lake Dust Impact

Figure 2

1.0 PM-10 Group I Area

1.1 PM-10 Air Quality Standard

The Environmental Protection Agency (EPA) promulgated a new ambient air quality standard in July 1987 for particulate matter less than 10 microns in diameter. This new standard, called PM-10, replaced the old Total Suspended Particulate (TSP) standard that had existed since 1971.

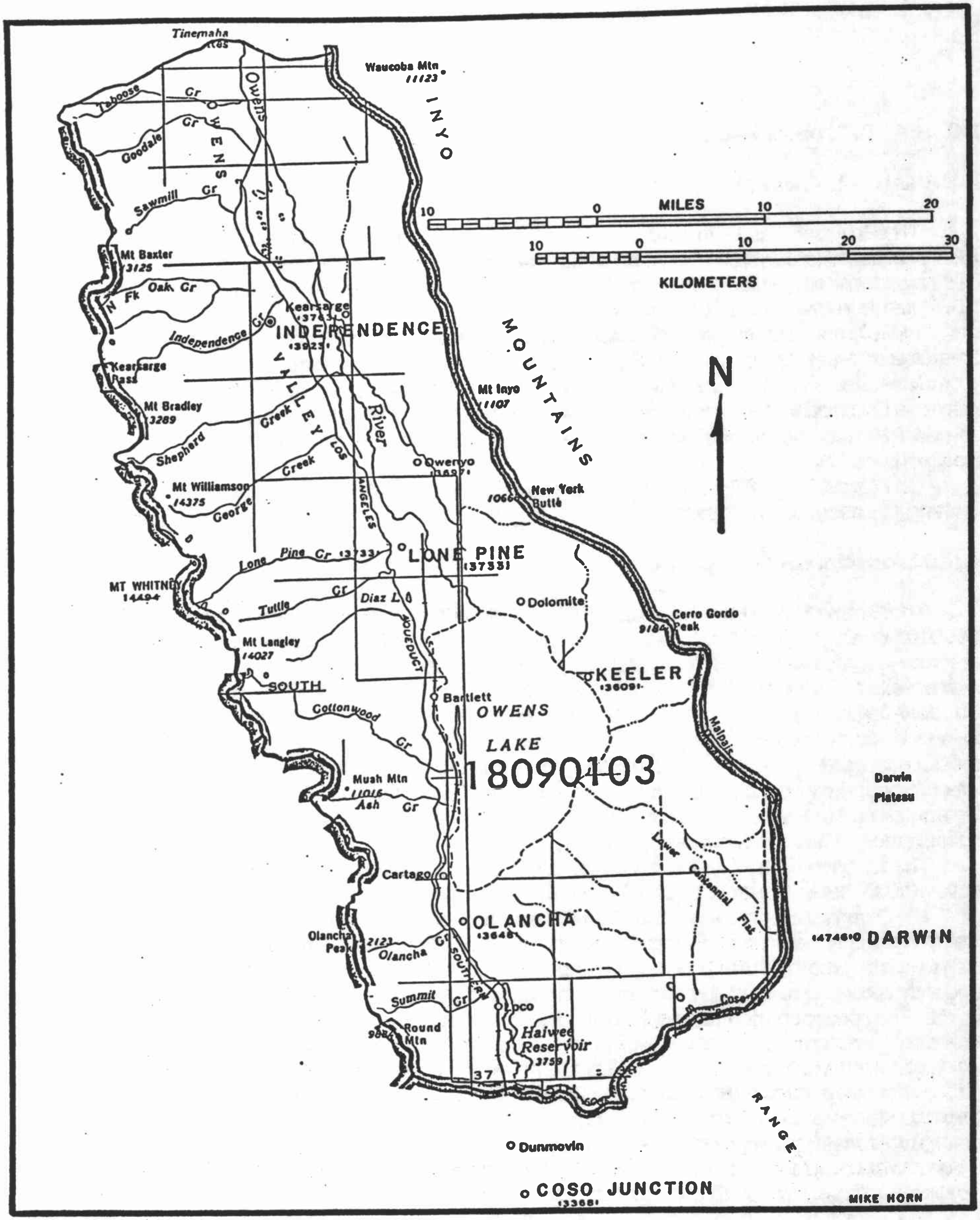
PM-10 replaced the old TSP standard to achieve a better relationship between the standard and human health. TSP included all airborne particulates without regard to particle size or ability to be inhaled into the human respiratory system. Thus health effects as opposed to welfare impacts of particulates were difficult to separate. With the new PM-10 standard one can more easily associate the ambient standard with health impact.

On August 7, 1987 EPA identified the southern Owens Valley as an area violating the new PM-10 Standard.

1.2 Description of Group I Area

The Owens Valley Group I Area (OVGA) is identified as hydrologic unit number 18090103 on the State of California, Hydrologic Unit Map - 1978. Tinemaha Dam and reservoir identify the northern boundary line that runs east and west across the Owens Valley. The crest of the Sierra Nevada Mountain Range makes up the western boundary beginning in the north at approximately Taboose Creek and running south to Round Mountain where it begins to curve eastward. The southern boundary crosses eastward at Haiwee Reservoir into the Coso Range to Coso Peak. At Coso Peak the boundary curves northward across Lower Centennial Flat. From Lower Centennial Flat the western boundary runs along the crest of the Inyo Mountains to approximately Waucoba Mountain (Figure 1).

The air shed in the OVGA is contained between the Sierra Nevada averaging above 13,000 feet to the west and the Inyo Mountains averaging over 9,000 feet to the east. The Owens Valley floor averages 3,600 feet in elevation. Morning and night time inversions are common during the winter months. The valley floor runs the entire north to south length of the OVGA and ranges from 6 to 12 miles wide. Winds are frequently recorded above 20 miles per hour during the fall, winter, and spring months. The predominant direction is from the northwest flowing down the valley. A secondary predominant direction is from the south and southeast flowing up valley. Most high wind events precede and follow storm fronts associated with low pressure troughs that move across the area off the Pacific Ocean. High west winds flowing down the slopes of the Sierra Nevada can also be associated with these same storm fronts. Additionally strong high pressure ridges building behind low pressure troughs produce wind events in the valley. These high pressure winds are similar to the so-called Santa Ana winds in the Los Angeles Basin area.



Map of OVGA Boundaries

Figure 1

Six communities are located within the OVGA boundaries. Starting from the north the communities are Independence (Inyo County Seat), Lone Pine, Dolomite, Keeler, Cartago, and Olancha. Additionally, small ranches and housing developments are located throughout the area. The total population permanently living within the OVGA is approximately 3,088 people. California State Highway 395 is the only major highway running through the OVGA, bringing tens of thousands of tourists per day to the area.

Tourism is the main economic source for the communities located throughout the OVGA. Hunting, fishing, hiking, camping, and skiing are among the many recreational opportunities that can be found along the Eastern Sierra Nevada. Visibility and excellent air quality are important assets to the recreational visitors that come to the area each year.

Several high visibility areas are located within 25 miles of the OVGA boundaries. All of these areas have been identified in some manner for recreational, environmental or military interest. Visibility is a high priority in these areas to protect their uniqueness, and is potentially threatened by their proximity to the OVGA.

The John Muir Wilderness is located along the northwest boundary of the OVGA. This area has been designated as a Class I area by the Environmental Protection Agency (EPA) for the Prevention of Significant Deterioration (PSD) program. Visibility and excellent air quality are major concerns for this scenic area of mountains and forest.

A second Class I area, the Dome Land Wilderness Area, is located approximately 24 miles south southwest of the OVGA boundary. This area was protected for its unique geology and wilderness status. Visibility and good air quality again are very valuable assets to this area.

The Golden Trout Wilderness Area is located on the southwest boundary of the OVGA. This area is designated as Class II. Golden Trout found in this area are the only trout native to the Sierra Nevada Mountain Range. Protection of this area is a major concern for the continued preservation of the Golden Trout and their natural habitat.

The Death Valley National Monument is located approximately 15 miles east of the OVGA. This area also holds a Class II designation. Desert wilderness and geology are among the many unique qualities that have been recognized as needing protection in this area.

Several other national parks and forests are located within 25 miles of the OVGA boundaries; the Kings Canyon National Park, Sequoia National Forest and Inyo National Forest. Parts of the Inyo National Forest are located inside the OVGA boundaries.

The Department of Defense has expressed concern for air quality and visibility in the R-2508 Airspace located to the south of the OVGA boundaries. The China Lake Naval Weapons Center (NWC) is partially located within the OVGA boundaries. Good atmospheric visibility is a requirement for continued flight and weapons testing at the NWC. As a result of the severe dust storms from the dry bed of Owens Lake, operations at China Lake are gravely affected at least 5 and as often as 10 days per year at a cost of about 500,000 dollars per day in lost range time. (Saint-Amand, private com. 1988)

Highway and air traffic from Red Rock Canyon to Mono Lake are often seriously hampered by the dust. (Saint-Amand, private com. 1988).

1.3 Air Quality Monitoring

The Great Basin Unified Air Pollution Control District (GBUAPCD) began monitoring for particulates in 1979. No long term monitoring had been completed prior to 1979 within the Great Basin Valleys Air Basin (GBVAB). The California Air Resources Board had conducted spot monitoring throughout the GBVAB in 1972 identifying particulates as the most likely air quality problem. Since 1979 the GBUAPCD has monitored particulates in 18 locations throughout the GBVAB from as far north as Mono Lake to Little Lake in the south.

Currently the GBUAPCD is monitoring particulates at 12 locations throughout the GBVAB. All twelve locations have been modified to monitor PM-10. The change over from TSP sampling systems to PM-10 sampling systems was accomplished over several years. Appendix A should be referenced for monitoring periods, and sampling method changes for each site.

1.3.1 Monitoring Network

PM-10 monitoring sites located within the OVGA have been divided into three main sites and two secondary sites that monitor the air quality to determine compliance. The Lone Pine site was used for determining Group I designation of the Owens Valley area. This site is located at 501 East Locust Street on top of the Southern Inyo Hospital building and has the longest record of PM-10 data in the OVGA. Two other monitoring sites that have shown high probability of exceeding the PM-10 standard based on previously collected TSP data are the Keeler site and the Olancha site. PM-10 sampling systems are currently operating at both of these locations. Violations of the PM-10 standard have already occurred at both the Keeler and Olancha sites since installation of the PM-10 systems. The two secondary monitoring sites are located near Independence. These two stations delineate the air quality in the northern OVGA. PM-10 monitoring began at these sites in June 1988. No PM-10 violations have been documented at either of these locations.

In addition to the monitoring system described within the OVGA, two PM-10 monitoring sites outside the OVGA will be used to complete an up wind, downwind system from Lone Pine and major sources within the OVGA. These sites are located at Darwin and Coso Junction south of the OVGA boundaries.

1.3.2 Quality Assurance Program

The Quality Assurance Program used for the monitoring performed by the GBUAPCD follows the guidelines laid out in the Federal Register and California State Quality Assurance Manual. Section 40 CFR 58 of the Federal Register discusses quality assurance necessary to assure data accuracy. To supplement this information the GBUAPCD uses the California Air Resources Quality Assurance Manual. Equipment operation manuals direct the operators in the proper use of their equipment. Thorough training and supervision of air monitoring personnel coupled with the federal and state documentation assures as complete and accurate a data base as possible. The reader is referred to the above described documents to gain further details of the quality assurance program utilized by the GBUAPCD. Quality assurance documentation for data discussed can be obtained from the GBUAPCD Bishop office.

1.4 Particulate Data Analysis

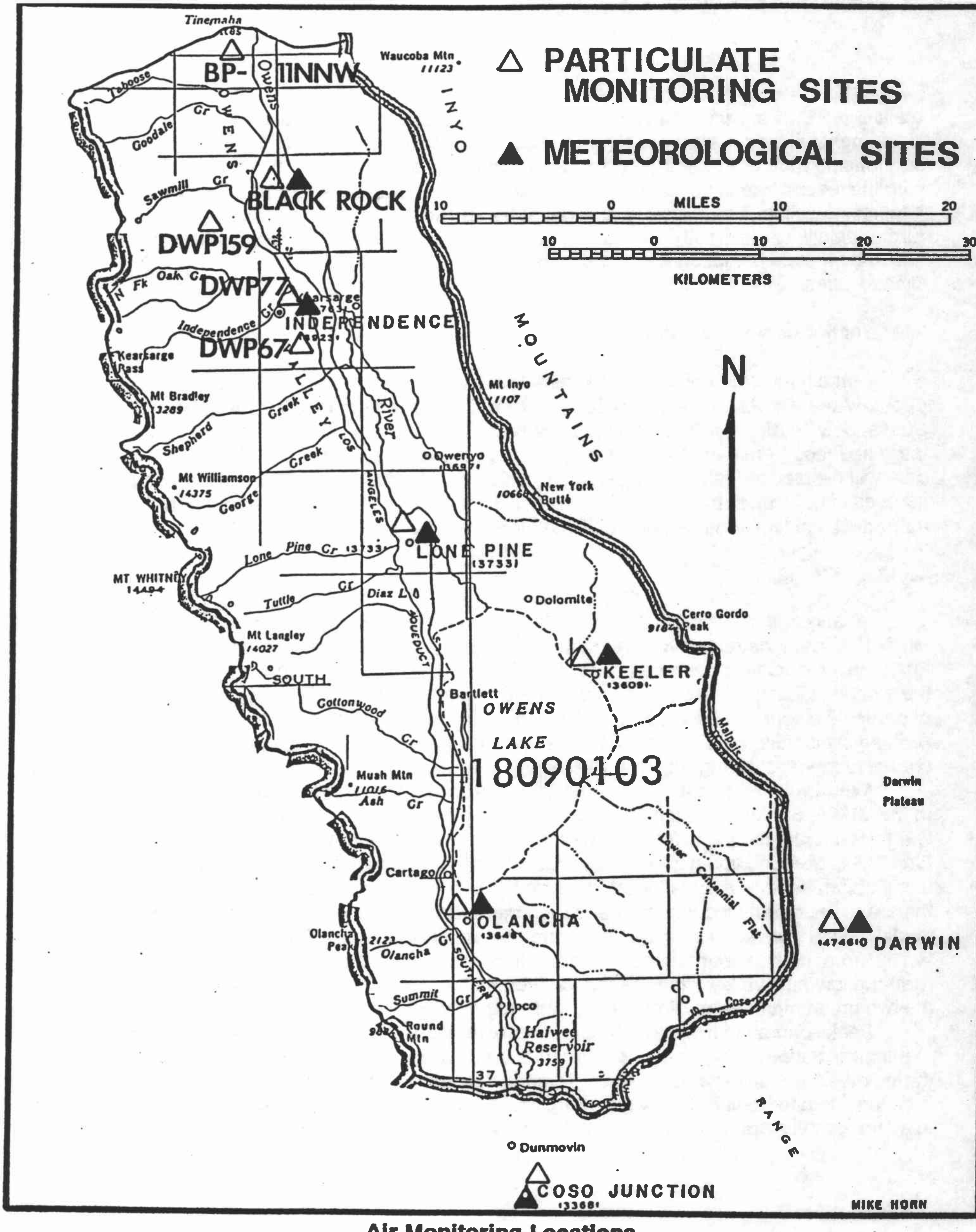
Particulate data has been collected at eight locations within the Owens Valley Group I Area (OVGA). Most of the data collected at these eight locations is Total Suspended Particulate (TSP) data. It seems pointless and wasteful to ignore such a large and long term data base just because the standard changed to PM-10. TSP data will be used to identify frequency of pollution episodes and to further identify the sources of pollutants in the area. The reader is referred to Figure 2 and Appendix A for names and locations of particulate sampling locations discussed in this SIP.

1.4.1 TSP Data

Analysis of the Total Suspended Particulate (TSP) data collected in the OVGA since 1979 demonstrates two clear facts about the particulate problem (Appendix B). First, the air quality in the area is excellent when the winds do not blow. Second, all the sampling locations down the Owens Valley become either up wind or down wind of particulate sources depending on the wind direction. The first fact identifies the problem as fugitive wind-blown dust. The second fact will allow us to identify the source or sources throughout the OVGA.

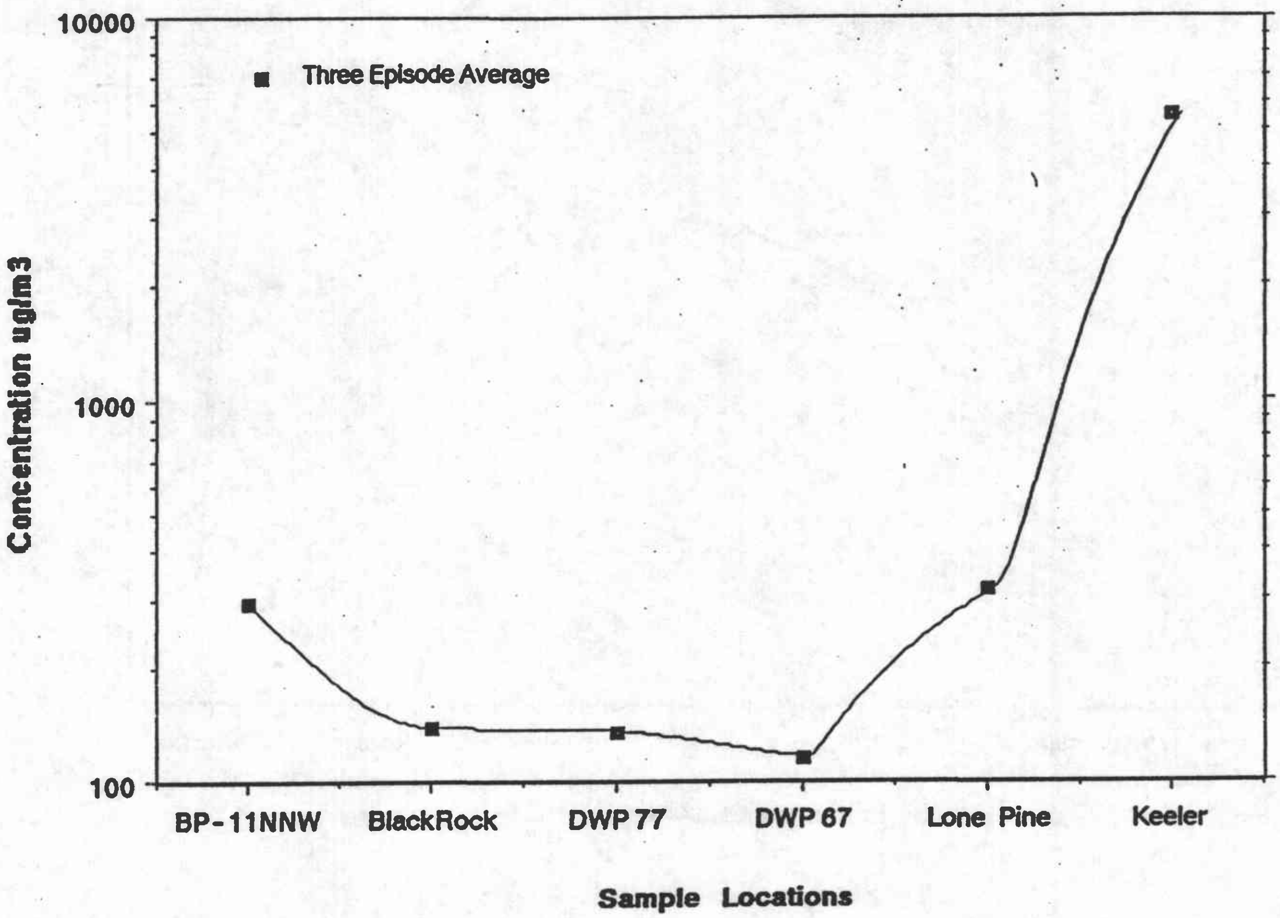
We have set the Lone Pine Monitoring Station as the middle or central station in the OVGA. Stations to the North and to the South will be used as up wind and down wind monitoring locations from Lone Pine. Since the normal day-to-day air quality in the OVGA averages about 30 micrograms per cubic meter (ug/m3), we will make the assumption that any concentration recorded above 100 ug/m3 is unusually high for the area. Therefore, all concentrations recorded above 100 ug/m3 will be scrutinized to allow us to isolate the sources impacting the sample locations. Profiling the Owens Valley from north to south using concentrations recorded in the monitoring system running down the valley identifies the locations of high and low particulate levels for the two predominate wind directions, South and North (Figures 3 through 6).

Peaks can be found at the Keeler, Independence # 77, and Big Pine - 11NNW monitoring stations. The Keeler location has by far the greatest frequency of peaks during events. Profiles tend to either gradually increase from the north to Keeler or from the south to Keeler. Comparing wind conditions for each event tells us that the up wind samples from Keeler are much lower in concentration approaching the



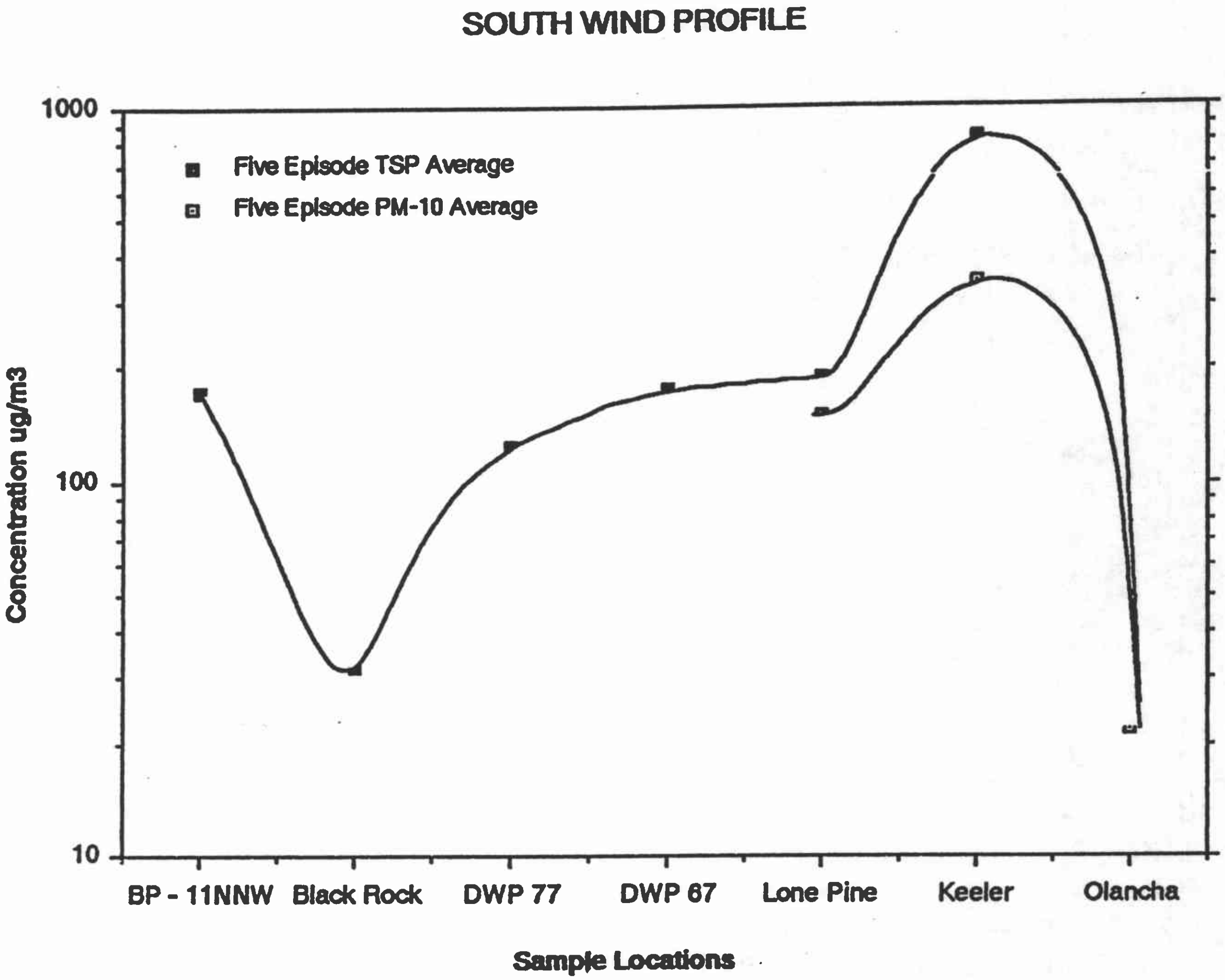
Air Monitoring Locations
Figure 2

NORTH WIND TSP PROFILE



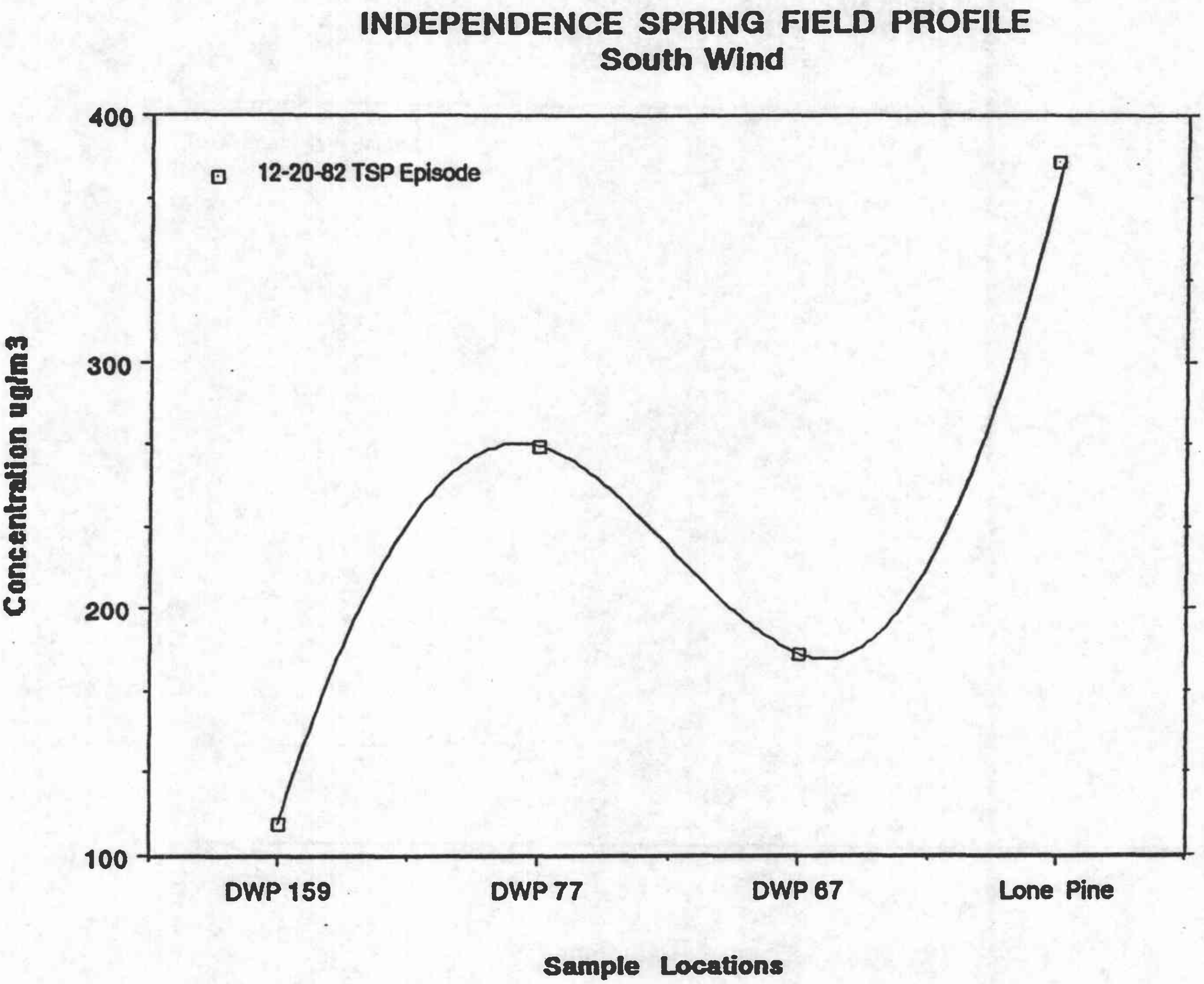
North Wind TSP Profile

Figure 3



South Wind TSP and PM-10 Profile

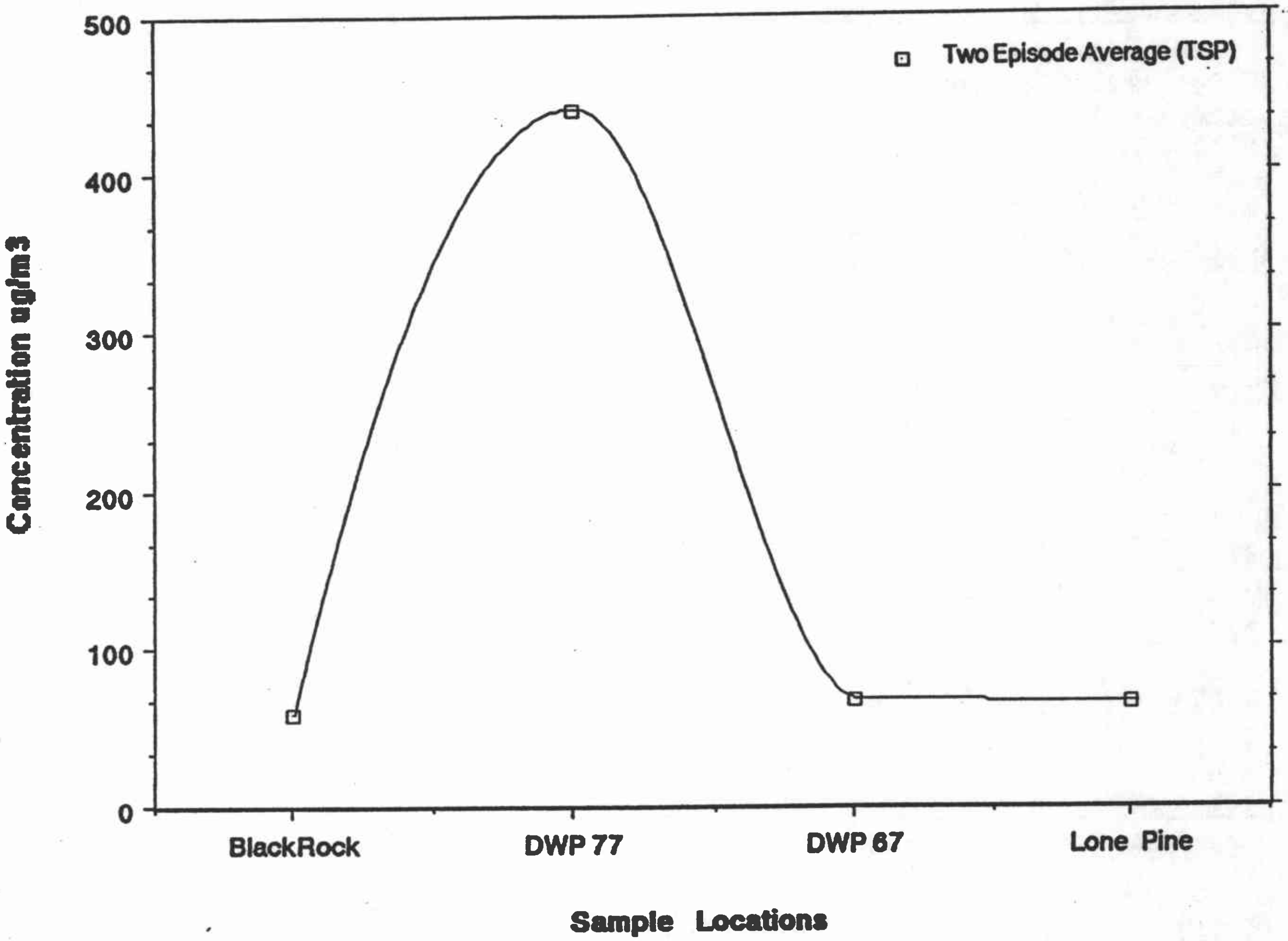
Figure 4



Independence Spring Field Profile # 1

Figure 5

INDEPENDENCE SPRING FIELD PROFILE
South Wind During Mitigation Construction



Independence Spring Field Profile # 2

Figure 6

background of 30 ug/m3. Concentrations at locations downwind of Keeler are higher than background, usually in the hundreds of micrograms per cubic meter. Therefore, Keeler must be located near a very large source of particulates. In fact, Keeler is located on the shoreline of Owens (Dry) Lake; 110 square miles of barren sand, silt, clay, alkali efflorescence and water.

Moving on to the peak identified at the Independence # 77 monitoring location (figure 5 and 6), we identify a potential local source smaller than that seen near Keeler. Impacts do not extend much beyond the next sample location or 7 miles from the source. Frequency of occurrence appears to be only one to two dust episodes per year. This source was identified in 1980 as an approximately 300 acre barren area located directly east of Independence. Two smaller sources were identified approximately .5 mile and 3 miles north of the sample site. As shown in figure 6 recent mitigation of this area has led to violations of the PM-10 standard during clearing of the land and construction.

Continuing north to the third peak located at the Big Pine - 11NNW, there appears to be a local source similar to that found near Independence. In fact, however, there must be two particulate sources impacting this monitoring site. Peaks can be found during both north and south wind periods. The closest source to the north is the Tinemaha Reservoir. When the water level in this small reservoir is lowered the barren soils exposed blow during wind events. This condition has been observed on many occasions by GBUAPCD staff. Air quality impact from this source has not been documented beyond the Independence area.

The monitoring profiles do not indicate that the sources identified near Independence and at Tinemaha impact the Lone Pine area. Then what sources cause the high concentrations recorded at Lone Pine when winds are from the North and at Big Pine - 11NNW when the winds are from the South? Observation and photographic documentation collected by GBUAPCD staff have identified the Owens Valley floor east of the Owens River as a major source. This area will be explained in more detail in the emission inventory section.

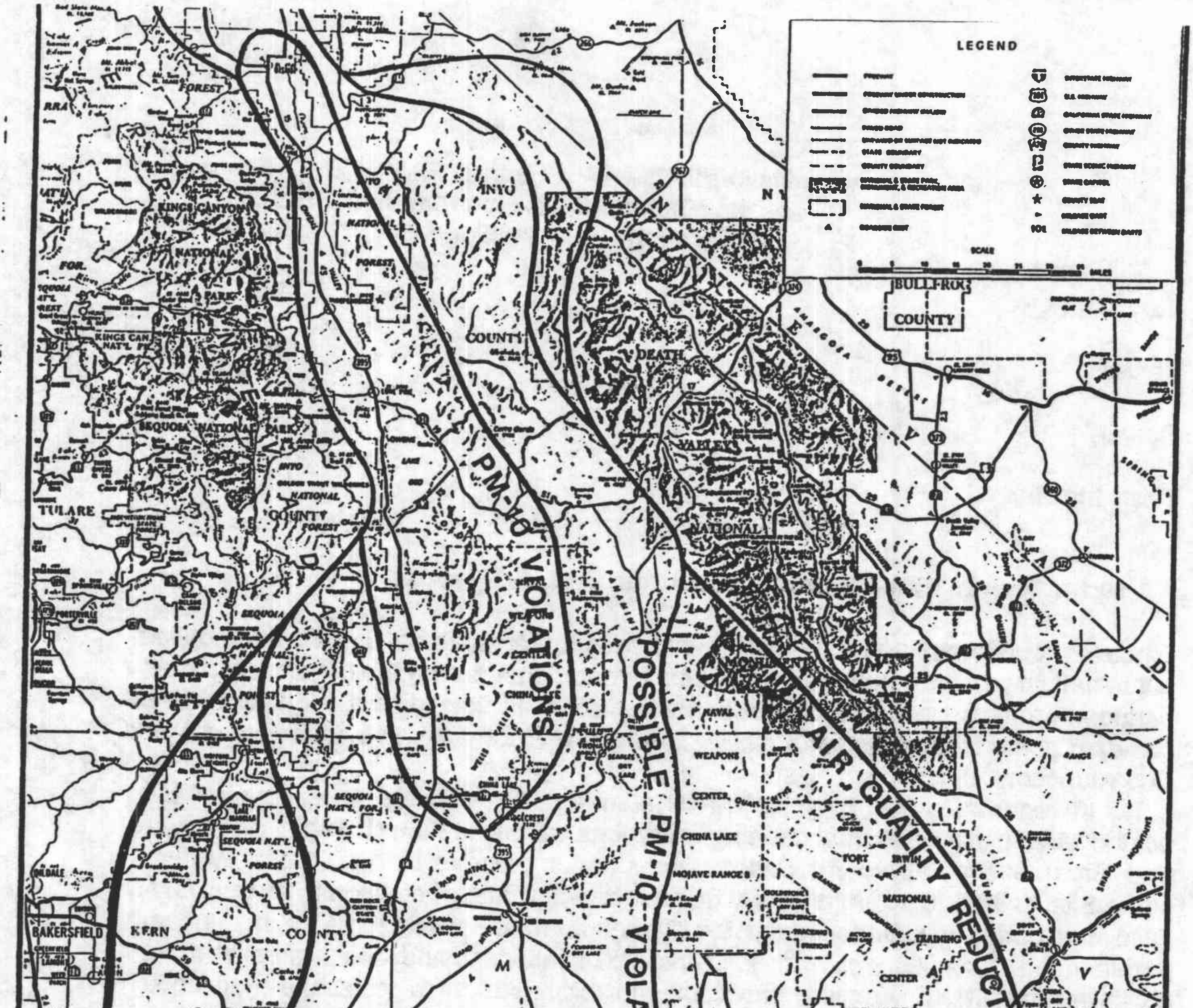
In conclusion, TSP data collected in the OVGA since 1979 identify four major particulate source areas in the OVGA. The first and by far the largest is the Owens (Dry) Lake Bed. The second largest would be the area East of the Owens River from Mazourka Canyon to Lone Pine. Third is the dry floor of the Tinemaha Reservoir when water levels have been lowered. The fourth area is located just east of Independence. These four sources were large enough to stand out in the up wind downwind monitoring system running the length of the Owens Valley. There are other sources within the valley that could not be identified through the monitoring system. These smaller cumulative sources are described in the Emission Inventory section.

1.4.2 PM-10 Data

PM-10 data has been collected at two locations within the OVGA and two locations just outside the OVGA. Three of the locations (Lone Pine, Coso Junction, and Darwin) began PM-10 sampling in March 1985. These three locations have the longest PM-10 record and are continuous through the present except for Darwin. The Darwin site was closed down in November 1986. The fourth location, Keeler, began monitoring in October 1986 and is in operation presently. The Keeler PM-10 sampler was co-located with the TSP sampler for more than one year allowing correlation of TSP to PM-10 at the Keeler location. The correlation equation is PM-10 = 0.551 x TSP - 19.16 with an R-squared of 0.985. All Keeler PM-10 data represented in this document prior to October 1986 was derived using this formula.

The analysis of these four PM-10 data sets correlates well with the previously discussed TSP data sets (Figure 4 and Appendix B). PM-10 data indicate the air quality is generally excellent with extreme dust episodes occurring periodically. All dust episodes correlate with hourly average wind speeds at or above 20 mph. The major dust episodes occur when the Owens Dry Lake is located up wind of the monitoring stations. High concentrations recorded at the Darwin (552 ug/m3) and Coso (1,175 ug/m3) monitoring locations attest to the magnitude of the impact dust storms leaving the Owens Lake Bed have over large airsheds downwind. Clouds of visibility-reducing dust have been observed and documented by GBUAPCD staff for more than 150 miles downwind of Owens Lake. These clouds of dust disperse and grow in depth and width filling entire valleys such as the Owens, Saline, Panamint, Indian Wells, Freemont, and Antelope valleys. Figure 7 illustrates the observed area of impact from Owens Lake dust storms. Vertical impact has been documented as high as 13,500 feet MSL. (5) It is conceivable that under certain conditions Owens Lake dust may be captured in front of moving troughs or within the jet stream and travel for hundreds or thousands of miles downwind.

PM-10 data confirm the problem identified from the previously collected TSP data. Violations of the Federal PM- 10 standard of 150 ug/m3 have occurred at all four PM-10 monitoring stations discussed in the preceding paragraphs. The highest violation of 1,175 ug/m3 was recorded at Coso Junction on April 2, 1986. The second highest, 672 ug/m3, was recorded at Keeler on January 27, 1987. Both of these concentrations exceeded the federally established significant harm to health level of 600 ug/m3. Following is a list of the number of PM-10 24 hour standards exceeded for the four PM-10 data bases from March 1985 through March 1988:



MIKE HORN

Area of Owens (Dry) Lake Dust Impact

Figure 7

	California PM-10 24 Hour Standard (50 ug/m3)	Federal PM-10 24 Hour Standard (150 ug/m3)	Total Samples Collected
Lone Pine	10	4	186
Keeler	28	15	229
Darwin	2	2	96
Coso Junction	11	4	183

Note: Keeler PM-10 data calculated from TSP data.

Since 24 hour sampling did not occur every day these numbers can be extrapolated out to indicate the frequency of violations for each area during the monitoring base period. From this we could conclude that Lone Pine is exceeding the Federal PM-10 standard about 8 days per year, Keeler 24 days per year, Darwin 8 days per year, and Coso Junction 8 days per year.

In regards to the Federal PM-10 standard, Owens Dry Lake appears to be the single major source causing violations of the standard within the OVGA and Great Basin Valleys Air Basin. Other major sources in the Owens Valley contribute to PM-10 violations but do not directly cause violations. Owens Dry Lake can cause violations in the significant harm to health level for distances greater than 25 miles downwind. Standard violations could occur greater than 60 miles downwind. Visibility reduction and contribution to violations may occur greater than 150 miles from the source.

In relation to the California PM-10 Standard, many of the sources identified in the OVGA could cause violations. Barren areas throughout the OVGA including dirt roads and community emissions could cause violations. The reader is referred to the emission inventory section for identification and descriptions of the sources inventoried in the OVGA that may contribute to or cause California Standard violations.

In summary, the air quality within the OVGA is excellent most of the time with major episodes causing violations of Federal and State 24 hour standards. Owens Dry Lake is the major source of these episodes, causing more than 90 percent of the violations. It is estimated that the Owens Dry Lake causes, at all sites, an average of 48 federal 24 hour PM-10 violations per year. Concentrations more than 25 miles down wind can go above the significant harm to health level for PM-10. Assuming a violation impact area of 60 miles the health of more than 40,000 people is affected by this one source.

1.4.3 Particulate Composition

Limited elemental analysis has been completed on Particulate samples collected in the OVGA. Analysis was completed on samples collected for the UC Davis, Air Quality Group Crocker Nuclear Laboratory report titled "A Study of Ambient Aerosols in the Owens Valley Area" in November 1979. The UC Davis report identified sulfates as a hazardous compound associated with Owens Lake dust. (2) The report concluded that the California Sulfate Standard (25 ug/m3) was being exceeded near the lake. Report calculations indicated sulfate concentrations would be 51.3 ug/m3 at Keeler, and 10.7 ug/m3 at Lone Pine during an Owens Lake dust storm.

The California ARB began sulfate analysis on Lone Pine PM-10 filters in 1984. Data to present indicate that sulfate concentrations are elevated during Owens Lake dust episodes. The California Sulfate standard was exceeded once on March 2, 1985 with a concentration of 45 ug/m3. Elevated concentrations were observed on January 27, 1987 (18.9 ug/m3) and February 2, 1987 (15.5 ug/m3). Average background sulfate concentrations run in the 1 to 1.5 ug/m3 range.

Analysis on 8 Keeler TSP samples collected in 1982, 1983, and 1984 indicate that sulfate is a major component of Owens Lake dust events. The highest sulfate concentration was 1,575 ug/m3 (13 percent), and the lowest concentration was 2.97 ug/m3 (0.47 percent). Removing the high and low, the average sulfate concentration for the remaining 6 samples was 34.7 ug/m3 or 11.6 percent of the total sample mass. Sodium averaged 15.4 percent and chlorides averaged 3.8 percent of the total sample. A large percentage of the samples' mass was presumed to be carbonates, but carbonate analysis was not completed for the samples.

1.5 Meteorological Data Analysis

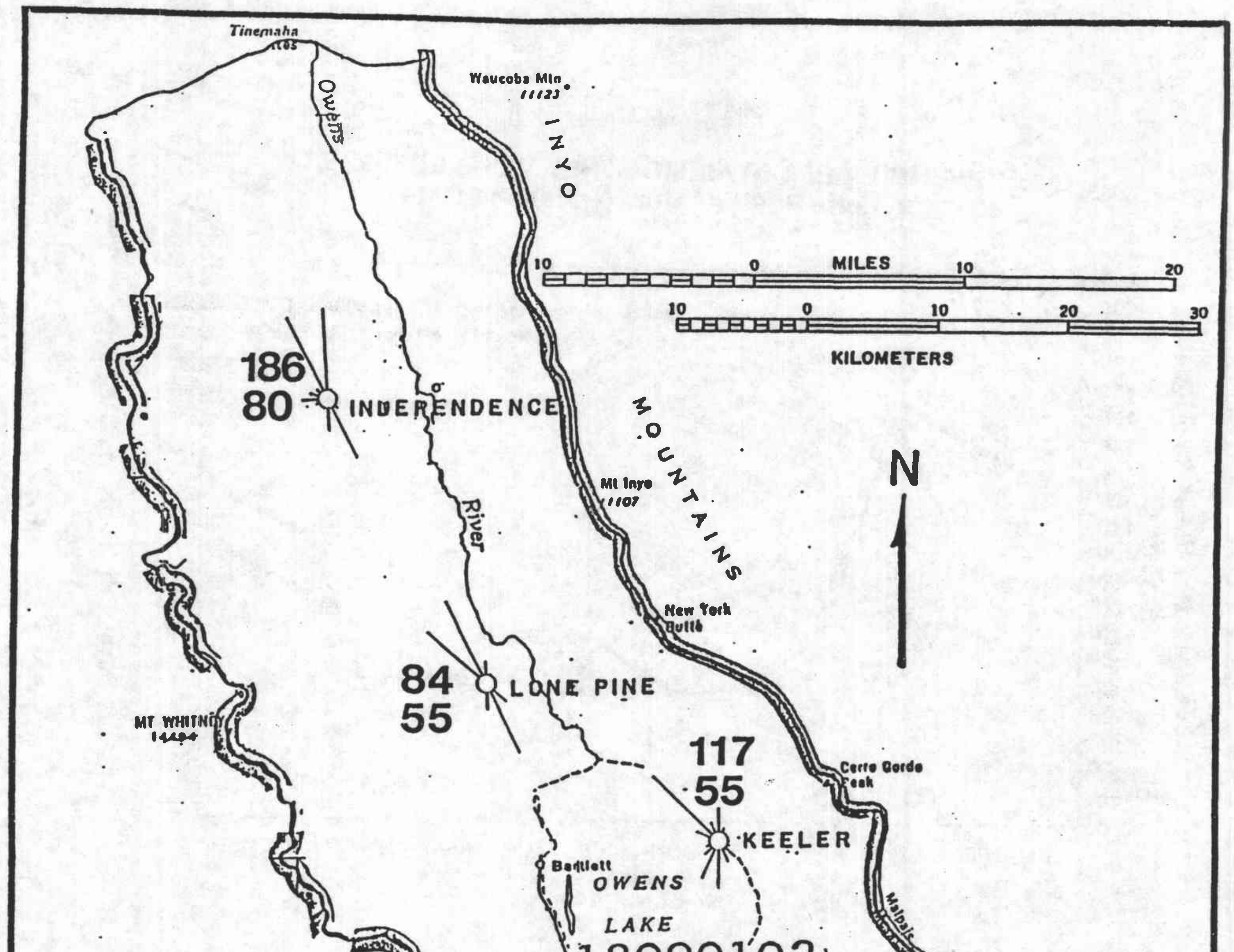
Four meteorological stations have data bases long enough and complete enough to analyze for identification of particulate sources and frequency of dust events within the OVGA. The sites from north to south are Independence, Keeler, Darwin, and Olancha. These four locations surround the major particulate source (Owens Lake) and the Lone Pine sample station.

Wind thresholds necessary to loft dust from the Owens Lake bed have been documented by Westec during the phase 1 studies and by the GBUAPCD. The Westec report identified a 15 mph hourly average as the threshold speed for "fluff" areas and 25 mph for sand movement. GBUAPCD has monitored and observed significant sand and dust movement at wind speeds in the 20 mph instantaneous range. EPA literature has identified a 20 mph hourly average as a threshold for dust entrainment from fugitive sources. (8) Therefore, a threshold speed of 20 mph and above was considered the speed necessary to produce significant quantities of dust from the Owens Lake bed (Appendix C). Wind data was reduced to 24 hour prevailing direction, total hours 20 mph and above, prevailing direction for hours 20 mph and above, 24 hour average wind speed, and time of day winds were 20 mph and above, expressed in military time.

Days that had average hourly wind speeds of 20 mph or more were placed into two categories: a minor category for days when 24 hour average wind speeds and total hours, 20 mph and above, were below the average calculated for all windy days; and a major category for the same wind data above this average. An assumption will be made that the first category represents potential minor dust events and the second potential major dust events. The average was calculated from the complete 20 mph and above data base at each monitoring site. Figure 8 shows the frequency of wind episodes for each site. Assuming soil conditions were favorable for dust entrainment, this wind frequency would also be the maximum potential frequency for dust episodes. The wind rose shown at each site indicates the predominate directions for 20 mph and above wind episodes. The two numbers located next to each wind rose are the number of days with winds 20 mph and above out of the 1,095 days from 3/85 through 3/88. The top number represents the total number of minor wind events, and the bottom number represents the total number of major wind events. Therefore, if we assume wind events represent potential dust episodes, if soil conditions are correct, then Keeler potentially experienced 117 minor dust episodes and 55 major dust episodes between March 1985 and March 1988.

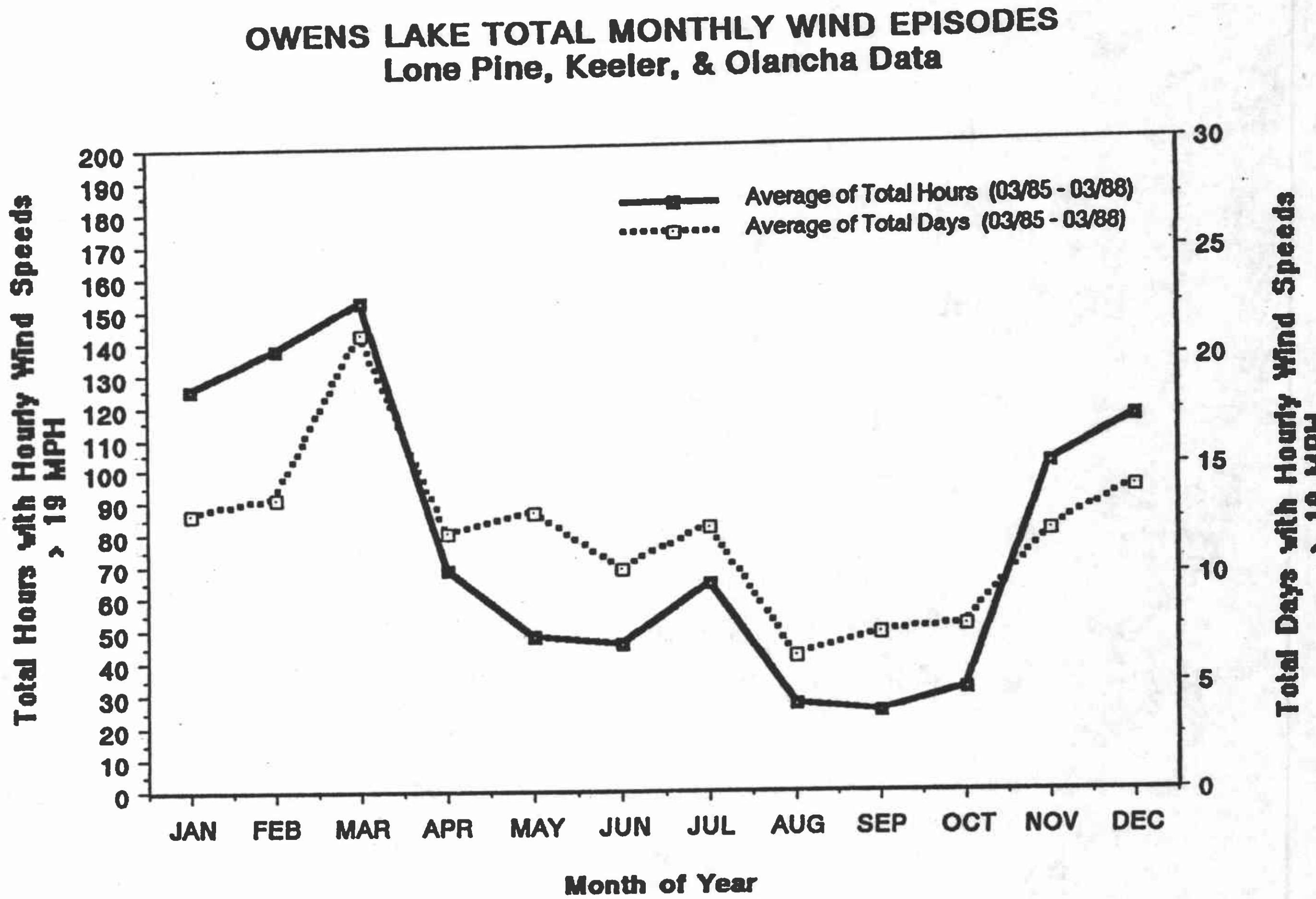
Figure 9 graphically illustrates the monthly frequency of potential high wind events for the Owens (Dry) Lake bed. This graph represents an average of the 20 mph and above data bases for the three meteorological sites located around the lake bed. Note that the ratio between total hours > 19 mph and total days with winds > 19 mph changes significantly around April and November. The ratio is greater during the months from May through October, and small during the months from November through April. The highest frequency of dust episodes correlates with the smaller ratio between total hours and total days from November through April. It can be assumed that dust lofting would occur during these wind events if surface soil conditions (dry, uncrusted, loose, exposed,etc) were correct.

Analyzing the hourly occurrences of 20 mph and above wind speeds can help us understand the population impacted by dust events. Figure 10 illustrates an hourly frequency distribution for 20 mph and above wind speeds. This graphic indicates that the afternoon hours have the highest potential for dust events to occur. This also correlates with the peak period of population movement within and surrounding the OVGA. Stagnation of Owens Lake dust clouds has often been observed when the winds quickly die down in the early evening hours. Evening inversions and calmer conditions can hold dust clouds within the valleys and canyons for extended periods of time, concentrating the impact. These conditions have led to the terminology "Keeler Fog" within the Keeler area. The longest documented continuous dust episode in Keeler lasted for approximately 34 hours from 7:00 AM April 25, 1985 to 6:00 PM April 26, 1985.



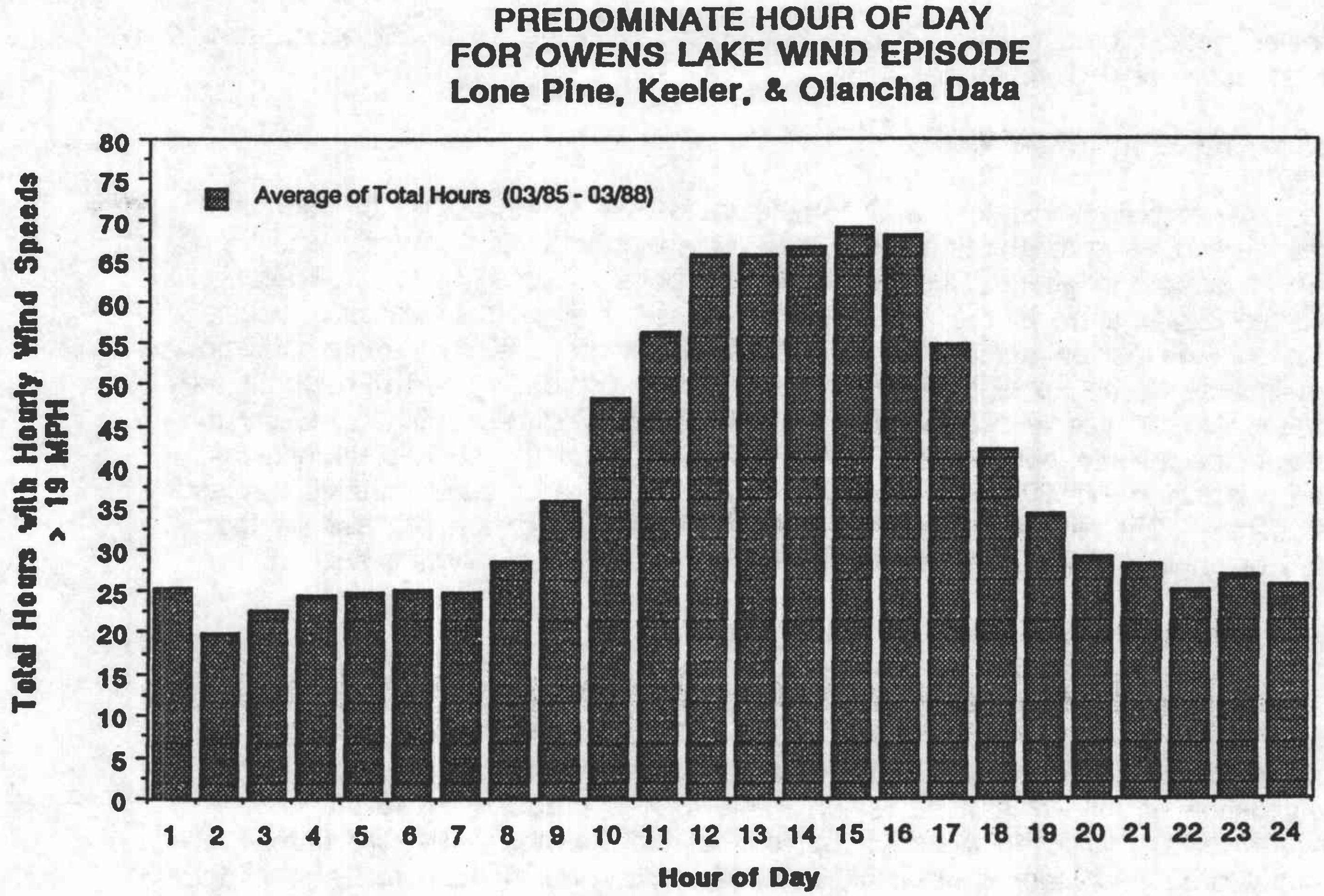
Frequency of Wind Episodes

Figure 8



Monthly Wind Episodes

Figure 9



Wind Episodes by Hour of Day

Figure 10

Keeler meteorological data indicate that episodes in the 15 to 20 hour duration range occur several times per year.

2.0 Emission Inventory

An emission inventory was completed for the entire OVGA for point and area particulate sources. Emphasis was placed on emission sources within one mile of sample locations. Due to the lack of point sources (industrial sources) and the rural nature of the area, point sources were not emphasized. Local area sources (barren land, roads, vehicles, etc.) were scrutinized in more detail to isolate bias in the up wind downwind monitoring approach used throughout the OVGA. Soiling type and coloration on sample filters were examined closely to help locate inventoried sources. Wind direction during the sample period was also used in identifying the major contributing source for each particular episode monitored. The emission inventory was used as a validation process for the up wind downwind monitoring results discussed in the Air Monitoring section.

2.1 Methods Used for Emission Inventory

All point sources must obtain an Air Quality Permit from the GBUAPCD. Files of sources holding permits with the GBUAPCD include emission levels for each source. Most of the emission levels are calculated emissions using the Compilation of Air Pollutant Emission Factors, AP-42 published by the U.S. Environmental Protection Agency. (8) None of the sources within the OVGA have records of sampled source or stack test emissions. Due to the small size of the operations and distance from sample locations, modeling of the emissions was not necessary to determine impact.

The method used for the area source emission inventory followed the method used by the GBUAPCD for the Coso Air Quality Baseline Data Collection report for the Coso (Known Geothermal Resource Area (KGRA). (9) Potential sources greater than 1/2 acre in size were located and documented within one mile of each sample location. Major areas greater than 5 acres or observed dust producing areas within five miles of the sample location were also documented. Each area was ranked according to potential to produce emissions during wind events. This ranking was a subjective determination made in the field by GBUAPCD staff. Factors considered in the determination were surface crust strength, texture, availability of material, exposure to wind fetch, disturbance potential, and area of source. Sources were ranked with a (H) high potential, (M) moderate potential, and (L) low potential. All sources located beyond a one mile distance from the sampling station ranked (M) or (L) were excluded as sources that could not significantly impact the sample concentrations collected at the Lone Pine site.

Surface soil samples were collected at each source located within one mile of the sample site. Samples were collected according to procedures described in the Final Guideline Procedures For Emission Inventory of Potential Fugitive Dust Sources in the Owens Valley, EMSI1302.22EIFR, prepared by Environmental Monitoring & Services, Inc., April 1986. Silt/clay percentage was determined for each sample collected to help in potential ranking of the source. Soil texture and coloration were compared to the material collected on the sample filter.

2.2 Point Source Inventory

The point source inventory was broken into two categories; a high emission category of sources with potential emissions greater than 100 tons per year, and a small category with sources between 25 and 100 tons per year potential emissions.

2.2.1 Sources > 100 Tons/Year

Only one source with potential emissions greater than 100 tons per year is located within the OVGA. That source is Big Pine Distributors located just south of Olancha. Big Pine Distributors is a clay and talc milling and bagging operation. Calculated emissions and details of the operation can be found in Appendix D. The nearest sample location to this facility is Olancha, located 2 3/4 miles to the north. The Lone Pine sampling site is located 23 1/2 miles to the north. This facility operates on a seasonal and as needed basis. Operations are sporadic based on product demands. Based on its sporadic operation schedule, emission analysis, and distance, this facility could never cause a violation at the Lone Pine monitoring site. It is possible that the Olancha site could be impacted by this source. It is highly unlikely that this single source could cause an ambient violation at the Olancha site.

A dispersion model was run on the Big Pine Distributors operation to estimate area of impact. The California Air Resources Board Gaussian Model PTPLU was used for this analysis. Results are shown in Appendix D for reference. In summary the maximum PM-10 concentration 107 meters downwind at 3 mph would be 72 ug/m3. This source is not considered to have a major impact on PM-10 concentrations monitored within the OVGA.

2.2.2 Sources > 25 Tons/Year < 100 Tons/Year

No sources fitting this category were found within the OVGA. Two potential point sources were identified in the Mazourka Canyon area. However, one has been under Authority to Construct for most of the data base period. It has been observed by the GBUAPCD staff on numerous occasions as not in operation. Discussions with the company confirm that the facility has not operated during the data base period. The second potential source, a gold and silver mine, has just begun in early 1988 to apply for Authority to Construct permits. It also has not operated during the data base period.

2.3 Area Source Inventory

Several area sources were identified within the OVGA and directly outside the OVGA boundaries. Figure 11 locates the area sources of significance, identified within the OVGA . Looking at the sources identified directly around the Lone Pine sample location indicates a possible local influence or potential impact. A dirt drive around the Southern Inyo Hospital building, an emergency heliport, and barren areas within the fields around the site could all impact PM-10 concentrations collected.

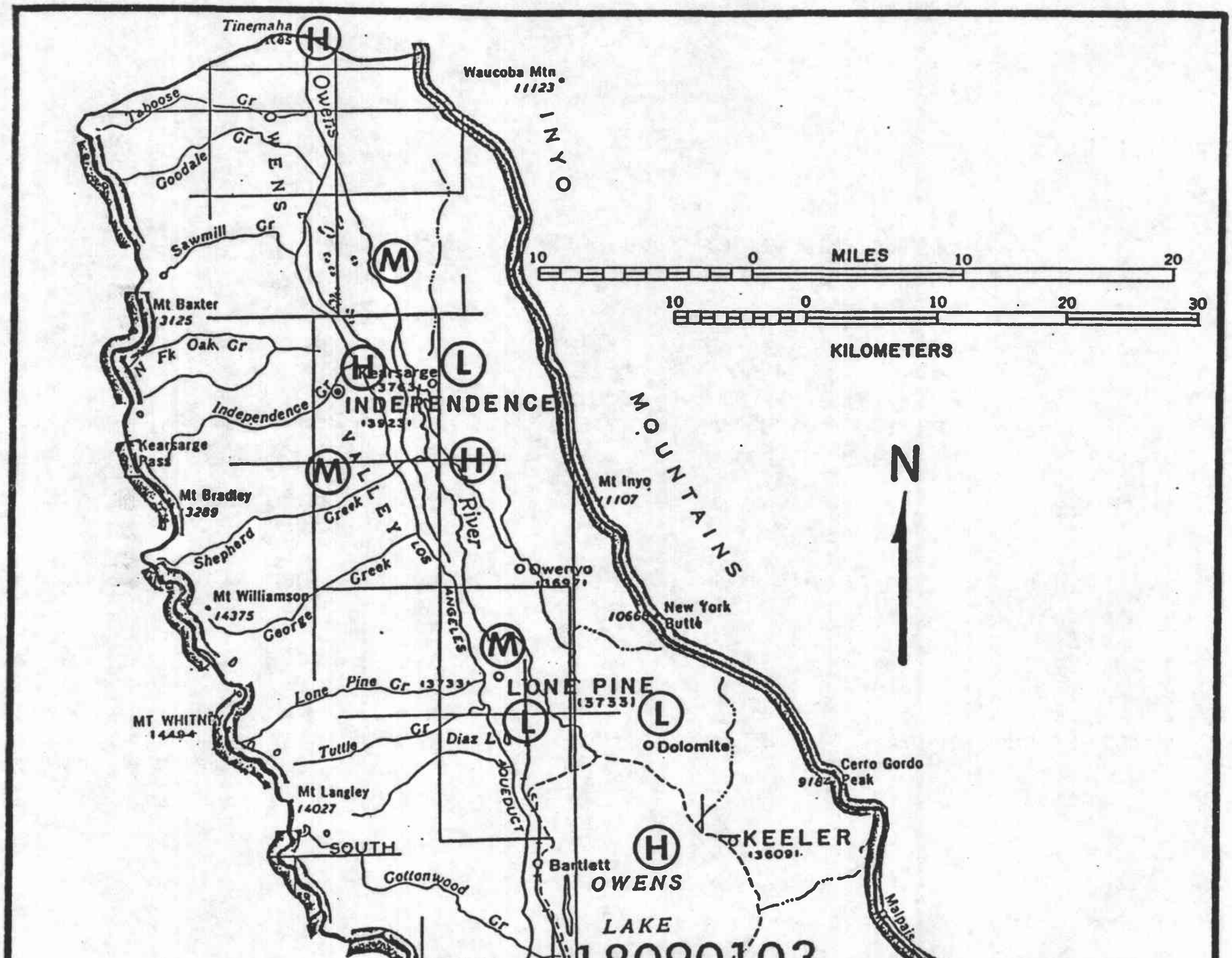
Soil color characteristics and soiled filter color and material observations were used to help determine localized impact. Soils from the heliport and drive were a sandy gravel soil, tan in color. Both areas were extensively covered with a surface gravel with grains approximately 0.1 centimeter in size. Dust has never been observed blowing from either area during high wind events. A helicopter was observed landing at the heliport on one occasion. Dust was observed blowing from the heliport while the helicopter was in operation.

The barren areas located in the surrounding fields are intermixed with tan soils similar to the heliport and darker gray soils. The darker gray soils have a finer texture consisting of silts and organics. These soils are much more susceptible to blowing during wind events if not covered with vegetation.

Wind directions, wind speeds, filter soiling coloration and description for the four Lone Pine violations are indicated in Table 1. After closely comparing these data it does not appear that the local sources directly around the site contributed to the violations recorded. The 3-2-85 violation occurred during a north wind event. Filter colorations and soil characteristics correspond to the fugitive dust sources located along the Owens River and East side. Correlations for the 5-20-86, 1-27-87, 2-2-87, and 1-16-88 samples identify the Owens (Dry) Lake as the major source.

2.4 Source Conclusions

Industrial point sources within the OVGA have an insignificant impact on the air quality. Very few industrial sources exist and all are located many miles from the sample locations. Smaller point and mobile sources, such as wood heating stoves, incinerators, and vehicle traffic do contribute to baseline concentrations, but could not cause sporadic episodes during wind events that correlate with the violations observed. Community sources impact the air quality on a daily basis and would impact the sample concentrations during stagnant meteorological conditions with low wind speeds. The annual average and daily concentrations recorded do not indicate a community or typical industrial pollution problem.



Map of Inventoried Particulate Sources
Figure 11

ANALYSIS SUMMARY OF FOUR LONE PINE VIOLATIONS

Date	PM-10	Wind Dir. WS>19	Total Hours WS>19	Filter Color	Description
03-02-85	239	NNW,N	---	Light Brown	Loose fine soil.
05-20-86	159	S	6	Light Gray	Loose fine soil.
01-27-87	178	SE	5	Light Gray	Loose fine soil.
01-16-88	172	SE	6	---	---

Note: Total hours WS > 19 mph determined from Keeler and Olancha Meteorological data if Lone Pine wind speeds did not exceed 19 mph.

Summary of Lone Pine Violations

Table 1

Five major sources of particulates were identified by the emission inventory. The largest source, the Owens Dry Lake, causes the majority of violations and is the single source that causes the alert level and significant harm to health concentrations recorded at all sample locations. The second largest potential source is the desert area found along the eastern Owens Valley from Mazourka Canyon to Lone Pine. Included in this source category are many small barren areas throughout the OVGA that contribute to the particulate problem when wind speeds exceed the 30 mph threshold. The third and fourth largest sources contribute similar quantities of particulates when exposed to winds. They are Tinemaha Reservoir and the Independence Spring Field. The Tinemaha Reservoir contributes larger emissions as the reservoir is lowered. Annual vegetation on the Spring Field area reduces the impact of this area for short periods during wet years. As vegetation is removed larger quantities of dust blow from this area. Dirt roads during wind events both from vehicle traffic and direct wind blown emissions make up the fifth largest source of emissions. Table 2 lists and ranks the sources of particulates within the OVGA.

Based on the identification of sources and ranking, only two particulate sources cause violations of the Federal PM-10 standard at the Lone Pine site. One is Owens Lake and the other is the area east of the Owens River. The area east of the Owens River is a natural dust-producing area undisturbed by man except for roads, grazing, and early 1900's uses. Reductions in the high Lone Pine concentrations that occur during north winds would have to come from reductions in dirt road, areas with damaged or removed vegetation, or community emissions. If all three of these man caused emission sources were controlled, concentrations at Lone Pine would still exceed the PM-10 standard.

The largest emission source of the potentially controllable sources, the Independence Spring Field, is currently being mitigated through the Inyo County, Los Angeles Department of Water and Power groundwater pumping Enhancement/Mitigation agreements. These areas are being revegetated by irrigation, eliminating the dust problems documented in previous years. Several Enhancement/Mitigation projects have already been implemented, reducing dust emissions from these areas. Emission reduction from these areas has been observed at 98 to 100 percent control. If the Enhancement / Mitigation projects are abandoned, the GBUAPCD will pursue continued dust mitigation programs under Health and Safety Code 42316.

Lone Pine violations from the south can only be reduced by reductions in the emissions coming from the Owens Dry Lake. Suggested controls for this source will be discussed in section 4.0.

3.0 Literature Review of Work Completed on Owens Lake

Several documents can be found discussing the air quality impacts, geology, soils, and climatology of Owens Lake. Wind erosion and agricultural

RANKING OF PM-10 SOURCES WITHIN THE OVGA*

Rank	Source	Number of 24 Hour** Violations Caused by Source		Potential Population Impacted by Source
		State	Federal	
1	Owens (Dry) Lake	73	46	41,290
2	Owens Valley	4	1	2,910
3	Tinemaha Res.	1	1	800
4	Ind. Spring Field	2	2	800
5	Dirt Roads	0	0	2,860
6	Res. Wood Heating	0	0	3,088
7	Wild Fires	0	0	3,088
8	Residential Burn	0	0	3,088
9	Controlled Burn	0	0	3,088
10	Waste Dumps	0	0	2,860
11	Grazing	0	0	3,088
12	Auto Traffic	0	0	3,088
13	Construction	0	0	3,088
14	Mining Operations	0	0	20

* Estimated, using correlation of upwind, down wind monitoring and size of source documented during emission inventory.

** TSP and PM-10 data from Jan. 1985 through Mar. 1988.

Table 2

documentation can also be found discussing dust problems similar to those found at Owens Lake. This literature review does not intend to discuss the scientific library of documentation associated with wind erosion. The SIP time restraints do not allow for extensive research and literature review at this time. More elaborate literature review is recommended prior to development of specific mitigation programs.

The SIP review will focus on documents leading to or discussing mitigation techniques for Owens Lake. The discussions will be separated into two categories, Discussion of Study Conclusions and Discussions of Mitigation Conclusions. Study discussions will relate to the physical setting or conditions of Owens Lake that must be addressed to select a successful mitigation. Mitigation discussions will address actual suggested or tested mitigation theories or projects. Five documents of interest will be reviewed and conclusions discussed. They are listed below for reference:

WESTEC Services, Inc., "Results of Test Plot Studies at Owens Dry Lake, Inyo County, California" Prepared for State Lands Commission, March 1984

Cahill, T. A., B. H. Kusko. "Study of Particle Episodes at Mono Lake" Prepared for California Air Resources Board, April 1984, Air Quality Group Crocker Nuclear Laboratory, UC Davis, Contract # A1-144-32

St.-Amand, P., L. A. Mathews, C. Gaines, and R. Reinking. "Dust Storms From Owens and Mono Valleys, California" Naval Weapons Center; NWC TP 6731, September 1986

Cochran G. F., T. M. Mihevc, S. W. Tyler, and T. J. Lopes. "Study of Salt Crust Formation Mechanisms on Owens (Dry) Lake, California" Prepared for Los Angeles Department of Water and Power, January 1988, DRI Water Resources Center, Publication # 41108

Lopes T. J. "Hydrology and Water Budget of Owens Lake, California" Prepared for Los Angeles Department of Water and Power, January 1988, DRI Water Resources Center, Publication # 41107

3.1 Discussion of Study Conclusions

Study conclusions related to mitigation of Owens Lake were developed during the Desert Research Institute (DRI), Study of Salt Crust Formation Mechanisms and Hydrology and Water Budget studies. Both studies were completed during the same time period, from April 1986 to January 1988.

The two studies were developed for the LADWP and GBUAPCD in an effort to identify the phenomena of salt "fluff" formation on the Owens Lake. Salt "fluff", a fine powdery white surface that develops on the lake bed, causes some of the worst and most unhealthful dust events associated with the lake. This "fluff" develops only during certain times of the year when soil and meteorological conditions are right. Evaporation of moisture from the surface allows capillary rise of brines from below the soil surface to bring salts to the surface. Continued dehydration of the brines at the surface and changes in temperature produce a salt "fluff" or crust. Production of this "fluff" is aggravated by continued wetting on an infrequent basis and cold dry winds. Because of the very fine nature of the salt "fluff", winds less than 15 mph can produce dust storms carrying this fine material for great distances. (4)

The Hydrology report identifies several geomorphic environments across the surface of Owens Lake. These environments become critical when choosing and implementing potential mitigation measures. Dust emissions from sand flats as opposed to salt pans may be quite different, requiring completely different mitigation approaches. Seven different geomorphic environments were identified in the Hydrology report: sandflats, salt crust, mudflats, beach ridges, dunes and megaripples, salt pans, and spring mounds.

Three major conclusions are stated within the Hydrology report that directly impact the selection of Owens Lake Mitigations. All other conclusions found in the report help clarify the relationship between climate, hydrology, and geochemistry.

First, limited aquifers extend up to two miles into the lake. The Cottonwood Creek alluvial fan and the fan south of Keeler have the highest potential for development. This identifies a potential source of water for use in theorized leaching and plant irrigation mitigation programs. However, both aquifers have not been defined as to size and quantity of water available for extraction. Further studies of the aquifers is necessary before production of the aquifers can go forward. Impacts on local users of the aquifers must be addressed.

Second, the difference in permeability between alluvial fans and lake clays plays an important role in the location of springs around the periphery of the lake. Location of potential drainage systems depends heavily on this information. Identification and control of areas that currently are unaccessible relies heavily on the identification of groundwater and spring water movement.

Third, salt crust distribution is controlled by spring and surface water drainages and flow patterns onto the lake surface from the surrounding mountain ranges. Drainage and vegetation projects rely heavily on knowing the source of salt concentration on the soil surface. To control the surface salt problem you must first know the salt distribution system over the lake bed. Areas with heavier salt concentrations may have to be mitigated completely differently than areas with lower concentrations.

Two major conclusions were derived from the DRI Salt Crust Experiment. Both again directly impact the decision making process for development of mitigations.

First, the deposition of thin layers of wind blown sand and silt over large areas of the lake bed may be increasing the capillary rise of brines to the surface, thus giving rise to heavier surface salt fluff formation and larger salt dust concentrations. This relates to the need for control of sand and silt areas of the lake. Clay areas or slicks may not be a dust problem if sands and silts can be kept off the surface.

Second, lowering the groundwater table by pumping (as a mitigation) may be impractical due to the impermeability of the clay soils over most of the lake bed. The high salt concentrations found within the clays could support continued evaporation of salts at the surface without capillary rise of groundwater. Precipitation could dissolve sufficient quantities of salts and allow movement to the surface and evaporation.

In summary there are many different hydrologic, geophysical, and geochemical factors that must be addressed before identifying and implementing any particular mitigation measure on Owens Lake. Each area has its own signature and size that must be identified before implementing large scale projects. Study conclusions found in one location may not apply in others. A close hands-on approach is necessary for success.

3.2 Discussion of Mitigation Conclusions

The document "Results of Test Plot Studies at Owens Dry Lake, Inyo County, California" (WESTEC Study) expresses conclusions related to direct testing of five separate dust mitigation techniques. All five tests were done on very small scale plots within the same area of the Owens Lake. The study plot location is shown in figure 12. Results of the tests are discussed on pages 3-1 through 3-17 of the document.

Conclusions for vegetation studies indicated that Distichlis spicata (Saltgrass), Sarcobatus vermiculatus, (Greasewood) and Sporobolus airoides (Dropseed) showed the best survival rates, while Tamarix aphylla (Tamarix) and Atriplex perryi (Parry's Saltbush) had the poorest. The results indicated that sand abrasion conditions and small plant size may have been the major cause for mortality in the Tamarix. Sand abrasion along with stem rot led to the mortality of the Saltbush. Soil salinity was not considered a major factor in mortality of any of the plants. There was a noticeable reduction in growth for plants planted directly within the finer lake bed soils as opposed to sandy soils.

These conclusions indicate that vegetation could be supported directly on the lake bed. Drainage of surface salts and alkalis would be an important first step. Protection from sand abrasion and a fresh water source would be needed to complete the necessary factors for plant survival. The most useful species tested for use as a mitigation would be the Saltgrass and Tamarix. The Saltgrass would allow grazing in the area and directly control the soil surfaces from blowing during winds. Tamarix could be used to break wind fetch and stop sand transport across the surface. From the WESTEC Study it can be concluded that Saltgrass can be grown directly on the lake bed surface if a fresh water supply could be identified and salts were leached from the surface. Tamarix

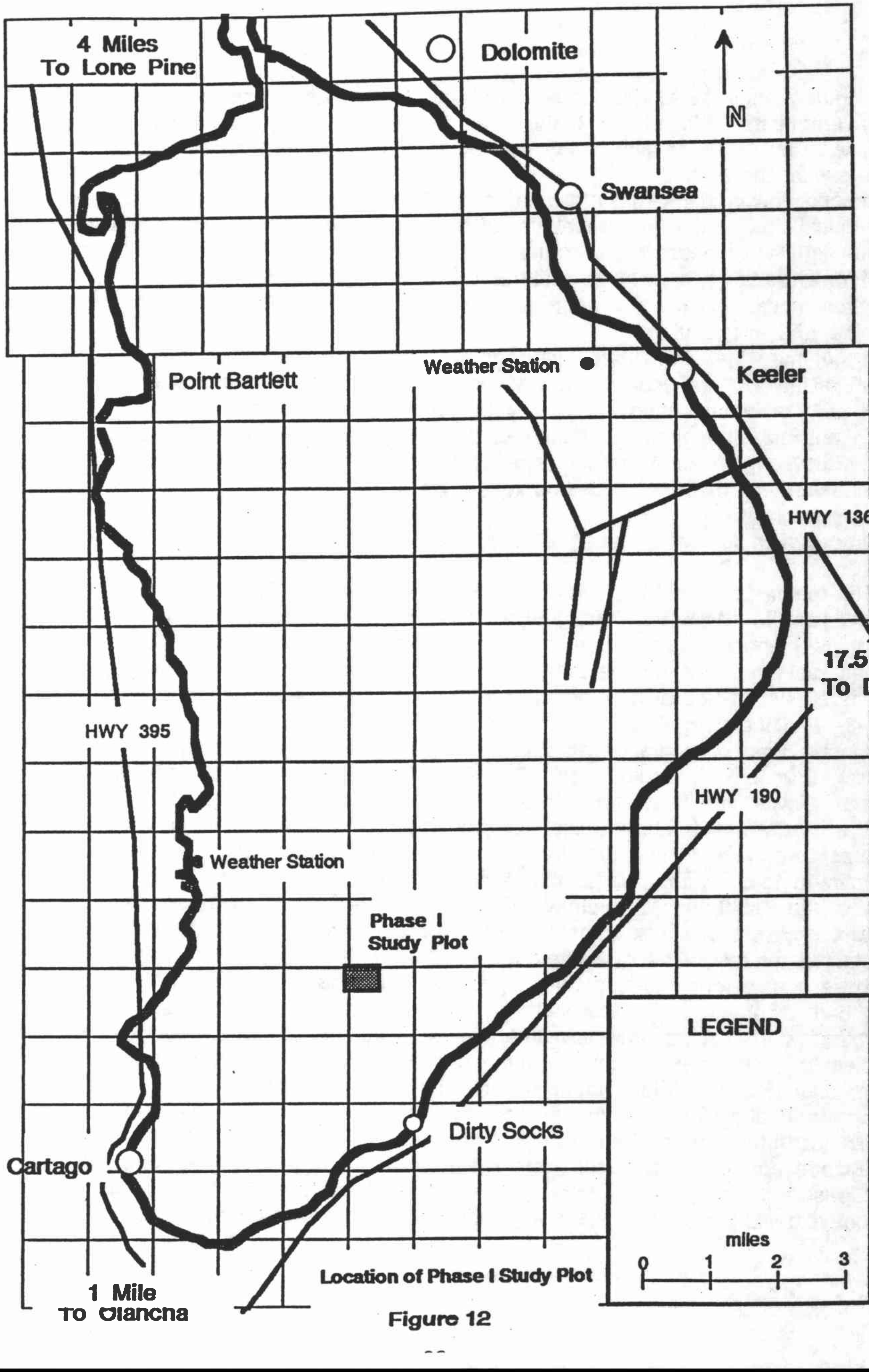

4 Miles
To Lone Pine
Dolomite
N
Swansea
Weather Station
Keeler
Point Bartlett
HWY 136
17.5 Miles
To Darwin
HWY 395
HWY 190
Weather Station
Phase I
Study Plot
LEGEND
Dirty Socks
Cartago
miles
0
1
2
3
Location of Phase I Study Plot
1 Mile
To Olancha

Figure 12

could be grown within more sandy soils if a fresh water supply could be identified.

The second mitigation test involved the use of sand fences as a way to control saltation across the lake bed. WESTEC study results concluded that sand and silt moving across the lake bed can be captured by use of three or four foot snow fences perpendicular to the wind direction. If you are looking at quantities of sand captured, a single fence system captures the largest volume for the dollar. If you are looking for captured sand stability, a parallel fence system in the 50 to 75 foot range gives you the best sand stability for the dollar. Stopping saltation across the lake surface with sand fences would involve the complete capture and control of all the sand available for transport.

A Phase II of the WESTEC Study sand fence approach is currently in progress to determine how much fencing would be needed to control all the saltation process over the lake bed. This project is scheduled for completion in September 1988. Preliminary data indicate that saltation is a major problem within several areas of the lake. The Phase II sand fence conclusions will be utilized by GBUAPCD to finalize the decision on the amount of fencing that will be utilized for mitigation on Owens Lake.

The third mitigation tested by the WESTEC Study was the use of leaching to reduce the salinity within the upper surface of soil. Conclusions indicate leaching would not be feasible due to the impermeability of the lake bed clays and silt. However, typical methods for leaching clays were not within the scope of the project. It is still possible that further testing of drainage and leaching techniques may be successful. This is especially true for other areas of the lake that have different soil characteristics and elevation gradients.

The fourth mitigation technique was the use of surface chemical applications to modify the surface characteristics to produce a permanently hard crust. Three different chemical stabilizers were used in the test. One was magnesium chloride and the other two were plastic polymers. Results indicated that none of the three stabilizers produced a crust any harder than the natural lake bed crust.

Further testing of chemical stabilizers were conducted in the Phase II project. Preliminary results indicate the same conditions found in the WESTEC Study.

The fifth mitigation test involved the use of cross ties laid across the lake bed surface to capture wind-blown sand for later planting of vegetation. Conclusions were that sand did accumulate around the cross ties, but accumulated sand was not stable enough to support vegetation. As winds shifted from south to north, sands would scour and blow to the opposite sides of the ties.

The "Study of Particle Episodes at Mono Lake" (UC,Davis) report identifies one potential mitigation technique that was identified under natural conditions at Mono Lake located near Lee Vining, California. This technique involves the placement of some type of wind barrier perpendicular to the wind direction to break the natural occurring wind fetch that produces dust from the Owens and

Mono exposed dry lake beds. The UC, Davis report suggests the use of water barriers 2 miles wide and 6 miles long perpendicular to the wind, running from the shoreline to the center of Owens Lake. Water would be held within bermed areas similar to the rice farming methods used in the San Joaquin Valley. The report also discusses the possibility of using fences perpendicular to the wind to produce a surface roughness effect to reduce wind shear at the surface.

The technique of breaking the wind fetch or surface shear could produce major lake bed emission reductions on Owens Lake. The majority of the dust episodes from the Owens Lake occur during periods of high winds moving from the north during frontal passage. These winds produce high surface speeds as they move across the barren lake bed moving any loose material on the surface. Anvil shaped dust clouds are often observed starting out small and low to the ground and rising and growing in size as they move downwind. These fetches of moving particulates and wind can be broken with any change in the surface roughness.

The next report discussing potential dust mitigation techniques for Owens Lake is the "Dust Storms From Owens and Mono Valleys, California" (St. Amand) report completed in 1986. This report lists and discusses 11 potential approaches to mitigate the Owens Lake dust problem. The 11 approaches are as follows:

1. Do Nothing.
2. Interfere With the Wind.
3. Cover the Playa With Sand.
4. Encourage Vegetation and/or Revegetation.
5. Flood the Playa.
6. Coat the Playa.
7. Treat With Chemicals.
8. Stabilize the Blowing Sand From the Lake Shores.
9. Clean the Playa by use of Polders.
10. Lower the Water Table.
11. Combine Polders With Groundwater Lowering.

The number 1 approach obviously would not achieve a reduction or compliance with the ambient air quality standards for PM-10.

Number 2 was discussed by the WESTEC and UC, Davis reports.

Number 3 would have unpredictable results and would have to be spread by truck, since it has been identified that large volumes of sand do not move over the entire lake bed surface. It would be more predictable to use gravel as opposed to sand.

Number 4 has potential as discussed earlier in the WESTEC discussions.

Number 5 addresses the use of ponded water to control the dust. This approach may be more practical if implemented to break wind fetch as discussed in the UC, Davis report. Allowing bodies of water to freely stand on the surface would be an impractical use of water to control the dust problem due to the high evaporation rate.

Coating the surface as suggested in number 6 would require considerable more research and testing, allowing the problem to continue unabated for many more decades.

Number 7 discusses the use of chemicals to modify the existing surface forming hard insoluble surface crusts. This method has the potential of being economical, semi-permanent, and very effective in controlling dust. However, testing to assure no adverse impacts and crust stability may take many years before implementation could take place.

Number 8 looks at the control of sand deposits on the old lake shorelines. Recent studies and observations indicate that these sand deposits do not migrate across the lake bed from north to south and back. These sand deposits appear to be localized sources of sand. Therefore, control of these areas would reduce dust emissions within the sand deposit areas only.

Number 9 addresses the use of polders to leach alkali salts from the surface soils. This approach would require considerable planning and control of the lake environment before implementation. Rewards, however, would be high. Reclamation of the alkali soils would allow areas of vegetation and wildlife habitats to be established. Dust control would be permanent as long as the systems were maintained.

Lowering the water table as described in number 10 may not be useful as a mitigation approach by itself. Areas have been identified on the lake bed that currently have water tables below 10 feet and continue to produce dust emissions. However, lowering of the water table is a necessary factor for leaching of the surface soils.

The last approach, number 11, combines the use of polders with groundwater lowering. Again this approach would require considerable planning and continuous maintenance yielding many pleasant rewards if successful.

In conclusion three potential dust mitigation techniques can be identified from previous work conducted on Owens Lake. All three involve intercepting a known mechanism in the production of particulate emissions from the lake bed. All three techniques are listed below with the process of dust production in brackets after each.

1. Interfere with Wind (Break wind fetch and/or stop wind shear)

2. Interfere with the Production of Alkali Salts on the Surface (Stop capillary rise of alkali salts to the surface or alter chemical makeup.)

3. Flood or Wet Surface (Stop dehydration of alkali salts that are in solution or hydrated at the surface.)

There are several mitigation subgroups that could not directly mitigate the dust problem, but could be used in conjunction with the three main techniques to aid in dust control efficiency, durability, effectiveness, and aesthetic value. Techniques such as fences, leaching, vegetation and others fall into this category.

4.0 Evaluation and Selection of Control Strategy

This section will focus on control strategies for the Owens Dry Lake as the only source requiring control for attainment of the Federal Ambient PM-10 Standard. Controls for other sources within the OVGA would reduce the particulate concentrations in the immediate vicinity of that particular source, but would not reduce the number of Federal PM-10 violations within the OVGA and surrounding areas. Owens Lake is the one and only major controllable source within the OVGA that must be mitigated in order to attain the Federal Standards.

Theorized and selected Owens Lake control strategies will be discussed separately. Theorized control discussions will include all envisioned potential controls of fugitive dust from exposed soil surfaces. These controls fit within a broad range of physical and technical fields. Some may appear or even be ludicrous in concept while others may appear overwhelming to the imagination. The intent of discussing or listing these controls is not to endorse them, but to keep the process open to all possible mitigations of a major source of PM-10 emissions. The Owens Lake is a nontraditional particulate source with over 46 square miles of dust producing surface. Many different fields of science and technology will interact to evolve and perfect the controls during field implementation. Selected control discussions will focus on theorized controls with sufficient background information to allow judgments to be made as to implementation within the Owens Lake environment. Based on our current understanding, the selected control strategies are recommended by the GBUAPCD for the control of Owens Lake dust episodes and attainment of the Federal PM-10 standard.

4.1 Theorized Controls

There are thirteen theorized dust control measures for discussion in this section. The following discussions focus on the concept behind each theorized control measure. Selected Owens Lake control strategies will be discussed in section 4.2.

Flood irrigate with water.

Establishing an irrigation system to allow flooding of the lake bed surface during the windy periods of the year would eliminate the dust producing potential of the lake bed. If enough water were available, dust emissions could be reduced by 100 percent. It is a known fact that very wet surfaces will not produce fugitive particulate emissions during high winds. However, the surface would have to be kept wet at all times.

Flood irrigation is physically feasible on the Owens Lake. Gradual drops in elevation from the shoreline and from north to south could allow canals to be built from the north to the south along the eastern shoreline of the lake. Irrigation could take place anywhere along this canal and be spread towards the center of the lake.

Sprinkle surface with water.

Wetting the surface by use of sprinkler systems could accomplish the same results as flood irrigation. At least 1/2 inch of the top soil would need to be wet to achieve control. Sprinkler systems could be operated on a wind prediction system wetting the surface two to three days prior to wind events. If the surface would remain wet during the wind event, 100 percent control could be achieved.

Leach soluble salts from the surface.

Establishing a drainage system for the lake and using the irrigation water described in the first measure, could leach soluble salts from the surface soils. These salts would be transported by the drainage system to the center of the lake where mining operations could recover the salts for commercial purposes. Leached soils could potentially be used for agricultural purposes if soils did not become dispersed and alkali.

Leaching is not physically feasible over the entire dust producing area. It may be feasible only along and below the shoreline where elevation drops are sufficient for drainage. Leaching in conjunction with irrigation would achieve the same control as for irrigation alone. However, removal of salts and establishment of vegetation might reduce the amount of water required for irrigation and dust control.

Lower the existing water table and dry the surface.

Intercepting surface water from the Owens River, springs and seeps along the periphery of the lake would dramatically reduce the size of the wet areas on the lake. Additional groundwater pumping around the periphery could lower the lake wide water table eliminating the capillary rise of brines to the surface. Water removed from the Owens Lake environment would need to be transported away from the Owens Lake to the south.

Lowering of the water table is physically feasible on Owens Lake. However, it is unclear what the reduction in dust emissions would be from lowering the water table. Sand transport and saltation would continue and perhaps be exacerbated by lowering of the water table. Where lake bed soils are very impermeable, salts would not leach below the surface, and it might take years to dry the clays. Precipitation could solubilize the salts and evaporation continue to produce the surface salt "fluffs" currently found on the lake. It would be optimistic to expect major dust control by dewatering.

Grow vegetation on the surface.

Establishing vegetation over the surface of the lake would reduce the wind shear and speeds at the surface decreasing the erosion of the soils. Reclamation of barren soils by use of vegetation is a well documented procedure. Use of natural vegetation can produce a permanent control of soils and greatly enhance the value of the land.

The feasibility of establishing vegetation on the Owens Lake is questionable. Toxic elements, soil permeability, and water availability are some of the negative factors that would have to be overcome before vegetation could be established. Vegetation in conjunction with irrigation could achieve more permanent control. It is highly unlikely natural vegetation could be established without irrigation and leaching of salts.

Cover the surface with gravel.

GBUAPCD studies have established that a four inch depth of 1/4 inch and greater diameter gravel on the Owens Lake bed can stop the capillary movement of salts to the surface as long as finer soils are not blown and deposited over the gravel layer. Control of the salt fluff surfaces and sand surfaces would eliminate the source of dust emissions. Gravel is a commonly used dust control measure for industry.

If drainage systems were established allowing access to all the dust producing areas of the lake, gravel could physically be spread over the entire dust producing areas. Dust control might be as high as 100 percent.

Cover the surface with plastic netting, tires, etc.

Placing man made materials such as plastic netting, tires, or compressed waste on the Owens Lake surface would control dust emissions by creating a surface roughness or by stopping capillary movement of brines to the surface. These materials, however, would have a negative impact on the visual appearance of the lake bed. It is also unknown what reaction would take place between the waste materials and the brines in the lake. Use of tires or any other form of waste materials would benefit communities capable of transporting the materials to Owens Lake.

Access to the dust producing areas would be necessary before materials could be transported and spread over the surface. The amount of dust control is unknown at this time.

Modify the soluble salts to insoluble salts.

Some forms of salts are insoluble, producing crusts that remain hard after dehydration. The soluble salts currently on the lake bed form the salt "fluff" surface that blows during wind events. Salt "fluff" is produced when certain forms of salts dehydrate and are exposed to extreme fluctuations in temperature during the winter months of the year. At certain temperatures the salt crystals are modified forming the finer fluffy salt surfaces. If the soluble salts could be chemically modified into the insoluble salts, dust would not blow from the surface. The hard crusts developed would protect the surface from wind erosion. Chemical phase changes due to temperature fluctuations must be well understood prior to modifying the crusts.

This approach, again, would require good drainage of the lake surface to allow implementation and to keep dehydration of soluble salts from breaking the surface crusts through expansion and contraction. Implementation of this measure could be very quick, easily within three years. Control would depend on the stability of the crusts during climatic changes throughout the annual cycle. If crusts remain undamaged, 100 percent control could be expected.

Oil or treat the surface with chemical surfactants.

Oiling or treating the surface with a chemical dust stabilizer would control dust through the same process as described for modification of the salt crust in the preceding paragraphs. Oiling the surface potentially could create negative impacts on the lake ecosystem and interfere with mining operations currently on the lake. To date, no chemical stabilizer has been identified that can stop the capillary movement of brines to the surface. Past applications of plastic polymer and oil based dust suppressants have not stopped the capillary movement, resulting in salt "fluffs" developing on the surface of the suppressant.

Based on past applications of dust suppressants, dust control would rapidly deteriorate directly after application. Application would have to be on a monthly or bi-monthly basis for about nine months out of the year.

However, Bentonite is a possible material that might be spread over the surface to stop capillary rise. Bentonite carpets have been developed for lining and sealing canals and ponds from water loss. These Bentonite carpets could be easily rolled out over the lake bed surface.

Capture sand movement across the surface via fence.

Saltation or sand blasting of surface crusts has been identified as one of the dust producing processes occurring on Owens Lake during wind episodes. Intercepting the movement of sand across the surface would stop the saltation process, eliminating the erosion and emission of finer clay and salt particles from the surface. Work is currently being completed on the lake bed addressing the control of sand via fence systems. Completion of this work during the summer of 1988 will address the control efficiency of this measure in reducing dust emissions.

GBUAPCD field work and observations indicate that about 35 percent of the dust producing areas of the lake are controlled by saltation. Four foot core sampling completed over the dust producing areas of the lake bed have identified sand deposits greater than six inches in depth in all of the areas where saltation is the dominating process. Sand deposits greater than one to two inches in depth can not be found in the identified "fluff" areas of the lake. Control efficiency for this measure is estimated between 50 and 80 percent depending on the wind speeds and lake bed surface conditions. This control measure would not be useful for the remaining portions of the lake controlled by capillary action and formation of salt "fluff".

Break wind fetch via fence, tree row, or water barriers.

Breaking the wind fetch across the barren lake bed surface would reduce the wind energy at the surface, reducing the erosion potential of the wind. Strategically located barriers perpendicular to the wind path would absorb or lift the wind energy away from the surface. The feasibility of establishing fence systems on the lake bed has already been proven. Establishing tree barriers or water barriers has not been proven to date. All three barriers would essentially have the same results. Maintenance, aesthetics, and construction would be the differing qualities for each.

It is estimated that dust control would range from 10 to 90 percent depending on the wind direction, speed, and uniformity of the barrier.

Compact or compress the surface.

During the DRI Salt Crust Study the formation of "fluff" on the lake bed surface was controlled by vehicle tire compaction. It is unknown at this time what factors were involved in controlling the production of "fluff" on the compacted areas. Further study into the process of compaction to control the formation of "fluff" is recommended. Good drainage of the surface would be required to eliminate surface ponding. Control using this measure has not been tested on the lake. Testing of this measure is expected in 1988.

The control efficiency is currently unknown for this control measure. Lightly wetting the surface during compaction might produce better control than compaction alone. It was noted that compaction directly after precipitation events produced a more lasting control of the "fluff" production. However, the formation of "fluff" might also be increased from wetting during compaction. Compacting the expanded surface soils and forming less erodible surfaces would be the goal of this control measure. There is a possibility that sand areas as well as salt "fluff" areas might be controlled by use of this measure.

Grow algae mats over surface.

Mats of algae covering the lake surface might stop capillary movement of brines and reduce erosion of the surface. Flood irrigation might allow certain forms of algae to grow over the surface producing a mat to mitigate the dust problem. Once the algae mats were produced, irrigation water could be removed. The dried mat would continue to mitigate the dust, while the irrigation water would be moved to a different area or stored. Organic mats could not be allowed to migrate to the lake center, as this would have detrimental effects on the ore body currently being mined.

Dust control by this method is presently unknown. Tests of the measure could be instituted when irrigation measures are undertaken. Assuming algae could grow on the lake bed and the capillary movement of brines did not destroy the dead organic mat rapidly, control could be as high as 100 percent.

4.2 Selected Controls

In this section we will discuss a proposed control plan for the Owens Lake dust producing areas shown in figure 13. The plan has been broken into three groupings, mitigations with high initial costs and low annual maintenance, mitigations with lower initial costs and high annual maintenance, and phased mitigation. The proposed plan is based on many assumptions that have not been fully clarified to date. We recognize this weakness in the plan. Future work on Owens Lake may identify more efficient and effective control measures for implementation. The intent of the plan is to present a general concept for mitigation and allow reasonable steady progress towards correction of the dust problem. The general nature of this plan will allow the development and implementation of the most acceptable control measure for each area of the lake.

Owens Lake dust producing areas of concern for mitigation are shown in figure 13 as the shaded portion of the map. The boundary of the shaded portion shown on this map was purposely forced to fit section boundaries to include the dust producing areas of concern. This represents an over estimate of the dust producing areas that need to be mitigated to attain the Federal Air Quality Standard. The large unshaded area in the center of the lake is wet or heavily crusted with very hard crusts. The dust producing area of concern makes up 46.5 square miles or 42.3 percent of the total 110 square miles of lake bed.

Within the dust producing area described above there are sub-areas that produce dust on a more frequent basis than others (figure 14). These sub-areas

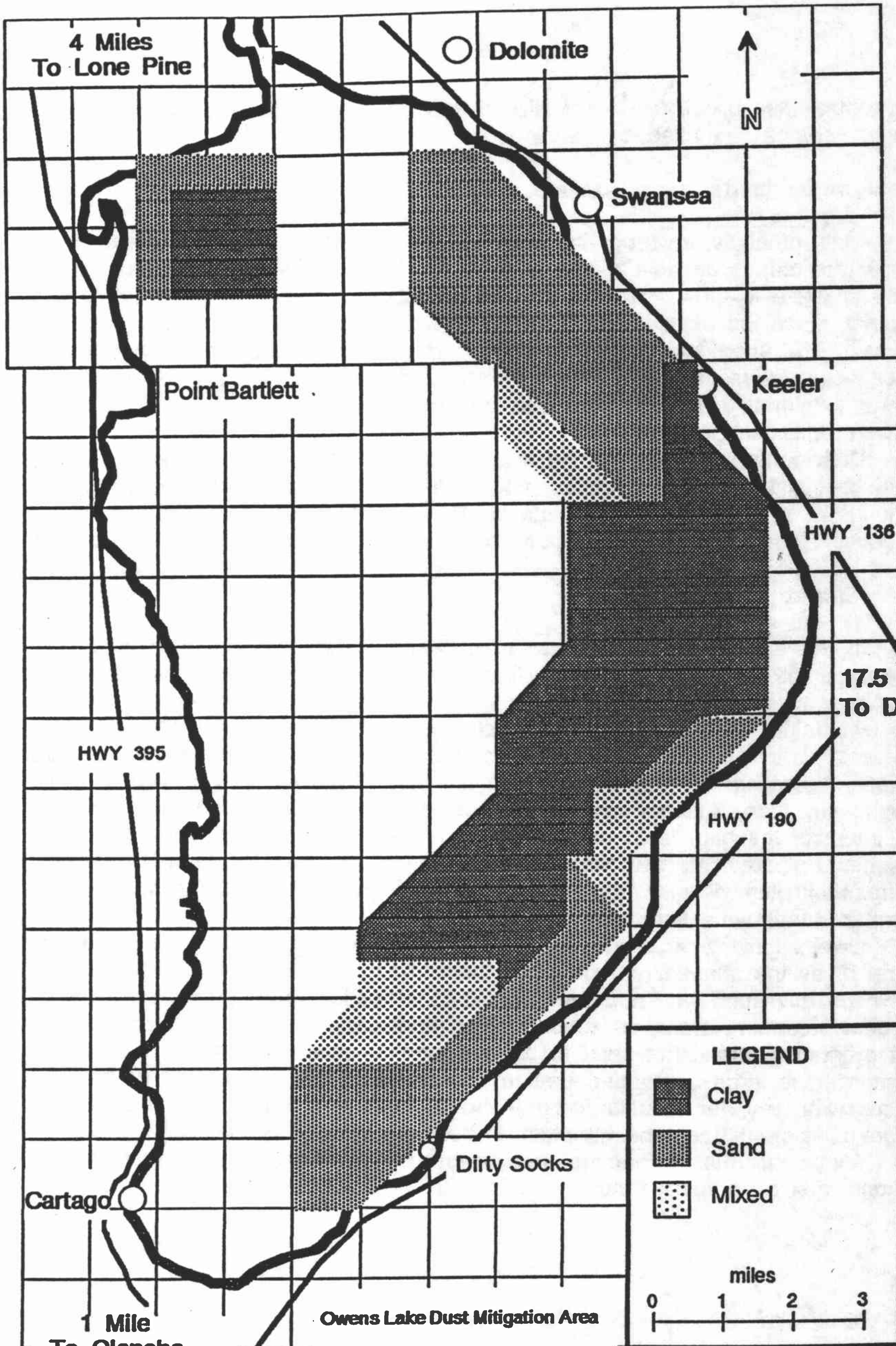
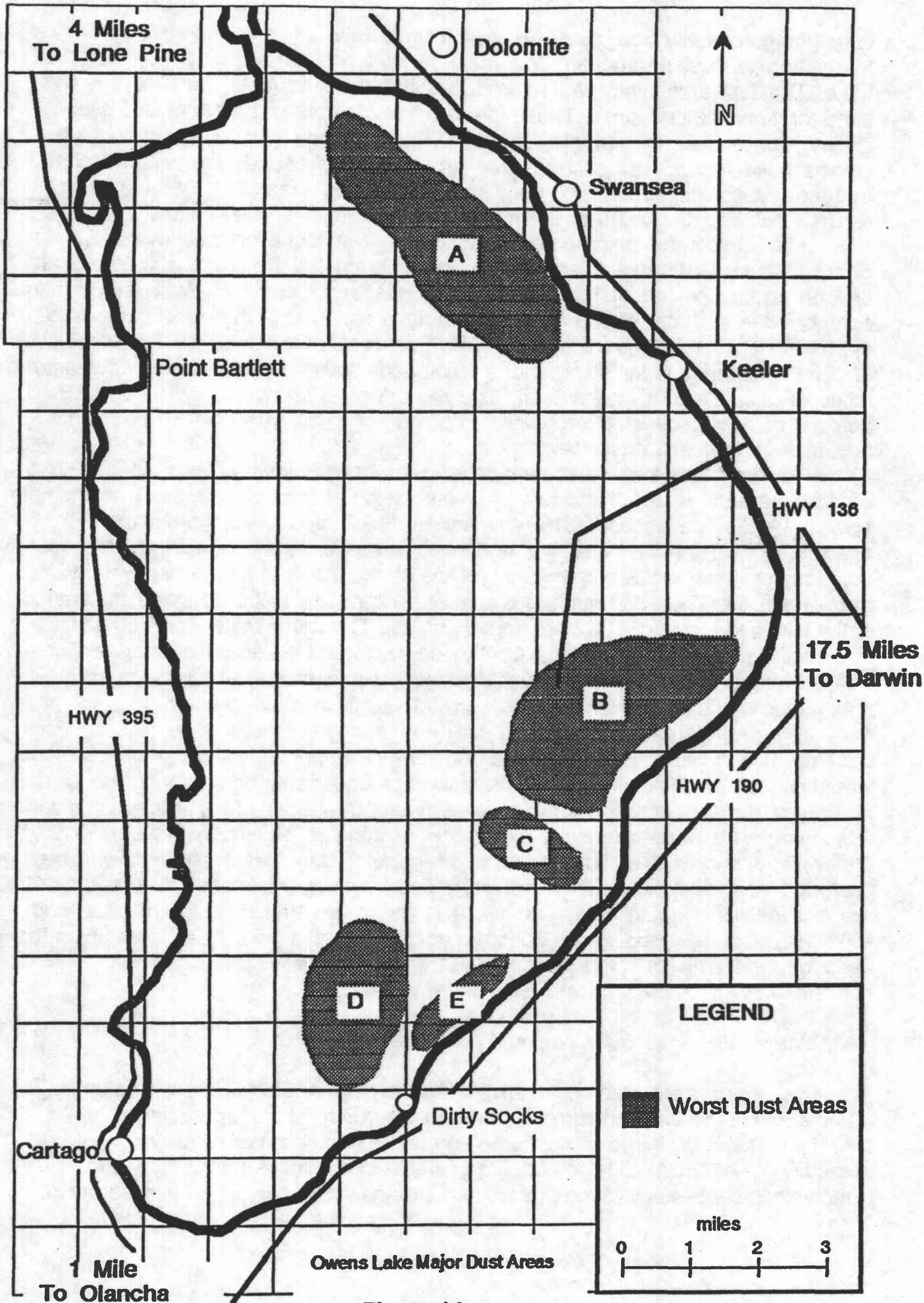

4 Miles
To Lone Pine
Dolomite
N
Swansea
Keeler
Point Bartlett
HWY 136
17.5 Miles
To Darwin
HWY 395
HWY 190
LEGEND
Clay
Sand
Mixed
Dirty Socks
Cartago
miles
0
1
2
3
1 Mile
To Olancha
Owens Lake Dust Mitigation Area

Figure 13



4 Miles
To Lone Pine
Dolomite
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Swansea
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Point Bartlett
Keeler
HWY 136
17.5 Miles
To Darwin
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HWY 190
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D
E
LEGEND
Worst Dust Areas
Dirty Socks
Cartago
miles
0
1
2
3
1 Mile
To Olancha
Owens Lake Major Dust Areas

Figure 14

vary geomorphically and range in size from a few acres to thousands of acres. In relation to dust production, two major area types stand out on the Owens Lake. The first area type, which produces the most frequent emissions, is the sand or sand related area. These areas were described as sandflats, beach ridges, dunes, and megaripples in the DRI, Hydrology and Water Budget of Owens Lake report. The second area type, which produces the second most frequent emissions, is the silt, clay and salt related area. The DRI Hydrology report described these areas as salt crusts, mudflats, and salt pans.

For the control plan these areas have been identified and mapped. Shaded areas in figures 13 delineate areas dominated by sand or clay/silt/salt environments. Looking at this map we can see that the clay/silt/salt environments compose the majority of the dust producing area. In fact this area composes approximately 21.25 square miles or 45.7 percent of the total 46.5 square miles of dust producing area. The sand environment covers approximately 16.5 square miles or 35.5 percent of the total. The remaining 8.75 square miles or 18.8 percent of dust producing area falls into the category of mixed environments having less frequent dust events.

The first task that must be addressed before implementation of any dust control measure is establishment of a lake wide drainage and water management system to alleviate access, surface water, and high groundwater problems associated with the many spring and seep areas around the lake. The four foot core hole program recently completed for the Phase II program identified water from the Owens River delta and numerous seeps, springs, and wells along the eastern half of the lake bed (figure 15). Waters from these sources cause the majority of the lake bed access problems. Areas away from these sources of water can support vehicle traffic during dry periods of the year. Construction of most of the theorized dust mitigations would require vehicle access within areas currently wet.

Figure 16 shows a proposed drainage and water management system for the lake bed. Dotted lines represent the major drainage systems. Major systems would consist of dikes and canals to intercept and transport brines to the center portion of the lake or to a holding area on the south west tip of the lake. In addition there would be minor drainage systems consisting of small furrows and ditches that will transport brines to the major drainage system. Minor systems will be designed and developed when control measures are implemented, and therefore are not indicated on the map. In all, it is estimated that 15 miles of dike, and 25 miles of canal need to be constructed on the lake bed. An assessment of the need for and feasibility of this system, and the design of any system deemed necessary, will take place in late 1988 and early 1989.

Mitigations with High Initial Costs and Low Maintenance

Gravel is currently the only known mitigation that would fall into this category. Some areas of the lake can currently support the transport and spreading of gravel over the surface. Drainage of most of the remaining portions would allow gravel spreading. The GBUAPCD completed a gravel dust control study in May 1987. Conclusions of the study found that a greater than four inch depth of washed gravel

Ellen Hardebeck
Control Officer

GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

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

December 14, 1988

Mr. James Boyd
Executive Office
Air Resources Board
P.O. Box 2815
Sacramento, CA 95812

Dear Mr. Boyd:

Attached please find the State Implementation Plan and Negative Declaration for the Owens Valley PM-10 Planning Area. This Plan was approved by the Great Basin Unified Air Pollution Control District Board on December 14, 1988.

The major source of the Federal PM-10 Ambient Air Quality Standard violations is Owens Lake, a 110 square-mile dry lake. Our District is developing and testing control measures for this source, but they will not be available soon enough to allow compliance with the standards within three years. Please request the Governor to ask the EPA Administrator for a two-year extension of the compliance date.

Thank you.

Sincerely,

HB Irwin

H. B. Irwin
Board Chairman

RESOLUTION OF THE GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT BOARD MAKING CERTAIN FINDINGS AND ADOPTING THE STATE IMPLEMENTATION PLAN FOR THE OWENS VALLEY PM-10 PLANNING AREA

WHEREAS, the United States Environmental Protection Agency (EPA) promulgated a new ambient air quality standard in July, 1987 for particulate matter less than ten (10) microns in diameter (PM-10); and

WHEREAS, on August 7, 1987, the EPA identified the portion of the Owens Valley between Tinnemaha Reservoir and Haiwee Reservoir as an area where the PM-10 standard was being violated; and

WHEREAS, Section 110 (a)(1) of the federal Clean Air Act mandates that the State of California, after reasonable notice and public hearings, adopt and submit to the EPA within nine (9) months after the promulgation of the new PM-10 standard, a revision of the State Implementation Plan (SIP) which provides for the implementation, maintenance and enforcement of the PM-10 standard within the southern Owens Valley; and

WHEREAS, under California law, the Great Basin Unified Air Pollution Control District (GBUAPCD) is the governmental entity charged with the responsibility of developing and of adopting such a SIP, and with timely submitting such an adopted SIP to the State of California Air Resources Board; and

WHEREAS, the staff of the GBUAPCD has developed and circulated for public review, and received and considered public comment upon, a draft SIP for the southern Owens Valley; and

WHEREAS, the SIP is now before this Board for consideration of final adoption.

THEREFORE, BE IT RESOLVED that following review by this Board of the SIP prepared by the GBUAPCD staff, after consideration of written public comments received on the draft SIP, and of oral public and staff comment on the draft SIP received at a public hearing held this date, this Board hereby finds as follows:

1. The single major source causing violations of the federal PM-10 standard in the area of the Owens Valley between Tinnemaha Reservoir and Haiwee Reservoir is Owens Dry Lake.

2. Wind blown dust from Owens Dry Lake causes violations of the federal PM-10 standard at distances greater than 25 miles downwind from the Lake.

3. Of the Owens Dry Lake total area of 110 square miles, there is 46.5 square miles of area that produces wind blown dust that contributes to violations of the federal PM-10 standard.

4. The necessary technology or other alternatives for controlling wind blown dust from sources such as Owens Lake has not yet been developed.

5. The SIP provides for the development of measures necessary to insure the attainment and maintenance of the federal PM-10 standard in the southern Owens Valley as expeditiously as practicable given the current lack of proven measures for controlling the wind blown dust from Owens Dry Lake.

6. THE SIP assures that through the implementation of the provisions of California Health and Safety Code section 42316 for study and mitigation of the air quality impacts on Owens Dry Lake caused by the production, diversion, storage or conveyance of water by the City of Los Angeles, and for annual funding of the GBUAPCD by the City of Los Angeles for the costs of the GBUAPCD associated with the development of mitigation measures with respect to these water gathering activities of the City of Los Angeles, as well as through the development and adoption by the GBUAPCD of regulations as necessary to provide for the implementation of reasonably available control measures not capable of implementation under section 42316, the GBUAPCD will have adequate personnel, authority and funding to carry out the provisions of the SIP.

7. The SIP includes provisions for the establishment and operation of appropriate devices, methods, systems and procedures necessary to monitor, compile and analyze data on ambient air quality in the southern Owens Valley.

BE IT FURTHER RESOLVED that in consideration of each of the foregoing findings, statements and legal requirements, this Board hereby approves and adopts, as modified by staff, the draft SIP as the State Implementation Plan for the Owens Valley PM-10 Planning Area.

BE IT FURTHER RESOLVED that the adopted SIP be forwarded for appropriate review to the California Air Resources Board.

Passed and Approved this 14th day of December, 1988.

AYES: 6

NOES: 0

ABSENT: 0

N B Lacci
Chairman

ATTEST:

Donna Leavitt
Clerk of the Board

STATE IMPLEMENTATION PLAN

AND NEGATIVE DECLARATION / INITIAL STUDY

FOR

OWENS VALLEY PM-10 PLANNING AREA

PREPARED BY

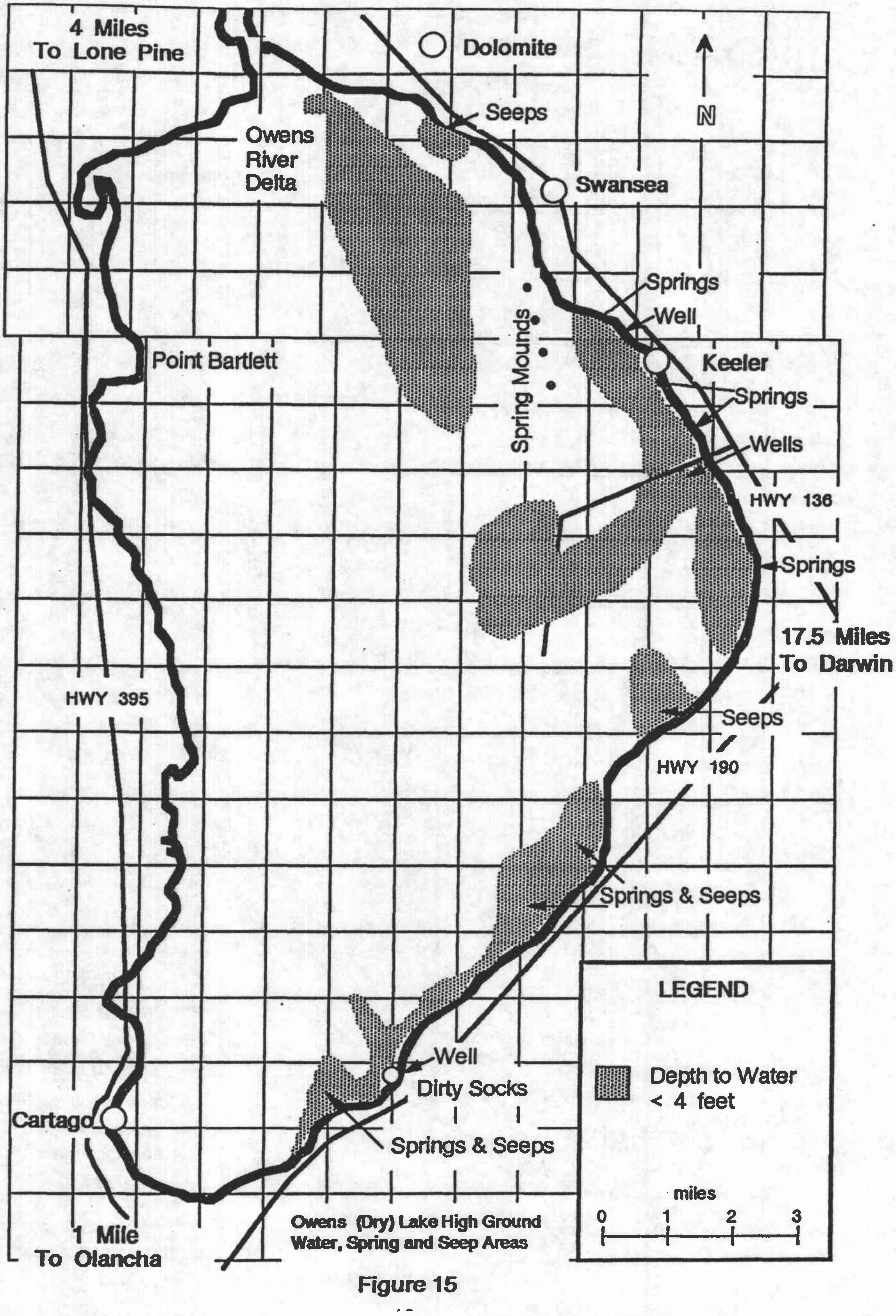
GREAT BASIN UNIFIED

AIR POLLUTION CONTROL DISTRICT

157 Short Street, Suite 6

Bishop, CA 93514

DECEMBER 1988


4 Miles
To Lone Pine
Dolomite
N
Seeps
Owens
River
Delta
Swansea
Springs
Well
Spring Mounds
Point Bartlett
Keeler
Springs
Wells
HWY 136
Springs
17.5 Miles
To Darwin
HWY 395
Seeps
HWY 190
Springs & Seeps
LEGEND
Well
Dirty Socks
Depth to Water
< 4 feet
Cartago
Springs & Seeps
miles
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1
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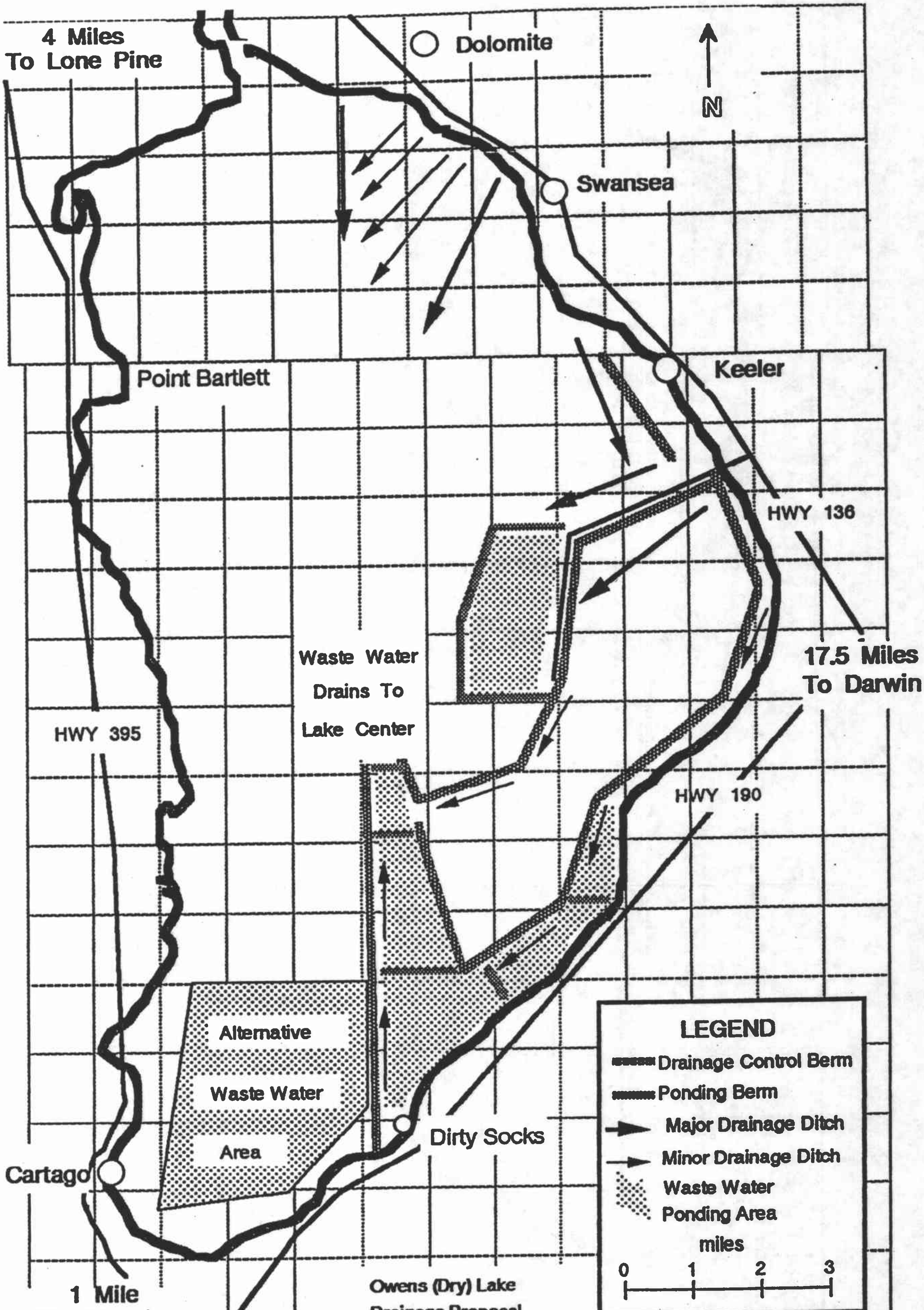
3
1 Mile
To Olancha
Owens (Dry) Lake High Ground
Water, Spring and Seep Areas

Figure 15



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Drains To
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Waste Water
Area
Dirty Socks
Cartago
1 Mile
To Olancha
LEGEND
Drainage Control Berm
Ponding Berm
Major Drainage Ditch
Minor Drainage Ditch
Waste Water
Ponding Area
miles
0
1
2
3
Owens (Dry) Lake
Drainage Proposal

Figure 16

with diameters greater than 1/4 inch would be required to eliminate the efflorescence of salt "fluff" to the surface. A thinner layer may be required on sand areas to produce the desert pavement necessary for dust control.

Implementation of the gravel mitigation would have to be accomplished in very short time period at a very high cost. Sand and dust storms can fill the large capillary spaces created by the gravel reducing the mitigation effects rapidly. Keeping the dust areas, not covered by gravel, from blowing onto the gravel covered areas would be difficult, requiring some other form of temporary control. If no temporary dust controls were used, the gravel mitigation would have to be implemented on the most frequent dust producing areas within two years.

Annual maintenance for the gravel mitigation would be limited to infrequent observations, gravel replacement for areas filled in by finer soils, and repair of flood damage to the water management system. Basic preventative maintenance costs would be small with larger costs incurred during years of high flood and wind damage.

Mitigation of the major dust producing areas would be two years from the date of initial construction. Remaining dust producing areas could be completed in three more years. Development, and final authority or approval to implement the program would take from three to five years. Assuming funding could be obtained, full mitigation could be achieved in 10 years. However, obtaining funding at the level necessary to implement such a program could delay mitigation of the dust problem indefinitely.

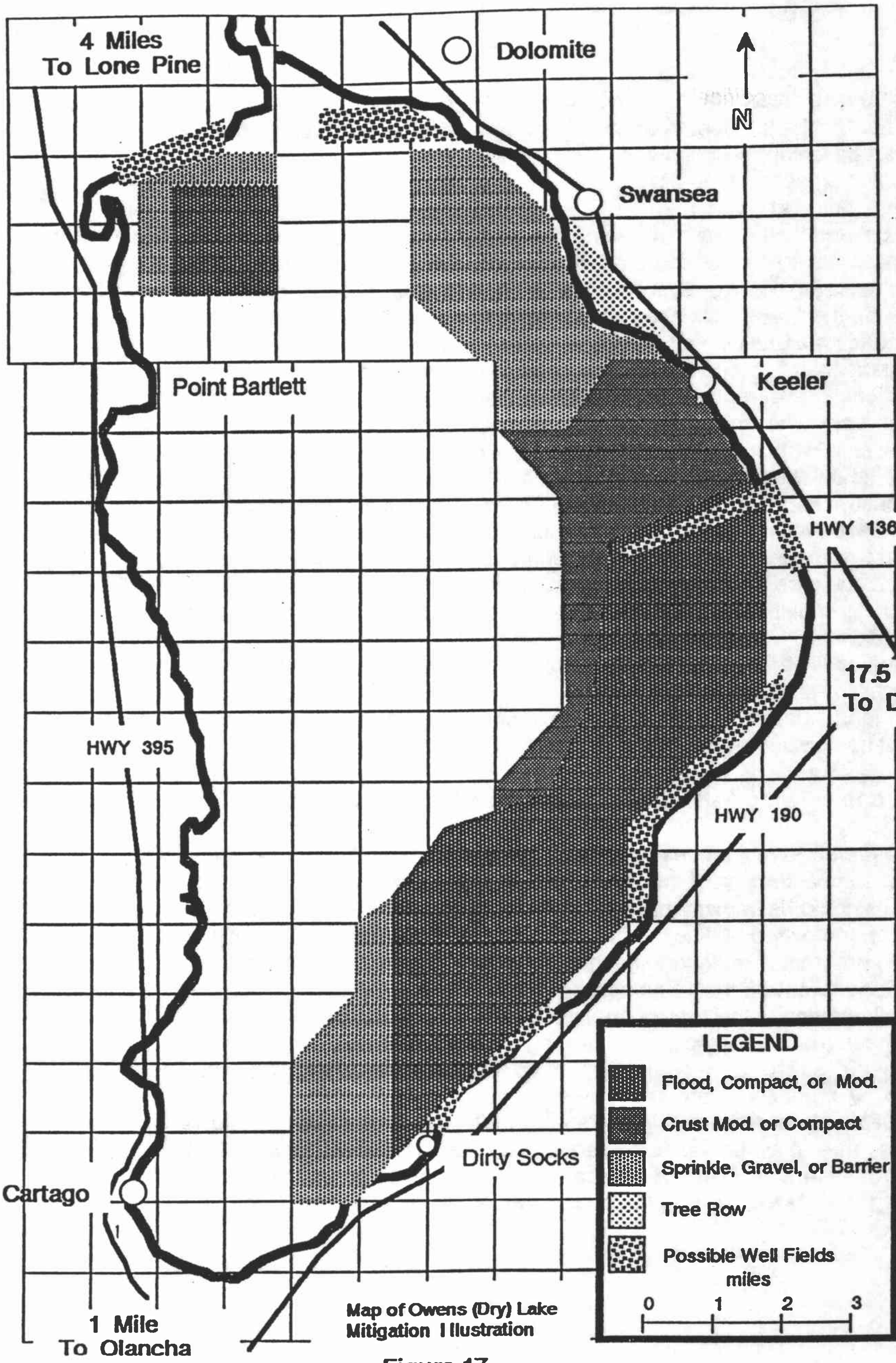
Additionally there are two irreversible impacts associated with the spread of gravel over the lake bed. Areas covered with gravel would limit the public use of the lake bed, and other uses such as mining, commercial development, and agriculture could not be pursued without first removing the gravel layer.

Mitigations with Lower Initial Costs and High Maintenance

The preferred mitigations falling into this category are flooding and leaching, sprinkler, compaction, crust modification, fence barriers, and tree row. All of these mitigations could be implemented at any pace desired. Initial funding can be set at any figure over any period of time. Maintenance costs would be high, increasing as mitigation programs continue to be implemented. Economic programs bringing in offset revenue would benefit this approach very well.

An illustration of this type of approach is shown in figure 17. This illustration depicts the use of four of the six preferred mitigation measures. The four measures proposed are salt crust modification, flood irrigation with leaching, sprinkle irrigation by prediction, and tree rows.

If future studies on the lake identify better control measures than those illustrated, they may be implemented as an alternative. **All four of the proposed primary control measures have <u>not</u> been tested on the lake bed to date.** Testing of these and other controls are scheduled for 1988 and 1989.


4 Miles
To Lone Pine
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HWY 190
LEGEND
Flood, Compact, or Mod.
Crust Mod. or Compact
Sprinkle, Gravel, or Barrier
Tree Row
Possible Well Fields
miles
0
1
2
3
Dirty Socks
Cartago
1 Mile
To Olancha
Map of Owens (Dry) Lake
Mitigation Illustration

Figure 17

Salt crust modification will involved chemically modifying the existing soluble crust to form an insoluble crust that does not go through an anhydrous crystal phase. Drainage of the modified areas will help stop capillary movement of brines from coming to the surface and damaging the hard crusts.

Flood irrigation is proposed in conjunction with leaching. Drainage systems for flooded areas will remove the flood waters fairly rapidly allowing only wetting of the soil surface. Ponding or standing water will not be allowed for long periods of time. Drainage collection systems at the sides and lower end of the flooded area will collect and transport remaining water to the next lower flood irrigation area. Soluble salts will be leached out of the upper irrigation areas and end up in the center of the lake or be transported to bermed deposit areas. Continued leaching of the up gradient areas may allow for future agricultural operations.

Water for the flood irrigation, and sprinkler projects would have to come from aquifers on the north, east, and south shoreline areas.Further studies are necessary to define the extent of the aquifers proposed for development. Any impacts on the current users of the aquifers would have to be identified and mitigated before reliance on aquifers as water sources for dust mitigation projects.

The sprinkler irrigation by prediction control measure will involve wetting the surface to no greater than 1/2 inch depth with moving agricultural type sprinkler systems. High wind periods will be predicted using the established National Weather Service and the local meteorological system operated by several agencies. Sprinkler systems will be activated 48 hours prior to predicted wind episodes. Predictions will be reevaluated every 12 hours. Sprinkling can be terminated at any time during the 48 hour period if predictions indicate the wind event will not occur.

The fourth primary control measure involves approximately 400 acres of sand area north of Keeler on the shoreline. Tree rows are proposed in this area to break the winds across this sand dominated area. Water for irrigation of the trees would come from the wells located on the north end of the lake. The tree rows would run in a southwest by northeast direction perpendicular to the predominant wind direction in the area. This is the only location where it is currently known that tree rows can be established.

Compaction in conjunction with wetting of the surface is proposed as an alternative for clay/silt/salt dominated areas of the lake. Long strings of heavy rollers would be pulled by tractor over the lake bed. A water tank mounted on the tractor will supply water to spray bars mounted several feet in front of the rollers. Lightly wetting the surface just before compaction would allow better compaction of the surface. Compaction would be completed based on wind prediction or as needed according to surface condition. A program to test this theory will be carried out during 1988-89.

Phased Mitigation

Phased mitigation involves the implementation of simpler tried and proven mitigations prior to development and implementation of larger more complicated permanent measures. An example of this approach would be the implementation of sand fence barriers to establish linear sand dunes for latter planting of tree rows. Or installing sprinkler systems to control dust in major dust producing areas until a more permanent mitigation can be developed and implemented. Gravel, sand fence barriers, sprinkler, and covering the surface with man made materials are examples of small scale proven mitigation measures. All of these have been used in industry for many years with varying degrees of documented success.

4.2.1 Owens Dry Lake Task Force

The Owens Dry Lake Task Force (ODLTF) currently organizes development and implementation of large scale studies and mitigation programs on the Owens Lake. Modification of this group is proposed for implementation of future projects within the OVGA. The ODLTF is currently represented by 11 agencies and the public. Funded projects are managed by an ODLTF Management Committee composed of the funding participants and the GBUAPCD.

The ODLTF will become an advisory group to the GBUAPCD renamed the Owens Dry Lake Advisory Group (ODLAG). Membership of the ODLAG would include the current membership in the ODLTF and any other group or organization that wished to become a member.

Responsibilities of the ODLAG would be representation of agency and public interests. The ODLAG will supply assistance and information to the GBUAPCD to facilitate correct decision making.

4.2.2 Other Lake Bed Management Needs

Currently the Owens Lake Bed has limited access for the public. Public use is mainly around the periphery of the lake and in areas that have road access. Traveling off developed roads is dangerous due to the uncertainty of the surface to support weight. Water from underground seeps and springs, as well as precipitation, can turn stable areas into very unstable areas very quickly.

The visual appearance of vehicles and construction of mitigation projects on the lake bed would encourage and allow public access to many portions of the lake not presently used by the public. Two possible problems could develop from this increased public access. First, damage to sensitive mitigation controls could occur from off road vehicles traveling over the surface. All of the mitigation measures proposed in this plan could be damaged by off road vehicle use in the area. Vandalism of equipment stored on the lake bed may also result.

Second, the public would be exposed to dangerous environments on the lake bed. Very soft unstable areas commonly appear dry on the surface due to salt crust formation or dust deposits. Vehicles or people crossing these areas will sink within seconds. GBUAPCD staff have sunk to depths of four feet within one step. These conditions could lead to property damage and personal injury or death.

Limited access is recommended to avoid problems associated with new and increased public use. Public access should be limited to the existing roads. Existing locked gates should remain in place with establishment of any new access routes locked as well. Access beyond locked gates would be controlled by the State Lands Commission by permission.

Many migrating water fowl currently use ponded water areas on the lake bed. Several of these habitats will be destroyed during construction of the water management program. With increased water from proposed wells and better water management, new larger wildlife habitats can be established on other areas of the lake to replace those destroyed.

5.0 Evaluate Need for Regulation Changes

EPA requires development of regulations necessary to assure maintenance of the Federal Air Quality Standards. Existing regulations may or may not be adequate to maintain the standard. The following sections will discuss adequacy of the existing regulations and propose regulation alternatives.

5.1 Existing Regulations and Laws

Regulations pertaining to air pollution and control of air pollution can be found at the Federal level in the Clean Air Act and the Federal Register, at the State level in the Health and Safety Code, and at the Local level in the book of Rules and Regulations for the Great Basin Unified APCD.

The Federal Clean Air Act requires that sources of PM-10 violations be controlled within 5 years. The GBUAPCD must have or adopt enforceable regulations as part of the State Implementation Plan.

The GBUAPCD has tried several local rules to control Owens Lake. The GBUAPCD applied local Rule 200 to the City of Los Angeles, Department of Water and Power (LADWP) operations in Spring 1980. In 1982, after LADWP Coso Geothermal Permit Applications were denied by the GBUAPCD, the LADWP petitioned the GBUAPCD Hearing Board for a variance. The Hearing Board denied the variance and upheld the decision to require air quality permits for LADWP water gathering operations. In 1983 Senator Dills introduced legislation (SB-270) exempting water gathering operations from air quality permit regulations. Compromise language for SB-270 resulted in the passage of the bill in 1983. SB-270 became law in January 1984 and can be found in the

State Health and Safety Code under section 42316. (Appendix E)

State Health and Safety Code 42316 exempts water gathering operations from having to obtain air quality permits. However, 42316 also contains language allowing the GBUAPCD to require the City of Los Angeles to undertake and fund reasonable measures, including studies, to mitigate the air quality impacts associated with the City's production, diversion, storage, or conveyance of water. (See Appendix E)

Under Health and Safety Code 42316 the GBUAPCD must first determine if the Owens Lake causes or contributes to violations of Federal or State Ambient Air Quality Standards. Sections 1.4 through 2.4 identified Owens Lake as the only source within the OVGA causing Federal PM-10 ambient violations. Health and Safety Code 42316 also requires the GBUAPCD to determine that LADWP water gathering operations caused the Owens Lake to produce emissions. Owens Lake is a confined lake without a geologically recent outlet. The Owens River and miscellaneous streams along the west edge of the lake are the only significant sources of water for the lake. Without these sources of water the lake becomes dry. The LADWP diverts the Owens River into the Los Angeles Aqueduct for use in the Los Angeles basin. Consequently Owens Lake is mostly dry allowing winds to blow large concentrations of dust from the surface.

Therefore, it appears that the necessary connection between LADWP water gathering operations and violations of ambient air quality standards can be established. Once the necessary connection is made, the GBUAPCD will require the LADWP to undertake reasonable measures including studies to mitigate the air quality impacts on Owens Lake of its water gathering activities; additionally, the GBUAPCD will require LADWP to pay to the GBUAPCD reasonable annual fees based on the costs to the GBUAPCD of developing dust control measures with respect to those activities of LADWP.

Maintenance of standards will be accomplished through continued PM-10 monitoring and source inspection. Monitoring stations at Lone Pine, Keeler, and Olancha will continue operation to document violations. If a violation is documented, the contributing source will be identified and appropriate action taken to correct the problem. Spot inspection of mitigated areas will be carried out by GBUAPCD staff to assure control efficiency. Visual observation and use of a portable wind tunnel device will be used to determine source compliance.

5.2 Regulation Alternatives

To assure maintenance of the standard it is recommended that additional regulation be developed. Following is suggested language for such regulation.

Rule 426. Owens Lake Mitigation Emissions

A. Dust emissions from Owens Lake mitigation projects, under normal wind conditions, may not travel beyond the boundary of the lake, known as the 3600 foot contour level. Dust monitoring may be conducted by observation or by portable 24 hour PM-10 monitoring at the lake boundary. Normal wind conditions will be determined from an anemometer located 10 meters above the surface near the center of the lake. If data from this station is missing, data from the Lone Pine, Keeler, and Olancha stations will be used to make the determination.

1. Normal wind conditions for this rule will be defined as average hourly wind speeds less than 30 mph.

B. District staff may inspect the surface of mitigation projects at any time without notification to determine compliance. A portable wind tunnel will be operated on the mitigated soil surface with a dust collection system attached. Dust loading on the filter collection system may not exceed ?? grams per minute at a wind speed equivalent to 25 mph. The wind tunnel must be operated in accordance with District quality assurance procedures.

The above recommended regulation could be adopted as a local rule or as a state regulation. This rule is an example, and should be used as a reference for possible future rule development.

Other suggested regulations would be to clarify the GBUAPCDs role in implementation of control measures.

5.3 Regulation Process

The regulation process is described in California Health and Safety Code Sections 40700 through Section 40704. The District may adopt regulations more stringent than State regulation. All regulation development and adoption is subject to the California Environmental Quality Act (CEQA).

6.0 CEQA Process

This State Implementation Plan for the Owens Valley Group I Area is subject to the CEQA process. CEQA documentation is contained in Appendix F. Additionally, all test plans and control measures developed later for implementation of dust mitigations and the establishment of a lake wide drainage and water management plan will have appropriate CEQA documentation. The reader is referred to the separate CEQA document for discussions of environmental impact of the individual projects as they are developed.

6.1 Public Involvement

Public hearings on this document and the CEQA document will be conducted by both the State of California Air Resources Board and the Great Basin Unified APCD. Written comments may be addressed to the:

Great Basin Unified APCD
157 Short St. Suite 6
Bishop, CA 93514

or

State of California
Air Resources Board
Attn: Steve DeMello
P.O. Box 2815
Sacramento, CA 95812

7.0 Adoption Process

The GBUAPCD Control Board must first adopt the OVGA SIP at the local level. Adoption by the Control Board will entail public hearings for public input to the SIP. After board approval the SIP will be submitted to the State.

The State Air Resources Board must then hold public hearings on the SIP prior to adoption. If the State does not adopt the SIP, it will be sent back to the local level for modifications. After modifications are made, the GBUAPCD Control Board must readopt the SIP and submit it back to the State. After adoption by the State the SIP will be submitted to the Environmental Protection Agency for approval.

Within 45 days of State submittal, the EPA will determine completeness or incompleteness of the SIP. If found incomplete the SIP will be returned to the State and GBUAPCD for modification. If found complete the EPA will approve or disapprove the SIP within four months after the date required for submission of the plan. If EPA disapproves the plan, EPA will then have nine months to write the plan for the State.

8.0 SIP Implementation Process

Development of the necessary information for implementation of this plan is currently in progress. Mitigation studies and pilot scale projects are currently in the planning stages or are reaching completion on the lake. This work is being completed through the ODLTF or under the GBUAPCD H&S Code 42316 budget. Information gained from these mitigation development programs will facilitate the final decision making process for selection of specific mitigation measures for large scale deployment on the lake.

Implementation of mitigations outlined in this plan will only take place after mitigations are tested on a small scale directly within dust producing areas of the lake. Feasibility of implementation, dust control, maintenance, period of effectiveness, and cost must be determined from small scale mitigation projects. Implementation of unsuccessful large dust control programs will be avoided by small scale testing.

The GBUAPCD will be responsible for developing and ordering implementation of all dust mitigation projects on the Owens Lake for lands owned by the LADWP and the State Lands Commission. Subsequent detailed technical reports and plans will be developed for each proposed project by GBUAPCD. Each of these project plans will be accompanied by a tiered CEQA document addressing the environmental impacts.

8.1 Time Schedule

Dust control on a source such as Owens Lake has not been executed within the United States. Control of such a large fugitive dust source will require time and patience. New and old control methods for fugitive dust sources will have to be investigated and tested within the Owens Lake environment. The time line shown in figure 18 represents an optimistically paced time schedule for development and implementation of dust control measures on the Owens Lake. A local staff of managers, clerical personnel, scientists, engineers and construction crews, fully equipped, would be required to accomplish this pace. All future projects will be flawed, delayed, or unsuccessful without very close and strict management.

As indicated in the time line, reduction in emissions from Owens Lake could not be expected until late 1991. Full control could not be achieved until July 1995. Careful design, development, and implementation of mitigation measures is a critical factor in the success of controlling Owens Lake dust emissions. Without the initial 3 1/2 years of control measure development, final control of emissions may not be accomplished.

However, the time line should not be strictly adhered to if test results and lake conditions warrant modification. Feasibility testing of control theories during the 1989-90 period might identify control measures that could be immediately implemented on portions of the lake. It will be the GBUAPCD's responsibility to modify the time schedule to achieve control of the emissions as soon as possible. Analysis of incoming data should be a continuous process, so that modification of the projects can take place before large amounts of time and money are lost.

OWENS LAKE DUST MITIGATION TIME LINE

					1988												1989										1990			
J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1											
						2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
							3	3	3	3	3	3	3	3	3	3														
																4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
										5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
																6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
																			7	7	7	7	7	7	7	7	7	7	7	7

		1990								1991												1992						
A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
2	2	2	2	2	2	2	2	2	2	2	2	2																
4	4	4	4																									
6	6	6	6	6	6	6	6	6	6	6	6	6	6															
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7							
	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8						
											9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

					1993												1994										1995			
J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9

LEGEND

1 = Finalize and Approval of OVGA SIP
2 = Feasibility Testing of Control Theories
3 = Design Water Management and Drainage System
4 = Construct Water Management and Drainage System
5 = Design Small Scale Control Projects
6 = Implementation of Small Scale Projects
7 = Observe and Validate Small Scale Projects
8 = Select and Design Large Scale Control Plan
9 = Implement Large Scale Control Plan

Figure 18

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6. Cochran G. F., T. M. Mihevc, S. W. Tyler, and T. J. Lopes. "*Study of Salt Crust Formation Mechanisms on Owens (Dry) Lake, California*" Prepared for Los Angeles Department of Water and Power, January 1988, DRI Water Resources Center, Publication No. 41108

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APPENDIX A

HISTORY OF AIR MONITORING SITES

HISTORY OF AIR MONITORING SITES
November 1978 - March 1988

SITE	DATE	COMMENTS
Big Pine - 11 NNW	85-08-26	Start of TSP & Met site.
	87-10-06	End of TSP & Met site.
Blackrock	84-06-22	Start of TSP site.
	85-10-01	Start of Met site.
	87-10-26	End of TSP site.
Coso Junction	79-04-04	Start of TSP site.
	81-05-28	End of TSP site.
	85-03-07	Start of PM-10 & Met site.
	87-01-15	Construction Nearby
	87-04-09	Construction Nearby
	87-06-08	Construction Nearby
	87-06-26	Construction Nearby
Darwin	85-03-01	Start of PM-10 & Met site.
	86-09-26	End of PM-10 & Met site.
Independence # 159	81-09-18	Start of TSP site.
	82-12-23	TSP site shut down.
	83-04-17	TSP site re-started.
	83-04-30	End of TSP site.
Independence # 67	82-03-18	Start of TSP site.
	82-12-23	TSP site shut down.
	83-12-19	TSP site re-started.
	88-03-15	End of TSP site.
	88-03-15	Start of PM-10 site.
Independence # 77	81-08-26	Start of TSP site.
	82-12-23	TSP site shut down.
	83-12-19	TSP site re-started.
	87-07-20	Construction of mitigation project.
	88-02-20	End of TSP site.
	88-02-20	Start of PM-10 site.
Independence Sewer Ponds	85-12-01	Start of Met. site.
Keeler	79-07-24	Start of TSP site.
	83-05-01	TSP site shutdown.
	83-12-08	TSP site re-started.
	84-08-28	Flash flood muds around site.
	86-02-01	Start of Met. site.
	86-10-23	Start of Andersen PM-10 site.
	87-04-26	Start of Wedding PM-10 site.
	87-11-01	End of Andersen PM-10 site.
	88-02-25	End of TSP site.

HISTORY OF AIR MONITORING SITES
November 1978 - March 1988

SITE	DATE	COMMENTS
Lone Pine 1452 S Main	78-11-22	Start of TSP site.
	79-08-17	End of TSP site.
Lone Pine Hospital	80-01-23	Start of TSP site.
	81-05-05	Start of PM-15 site.
	83-05-01	TSP & PM-15 shut down.
	83-11-02	TSP & PM-15 re-started.
	84-10-01	End of PM-15 site.
	84-10-01	Start of PM-10 site.
	87-10-07	End of TSP site.
Lone Pine Sewer Ponds	86-05-01	Start of Met. site.
Lone Pine Visitor Center	79-08-17	Start of TSP site.
	80-01-23	End of TSP site.
Olancha - Post Office	85-11-01	Start of Met. site.
	85-11-03	Start of TSP site.
	87-06-20	End of TSP site.
	87-06-20	Start of PM-10 site.

APPENDIX B

TSP AND PM-10 DATA

OWENS VALLEY GROUP I AREA PARTICULATE DATA *
November 1978 - March 1988

SITE	DATE	TSP (ug/m3)	PM-10 (ug/m3)
Big Pine - 11 NNW	86-04-02	293	
	87-01-27	116	
	87-03-04	229	
	Average:	213	
	Count:	3	0
Blackrock	85-03-02	186	
	85-04-25	428	
	Average:	307	
	Count:	2	0
Coso Junction	79-10-29	126	
	79-12-11	140	
	80-03-16	137	
	80-03-22	111	
	80-03-28	125	
	81-04-28	148	
	81-05-16	222	
	85-03-08		62
	85-03-14		53
	85-03-26		52
	85-04-25		307
	85-05-01		59
	85-06-18		52
	85-06-24		58
	85-08-11		60
	85-08-23		50
	86-04-02		1,175
	86-04-26		84
	86-06-07		157
	86-06-19		63
	86-07-13		58
	86-09-05		52
	86-11-04		77
	86-12-26		102
	87-01-15		196
	87-03-22		65
	87-04-09		56
	87-06-08		124
	87-06-26		115
	87-08-10		59
	87-10-12		73
	88-03-28		92

* TSP > 100 UG/M3, PM-10 > 50 UG/M3

OWENS VALLEY GROUP I AREA PARTICULATE DATA *
November 1978 - March 1988

SITE	DATE	TSP (ug/m3)	PM-10 (ug/m3)
	Average:	144	132
	Count:	7	25
Darwin	85-03-02		552
	85-03-26		128
	85-04-25		372
	85-10-04		53
	85-11-09		60
	Average:		233
	Count:	0	5
Independence # 159	82-12-20	113	
	Average:	113	
	Count:	1	0
Independence # 67	82-03-31	124	
	82-12-20	181	
	82-12-21	141	
	85-03-02	100	
	85-05-07	122	
	86-04-02	157	
	86-05-20	181	
	87-01-03	107	
	87-01-27	207	
	87-10-12	143	
	88-01-16	222	
	Average:	153	
	Count:	11	0
Independence # 77	81-10-07	113	
	82-01-26	120	
	82-03-31	223	
	82-12-20	266	
	83-00-00		
	84-03-13	101	
	84-03-31	157	
	85-03-02	165	
	85-04-25	193	
	85-05-07	102	
	86-04-02	141	
	87-01-27	173	
	87-06-14	138	
	87-07-20	417	

* TSP > 100 UG/M3, PM-10 > 50 UG/M3

OWENS VALLEY GROUP I AREA PARTICULATE DATA *
November 1978 - March 1988

SITE	DATE	TSP (ug/m3)	PM-10 (ug/m3)
Independence # 77	87-07-26	465	
	88-01-16	157	
	Average:	195	
	Count:	15	0
Keeler	79-07-19	250	
	79-09-30	128	
	79-10-28	1,247	
	79-10-29	635	
	79-11-03	153	
	79-11-19	537	
	79-11-20	389	
	79-12-10	188	
	79-12-11	321	
	79-12-26	1,865	
	80-01-18	1,106	
	80-01-19	668	
	80-01-21	245	
	80-01-28	774	
	80-02-07	587	
	80-02-08	1,244	
	80-02-09	103	
	80-02-16	274	
	80-03-16	310	
	80-03-22	264	
	80-04-09	154	
	81-03-29	983	
	81-04-10	389	
	81-05-16	373	
	81-10-07	474	
	81-11-16	134	
	81-11-23	863	
	81-11-24	871	
	81-12-16	100	
	81-12-21	280	
	82-01-11	113	
	82-01-12	507	
	82-01-18	562	
	82-01-19	122	
	82-01-25	126	
	82-01-28	1,442	
	82-02-01	818	
	82-02-16	164	
	82-03-02	2,181	
	82-03-15	256	

* TSP > 100 UG/M3, PM-10 > 50 UG/M3

OWENS VALLEY GROUP I AREA PARTICULATE DATA *
November 1978 - March 1988

SITE	DATE	TSP (ug/m3)	PM-10 (ug/m3)
Keeler	82-04-29	210	
	82-05-04	256	
	82-09-26	114	
	82-09-29	633	
	82-11-18	121	
	82-12-07	465	
	82-12-08	144	
	82-12-20	3,295	
	82-12-21	363	
	83-02-18	455	
	83-03-31	919	
	84-01-31	323	
	84-02-06	101	
	84-02-09	12,122	
	84-02-18	239	
	84-02-24	187	
	84-03-13	5,643	
	84-03-19	106	
	84-03-31	1,087	
	84-04-18	109	
	84-04-24	858	
	84-05-30	189	
	84-07-05	592	
	84-08-28	200	
	84-09-03	405	
	84-09-09	144	
	84-09-15	992	
	84-09-21	136	
	84-10-03	182	
	84-10-10	194	
	84-10-15	1,873	
	84-10-21	375	
	84-11-02	792	
	84-11-08	1,203	
	84-11-20	1,313	
	84-12-14	2,469	
	85-01-13	150	
	85-01-26	101	
	85-02-18	111	
	85-02-22	208	
	85-03-02	7,628	
	85-03-05	1,977	
	85-03-08	761	
	85-03-10	3,989	
	85-03-11	280	
	85-03-12	142	

* TSP > 100 UG/M3, PM-10 > 50 UG/M3

OWENS VALLEY GROUP I AREA PARTICULATE DATA *
November 1978 - March 1988

SITE	DATE	TSP (ug/m3)	PM-10 (ug/m3)
eeler	85-03-14	213	
	85-03-15	102	
	85-03-17	122	
	85-03-19	218	
	85-03-22	267	
	85-03-23	176	
	85-03-24	6,869	
	85-03-25	686	
	85-03-26	989	
	85-03-27	3,509	
	85-03-28	2,060	
	85-03-30	101	
	85-04-01	117	
	85-04-03	118	
	85-04-13	106	
	85-04-18	403	
	85-04-19	165	
	85-04-25	797	
	85-04-26	1,275	
	85-04-27	152	
	85-04-28	102	
	85-05-01	148	
	85-05-02	542	
	85-05-05	100	
	85-05-07	260	
	85-05-08	428	
	85-05-09	344	
	85-05-25	285	
	85-05-31	192	
	85-06-19	125	
	85-06-24	103	
	85-09-04	148	
	85-11-09	684	
	86-02-19	522	
	86-03-15	195	
	86-04-02	3,202	
	86-05-02	134	
	86-05-20	333	
	86-06-07	540	
	87-01-15	249	100
	87-01-27	1,271	672
	87-02-02	455	251
	87-02-20	130	54
	87-02-26	101	39
	87-03-04	125	71
	87-03-10	380	230

* TSP > 100 UG/M3, PM-10 > 50 UG/M3

OWENS VALLEY GROUP I AREA PARTICULATE DATA *
November 1978 - March 1988

SITE	DATE	TSP (ug/m3)	PM-10 (ug/m3)
Keeler	87-03-16	167	55
	87-03-22	316	166
	87-06-14	229	70
	87-06-26	182	91
	87-07-20	107	40
	87-10-22	199	65
	87-12-23	240	111
	88-01-16	1,101	394
	88-02-21	108	14
	88-03-15		69
	88-03-19		115
	Average:	770	145
	Count:	141	18
Lone Pine 1452 S Main	79-06-14	269	
	79-07-02	102	
	Average:	186	
	Count:	2	0
Lone Pine Hospital	80-01-28	118	
	80-04-21	412	
	80-11-23	107	
	81-05-16	107	
	81-10-07	162	
	81-11-12	159	
	81-11-16	107	
	81-12-09	110	
	82-01-12	107	
	82-01-25	212	
	82-03-31	102	
	82-09-15	102	
	82-12-20	381	
	82-12-21	179	
	83-03-31		62
	83-04-24	124	86
	84-02-09	284	274
	84-03-07	152	
	84-03-13		310
	84-04-24	140	
	84-07-05	83	57
	84-07-11	59	55
	84-08-10	91	55
	84-11-20	127	56
	85-03-02	464	239

* TSP > 100 UG/M3, PM-10 > 50 UG/M3

OWENS VALLEY GROUP I AREA PARTICULATE DATA *
November 1978 - March 1988

SITE	DATE	TSP (ug/m3)	PM-10 (ug/m3)
Lone Pine Hospital	85-03-26	148	72
	85-04-25	174	92
	85-05-07	90	54
	85-11-09	136	79
	86-04-02	182	95
	86-05-20	239	159
	87-01-27	253	178
	87-02-02	208	140
	88-01-16		172
	Average:	172	124
	Count:	31	18
Lone Pine Visitor Center	79-10-19	172	
	Average:	172	
	Count:	1	0
Olancha - Post Office	86-02-06	148	
	86-04-02	610	
	87-01-15	115	
	87-02-20	145	
	87-03-22	110	
	87-04-22	124	
	88-03-28		50
	Average:	209	50
	Count:	6	1
	Average:	558	140
	Count:	220	67

* TSP > 100 UG/M3, PM-10 > 50 UG/M3

APPENDIX C

METEOROLOGICAL DATA 20 MPH AND ABOVE

INDEPENDENCE TSP, PM-10 & MET DATA FOR WS > 19 MPH*
December 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
85	12	11		N	15	4	N	10-13
	Average:				15	4		
	Total:					4		
	Count:	1	0					
86	01	20	26	N	11	2	N	8-9
		31		SSW	7	1	S	14
		06		N	11	4	N,NNW	13-18
		29		S	14	7	S	14,17-22
		14	27	S	7	3	S	13-15
	02	04		NNW	15	5	N	9,11-14
		03		NNW	10	1	SW	13
		02		WSW,W	8	1	WNW	13
		06		N	19	3	N	16-17,19
		08		N	14	4	NNE,N	9-10,21-22
		09		N	19	14	N	2-15
		15		S	11	5	S	0,6-9
		17		N	12	2	WNW,NNW	10,12
		19	2	NW	16	7	S,WNW,NW	1-5,11,22
		14		S	21	14	S	10-23
	03	07		NW	8	1	WSW	15
		10		S	10	2	S	8-9
		12		N	11	5	N	10-14
		15	21	SSE,S	9	2	S,SE	11-12
		17		N	17	10	N	8-17
		18		N	15	3	N	8-9,15
		19		N	11	3	N	9-11
	04	01		W,WNW	11	5	W	13-15,18,22
		02	141	N	27	20	N,NNW	0-18,20
		03		N	11	2	N,NNE	8-9
		04		S	9	1	S	15
		12		WNW	15	5	W	10-12,15,17
		14	31	S	10	1	S	18
		15		S,WNW	11	4	SSE	11-13,15
		18		N	12	2	N	8-9
		29		N	9	1	NNW	0
		28		WNW	13	8	W,WNW,WSW	16-23
		26	31	N	15	2	N	3,7
		25		N,W	15	7	W	12-18
		23		SSE	9	1	W	15
		22		NW	9	2	W,WNW	16-17
	05	00		NO DATA				
	06	00		NO DATA				
	07	04		WNW	12	7	N,W,WNW	11-13,17,21-23
		17		SSE	11	3	SSE	14-16

* PM-10 data after Feb.21,1988

INDEPENDENCE TSP, PM-10 & MET DATA FOR WS > 19 MPH*
December 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
86	07	24		SSE	9	1	SSE	15
		28		SSE	10	4	SSE	14-17
		05		N	16	6	N,SSE	0-3,15-16
		06		S	10	1	SSE	19
		12		SSE	9	2	SSE	13-14
		13	47	SSE	9	1	SSE	14
		15		SSE	11	1	SSE	14
		16		WNW	8	1	WNW	14
	08	23		SSE	9	2	SSE	14-15
		24	28	S	10	3	SSE	13-15
		29		W	8	1	W	17
	09	25		NNW	9	1	WNW	15
		08		W	12	5	W	16-20
		24		WSW	9	1	SW	20
		09		W	14	7	WSW,W	0-1,12,14-16,23
		19		NNW	11	2	W	17-18
		10		N	11	3	N	0,8-9
		17	22	WNW	12	2	WSW,WNW	15,19
		12		S	9	1	S	14
		16		NW	10	5	W	15-19
		14		SSE	12	4	SSE,S,SE	12-15
	10	31		NNW	17	6	NNW	0-1,3,8-10
		30		NW	8	3	N	21-23
		19		NNW	12	1	N	10
		18		N	17	7	N	9-15
		11	54	NNW	20	15	N,NNW	4-14,17,20-21,23
		09		SSE	9	2	SSE	12-13
		02		NNW	16	7	N	9,11-16
		01		NNW	11	3	N	7-9
	11	29		NNW	19	12	N,NNW,NW	6-17
		25		NNW	19	13	NNW,N	0-7,9-13
		23		NNW	13	6	NW,NNW,N	4-6,9,12-13
		22	13	NNW	12	7	NNW,N	13-16,18-20
		21		NNW	11	7	NNW,N	13-16,19-21
		06		NNW	22	14	NNW,N	2-13,20-21
		04	21	N	11	3	N	9-11
		03		NNW	18	7	NNW,N	3,7,10-14
		02		NNW	16	8	N,NNW	8-15
		01		NNW	17	6	N,NNW	9-14
	12	23		NNW	14	2	N	13-14
		20		NNW	13	3	N	10-12
		09		NNW	13	5	NNW	11-15
		07		NNW	21	13	NNW,N	0,8-16,18,20-21
		06		NNW	7	2	N	21-23

* PM-10 data after Feb.21,1988

INDEPENDENCE TSP, PM-10 & MET DATA FOR WS > 19 MPH*
December 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
	Average:		36		13	5		
	Total:					376		
	Count:	84	13					
87	01	20		N	13	7	N,NNW	0-2,10-13
		19		NNW	21	15	NNW,N	9-23
		23		N	8	1	N	12
		28		N	12	3	SSE,N	2-3,10
		17		NNW	24	13	N,NNW	10-22
		16		NNW	27	17	NNW,N	6-22
		15	45	N	23	11	N	0,2-4,8-11,15,20-21
		14		NNW	9	1	N	23
		13		N	21	9	N,NNW	11-17,22-23
		03	64	S	13	6	S	18-23
	02	02	56	WSW	8	2	W,WNW	16-17
		03		N	16	5	N	3-4,9-10
		09		SSE	8	1	SSE	21
		15		NNW	14	5	NW,NNW	11-12,22-23
		26	8	NNW	14	6	N,NNW	7-12
		20	12	N	12	2	N	8-9
		23		N	14	6	N	9-14
		19		N	21	14	N,NNW	4-5,8-19
		18		N	17	12	N	9-20
		17		N	14	4	N	9-12
		16		NNW	16	8	NNW,N	0-1,5,9-12,14
	03	05		SSW	15	4	S,SSE	1-2,4,14
		12		SSE	9	6	SSE	13-18
		13		N	8	1	N	8
		18		N	9	5	N	16,20-23
		19		NNW	15	3	N	0-2
		23		NNW	9	2	NNW,N	18-19
		21		S	12	3	S,SSE,WNW	9-10,14
		29		N	14	6	N,NNW	1-2,7-10
		22	27	NNW	17	13	N,NNW	2-4,6-15
		28	25	NNW	18	11	NNW,N,NW	8-9,11-16,18-20
		27		NNW	16	10	N,NNW	7-12,14-17
		25		NNW	15	3	N,NNW	8-10
		24		NNW	16	4	N	11,13,15,18
		04	41	S	14	10	S	10-19
	04	02		SSE	13	7	SSE,S	12-18
		03	37	NNW	13	1	N	11
		04		NNW	14	8	NNW,N	2-3,7-12
		09	23	N	10	3	N	7-9
		10		NW	12	3	WNW,W	16-17,21
		11		NNW	9	2	NNW	22-23
		12		NNW	14	10	NNW,N	0-9

* PM-10 data after Feb.21,1988

INDEPENDENCE TSP, PM-10 & MET DATA FOR WS > 19 MPH*
December 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
87	04	16		NW	9	3	SSE	14-16
		17		W	11	6	W	14-19
		18		WNW	21	16	WNW,NNW,W	0-3,11-14,16-23
		19		NNW	17	6	NNW,N	0-1,6-9
		26		NW	8	2	S,SE	13,16
		27	29	SSE	8	1	SSE	14
		29		S	9	3	SSE,S	12-14
		30		WNW	13	4	SSE,S,W	0,3-4,17
	05	01		NNW	10	2	WSW,W	13-14
		03	23	NNW	12	1	NNW	8
		06		NW	9	2	SSE	13-14
		07		SSE	9	2	SSE	15-16
		08		S	7	2	S	18-19
		10		NNW	12	1	N	18
		15	31	NNW	10	3	SSE,NNW	12-13,19
		17		SSE	8	3	SSE	13-15
		18		SSE	12	5	SSE	13-17
		19		SSE	11	4	SSE	13-14,19-20
		22		NNW	8	1	NNW	19
		24		SSE	11	5	SSE	11,13-16
		25		NW	12	2	SSE	14-15
	06	14	138	SSE	19	13	SSE,S	12-23
		30		SSE	11	4	SSE	14-17
		28		NNW	10	1	W	15
		26	51	NNW	10	4	N,NNW,W	17,19-21
		22		NNW	11	6	NNW,N	1,3,5-8
		21		NNW	12	3	W,NW,NNW	18,21,23
		15		SSE	13	4	S,W,WNW	0-1,18-19
		04		NW	12	7	SE,SSE,V	11-17
		05		SSE	9	1	SSE	18
		08	24	NW	12	3	NNW,SSE	14,18-19
		10		SSE	13	8	SSE	11-17,19
		11		SSE	11	8	SSE	10-17
		13		NW	11	5	SE,SSE	13-17
	07	06		NW	10	2	NNW,N	7-8
		05		SSE	9	4	SSE	14-17
		04		SSE	9	3	SSE	15-17
		07		NW	11	1	SSE	16
		17		WNW	17	11	WNW	6-7,11-19
		18		SSE	10	1	SSE	16
		09		SSE	10	5	SSE	13-17
		08	75	SSE	10	2	SSE	14-15
		03		SSE	9	2	SSE	14-15
		19		SSE	11	4	SSE	13-16
		10		SSE	11	5	SSE	13-17
		20	417	S	17	11	SSE,S	10-20

* PM-10 data after Feb.21,1988

INDEPENDENCE TSP, PM-10 & MET DATA FOR WS > 19 MPH*
December 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
87	07	11		SSE	10	5	SSE	13-17
		21		SSE	13	7	SSE	10-16
		12		SE	8	4	SSE,SE,NNW	15-18
		22		SSE	8	1	SSE	16
		23		SSE	11	5	SSE	14-17,19
		24		SSE	12	5	SSE	14-18
		25		SSE	11	4	SSE	13-16
		26	465	SSE	15	9	SSE	10-18
		27		SSE	15	9	SSE,S	8-14,18,22
		28		SSE	11	2	SSE	15,17
		29		SSE	11	3	SSE	15-17
		30		SSE	9	4	SSE	13-16
		31		SSE	9	1	SSE	16
		16		NNW	15	6	W	15-20
		15		WNW	9	1	W	14
	08	03		NNW	9	1	SSE	18
		04		W	7	1	S	14
		05		SSE	10	2	SSE	14-15
		09		SSE	9	1	SSE	15
		11		NW	8	2	SSE	14-15
		13		SSE	11	3	SSE	13-15
		28		SSW	7	1	SE	15
		23		SSE	11	6	SSE	12-17
		22		SSE	17	9	SSE	11-19
		21		SSE	20	11	SSE	9-19
		20		SSE	10	2	SE	13-14
		18		SSE	9	1	SSE	16
		15	44	SSE	11	1	N	8
		14		W	9	3	W	15-17
		08		SSE	9	4	SSE	13-16
		07		SSE	10	4	SSE	14-17
		06		SSE	10	2	SSE	15-16
	09	05		SSE	8	1	SSE	15
		11		NW	9	1	SSE	15
		12	57	SSE	7	1	SSE	15
		13		NW	6	2	SSE	15-16
		14		SSE	6	1	SSE	16
	10	12	52	SSE	11	3	SSE,NNW	17,19
		13		NNW	11	1	N	13
		22		SSE	8	1	S	19
	11	13		NW	8	1	WNW	15
		14		NNW	19	10	NNW	7-10,18-23
		15		SSE	8	2	NW,NNW	0-1
		20		SSE	13	4	SSE,W	15-17,19
		25		N	27	19	N	0-5,8-20
		26		N	12	4	N	3,9-11

* PM-10 data after Feb.21,1988

INDEPENDENCE TSP, PM-10 & MET DATA FOR WS > 19 MPH*
December 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
87	12	11	22	N	14	8	N,NNW	8-13,21-22
		12		N	24	14	N,NNW	1,3-15
		13		N	24	12	N,NNW	5,13-23
		14		NW	10	1	NW	2
		22		NNW	10	5	NNW	19-23
		23	15	N	21	17	NNW,N	0-4,7-17
		25		NNW	21	10	NNW	0-1,7-14
		24		N	24	12	N	5-16
		04		SSE	9	1	S	15
		19		NNW	12	3	NNW	12-14
		07		N	12	5	NNW,N	5,10-13
	Average:		74		12	5		
	Total:					714		
	Count:	145	24					
88	01	15		NNW	10	1	NNW	10
		19		NNW	17	6	N	7-10,14-15
		21		NNW	20	14	NNW	8-21
		29		N	10	1	W	14
		23		NNW	9	1	NNW	15
		22	12	NNW	9	3	NNW	1-3
		18		NNW	20	8	NNW	4-11
		17		NNW	10	5	NNW	18-22
		11		NNW	18	11	NNW	9-19
	02	10		NNW	18	8	NNW	8-15
		18		N	20	11	N	6-17
		19		NNW	19	8	NNW	0-1,9-14
		16		NNW	25	12	N,NNW,NW	8-14,17,19-22
		20		NNW	12	2	N	10-11
		17		NNW	12	4	NNW	3-4,9-10
		04		NW	13	2	N	11-12
		03		NW	14	1	NNW	9
		28		S	12	2	S	14-15
		29		SSE	11	2	S	13-14
	03	02		NNW	14	3	N	10-12
		07		NW	14	6	N	8-13
		09		NNW	17	12	WSW,NNW	10-20,23
		10		NNW	19	9	NNW,N	7-11,15,19-21
		11		NNW	14	1	N	9
		12		NNW	10	2	NNW	8-9
		15		NNW	15	9	N,NNW	11-17,22-23
		17		NNW	11	2	N	8-9
		16		NNW	17	8	NNW	0-4,8-10
		21		NNW	9	2	WSW,W	13,17
		22		SSE	6	1	NNW	0

*, PM-10 data after Feb.21,1988

INDEPENDENCE TSP, PM-10 & MET DATA FOR WS > 19 MPH*
December 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
88	03	23		WNW	6	1	W	17
		24		NNW	7	1	NNW	0
		28		NNW	17	11	NNW,N	2-3,5,7,10-15
		30		NNW	25	21	NNW	2-13,15-23
		31		NNW	17	7	NNW	7-13
		27		N	21	13	N	11-23
	Average:		12		14	6		
	Total:					211		
	Count:	36	1					
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	Average:		59		13	5		
	Total:					1,305		
	Count:	266	38					
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* PM-10 data after Feb.21,1988

INDEPENDENCE DATA SUMMARY BY MONTH FOR WS > 19 MPH
December 1985 - March 1988

MO	DAYS > 19	TSP	HRS > 19	24 HR AVG WS
01				
Average:		35		14
Total:			150	
Count:	17	5		
02				
Average:		20		15
Total:			173	
Count:	18	4		
03				
Average:		29		13
Total:			216	
Count:	24	4		
04				
Average:		49		12
Total:			136	
Count:	22	6		
05				
Average:		27		10
Total:			33	
Count:	14	2		
06				
Average:		71		12
Total:			67	
Count:	14	3		
07				
Average:		251		11
Total:			144	
Count:	28	4		

* PM-10 data after Feb.21,1988

INDEPENDENCE DATA SUMMARY BY MONTH FOR WS > 19 MPH
December 1985 - March 1988

MO	DAYS > 19	TSP	HRS > 19	24 HR AVG WS
08				
Average:		36		10
Total:			60	
Count:	19	2		
09				
Average:		40		10
Total:			37	
Count:	13	2		
10				
Average:		53		13
Total:			49	
Count:	11	2		
11				
Average:		17		15
Total:			123	
Count:	15	2		
12				
Average:		19		16
Total:			117	
Count:	14	2		
Average:		59		13
Total:			1,305	
Count:	209	38		

* PM-10 data after Feb.21,1988

INDEPENDENCE DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN WIND DIRECTION
December 1985 - March 1988

NO		DAYS > 19	TSP	HRS > 19	24 HR AVG WS
01					
	Average:		28		15
	Total:			132	
	Count:	14	3		
02					
	Average:		20		15
	Total:			148	
	Count:	15	4		
03					
	Average:		26		14
	Total:			188	
	Count:	22	2		
04					
	Average:		58		14
	Total:			86	
	Count:	13	4		
05					
	Average:		27		11
	Total:			6	
	Count:	4	2		
06					
	Average:		38		12
	Total:			20	
	Count:	5	2		
07					
	Average:				12
	Total:			31	
	Count:	6	0		

* PM-10 data after Feb.21,1988

INDEPENDENCE DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN WIND DIRECTION
December 1985 - March 1988

MO	DAYS > 19	TSP	HRS > 19	24 HR AVG WS
08				
Average:		44		11
Total:			1	
Count:	1	1		
09				
Average:		22		11
Total:			6	
Count:	3	1		
10				
Average:		53		14
Total:			46	
Count:	9	2		
11				
Average:		17		15
Total:			119	
Count:	14	2		
12				
Average:		19		16
Total:			116	
Count:	13	2		
Average:		33		14
Total:			899	
Count:	119	25		

* PM-10 data after Feb.21,1988

INDEPENDENCE DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN WIND DIRECTION
December 1985 - March 1988

MO		DAYS > 19	TSP	HRS > 19	24 HR AVG WS
01					
	Average:		46		11
	Total:			20	
	Count:	5	2		
02					
	Average:		2		13
	Total:			32	
	Count:	7	1		
03					
	Average:		31		11
	Total:			42	
	Count:	8	2		
04					
	Average:		30		10
	Total:			34	
	Count:	10	2		
05					
	Average:		31		10
	Total:			38	
	Count:	10	1		
06					
	Average:		81		12
	Total:			53	
	Count:	9	2		
07					
	Average:		251		11
	Total:			116	
	Count:	27	4		

* PM-10 data after Feb.21,1988

INDEPENDENCE DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN WIND DIRECTION
December 1985 - March 1988

MO	DAYS > 19	TSP	HRS > 19	24 HR AVG WS
08				
Average:		28		10
Total:			55	
Count:	16	1		
09				
Average:		40		9
Total:			21	
Count:	8	2		
10				
Average:		52		9
Total:			6	
Count:	3	1		
11				
Average:				13
Total:			4	
Count:	1	0		
12				
Average:				9
Total:			1	
Count:	1	0		
Average:		87		11
Total:			414	
Count:	105	18		

* PM-10 data after Feb.21,1988

LONE PINE PM-10 & MET DATA FOR WS > 19 MPH
November 1986 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
86	11	29		NNW	17	9	NW,NNW	3-4,9-15
		25		NW	20	14	NW	1-6,8-15
		23		N,NNW	14	8	NW,N	0-3,10-13
		22	5	NNW	13	6	NW,NNW	15-17,19-20,23
		21		NW,NNW	10	5	NW	16-20
		14		S	10	2	S	14-15
		06		NW	20	14	NW	4-16,19
		03		NNW	17	4	NNW	7,9-11
		02		NNW	15	5	NNW	8-12
		01		NNW	18	8	NNW,NW	8-13,19-20
	12	07		NNW	19	12	NNW	0,2-3,9-17
	Average:		5		16	8		
	Total:					87		
	Count:	11	1					
87	01	18		NW	16	9	NW	0-2,7-8,20-23
		17		NNW	21	18	NNW	0,2-18
		19		NNW	20	15	NNW,NW	8-20,22-23
		20		N,NNW	13	4	NNW	6-9
		27	178	SE	10	5	SE,SSE	15,17-18,22-23
		28		NNW	11	4	SE,V	0-1,3,9
		16		NNW	24	21	NNW,NW	3-23
		15	25	NNW	23	18	NNW	3-20
		14		N	9	2	N	0,3
		13		NNW	14	8	NNW,NW	13-19,23
		04		S	14	6	SE	0-5
		03	45	SE	17	13	SE	9,12-23
	02	20	7	NNW	17	8	NNW,NW	0-2,4-6,11,15
		26	8	NNW	14	4	NNW	9-12
		23		NNW	10	4	NNW	10-13
		21		SSE	10	3	SE,SSE,S	15-17
		09		SSE	9	1	ESE	21
		15		N,NNW	14	2	NNW,NW	20,22
		16		NNW	16	5	NW,NNW	4-6,9-10
		18		N,NNW	14	8	NNW,N	11,14-17,19-21
		19		N	18	11	NNW,N	10-19,23
	03	13		V	11	2	S,NNW	0,10
		12		SSE	14	7	SSE	12-17,23
		10	17	S	7	1	SE	14
		05		SE	18	7	SSE,SE	3-5,14-16,22
		04	38	SSE	17	11	SSE,S	9-19
		03		S	10	2	S	15-16
		15		NNW	20	13	N,NNW,NW	3,8-16,21-23
		16	8	NW	19	9	NNW,NW	8-12,15,18-20
		26		NW	7	1	NW	22
		18		N	17	10	N	8-17

LONE PINE PM-10 & MET DATA FOR WS > 19 MPH
November 1986 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
87	03	27		NNW	14	5	NNW	9-12,16
		21		SSE	15	4	SSE	8-11
		28	13	NNW	15	7	NW,NNW	13-19
		22	13	NNW	14	3	NNW	9-11
		25		NNW	13	2	NNW	9-10
		24		NNW	15	1	NNW	20
		23		NNW	8	2	NNW	19-20
	04	02		SSE	12	6	SSE	12-17
		04		NW	15	6	NW	6-11
		12		NNW	13	4	NNW	5-8
		16		S	9	1	S	16
		18		NW	16	6	NW	18-23
		19		NNW	14	3	NW	0-2
		23		SSE	10	1	SSE	17
		30		SE	12	3	SE	3,6-7
		29		SSE	8	2	S,SSE	12-13
	05	25		NNW	9	2	SSE,SE	14-15
		24		SSE	11	4	SSE,S	12-15
		19		SSE,S	13	7	S	13-18,20
		18		SSE	13	8	SSE,SE	12-19
		15	13	NNW	9	2	S,SE	11-12
		08		V	8	1	SSE	19
		07		SE,NNW	8	1	SE	15
		03	15	N	12	1	N	8
	06	26	29	NNW	9	3	NW	20-22
		21		SSE	11	3	NW	21-23
		15		SSE	14	5	SSE	2-4,7,10
		14	35	SSE	15	8	SSE	11-18
		11		SSE	11	4	SSE	13-16
		10		SSE	12	6	SSE	11-15,17
		05		SSE	9	1	SSE	18
		04		NW	8	2	SSE	12-13
	07	20	48	SSE	19	11	SSE	9-19
		19		SSE	13	7	SSE	13-19
		17		SE	13	2	SE,NNW	2,11
		15		NW	7	2	WSW	14-15
		11		S	9	2	S,SSE	13-14
		08	27	S	10	1	S	13
		05		SSE	8	1	S	15
		25		SSE	14	8	SSE,S	0,12-18
		27		SSE	17	12	SSE	9-20
		28		SSE	12	5	SSE	12-14,1
		28		SSE	12	5	SSE	12-14,16-17
		29		SSE	12	2	SSE	16-17
		30		S	10	1	S	13
		26	26	SSE	15	7	SSE	10-16
		21		SSE	19	9	SSE	8-16

LONE PINE PM-10 & MET DATA FOR WS > 19 MPH
November 1986 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
87	07	23		SSE	12	6	SSE	13-18
		24		SSE	13	8	SSE	13-20
	08	05		NW	9	1	SE	14
		13	25	SSE	9	2	S	13-14
		20		SSE	11	2	SSE	12-13
		21		SSE	18	10	SSE	9-18
		23		SSE	16	7	SSE	10-16
		22		SSE	16	9	SSE,S	10-18
	09	13		SSE	7	1	SSE	15
		23		NNW	7	1	SE	19
	10	11		SSE	10	3	S	14-16
		12	28	SSE	16	5	S,SSE,NNW	13-16,20
		22		SSE	9	2	SE,S	18-19
		28		SSE	11	4	SSE	12-15
	11	14		NNW	16	3	NW	16-18
		25		NW	26	19	NW,NNW	0-17,19
		20		NNW	13	7	SSE	11-17
	12	11	13	NNW	11	2	NNW	9-10
		12		NNW	19	12	NNW	8-19
		15		SSE	8	1	SSE	23
		16		SSE	11	1	SSE	0
		19		NNW	12	2	NW,NNW	12-13
		22		NNW	8	3	NW	21-23
		23	5	NW	19	15	NW	0-14
		24		NNW	20	13	NNW,NW	5-7,9-16,22-23
		25		NNW	18	8	NNW	0,3,9-14
		13		NNW	23	20	NNW,NW	3-22
		06		SSE	15	11	SSE,SE	12-22
		04		SSE	13	8	SSE	11-18
	Average:		29		13	6		
	Total:					607		
	Count:	107	21					
88	01	11		NNW	13	7	NW,N	11-17
		15		NNW	9	2	NW	10-11
		17		NNW	10	3	NW	19,21,23
		19		NNW	17	6	NNW	0-1,3-4,7-8
	02	10		NNW	16	8	NNW	9-15,18
		16		NNW	15	11	NNW	9-19
		17		N	11	3	N,NNW	5,9-10
		18		NNW	22	17	NNW	6-20,22-23
		19		NNW	20	11	NNW	0,2,5,8-15
		28		SSE	16	6	SSE	10-15
		29		SSE	16	7	SSE	10-16
	03	02		NNW	14	2	NW	10-11
		07		NNW	13	2	NNW	7,9

LONE PINE PM-10 & MET DATA FOR WS > 19 MPH
November 1986 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
88	03	09	29	NNW	15	11	NW	12-22
		10		NNW	15	3	NNW	8-10
		15	43	NNW	15	9	NNW,NW	11,13-18,21,23
		16		NW	14	4	NW	0-3
		23		NW	9	2	NW	16,22
		27		NNW	15	11	NNW	12-22
		30		NNW	21	15	NNW,NW	3-5,7-11,17-23
		31		NNW	18	13	NW,NNW	0,2-13
	Average:		36		15	7		
	Total:					153		
	Count:	21	2					
	Average:		29		14	6		
	Total:					847		
	Count:	139	24					

LONE PINE DATA SUMMARY BY MONTH FOR WS > 19 MPH
November 1986 - March 1988

MO		DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01					
	Average:		83		15
	Total:			141	
	Count:	13	3		
02					
	Average:		8		15
	Total:			109	
	Count:	13	2		
03					
	Average:		23		14
	Total:			159	
	Count:	22	7		
04					
	Average:				12
	Total:			32	
	Count:	9	0		
05					
	Average:		14		10
	Total:			26	
	Count:	8	2		
06					
	Average:		32		11
	Total:			32	
	Count:	8	2		
07					
	Average:		34		13
	Total:			89	
	Count:	16	3		

LONE PINE DATA SUMMARY BY MONTH FOR WS > 19 MPH
November 1986 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
08				
Average:		25		13
Total:			31	
Count:	6	1		
09				
Average:				7
Total:			2	
Count:	2	0		
10				
Average:		28		12
Total:			14	
Count:	4	1		
11				
Average:		5		16
Total:			104	
Count:	11	1		
12				
Average:		9		15
Total:			108	
Count:	13	2		
Average:		29		14
Total:			847	
Count:	125	24		

LONE PINE DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN WIND DIRECTION
November 1986 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01				
Average:		25		16
Total:			113	
Count:	9	1		
02				
Average:		8		16
Total:			92	
Count:	9	2		
03				
Average:		21		14
Total:			127	
Count:	17	5		
04				
Average:				15
Total:			19	
Count:	4	0		
05				
Average:		15		12
Total:			1	
Count:	1	1		
06				
Average:		29		10
Total:			6	
Count:	2	1		
07				
Average:				13
Total:			2	
Count:	1	0		

LONE PINE DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN WIND DIRECTION
November 1986 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
10				
Average:		28		16
Total:			5	
Count:	1	1		
11				
Average:		5		17
Total:			95	
Count:	10	1		
12				
Average:		9		17
Total:			87	
Count:	9	2		
Average:		17		15
Total:			547	
Count:	63	14		

LONE PINE DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN WIND DIRECTION
November 1986 - March 1988

MO		DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01					
	Average:		112		13
	Total:			28	
	Count:	4	2		
02					
	Average:				13
	Total:			17	
	Count:	4	0		
03					
	Average:		28		13
	Total:			34	
	Count:	7	2		
04					
	Average:				10
	Total:			13	
	Count:	5	0		
05					
	Average:		13		10
	Total:			25	
	Count:	7	1		
06					
	Average:		35		12
	Total:			26	
	Count:	6	1		
07					
	Average:		34		13
	Total:			89	
	Count:	16	3		

LONE PINE DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN WIND DIRECTION
November 1986 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
08				
Average:		25		13
Total:			31	
Count:	6	1		
09				
Average:				7
Total:			2	
Count:	2	0		
10				
Average:		28		12
Total:			14	
Count:	4	1		
11				
Average:				12
Total:			9	
Count:	2	0		
12				
Average:				12
Total:			21	
Count:	4	0		
Average:		44		12
Total:			309	
Count:	67	11		

KEELER PM-10 & MET DATA FOR WS > 19 MPH *
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
85	03	31		N	11	3	N	12-14
		19	101	NW	17	6	NW,WNW	0-4,10
		27	1,914	SSE	17	4	SSE,WSW	13-14,22-23
		28	1,116	NW	15	4	NW	9,13-15
		29		NW	15	2	NW	13-14
	04	26		NW	22	14	N,WNW	5-18
		25	420	NW	19	9	N,NW	7-8,11,15-20
		18		NW	12	4	NW	7-10
		16		SE	13	6	SE	11-12,15-18
	05	28		SSE	9	1	S	19
		09	170	SE	11	2	SE,SSE	12-13
		07	124	SE	11	3	SE	15-17
		02	279	SE	10	1	SSE	12
	06	00		NO DATA				
	07	20		NW	7	2	WNW	19-20
		16		S	7	1	WNW	18
	08	00		NONE				
	09	01		(V)	6	1	SW	16
		09		ESE	12	2	SE	13-14
		17		S	10	1	SE	20
	10	06		E	10	3	SSW	13-15
		09		NW	17	10	NW	5-6,10-15,22-23
		21		SE	14	2	SSE,WNW	12,14
		31		NW	14	1	NW	13
	11	08		(V)	7	3	NW	21-23
		09	358	ESE	9	1	NW	0
		10		SSE	14	2	SE,SSE	7,10
	12	00		NONE				
	Average:		560		12	4		
	Total:					88		
	Count:	28	8					
86	01	06		NW	10	4	WNW,NW	11,13-15
	02	02		(V)	9	4	SSW	12-15
		04		NW	16	3	WNW	10-11,14
		06		NW	15	1	WNW	10
		14		ESE,SE	13	7	SE,ESE,SSE	13-17,19-20
		17		S	9	2	S	13-14
		18		WNW	9	3	SSE	21-23
		19	268	SW	16	4	SSW,SW	9,18-20
	03	08		S	12	3	S,SSW	15-17
		09	0	SSE	8	3	S	16-18
		12		NW	10	1	NW	12
		15	88	N	7	3	SW,SSW	12-14
		18		NW	17	10	NW	6-15

* 1985-86 PM-10 data calculated from TSP data.

KEELER PM-10 & MET DATA FOR WS > 19 MPH *
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
86	03	30		S	6	1	SSW	14
	04	02	1,745	NW	23	18	NW,N,WNW	0-17
		04		SSW	6	1	SSW	14
		11		SE	7	1	SSW	16
		12		SE	11	4	WSW,SSW	10,14-16
		15		SE,SW	12	2	SW,WSW	15-16
		16		NW	14	2	NW	15-16
		23		S	9	2	S	17-18
	05	03		SSE,S	18	12	S,SSW	9-10,12-21
		05		SSE	8	4	SSW,SE	13-14,16,18
		06		NNW	11	2	NNE	18-19
		07		NW	18	5	NW	0,2-3,9-10
		10		SE	11	4	WSW,SW	12-15
		16		NW	15	1	WNW	14
		20	164	S	11	6	S,SSE	18-23
		21		ESE	12	5	NW,WNW,S	0,18-21
		31		SSW	9	6	SSW,NW	14-16,21-23
	06	08		NW	17	9	NW	0-4,6-7,9-10
		28		S	14	2	S	21-22
		19	16	NW	8	1	NW	0
		04		S	9	4	SSW,S	14-17
		07	278	NW	9	4	WNW,NW	20-23
	07	28		(V)	9	2	SSW,SSE	15,18
		21		SE,SW	8	1	ENE	17
	08	29		S	7	1	S	16
	09	24		SSW	14	8	SW,SSW	11-15,18-20
		14		S	12	3	S	16-18
		10		NW	10	5	NW	0-4
		09		NW	11	4	NW	18-21
		08		S	17	3	SSW,WSW	15-17
	10	31		NW	17	7	NW	4,6-11
		18		NW,NNW	14	1	NW	11
		01		NW	7	1	WNW	13
	11	02		NW,NNW	16	6	NW,WNW	5,7-11
		06		NW	14	4	NW	6-7,10-11
		23		NNW	9	3	NNW	1-3
		29		NW	15	9	NW,SSW	5-6,9-15
		25		NW	16	7	NW	2-3,9-13
		01		NW	18	8	NW,NNW	5-11,23
	12	07		NW	17	5	NW	3,16-17,20-21
	Average:		366		12	4		
	Total:					222		
	Count:	53	7					
87	01	20		NNW	8	1	NNW	6

* 1985-86 PM-10 data calculated from TSP data.

KEELER PM-10 & MET DATA FOR WS > 19 MPH *
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
87	01	27	672	S	9	5	S,SSE	14-18
		28		SSE	9	1	SSE	3
	02	02	251	SE	8	2	S	14-15
		15		NW	13	4	NW,S	3,15-17
		16		NW	13	2	NW	10-11
		18	22	N	11	4	N,NNW	11-12,14-15
		19		NW	19	16	NW,NNE	4-19
		23		WNW	9	3	WNW	11-13
		26	39	NW	13	7	NW	4-10
		20	54	NW	14	3	WNW	10-11,13
	03	28	31	NW	8	1	NW	14
		23		N	7	1	WNW	20
		22	166	NW	14	7	NW	5,8-13
		21		S	11	3	S	10-12
		18		WNW	9	4	WNW	11-14
		16	55	NW	12	4	NW	10-12,15
		15		NW	16	7	NW,NNW	9-13,15-16
		13		WNW	12	5	SSW	0,2-4,7
		12		SSW	9	3	S,SSW	13,15,23
		10	230	SE	7	2	S	16-17
		04	71	SE	8	3	SSW	12-14
	04	30		SSE	13	2	SSE	7,9
		29		S	6	1	S	12
		26		NNW	6	1	S	15
		19		NW	10	5	NW	0-4
		18		NW	18	11	NW,(V)	8-10,12,17-23
		12		NW	8	2	NW	2-3
		04		NW	12	3	NW	9-11
		03	33	NW	12	2	NW	14-15
	05	19		S	9	3	S	15-17
		24		S	9	2	S	15-16
		27	10	SSW	8	1	NW	22
		28		SSW	7	2	SSW,E	14,16
		23		SE	6	1	SE	13
		01		NW	8	3	NW	18-20
		03	10	NW	12	2	NNE	16-17
		12		NW	6	1	NW	17
		15		SSW	7	1	SSW	11
		18		ESE	7	1	SSE	16
	06	04		SSE	9	4	SSW,SW	11-12,16-17
		14	70	SE	13	8	SE,SSE	11-18
		15		SSE	15	7	S,SSE	12-18
		16		S	8	2	S	16-17
		21		NW	10	3	S,NW	16,22-23
		26	91	NW	10	2	WNW	21-22
		27		NW	7	2	WNW	15-16

* 1985-86 PM-10 data calculated from TSP data.

KEELER PM-10 & MET DATA FOR WS > 19 MPH *
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
87	06	22		NW	7	2	WNW	0-1
	07	14	28	SSW	7	1	SSW	14
		15		WNW,NNW	6	1	WSW	15
		17		(V)	19	15	S,SSW,SW	0-5,10-12,15-20
		20	40	SE	11	3	SE	17-19
		21		SSE	11	2	S	11,17
		23		N,NW	8	1	S	16
		24		N	8	2	S	15-16
		26	33	SSE	10	3	SSE	12-13,15
		16		WSW	8	4	WSW	15-18
	08	14		E	8	2	E	15,17
		20		NW	9	4	S	14-17
		21		SSE	8	2	SSE	15-16
		22		SSE	9	2	SSE	14-16
	09	14		SSW	5	1	SSW	16
		03		NW	5	1	NW	17
	10	12	65	SSE	10	2	S,WNW	15,21
	11	25		NW	22	16	NW	1-7,9-12,17-18,21-23
		14		NW	12	6	NW,WNW	15-17,19-21
		03		NW	7	1	NW	23
	12	07		NW	9	2	S	0-1
		12		N	15	9	N,NW,NNW	11-17,19-20
		13		NW	17	9	NW,NNW,N	2-4,9-12,14-15
		22		NW	4	2	NW	22-23
		23	111	NW	18	8	WNW,NW	0-3,8,10-11,16
		25		NNW	17	9	NNW,NW	0,4-6,8-12
		24		NW	15	2	N	11,16
	Average:		104		10	4		
	Total:					272		
	Count:	74	20					
88	01	11		NW	12	5	NW	12,14-17
		15		NNE	9	3	S,NW	7,10-11
		19		NW	12	3	NW	5-7
		21		ESE	9	1	NNW	20
		29		SSW	11	4	S	10-13
	02	04		ESE	7	1	N	16
		10		N	11	3	NNW	11-13
		18		N	16	10	NW,N,NNW	8,11-13,17-20,22-23
		16		N	14	9	N	14-19,21-23
		19		NW	17	11	NW,N	0-6,9-11,14
		17		N	7	1	N	0
	03	09	115	NW	12	7	NW	12-18
		10		NW	15	4	N	18-21
		27		NW	13	10	NW	13-22

* 1985-86 PM-10 data calculated from TSP data.

KEELER PM-10 & MET DATA FOR WS > 19 MPH *
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
88	03	30		NW	16	7	NW,N	3-7,17-18
		31		NW	16	6	NNW,NW,NNE	2-3,7-8,11-12
		15	69	NW	10	2	WNW	16-17
	Average:		92		12	5		
	Total:					87		
	Count:	17	2					
	Average:		252		11	4		
	Total:					669		
	Count:	172	37					

* 1985-86 PM-10 data calculated from TSP data.

KEELER DATA SUMMARY BY MONTH FOR WS > 19 MPH *
March 1985 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01				
Average:		672		10
Total:			27	
Count:	9	1		
02				
Average:		127		12
Total:			100	
Count:	13	5		
03				
Average:		330		12
Total:			116	
Count:	18	12		
04				
Average:		733		12
Total:			90	
Count:	14	3		
05				
Average:		126		10
Total:			69	
Count:	20	6		
06				
Average:		114		10
Total:			50	
Count:	13	4		
07				
Average:		34		9
Total:			38	
Count:	10	3		

* 1985-86 PM-10 data calculated from TSP data.

KEELER DATA SUMMARY BY MONTH FOR WS > 19 MPH *
March 1985 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
08				
Average:				8
Total:			11	
Count:	6	0		
09				
Average:				10
Total:			29	
Count:	8	0		
10				
Average:		65		13
Total:			27	
Count:	7	1		
11				
Average:		358		13
Total:			66	
Count:	11	1		
12				
Average:		111		14
Total:			46	
Count:	8	1		
Average:		252		11
Total:			669	
Count:	137	37		

* 1985-86 PM-10 data calculated from TSP data.

KEELER DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN WIND DIRECTION *
March 1985 - March 1988

NO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01				
Average:				10
Total:			17	
Count:	6	0		
02				
Average:		38		13
Total:			78	
Count:	11	3		
03				
Average:		236		13
Total:			86	
Count:	14	7		
04				
Average:		733		15
Total:			70	
Count:	9	3		
05				
Average:		10		11
Total:			26	
Count:	9	2		
06				
Average:		128		10
Total:			23	
Count:	7	3		
07				
Average:				7
Total:			4	
Count:	3	0		

* 1985-86 PM-10 data calculated from TSP data.

KEELER DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN WIND DIRECTION *
March 1985 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
09				
Average:				9
Total:			10	
Count:	3	0		
10				
Average:		65		13
Total:			24	
Count:	6	1		
11				
Average:		358		13
Total:			64	
Count:	10	1		
12				
Average:		111		15
Total:			44	
Count:	7	1		
Average:		234		12
Total:			446	
Count:	85	21		

* 1985-86 PM-10 data calculated from TSP data.

KEELER DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN WIND DIRECTION *
March 1985 - March 1988

MO		DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01					
	Average:		672		10
	Total:			13	
	Count:	4	1		
02					
	Average:		260		11
	Total:			26	
	Count:	6	2		
03					
	Average:		461		10
	Total:			30	
	Count:	10	5		
04					
	Average:				9
	Total:			20	
	Count:	9	0		
05					
	Average:		184		10
	Total:			54	
	Count:	15	4		
06					
	Average:		70		11
	Total:			30	
	Count:	6	1		
07					
	Average:		34		10
	Total:			34	
	Count:	10	3		

* 1985-86 PM-10 data calculated from TSP data.

KEELER DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN WIND DIRECTION *
March 1985 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
08				
Average:				8
Total:			9	
Count:	4	0		
09				
Average:				11
Total:			19	
Count:	6	0		
10				
Average:		65		11
Total:			7	
Count:	3	1		
11				
Average:				15
Total:			11	
Count:	2	0		
12				
Average:				9
Total:			2	
Count:	1	0		
Average:		263		10
Total:			255	
Count:	76	17		

* 1985-86 PM-10 data calculated from TSP data.

OLANCHA TSP, PM-10 & MET DATA FOR WS > 19 MPH *
November 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
85	11	23		SE,SSE	12	9	SSE	12-15,19-23
		24		S	20	16	SSE	0,5-14,16,20-23
		29		SSE	12	7	SSE,WNW	0-1,6,9-12
		25		S	10	5	S	0-3,7
	12	02		S	14	8	S	6-9,12-15
		09	18	NNE	15	13	NNE	9-21
		10		NNE,NNW	7	3	NNE	21-23
		11		NNE	13	5	NNE	10-14
		30		NNE	7	3	SSE	2-4
	Average:		18		12	8		
	Total:					69		
	Count:	9	1					
86	01	14	31	SSE	16	12	SSE	7-15,17-18,22
		19		SSE	7	2	SSE	15-16
		29		S	17	10	S,SSE	9-15,21-23
		30		S	17	6	S	13-15,18-20
	02	13	14	-	19	5	SSE	15-18,23
		14		S	25	23	S	0-15,17-23
		15		S	19	9	S	0-3,5,8-9,11,13
		16		N,W	11	3	W	1-3
		17		WSW	20	8	WSW	7,9-10,13-16,23
		18		NW,NNW	15	6	V	0-1,11,21-23
		19	11	S	17	11	S,SSW,SSE	0-10
	03	08		WSW	16	8	WSW,S	2-7,15-16
		23		S	6	2	SSE	14-15
		18		NNE	23	6	S,V	0-15
		17		NW	12	6	NW	18-23
		16		S	11	1	SSE	0
		15	43	SSE	15	8	SSE,S	8-13,22-23
		13		SSE	8	2	SSE	13-14
		10		S	14	5	S	8-12
		09	9	S	11	5	S,SSE	14-17,22
	04	03		NE	11	1	NE	9
		18		NNE	12	6	NNE,N	1-3,7-9
		15		SSE	15	6	SSE	7-12
		14	25	S	13	4	SSE	11-12,15-16
		12	20	WNW	14	6	WSW,W,NW	12,14-15,18-20
		02	610	N	28	19	NNW,N	2-8,10-12
		01		SSE	10	1	WNW	23
		22		S	8	1	SSE	12
		25		S	6	1	W	16
	05	05		S	9	3	SSE	11-13
		06		N	12	3	N,W	17,22-23
		07		N	14	7	N,NNW	0-2,4-6,8

* PM-10 data from July 1987 forward.

OLANCHA TSP, PM-10 & MET DATA FOR WS > 19 MPH *
November 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
86	05	15		SW	4	1	WSW	8
		02	32	SSE	13	5	SSE	7-11
		03		S	17	12	SSE,SSW	5-16
	06	07	56	SE	7	4	NW	20-23
		08		N,NW	14	10	NW	0-9
		17		SSE	9	2	SSE	10-11
	07	28		SSE	11	1	SSE	13
	08	24	49	SSE	12	1	SSE	9
	09	25		NW	9	1	WNW	17
		24		SW	13	6	SW,WSW	16-21
		07		V	9	1	SE	15
		19		SE	11	3	SE,ESE	0-2
		08		SSE,S	11	2	SE,S	11-12
		18		SSE	11	4	SSE,SE	14-15,22-23
		09		N	8	1	N	23
		14		SSE	18	7	SSE	7-12,20
		10		N	13	6	N	0-4,9
		13		SSE	9	2	SSE	13-14
		12		SSE	13	6	SSE	9-13,15
	10	31		N	16	12	N,NNE	4-15
		19		SSW	5	2	N	9-10
		18		N	13	6	N	9-10,12-13,19,21
		11	43	N	9	2	NNE	8-9
		09		S	7	3	SSE	11-13
		05	27	NE	8	1	NNE	9
		03		NNE	8	1	NNE	10
		02		N	16	11	N	11-16,19-23
	11	29		V	20	14	NNE,N,SW,V	1-14
		28	19	S	12	8	SSE	15-22
		25		NNE	23	14	NNE	2-15
		23		NNE	16	7	NNE	0-5,9
		22	5	NNE	13	7	N,NNE	17-23
		21		NE	8	1	NNE	19
		14		S	14	4	S	11-14
		13		S	9	2	S	14-15
		06		N	13	9	N	9-17
		01		NNE	7	1	?	5
	12	20		S	11	6	NNE	10-15
		18		S	9	3	S	13-15
		07		NNE	23	14	NNE	2-15
		05		WSW	7	1	SE	0
		04		S	6	1	S	23

* PM-10 data from July 1987 forward.

OLANCHA TSP, PM-10 & MET DATA FOR WS > 19 MPH *
November 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
	Average:		66		13	5		
	Total:					401		
	Count:	74	15					
87	01	20		N,NE	11	3	NE	0,5-6
		19		NE	20	13	NE,N,V	8,11,13-23
		23		SSE	11	2	ENE,SE	3-4
		27	37	SSE	15	13	SSE	11-23
		28		SSW	13	7	SW,SSW	0-5,8
		17		NE	17	7	NE,V	0-2,15,17-18,20
		16		NNE	31	21	NNE,NE	0-16,20-23
		15	115	NNE	28	20	NNE,NE	4-23
		13		NNE	10	5	NNE	16-20
		04		S	17	15	S	0-14
		03	35	S	23	17	S	1-15,22-23
	02	02	21	SSE	14	7	SSE	9-15
		15		SSE,WNW	17	2	SSE,SE	4,8
		16		NNE	17	13	NNE,NE	0-12
		26	33	NNE	19	13	NNE	1-13
		25		NNE	9	3	NE	20-22
		23		SW,NW	10	3	W,SW,SSW	9-11
		21		SSE,S	8	1	S	14
		20	145	NNE	19	16	NNE	0-15
		19		NNE	25	18	NNE,N,NE	0,4-6,9-22
		18		NNE	15	11	NNE,N	12-13,15-23
	03	03		S	9	1	S	15
		04	19	S	13	3	S	14-16
		10	13	S	10	5	S	11-14,16
		12		S	14	8	S	9-16
		14		S	11	5	W,S	13-15,21-22
		15		NNE	17	8	NNE	2,10-12,14-17,23
		16	68	NNE	16	6	NNE	0,8-12
		18		NW	14	6	NW,WNW	11,13-15,17,19
		23		N,NNE	9	3	NNE	20-22
		24		NNE	19	11	NNE,N	8,12-17,20-23
		25		NE	15	8	NNE	0,8-14
		27		SW	7	1	NNE	11
		22	110	NNE	17	8	NNE	5,7-13
		21		S	17	6	S,NW	3,8-9,11,20-21
		19		WNW	13	2	NNE	8-9
	04	02		S	10	3	SSE	12,15-16
		03	29	SSE,S	13	5	V	6-8,12,15
		04		N	13	4	NNE	9-12
		12		S	9	2	NNE	8-9
		14		S	9	2	SSE	15-16
		18		WNW	18	6	NNE,WNW	10-11,20-23

* PM-10 data from July 1987 forward.

OLANCHA TSP, PM-10 & MET DATA FOR WS > 19 MPH *
November 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
87	04	19		NNE	14	9	NNE	0-8
		23		SSE	12	3	SSE	10-11,14
		30		SSE	15	5	SSE,S	3-7
	05	03	21	SSE	11	2	NNE,NE	7-8
		14		SW	7	1	SSE	18
		18		S	13	6	SSE	11-16
		19		SSE	13	5	SSE	11,14-17
		24		S	10	2	SSE,S	13-14
		29		S	12	2	SSE	12-13
	06	04		WSW,W	10	3	SSE	11-13
		10		SSE	11	2	SSE	12-13
		14	42	SSE	16	10	SSE	11-17,21-23
		15		SSE	19	14	SSE	0-13
		16		SSE	9	1	SSE	14
		17		S	9	2	SSE,S	13-14
		21		S	12	5	SSE	12-15,23
		22		N	8	1	N	0
	07	31		S	11	1	SSE	14
		19		S	14	5	S	11-15
		20	13	SSE	20	12	S,SSE	8-19
		21		S	16	7	SSE,S	6-12
		23		S	15	5	S	10-11,13-15
		24		S	14	6	S,SSE	11-16
		25		S	13	6	SSE	11-16
		26	14	SSE	15	8	SSE	10-17
		27		SSE	17	6	SSE	9-14
		28		SSE	14	3	SSE	9-11
		30		S	12	5	S	12-16
	08	13	25	S	13	6	SSE,S	10-12,14-16
		20		SSE	15	5	SSE	10-14
		21		SSE	18	10	SSE	8-17
		22		SSE	18	9	SSE	8-16
		23		SSE	16	6	SSE,S	9-14
		06		S	9	2	SSE	15-16
	09	03		NW	5	1	WNW	18
		08		S	9	1	S	15
		13		SSE	8	2	S	13-14
	10	13		S	6	1	N	14
		28		S	12	5	S	10-14
		22		S	12	2	S	16,18
		12	15	S	18	9	SSE	7-14,21
	11	02		SSE	14	2	SSE	4-5
		20		S	13	8	S	10-16,18
		25		NNE	26	17	NNE	4-20
		26		N	7	1	NNE	1
		14		N	7	1	N	18

* PM-10 data from July 1987 forward.

OLANCHA TSP, PM-10 & MET DATA FOR WS > 19 MPH *
November 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
87	12	04		S	20	14	S	2,4-16
		08		S	9	3	S	8,10-11
		14		S	6	1	NE	0
		15		S	12	4	S	12,19-21
		22		N	7	1	N	23
		23	14	NNE	22	16	N,NNE	0-10,18-19,21-23
		24		NNE	25	21	NNE	3-23
		25		NNE	25	18	NNE	0-6,8-18
		19		SSW	6	3	NNE	12-14
		13		NNE	31	23	NNE	0-1,3-23
		12		N	23	16	N,NNE	8-23
		06		S	20	13	S	11-23
	Average:		43		14	7		
	Total:					671		
	Count:	100	18					
88	01	11		WNW	17	11	WNW,N,NNE	3-6,10-14,16-17
		14		S	6	1	SSE	23
		15		NNE	12	7	W,SSE	0-1,3-7
		16	25	W	12	6	W	10-15
		17		S	7	3	S	3-5
		18		SW	10	4	NNE	20-23
		19		NNE	17	6	NNE,N	0-5
		21		NNE	9	3	NNE	14-16
		28	13	S	10	2	S	22-23
		29		SSE	16	11	SSE,SW	0-5,9-11,13-14
	02	10		NNE	10	5	NNE	11-15
		16		NNE	15	10	NNE	11-12,14-15,17-22
		17		NNE	10	2	NNE	0-1
		18		N	29	17	N	7-23
		19		NNE	19	11	NNE	0-4,9-14
		29		S	14	6	S	10-15
	03	01		S	5	1	NNE	23
		02		NNE	19	13	NNE	0-3,6-14
		09		N	12	7	NW,WNW,N	11,13-14,19-22
		10		NNE	12	7	NNE	8-11,21-23
		11		NNE	12	3	NNE	0,8-9
		15		N	10	2	N	15,22
		27		NNE	11	2	N,ENE	18,22
		30		NNE	17	10	NNE,N	6-10,19-23
		31		NNE	20	13	NNE	0-12

* PM-10 data from July 1987 forward.

OLANCHA TSP, PM-10 & MET DATA FOR WS > 19 MPH *
November 1985 - March 1988

YR	MO	DAY	TSP	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
	Average:		19		13	7		
	Total:					163		
	Count:	25	2					
	Average:		51		13	6		
	Total:					1,304		
	Count:	208	36					

* PM-10 data from July 1987 forward.

OLANCHA DATA SUMMARY BY MONTH FOR WS > 19 MPH *
November 1985 - March 1988

MO	DAYS > 19	TSP	HRS > 19	24 HR AVG WS
01				
Average:		43		15
Total:			207	
Count:	17	6		
02				
Average:		45		16
Total:			203	
Count:	15	5		
03				
Average:		44		13
Total:			182	
Count:	24	6		
04				
Average:		171		13
Total:			84	
Count:	13	4		
05				
Average:		27		11
Total:			49	
Count:	11	2		
06				
Average:		49		11
Total:			54	
Count:	10	2		
07				
Average:		14		14
Total:			65	
Count:	11	2		

* PM-10 data from July 1987 forward.

OLANCHA DATA SUMMARY BY MONTH FOR WS > 19 MPH *
November 1985 - March 1988

MO	DAYS > 19	TSP	HRS > 19	24 HR AVG WS
08				
Average:		37		14
Total:			39	
Count:	7	2		
09				
Average:				11
Total:			43	
Count:	12	0		
10				
Average:		28		11
Total:			55	
Count:	12	3		
11				
Average:		12		13
Total:			133	
Count:	14	2		
12				
Average:		16		14
Total:			190	
Count:	21	2		
Average:		51		13
Total:			1,304	
Count:	167	36		

* PM-10 data from July 1987 forward.

OLANCHA DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN WIND DIRECTION *
November 1985 - March 1988

MO		DAYS > 19	TSP	HRS > 19	24 HR AVG WS
01					
	Average:		115		16
	Total:			95	
	Count:	10	1		
02					
	Average:		89		17
	Total:			119	
	Count:	8	2		
03					
	Average:		89		14
	Total:			123	
	Count:	18	2		
04					
	Average:		315		14
	Total:			54	
	Count:	7	2		
05					
	Average:		21		12
	Total:			12	
	Count:	3	1		
06					
	Average:		56		10
	Total:			15	
	Count:	3	1		
09					
	Average:				9
	Total:			9	
	Count:	4	0		

* PM-10 data from July 1987 forward.

OLANCHA DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN WIND DIRECTION *
November 1985 - March 1988

MO	DAYS > 19	TSP	HRS > 19	24 HR AVG WS
10				
Average:		35		10
Total:			36	
Count:	8	2		
11				
Average:		5		15
Total:			78	
Count:	8	1		
12				
Average:		16		16
Total:			140	
Count:	13	2		
Average:		92		14
Total:			681	
Count:	82	14		

* PM-10 data from July 1987 forward.

OLANCHA DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN WIND DIRECTION *
November 1985 - March 1988

MO	DAYS > 19	TSP	HRS > 19	24 HR AVG WS
01				
Average:		29		13
Total:			108	
Count:	11	4		
02				
Average:		15		16
Total:			75	
Count:	9	3		
03				
Average:		21		13
Total:			65	
Count:	13	4		
04				
Average:		23		12
Total:			30	
Count:	7	2		
05				
Average:		32		11
Total:			37	
Count:	9	1		
06				
Average:		42		12
Total:			39	
Count:	7	1		
07				
Average:		14		14
Total:			65	
Count:	11	2		

* PM-10 data from July 1987 forward.

OLANCHA DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN WIND DIRECTION *
November 1985 - March 1988

MO	DAYS > 19	TSP	HRS > 19	24 HR AVG WS
08				
Average:		37		14
Total:			39	
Count:	7	2		
09				
Average:				11
Total:			34	
Count:	8	0		
10				
Average:		15		12
Total:			19	
Count:	4	1		
11				
Average:		19		14
Total:			75	
Count:	9	1		
12				
Average:				12
Total:			50	
Count:	8	0		
Average:		24		13
Total:			636	
Count:	103	21		

* PM-10 data from July 1987 forward.

COSO PM-10 & MET DATA FOR WS > 19 MPH
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
85	03	31		NW	12	1	WNW	8
		29		(V)	16	9	NNW	8-16
		28		WSW	16	6	WSW	0-3,8,15
		27		SW	28	18	WSW	6-23
		26	52	SW	11	4	SW	15-16,18,23
	04	27		NW	11	1	NNW	0
		26		NNW	24	19	NNW	0,3-15,17-21
		25	307	NW	19	11	NNW	8-9,15-23
		24		WSW	15	5	WSW	17-21
		21		SE	10	4	WSW	16-19
		19	42	WSW	10	5	WSW	16-20
		16		ESE	11	7	ESE	11-17
		15		ESE	7	1	ESE	14
		12		WNW	9	1	WNW	9
	05	04		NW	10	1	NW	8
		02		SE	10	3	SE	13-15
		26		SE	10	2	ESE	14-15
		27		ESE/SE	9	2	ESE	14-15
		28		SE	9	1	WSW	17
		31	42	ESE/W	11	2	W	19,22
		29		W	14	5	WSW	12-13,16-18
		21		NW	12	3	WNW	2-3,7
		20		WSW/NW	14	7	WSW	14-20
		16		SE	9	1	SE	14
		15		NW	13	2	SE	13-14
		07	41	ESE	9	3	SE	15-17
		08		SE	11	2	SE	11-12
		09		ESE	11	3	SW	20,22-23
		10		WSW	13	6	WSW	0-5
		14		NW	10	7	WSW	15-17,19-22
	06	24	58	W	10	4	W	17-20
		19		(V)	8	1	SE	15
		02		SW/NNW	14	7	WSW/NNW	15-21
		11		NW	12	2	NW	8-9
		03		NNW	12	4	NNW	8-11
		10		WNW/NW	11	3	NW	6-8
		07		ESE	9	1	ESE	14
		25		NNW	11	3	NNW	7-9
	07	15		SE	7	1	SE	16
		31		SW	8	1	SE	10
	08	01		SE	8	1	SE	14
		08		SE	7	1	WSW	17
		09		(V)	11	2	NNW	7-8
		11	60	NW/NNW	8	1	NNW	8
		16		SE	8	2	SE	14-15
		17	29	SE	9	4	SE	11-14
		18		SE	8	1	SE	13

COSO PM-10 & MET DATA FOR WS > 19 MPH
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
85	08	20		SE	8	3	SE	14-16
		21		SE	6	1	SSE	15
		25		NW	7	1	SE	11
		27		WSW	9	3	WSW	15-17
		29	31	NW	11	1	WSW	18
	09	01		WSW	13	6	WSW	15-20
		08		SE	11	3	SE	11-13
		09		SW	12	1	ESE	11
	10	06		W	9	1	SW	16
		07		W	14	5	W	14,16-19
		10	26	NNW	12	7	NW/NNW	0-2,7-10
		09		NW	17	9	NW/NNW	6-13,23
	11	00		NONE				
	12	00		NONE				
	Average:		69		11	4		
	Total:					222		
	Count:	61	10					
86	01	25		NW	10	1	WNW	11
		06		NW	15	3	NW	10,12,14
		17		NW	15	6	N/NW	9,11-15
	02	18		WSW	18	9	WSW	0-3,10-12,14-15
		27		NW	11	1	NW	8
		26		NW	12	4	NW	5-6,8-9
		23		NW	12	1	NW	10
		20		(V)	10	1	WSW	1
		19	6	SW	14	1	S	4
		06		NW/NNW	17	6	NNW	13-17,23
		09		NW	11	2	NW	2-3
		14		SE	11	2	SE	20-21
		15		SE	11	2	SW	14-15
		16		NW	11	2	WSW/W	0-1
		17		WSW	21	8	WSW	10-12,15-16,21-23
		05		SE	7	2	W	22-23
		04		NW	14	2	N	10-11
		03		WSW	15	7	WSW/W	11-15,17-18
		02		WSW	15	8	WSW	11-18
	03	02		NW	14	3	NNW/WNW	16-18
		01		NW	6	1	SE	16
		19		NNW	11	2	NNW	4-5
		18		NNW	19	9	NNW	7-15
		17		NW	13	2	NNW	21-22
		07		WSW	10	1	WSW	22
		10		SE	11	1	SE	9
		08		SW	19	8	WSW	1-5,7,11,17
		15	10	ESE	9	1	ESE	12

COSO PM-10 & MET DATA FOR WS > 19 MPH
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
86	04	03		NW	11	2	NNW	0-1
		01		W	12	2	W	20-21
		02	1,175	N	22	16	NNW/N	1-13,16-17,23
		16		W	16	8	W/WNW	13-19,21
		12		W	17	8	W	12-18,23
		18		N	13	5	N	1,5-8
		13		NNW	10	1	W	0
		20	29	NNW	11	1	NNW	9
		15		SSE	10	3	SSE	10-12
	05	01		SE/S	8	1	SE	14
		03		SW	13	2	SSE	10-11
		06		W	16	7	W	13-19
		07		NNW	13	3	N/NNW	1,7-8
		12		NW	11	2	N	7-8
		21		E	14	1	E	10
		22		NW	12	2	NNW	7-8
		31		NW	10	3	NNW/NW	17,22-23
	06	01	22	NW	12	1	NW	0
		02		(V)	12	1	W	18
		07	157	SE	11	6	W/N	16-18,21-23
		08		NNW	17	10	N/NNW	0-9
		09		NW	11	1	N	8
		19	63	NW/NNW	12	3	NNW	6-8
		24		W	11	1	W	19
		25	35	NNW	12	3	W	16-18
		26		W	10	2	W	18-19
	07	00		NO DATA				
	08	28		N/NNW	10	1	SSE	18
		27		NW	9	1	N	2
		20		S	6	1	N	16
	09	10		NW	12	2	NNW	2-3
		09		WSW	13	7	WSW	12-18
		07		SE	8	1	SSE	14
		12		SE	8	2	SE	15-16
		13		SE	8	1	SE	15
		16		W	10	1	W	21
		19		SW	10	2	SW/W	14,18
		23		*	9	1	W	15
		24	43	*	16	7	WSW/*	13-14,19-23
	10	04		*	12	2	NNW	9-10
		18		N	12	1	N	9
		31		NW	19	10	N	4,7-15
		01		*	10	2	*	17-18
		02		*	13	1	N	13
	11	01		NW	16	8	N	8-10,12-15,22
		02		N	18	9	N	1-5,11-14
		03		NW	15	3	NW/NNW	4,7-8

COSO PM-10 & MET DATA FOR WS > 19 MPH
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
86	11	04	77	NNW	10	2	NW/NNW	9-10
		06		NNW	18	9	NNW	7-15
		10	27	NNW	9	2	NNW	10-11
		11		NNW	12	4	NNW	9-12
		12		NNW	11	3	NNW	10-12
		25		NW	20	13	N/NNW/NW	2-5,7-15
		29		NNW	14	5	WNW/N	6-7,10-12
		30		NW	9	1	N	11
	12	07		NW	19	10	NNW/NW	3-4,6-7,10-15
		08		NW	12	2	NW	3-4
		21		NW	11	1	NNW	12
		20		NW	12	1	N	13
	Average:		149		13	4		
	Total:					307		
	Count:	87	11					
87	01	28		(V)	11	3	WSW	6-8
		23		WNW	9	1	WSW	11
		20		NNW	14	5	NNW	1-2,9-11
		19		N/NNW	20	12	N/NNW	9-20
		16		NNW	26	20	NNW/N	0-14,18-20,22-23
		15	196	N	24	15	N/NNW	7-17,20-23
		14		NNW	15	8	NNW/NW	0-3,9-12
		11		NNW	10	2	NW	9-10
		10		NNW	14	3	NNW	7-9
		13		NNW	13	3	NNW/NW	10,20,23
	02	23		W	20	13	W/WSW	6,8-19
		20		N	20	12	N	1-2,5-14
		19		N	22	17	N/NNW	0,2-4,6,10-16,18-22
		18		N	17	10	N	13-22
		16		NNW	14	4	NNW	6,9-11
		15		WNW	15	6	WNW/W	14-19
		14	12	NNW	9	2	W	0-1
	03	00		NO DATA				
	04	30		W	12	1	W	13
		29		SE	9	1	SSE	11
		28		S	7	1	SSE	15
		23		SSE	9	1	SSE	12
	05	24		SSE	8	1	SSE	14
		20		S	10	2	NNE/W	14-15
		19		SSE	9	1	SSE	16
		01		ESE	10	3	W	15-17
	06	22		NW	13	7	NW/SSW	0,2,4,6-9
		17		SE	10	3	W	16-18
		16		SSE	8	1	SSE	15
		07		SSE/W	6	1	W	16

COSO PM-10 & MET DATA FOR WS > 19 MPH
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
87	06	04		W	10	1	SSE	12
	07	20	13	SSE	14	8	SSE	11-18
		17		W	12	1	W	8
		16		W	12	5	W	15-19
		15		SE	9	1	WNW	15
		10		SE	9	2	SE	14-15
		03		SSE/W	7	1	SE	14
		21		SSE	11	4	SSE	11-14
		23		SSE	9	2	SSE	15-16
		26	27	SSE	10	3	SSE	12-13,15
		27		SSE	11	5	SSE	11-12,14,16-17
		28		SSE	12	6	SSE	11-16
		29		SSE	10	2	SSE	16-17
	08	01		SSE	10	1	SSE	12
		09		W	10	2	W	18-19
		10	59	S/W	11	5	W/WSW	16-20
		13	43	SSE	10	1	W	19
		14		W	11	3	W	14-16
		20		S	10	2	W	12,14
		21		SSE	11	6	SSE	12-17
		22		SSE	10	6	SSE	11-16
		23		SSE	9	2	SSE	11-12
		11		W	9	3	W	16-18
	09	02		NW	9	1	WNW	18
		03		W	11	2	W	18-19
		15		W	8	1	WSW	18
	10	12	73	SSE	11	2	S	12-13
	11	14		NNW	13	1	WNW	0
		25		NNW	19	12	NNW,(V)	3-5,8-16
		26		NNW	10	1	NNW	10
		20		S	7	1	S	15
	12	11	11	NNW	11	1	NNW	11
		12		N		17	N,NNW,SSW	
		13		S,WSW	30	24	WSW,S,(V)	0-23
		14		NW	7	1	NNW	0
		22		S	11	4	W	14-15,21,23
		23	30	N	17	5	N,SE	0-2,5,23
		24		N,NNW	23	19	NNW,N,(V)	5-23
		25		NNW	21	16	NNW,NE,(V)	2-15,22-23
Average:			52		12	5		
Total:						339		
Count:		69	9					
88	01	01		NNW	14	4	NNW	9-12
		11		WNW	16	8	W,NNW	6-7,10-11,13-16
		15		WSW	9	3	W	7-9

COSO PM-10 & MET DATA FOR WS > 19 MPH
March 1985 - March 1988

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
88	01	16	15	WSW	15	7	W	11-17
		19		NNW	15	7	NW,NNW	2,4-6,9-11
		29		SSW	6	1	W	13
	02	04		NNW	15	4	NNW	9-12
		10		NNW	15	6	NNW,S	10-15
		17		N	14	7	W,NNW,N	0-1,3,5-7,11
		22		N	8	1	N	9
		19		N,NNW	16	9	NNW,NW,N	0-5,8,13,18
		18		N	21	17	N	7-23
		16		NNW	18	9	NW,SW	10-12,18-23
		11		NNW	14	6	NNW,NW	4-5,9-12
	03	21		N	10	2	WNW	18-19
		31		N	16	11	N	1-5,7-12
		30		N	17	9	NW,N,NNW	0,5,7-9,20-23
		28	92	NW	12	3	NW	1-3
		10		NW	12	2	NNW	8-9
		27		NNW	15	4	NNW	20-23
		15		NW	11	7	NW	10-16
		11		NNW	11	1	N	9
		09		NNW	16	9	NW,NNW	11-18,20
		07		N,NNW	10	2	N	8-9
	Average:		54		14	6		
	Total:					139		
	Count:	24	2					
	Average:		91		12	4		
	Total:					1,007		
	Count:	241	32					

COSO DATA SUMMARY BY MONTH FOR WS > 19 MPH
March 1985 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01				
Average:		106		14
Total:			112	
Count:	15	2		
02				
Average:		9		14
Total:			181	
Count:	19	2		
03				
Average:		51		14
Total:			116	
Count:	19	3		
04				
Average:		388		13
Total:			104	
Count:	19	4		
05				
Average:		42		11
Total:			78	
Count:	23	2		
06				
Average:		67		11
Total:			66	
Count:	16	5		
07				
Average:		20		10
Total:			42	
Count:	14	2		

COSO DATA SUMMARY BY MONTH FOR WS > 19 MPH
March 1985 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
08				
Average:		44		9
Total:			55	
Count:	18	5		
09				
Average:		43		11
Total:			38	
Count:	14	1		
10				
Average:		50		13
Total:			40	
Count:	10	2		
11				
Average:		52		13
Total:			74	
Count:	15	2		
12				
Average:		21		16
Total:			101	
Count:	13	2		
Average:		91		12
Total:			1,007	
Count:	195	32		

COSO DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN DIRECTION
March 1985 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01				
Average:		196		16
Total:			97	
Count:	12	1		
02				
Average:				15
Total:			124	
Count:	15	0		
03				
Average:		92		13
Total:			76	
Count:	15	1		
04				
Average:		504		15
Total:			64	
Count:	9	3		
05				
Average:				11
Total:			16	
Count:	7	0		
06				
Average:		81		12
Total:			47	
Count:	11	3		
07				
Average:				9
Total:			1	
Count:	1	0		

COSO DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN DIRECTION
March 1985 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
08				
Average:		60		9
Total:			5	
Count:	4	1		
09				
Average:				11
Total:			3	
Count:	2	0		
10				
Average:		26		14
Total:			30	
Count:	6	1		
11				
Average:		52		14
Total:			73	
Count:	13	2		
12				
Average:		21		15
Total:			73	
Count:	10	2		
Average:		162		14
Total:			609	
Count:	105	14		

COSO DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN DIRECTION
March 1985 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01				
Average:				10
Total:			4	
Count:	2	0		
02				
Average:		6		15
Total:			68	
Count:	11	1		
03				
Average:		31		14
Total:			40	
Count:	8	2		
04				
Average:		42		10
Total:			28	
Count:	8	1		
05				
Average:		41		11
Total:			49	
Count:	17	1		
06				
Average:				10
Total:			18	
Count:	6	0		
07				
Average:		20		10
Total:			35	
Count:	11	2		

COSO DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN DIRECTION
March 1985 - March 1988

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
08				
Average:		40		9
Total:			39	
Count:	14	3		
09				
Average:		43		11
Total:			31	
Count:	9	1		
10				
Average:		73		10
Total:			3	
Count:	2	1		
11				
Average:				7
Total:			1	
Count:	1	0		
12				
Average:		30		24
Total:			46	
Count:	3	1		
Average:		35		11
Total:			362	
Count:	92	13		

DARWIN PM-10 & MET DATA FOR WS > 19 MPH
March 1985 - September 1986

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
85	03	29		NNW	15	9	NNW	9-17
		27		WSW	19	11	WSW	0-9,11
		06		WSW	23	6	WSW	18-23
	04	26		NW	22	20	NW	0-14,16-17,20,22-23
		25	372	NW	17	9	NNW	15-23
		18		NW	11	1	NNW	8
		16		SSE	14	5	SSE	12-16
	05	02		E,SSE	11	4	SSE	12-15
		09		SSE	14	5	SSE	12-16
		15		SSE	12	1	SSE	17
		16		SSE	10	1	SSE	17
		20		NW	11	1	NW	22
		27		NE,S	10	3	S	16-18
		29		NE	12	3	WNW	17-19
		08		SSE	11	1	SSE	16
	06	02		WNW	13	7	WNW	16-22
		03		NW,NNW	12	2	NNW	8-9
		19		SSE	10	3	WSW	15-17
	07	15		NE,SSE	7	1	SSE	16
		29		SSE	11	2	SSE	15-16
		31		SSE	11	2	SSE	13-14
	08	20		SSE	10	1	S	15
	09	08		S	13	3	S	14-16
		09		SSE	14	5	S	11,14-17
	10	00		NONE				
	11	00		NONE				
	12	00		NONE				
	Average:		372		13	4		
	Total:					106		
	Count:	27	1					
86	01	06		NW	12	1	NNW	21
	02	03		NNW	12	2	W	15-16
		14		SSE	16	6	S	16-21
		17		W	12	4	W	16,21-23
		18		WSW	13	3	WSW	0-1,3
		19	4	S	17	8	S,SW	2-4,10-14
		16		WSW	10	1	WSW	3
		15		S	15	4	S,WSW	10-11,20-21
		09		NW	12	4	NNW	4,7,9-10
		06		NW	16	6	NNW	10-15
	03	15	7	SE	9	1	SSE	12
		18		NNW	17	7	NNW	6,8-11,13,15
	04	01		NE,W	12	7	S,WSW	16-22
		02	190	WNW	17	6	W,NW	2-3,9-11,17
		12		SW	15	7	WSW	12-18
		15		SSE	12	4	SSE	14-17

DARWIN PM-10 & MET DATA FOR WS > 19 MPH
March 1985 - September 1986

YR	MO	DAY	PM-10	24 HR PRV DIR	24 HR AVG WS	TOT HRS > 19	PRV HRS > 19	HRS > 19
86	04	18		NNW	11	1	NNW	8
		23		NE,SSE	10	2	SSE	14-15
	05	02	17	S	11	2	S	15-16
		03		SSE	14	6	SSE	11-16
		04		W	10	2	W	2,4
		05		NE,NNW	10	2	SW	16,19
		14	42	NW	10	2	W	19-20
		21		SE	14	2	SW	0-1
		31		NE	11	4	W	16-17,22-23
	06	01	23	W	10	2	W	0-1
		04		SSE	9	1	SSE	15
		08		NW	16	6	NW	4-5,7-10
		16		NE,SSE	10	3	SSE	16-18
		28		S	14	2	S	11,17
	07	16		NE	9	2	SSE	15-16
		28		SSE	9	2	SSE	16-17
	08	00		NONE				
	09	08		SSE	14	1	SSE	15
		16		NE	9	2	SW	16-17
		24	33	(V)	13	7	WSW,SW,S	11,15-16,19-22
	Average:		45		12	3		
	Total:					122		
	Count:	36	7					
	Average:		86		13	4		
	Total:					228		
	Count:	63	8					

DARWIN DATA SUMMARY BY MONTH FOR WS > 19 MPH
March 1985 - September 1986

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01				
Average:			1	12
Total:			1	
Count:	1	0		
02				
Average:		4	4	14
Total:			38	
Count:	9	1		
03				
Average:		7	7	17
Total:			34	
Count:	5	1		
04				
Average:		281	6	14
Total:			62	
Count:	9	2		
05				
Average:		30	3	11
Total:			39	
Count:	14	2		
06				
Average:		23	3	12
Total:			26	
Count:	8	1		
07				
Average:			2	9
Total:			9	
Count:	5	0		

DARWIN DATA SUMMARY BY MONTH FOR WS > 19 MPH
March 1985 - September 1986

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
08				
Average:			1	10
Total:			1	
Count:	2	0		
09				
Average:		33	4	13
Total:			18	
Count:	4	1		
10				
Average:				
Total:				
Count:	1	0		
11				
Average:				
Total:				
Count:	1	0		
12				
Average:				
Total:				
Count:	1	0		
Average:		86	4	13
Total:			228	
Count:	60	8		

DARWIN DATA SUMMARY FOR WS > 19 MPH FROM NORTHERN WIND DIRECTION
March 1985 - September 1986

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
01				
Average:			1	12
Total:			1	
Count:	1	0		
02				
Average:			5	14
Total:			10	
Count:	2	0		
03				
Average:			8	16
Total:			16	
Count:	2	0		
04				
Average:		281	7	16
Total:			37	
Count:	4	2		
05				
Average:			2	12
Total:			4	
Count:	2	0		
06				
Average:			5	14
Total:			15	
Count:	3	0		
Average:		281	6	14
Total:			83	
Count:	14	2		

DARWIN DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN WIND DIRECTION
March 1985 - September 1986

MO.	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
02				
Average:		4	4	14
Total:			22	
Count:	5	1		
03				
Average:		7	6	17
Total:			18	
Count:	3	1		
04				
Average:			5	13
Total:			25	
Count:	5	0		
05				
Average:		17	3	12
Total:			27	
Count:	9	1		
06				
Average:			2	11
Total:			9	
Count:	4	0		
07				
Average:			2	9
Total:			9	
Count:	5	0		
08				
Average:			1	10
Total:			1	
Count:	1	0		

DARWIN DATA SUMMARY FOR WS > 19 MPH FROM SOUTHERN WIND DIRECTION
March 1985 - September 1986

MO	DAYS > 19	PM-10	HRS > 19	24 HR AVG WS
09		.		
Average:		33	4	13
Total:			18	
Count:	4	1		
Average:		15	3	12
Total:			129	
Count:	36	4		

APPENDIX D

MODEL RESULTS FOR SOURCES > 100 TONS/YEAR

PTPLU
ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED
(CALIFORNIA AIR RESOURCES BOARD MODELING SECTION VERSION)

BIG PINE DISTRIBUTORS - CRUSHING

SOURCE CONDITIONS

EMISSION RATE = 2.646 G/SEC = 21 LBS/HR
PHYSICAL STACK HEIGHT = 6.1 M = 20 FT
STACK GAS TEMPERATURE = 294.3 DEG. K = 70 DEG. F
STACK GAS VELOCITY = 20.32 M/SEC = 4000 FT/MIN
STACK DIAMETER = .254 M = 10 IN
VOLUME FLOW RATE = 1.03 M^3/SEC
BUOYANCY FLUX = .12 M^4/SEC^3

METEOROLOGICAL CONDITIONS

AMBIENT TEMPERATURE = 283.1 DEG. K = 50 DEG. F
ANEMOMETER HEIGHT = 10.06 M = 33 FT
MIXING HEIGHT = 152.4 M = 500 FT
WIND EXPONENTS: A: .07, B: .07, C: .1, D: .15, E: .35, F: .55

RECEPTOR DATA

RECEPTOR ELEVATION ABOVE GROUND LEVEL = 1.5 M = 5 FT

OPTIONS USED

STACK DOWNWASH

RESULTS - USING EXTRAPOLATED WINDS

STABILITY	WIND SPEED (M/SEC)	MAXIMUM CONCENTRATION (UG/M^3)	DISTANCE OF MAX (M)	EFFECTIVE HEIGHT (M)
A	.48	5.118E+2	193	38.2
A	.77	6.396E+2	135	26.1
A	.97	6.971E+2	115	22.1
A	1.45	7.888E+2	84	16.8
A	1.93	8.327E+2	70	14.1
A	2.41	8.458E+2	61	12.5
A	2.90	8.417E+2	55	11.4
B	.48	5.054E+2	273	38.2
B	.77	6.574E+2	182	26.1
B	.97	7.315E+2	152	22.1
B	1.45	8.449E+2	112	16.8
B	1.93	8.959E+2	92	14.1
B	2.41	9.129E+2	81	12.5
B	2.90	9.107E+2	73	11.4
B	3.86	8.782E+2	63	10.1
B	4.83	8.314E+2	57	9.3

C	1.90	9.687E+2	136	14.2	
C	2.38	9.926E+2	118	12.6	
C	2.85	9.944E+2	107	11.5	<--MAX
C	3.80	9.650E+2	92	10.2	
C	4.76	9.175E+2	83	9.4	
C	6.66	8.154E+2	73	8.4	
C	9.51	6.849E+2	66	7.7	
C	11.41	6.157E+2	63	7.5	
C	14.27	5.393E+2	60	7.1	
D	.46	4.125E+2	808	39.5	
D	.74	5.819E+2	503	27.0	
D	.93	6.672E+2	407	22.8	
D	1.39	8.099E+2	293	17.2	
D	1.86	8.764E+2	238	14.4	
D	2.32	9.062E+2	205	12.8	
D	2.78	9.144E+2	184	11.7	
D	3.71	8.967E+2	157	10.3	
D	4.64	8.589E+2	141	9.4	
D	6.49	7.708E+2	123	8.5	
D	9.28	6.529E+2	110	7.8	
D	11.13	5.892E+2	104	7.5	
D	13.91	5.153E+2	99	7.2	
D	18.55	4.481E+2	90	6.7	
E	1.68	5.266E+2	468	18.3	
E	2.10	4.701E+2	438	17.5	
E	2.52	4.276E+2	415	16.8	
E	3.36	3.668E+2	382	15.8	
E	4.20	3.246E+2	359	15.1	
F	1.52	6.632E+2	700	16.6	
F	1.90	5.877E+2	672	15.8	
F	2.28	5.311E+2	640	15.3	
F	3.04	4.510E+2	594	14.4	
F	3.80	3.960E+2	562	13.8	

PTPLU
ANALYSIS OF CONCENTRATION AS A FUNCTION OF STABILITY AND WIND SPEED
(CALIFORNIA AIR RESOURCES BOARD MODELING SECTION VERSION)

BIG PINE DISTRIBUTORS - ROTARY DRIER

SOURCE CONDITIONS

EMISSION RATE = 2.646 G/SEC = 21 LBS/HR
PHYSICAL STACK HEIGHT = 7.32 M = 24 FT
STACK GAS TEMPERATURE = 355.4 DEG. K = 180 DEG. F
STACK GAS VELOCITY = 63.5 M/SEC = 12500 FT/MIN
STACK DIAMETER = 1.219 M = 4 FT
VOLUME FLOW RATE = 74.13 M^3/SEC
BUOYANCY FLUX = 47.03 M^4/SEC^3

METEOROLOGICAL CONDITIONS

AMBIENT TEMPERATURE = 283.1 DEG. K = 50 DEG. F
ANEMOMETER HEIGHT = 10.06 M = 33 FT
MIXING HEIGHT = 152.4 M = 500 FT
WIND EXPONENTS: A: .07, B: .07, C: .1, D: .15, E: .35, F: .55

RECEPTOR DATA

RECEPTOR ELEVATION ABOVE GROUND LEVEL = 1.5 M = 5 FT

OPTIONS USED

STACK DOWNWASH
BUOYANCY-INDUCED DISPERSION

RESULTS - USING EXTRAPOLATED WINDS

STABILITY	WIND SPEED (M/SEC)	MAXIMUM CONCENTRATION (UG/M^3)	DISTANCE OF MAX (M)	EFFECTIVE HEIGHT (M)
A	.49	0.0	999999(3)	794.2(4)
A	.78	0.0	999999(3)	499.1(4)
A	.98	0.0	999999(3)	400.7(4)
A	1.47	0.0	999999(3)	269.6(4)
A	1.96	0.0	999999(3)	204.0(4)
A	2.44	0.0	999999(3)	164.7(4)
A	2.93	1.758E+1	539	138.5
B	.49	0.0	999999(3)	794.2(4)
B	.78	0.0	999999(3)	499.1(4)
B	.98	0.0	999999(3)	400.7(4)
B	1.47	0.0	999999(3)	269.6(4)
B	1.96	0.0	999999(3)	204.0(4)
B	2.44	0.0	999999(3)	164.7(4)
B	2.93	1.326E+1	955	138.5
B	3.91	1.090E+1	813	105.7
B	4.89	1.134E+1	576	86.0

C	1.94	0.0	999999(3)	205.9(4)	
C	2.42	0.0	999999(3)	166.2(4)	
C	2.91	1.149E+1	1664	139.7	
C	3.87	9.673	1338	106.6	
C	4.84	1.061E+1	911	86.8	
C	6.78	1.380E+1	649	64.1	
C	9.69	1.773E+1	482	47.0	
C	11.62	1.986E+1	414	40.4	
C	14.53	2.258E+1	345	33.8	<--MAX
D	.48	0.0	999999(3)	814.5(4)	
D	.76	0.0	999999(3)	511.8(4)	
D	.95	0.0	999999(3)	410.9(4)	
D	1.43	0.0	999999(3)	276.4(4)	
D	1.91	0.0	999999(3)	209.1(4)	
D	2.38	0.0	999999(3)	168.7(4)	
D	2.86	6.074	4380	141.8	
D	3.81	5.601	2999	108.2	
D	4.77	6.925	1924	88.0	
D	6.67	1.015E+1	1217	65.0	
D	9.53	1.428E+1	902	47.7	
D	11.44	1.638E+1	753	40.9	
D	14.30	1.910E+1	609	34.2	
D	19.07	2.254E+1	487	27.5	
E	1.79	1.102E+1	3919	94.7	
E	2.24	1.049E+1	3494	88.4	
E	2.68	1.006E+1	3184	83.6	
E	3.58	9.413	2753	76.7	
E	4.47	8.924	2463	71.7	
F	1.68	1.117E+1	6275	81.4	
F	2.10	1.084E+1	5478	76.1	
F	2.52	1.056E+1	4908	72.0	
F	3.36	1.012E+1	4135	66.1	
F	4.20	9.777	3627	61.9	

CAUTIONARY NOTES:

(1) THE DISTANCE TO THE POINT OF MAX. CONCENTRATION IS SO GREAT THAT THE SAME STABILITY ISN'T LIKELY TO PERSIST LONG ENOUGH FOR THE PLUME TO TRAVEL THIS FAR

(2) THE PLUME IS OF SUFFICIENT HEIGHT THAT EXTREME CAUTION SHOULD BE USED IN INTERPRETING THIS COMPUTATION AS THIS STABILITY TYPE MAY NOT EXIST TO THIS HEIGHT. ALSO WIND SPEED VARIATIONS WITH HEIGHT MAY EXERT A DOMINATING INFLUENCE

(3) NO COMPUTATION WAS ATTEMPTED FOR THIS HEIGHT AS THE POINT OF MAXIMUM CONCENTRATION IS GREATER THAN 100 KM OR LESS THAN 1 METER FROM THE SOURCE

(4) THE EFFECTIVE HEIGHT OF EMISSION IS GREATER THAN THE MIXING HEIGHT. SO A RELIABLE CALCULATION COULD NOT BE MADE

APPENDIX E

HEALTH AND SAFETY CODE 42316

42316. (a) The Great Basin Air Pollution Control District may require the City of Los Angeles to undertake reasonable measures, including studies, to mitigate the air quality impacts of its activities in the production, diversion, storage, or conveyance of water and may require the city to pay, on an annual basis, reasonable fees, based on an estimate of the actual costs to the district of its activities associated with the development of the mitigation measures and related air quality analysis with respect to those activities of the city. The mitigation measures shall not affect the right of the city to produce, divert, store, or convey water and, except for studies and monitoring activities, the mitigation measures may only be required or amended on the basis of substantial evidence establishing that water production, diversion, storage, or conveyance by the city causes or contributes to violations of state or federal ambient air quality standards.

(b) The city may appeal any measures or fees imposed by the district to the state board within 30 days of the adoption of the measures or fees. The state board, on at least 30 days' notice, shall conduct an independent hearing on the validity of the measures or reasonableness of the fees which are the subject of the appeal. The decision of the state board shall be in writing and shall be served on both the district and the city. Pending a decision by the state board, the city shall not be required to comply with any measures which have been appealed. Either the district or the city may bring a judicial action to challenge a decision by the state board under this section. The action shall be brought pursuant to Section 1094.5 of the Code of Civil Procedure and shall be filed within 30 days of service of the decision of the state board.

(c) A violation of any measure imposed by the district pursuant to this section is a violation of an order of the district within the meaning of Sections 41513 and 42402.

(d) The district shall have no authority with respect to the water production, diversion, storage, and conveyance activities of the city except as provided in this section. Nothing in this section exempts a geothermal electric generating plant from permit or other district requirements.

Appendix F

Negative Declaration and Initial Study

Pursuant to the California Environmental Quality Act of 1970 (CEQA) (Public Resources Code, Section 21000, et seq) and the State Guidelines (Title 14, Division 6, California Administrative Code, as amended), Great Basin Unified Air Pollution Control District has made an Initial Study of the possible environmental impacts of the State Implementation Plan for the Owens Valley PM-10 Planning Area. As a result of this Initial Study, we do not expect significant adverse impacts to sensitive species, or hydrologic or cultural resources. If such impacts are identified at a later date when projects have been chosen for implementation, the project will be modified or mitigations will be proposed to reduce the impacts to insignificance.

Location:

The Owens Valley, in Inyo County, California, from Tinemaha Reservoir to Haiwee Reservoir (Hydrologic unit number 18090103, State of California Hydrologic Unit Map, 1978).

Description of Proposed Project:

A number of tentative measures are proposed in this Plan to reduce the levels of particulate emissions from Owens Dry Lake. Most of the proposed projects will be confined entirely to the lake bed, but rows of trees may be planted along the shoreline north of the town of Keeler to reduce the levels of resuspended particulates in that town. All of the measures will be tested on a small scale, and then on a one-square mile scale, before implementation over the area of emissions, about 47 square miles.

The control measures preferred at this time are flood irrigation, sprinkler irrigation, modification of the chemical composition of the salts, compression, and gravel. The details of these measures and the locations are not yet decided.

Intital Study:

The attached checklist indicates what potential adverse impacts might occur from these suggested control measures. These impacts were assessed by professionals in the fields of hydrology, vertebrate zoology, plant ecology, and archaeology. They concluded that the effects would be insignificant or could be mitigated. Their opinions are attached.

Findings

The proposed plan should be issued a Negative Declaration because all issues identified in the Initial Study are insignificant or can be mitigated. As each detailed project is proposed to be implemented it will also go through the CEQA process. Therefore, this plan will not have a significant adverse impact upon the environment.

Any person may object to dispensing with preparation of an EIR on the proposed plan, or may respond to the findings contained in the Initial Study. Information related to the plan is on file at the Great Basin Unified Air Pollution Control District at 157 Short Street, Suite 6, Bishop, California, 93514; (619) 872-8211. Any person wishing more information may inquire at the District office during regular business hours.

Signed: x H B Irwin　　　　Date: Dec 14 1988
GBUAPCD Board Chairman

ENVIRONMENTAL CHECKLIST FORM
(To Be Completed By Lead Agency)

I. Background

1. Name of Proponent GREAT BASIN UNIFIED AIR POLLUTION CONTROL DISTRICT

2. Address and Phone Number of Proponent 157 Short Street, Suite 6
   Bishop, CA 93514 (619) 872-8211

3. Date of Checklist Submitted November 1, 1988

4. Agency Requiring Checklist ____________

5. Name of Proposal, if applicable Owens Valley S.I.P.

II. Environmental Impacts

(Explanations of all "yes" and "maybe" answers are required on attached sheets.)

	Yes	Maybe	No
1. Earth. Will the proposal result in:			
a. Unstable earth conditions or in changes in geologic substructures?			X
b. Disruptions, displacements, compaction or overcovering of the soil?		X - insignificant	
c. Change in topography or ground surface relief features?		X - insignificant	
d. The destruction, covering or modification of any unique geologic or physical features?			X
e. Any increase in wind or water erosion of soils, either on or off the site?			X
f. Changes in deposition or erosion of beach sands, or changes in siltation, deposition or erosion which may modify the channel of a river or stream or the bed of the ocean or any bay, inlet or lake?			X
g. Exposure of people or property to geologic hazards such as earthquakes, landslides, mudslides, ground failure, or similar hazards?			X

	Yes	Maybe	No
2. **Air.** Will the proposal result in:			
a. Substantial air emissions or deterioration of ambient air quality?			X
b. The creation of objectionable odors?			X
c. Alteration of air movement, moisture, or temperature, or any change in climate, either locally or regionally?			X
3. **Water.** Will the proposal result in:			
a. Changes in currents, or the course of direction of water movements, in either marine or fresh waters?		X	
b. Changes in absorption rates, drainage patterns, or the rate and amount of surface runoff?		X	
c. Alterations to the course or low of flood waters?		X	
d. Change in the amount of surface water in any water body?		X	
e. Discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen or turbidity?		X	
f. Alteration of the direction or rate of flow of ground waters?		X	
g. Change in the quantity of ground waters, either through direct additions or withdrawals, or through interception of an aquifer by cuts or excavations?		X	
h. Substantial reduction in the amount of water otherwise available for public water supplies?			X
i. Exposure of people or property to water related hazards such as flooding or tidal waves?			X
4. **Plant Life.** Will the proposal result in:			
a. Change in the diversity of species, or number of any species of plants (including trees, shrubs, grass, crops, and aquatic plants)?		X	

See pages F10 through F13 (items 3a–3g)

See pages F14 and F15 (item 4a)

	Yes	Maybe	No
b. Reduction of the numbers of any unique, rare or endangered species of plants?			X
c. Introduction of new species of plants into an area, or in a barrier to the normal replenishment of existing species?			X
d. Reduction in acreage of any agricultural crop?			X
5. **Animal Life.** Will the proposal result in:			
a. Change in the diversity of species, or numbers of any species of animals (birds, land animals including reptiles, fish and shellfish, benthic organisms or insects)?		X	
b. Reduction of the numbers of any unique, rare or endangered species of animals?			X
c. Introduction of new species of animals into an area, or result in a barrier to the migration or movement of animals?			X
d. Deterioration to existing fish or wildlife habitat?		X	
6. **Noise.** Will the proposal result in:			
a. Increases in existing noise levels?			X
b. Exposure of people to severe noise levels?			X
7. **Light and Glare.** Will the proposal produce new light or glare?			X
8. **Land Use.** Will the proposal result in a substantial alteration of the present or planned land use of an area?			X
9. **Natural Resources.** Will the proposal result in:			
a. Increase in the rate of use of any natural resources?			X
10. **Risk of Upset.** Will the proposal involve:			
a. A risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?			X

See pages F16 through F19

	Yes	Maybe	No
b. Possible interference with an emergency response plan or an emergency evacuation plan?			X
11. Population. Will the proposal alter the location, distribution, density, or growth rate of the human population of an area?			X
12. Housing. Will the proposal affect existing housing, or create a demand for additional housing?			X
13. Transportation/Circulation. Will the proposal result in:			
a. Generation of substantial additional vehicular movement?			X
b. Effects on existing parking facilities, or demand for new parking?			X
c. Substantial impact upon existing transportation systems?			X
d. Alterations to present patterns of circulation or movement of people and/or goods?			X
e. Alterations to waterborne, rail or air traffic?			X
f. Increase in traffic hazards to motor vehicles, bicyclists or pedestrians?			X
14. Public Services. Will the proposal have an effect upon, or result in a need for new or altered governmental services in any of the following areas:			
a. Fire protection?			X
b. Police protection?			X
c. Schools?			X
d. Parks or other recreational facilities?			X
e. Maintenance of public facilities, including roads?			X
f. Other governmental services?			X
15. Energy. Will the proposal result in:			
a. Use of substantial amounts of fuel or energy?			X

	Yes	Maybe	No
b. Substantial increase in demand upon existing sources or energy, or require the development of new sources of energy?			X
16. Utilities. Will the proposal result in a need for new systems, or substantial alterations to the following utilities:			X
17. Human Health. Will the proposal result in:			
a. Creation of any health hazard or potential health hazard (excluding mental health)?			X
b. Exposure of people to potential health hazards?			X
18. Aesthetics. Will the proposal result in the obstruction of any scenic vista or view open to the public, or will the proposal result in the creation of an aesthetically offensive site open to public view?			X
19. Recreation. Will the proposal result in an impact upon the quality or quantity of existing recreational opportunities?			X
20. Cultural Resources.			
a. Will the proposal result in the alteration of or the destruction of a prehistoric or historic archaeological site?		X	

See pages F21 through F24

	Yes	Maybe	No
b. Will the proposal result in adverse physical or aesthetic effects to a prehistoric or historic building, structure, or object?			X
c. Does the proposal have the potential to cause a physical change which would affect unique ethnic cultural values?			X
d. Will the proposal restrict existing religious or sacred uses within the potential impact area?			X

21. Mandatory Findings of Significance.

a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate

	Yes	Maybe	No
important examples of the major periods of California history or prehistory?	___	___	X
b. Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals? (A short-term impact on the environment is one which occurs in a relatively brief, definitive period of time while long-term impacts will endure well into the future.)	___	___	X
c. Does the project have impacts which are individually limited, but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of those impacts on the environment is significant.)	___	___	X
d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	___	___	X

The four page hydrology report which follows was prepared by the staff of the City of Los Angeles Department of Water and Power, under the direction of Dennis Williams, Engineer in Charge of the Los Angeles Aqueduct Division.

October 27, 1988

SECTION I - HYDROLOGY OF THE OWENS LAKE AREA

A. Introduction

Owens Lake lies within a hydrologically closed basin. It is located between the Sierra Nevada on the west and the Inyo and Coso Mountains on the east. The elevation within the basin ranges from 3,551 feet at Owens Lake to 14,495 feet at Mount Whitney. The Lake has been essentially dry since the mid 1920s.

The Owens Lake Basin, which is the focus of this report, is bounded by the basement rock - valley fill contact on the east and west, and the boundaries that separate surface flow in the Haiwee Reservoir and the Owens River from surface inflow to Owens Lake on the south and north.

B. Owens Lake Basin Hydrologic System

Four sources contribute inflow to the Owens Lake Basin: 1) precipitation; 2) Owens River; 3) mountain runoff and recharge; and 4) subsurface flow from outside of the Owens Lake basin.

1. Precipitation

Owens Lake is within a "rain shadow" caused by the Sierra Nevada immediately to the west. The precipitation along the eastern slopes of the Sierra Nevada decreases sharply with elevation. The annual precipitation near the crest of the mountains is over 22 inches, while at Keeler, on the east side of Owens Lake, is less than 4 inches. Precipitation is the largest inflow component to the area. An average of approximately 75,000 acre-feet falls on Owens Lake and the valley fill deposits surrounding the lake.

2. Owens River

The Owens River carries an estimated base flow of approximately 3000 acre-feet per year to Owens Lake. During high runoff years, water is released from the Aqueduct System into the lower Owens River for operational purposes. The mean annual inflow to Owens Lake measured at Keeler Bridge from 1940 to 1980 is 10,700 acre-feet.

3. Mountain Runoff and Recharge

Runoff from the surrounding mountains is the second largest component of inflow to the area. Significant recharge of the groundwater basin occurs when the creeks pass over the highly permeable alluvial material. Approximately 45% of the base of mountain flow infiltrates the groundwater basin by the time the flow reaches the aqueduct. Most of the surface runoff from the Sierra Nevada that reached the Los Angeles Aqueduct is diverted to Los Angeles and away from Owens Lake. Most of the runoff from the Inyo and Coso Mountains infiltrates into the groundwater basin. Occasional flash floods reach the lake through intermittent stream channels. An estimated 40,000 acre-feet recharges the Owens Lake Basin groundwater system annually.

4. Subsurface Flow

Subsurface inflow to the groundwater system occurs from Centennial Flat, intermediate mountain recharge, and the upper Owens Valley. An estimate of the average subsurface inflow to this area is 18,800 acre-feet per year.

C. Occurrence and Movement of Groundwater

Owens Lake is located at the lowest point within the basin, and groundwater entering the area as subsurface flow and percolating runoff generally flow towards Owens Lake.

Several well-defined aquifers exist below Owens Lake. The aquifers consist of coarse sand and gravel and are separated by layers of clay. Water naturally escapes the groundwater basin as spring flow, or evaporation of confined water leaking upward.

A large confined aquifer system exists on the eastern side of Owens Lake about 250-300 feet deep. Several artesian wells near the eastern shore of the lake tap into this aquifer, and flow at approximately 300-600 gpm. This aquifer is most likely recharged by runoff from the Inyo Mountains. The western extent of this aquifer is unknown, but appears to extend southerly beneath the eastern portion of Owens Lake.

SECTION II - SIGNIFICANT IMPACTS

The proposed test projects on Owens Lake are located on the east side of the Lake. A large confined aquifer system which has an annual recharge estimated to be approximately 29,900 acre-feet exists beneath Owens Lake. Since the project's pumping will be from the confined aquifer system and have a periodic water demand of only 100 acre-feet, the pumping should have little or no effect on surface flow or existing well conditions. Temporary vertical hydraulic gradient changes may occur in the aquifer system. However, these gradient changes should have no surface effect. Minor changes may occur in spring flow rates, but these changes would not be expected to significantly affect surface conditions.

SECTION III - MITIGATION

This aquifer system appears large enough to supply water for the proposed projects without significant effects on the surface environment, wells, or water availability in the vicinity of the project, therefore, no need for mitigation is anticipated.

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Prepared for the GBUAPCD by David P. Groeneveld

October 17, 1988

The rigorous conditions on the Owens Dry Lake margin influence the type and placement of vegetation. Three general vegetation assemblages can be noted on the lands that abut the dry lakebed. These assemblages are controlled by hydrology and geochemistry. In decreasing order of requirement for water of low salinity and in increasing order of drought tolerance, these assemblages are (1) emergent aquatic, (2) phreatophytic and (3) desert fan/lake margin vegetation. Only the dominant perennial plants will be described.

Assemblage 1, emergent aquatic vegetation - plants which grow in the relatively fresh water which emanates from springs located on the Lake margin. The species of this assemblage include bulrushes (Scirpus sp.) and cattail (Typha sp.) and may also contain floating aquatic species such as duckweed (Lemna sp.) or water fern (Azolla sp.). These species are not drought tolerant and therefore decline relatively quickly with diversion of surface water.

Assemblage 2, phreatophytic vegetation - plants which require shallow groundwater but are also relatively drought tolerant. The species of this assemblage include the grasses alkali sacaton (Sporobolus airoides), saltgrass (Distlichlis spicata var. stricta) and rabbitfoot grass (Polypogon monsepliensis), grasslike plants such as wire rush (Juncus balticus) herbs such as yerba mansa (Anemopsis californicum) and wild sunflower (Helianthus anuus var. jaegeri. Two dominant shrubs are found around the margins of spring zones, rabbitbrush (Chrysothamnus nauseosus var. viridulus) and greasewood (Sarcobatus vermiculatus). Because of their greater drought tolerance, these species may invade zones formerly occupied by aquatic species following the diversion of surface water.

Assemblage 3, desert fan/ lake margin vegetation - plants which do not require shallow groundwater but are tolerant of the salts which have become enriched in the soil due to the adjacent location of the highly saline playa. The dominant perennial species in this zone are shrubs represented by cheesebush (Hymenochlea salsola), shadscale (Atriplex confertifolia), spiny sagebrush (Artemisia spinescens, desert tomato (Lycium sp.) and spiny horsebush (Tetradymia axilaris). These species survive on precipitation water alone and will not directly be affected by development and redistribution of water on the Owens Lake Playa.

Assemblage 3 covers the majority of area around the Lake margin. Salt enrichment has occurred within this zone due to prehistoric high stands of the lake, wind blown salt deposition from the playa and reconcentration from past seepage of shallow groundwater. Although, by virtue of their hydrology, the initial two assemblages are unique when compared to the vast majority of surrounding desert area, the vegetation of assemblage 3 may be discerned more by the lack of species diversity rather than by the presence of a particular indicator.

Because of soil wetness, fine texture and low oxygen permeabilities, the initial two vegetation assemblages almost never contain plants which grow on the surrounding fans. Likewise, because of the well drained and droughty conditions of the fan environments, species from the emergent aquatic and phreatophytic assemblages are almost never found growing on the fans. However, because of the dynamic fluctuations in water table elevations due to variation in regional precipitation, the zonation of the phreatophytic and emergent aquatic vegetation may also fluctuate.

Due to water diversion the Owens Lake has dried recently during the past 80 years. In the time scale for the evolution of vegetation which is on the order geologic time, this sequence of events has not permitted the vegetation cover of the lake margin to achieve uniqueness, either in terms of cover or composition. The species that make up the three assemblages are found throughout the Owens Valley, the Northern Mojave Desert and the Western Great Basin. According to the California Natural Diversity Data Base, no rare or endangered plants are known to exist on the lake margins or in the vicinity of areas which may be affected by the proposed project.

The activities planned for the abating the dust from the Owens Dry Lake as part of the Owens Valley State Implementation Plan should not have significant adverse impacts upon the vegetation of the Lake margin. These activities, including development and redistribution of groundwater and various lakebed surface treatments may induce change in localized vegetation cover, particularly in the emergent aquatic and phreatophytic vegetation. However, the presence of relatively fresh water on the land surface may encourage the establishment of these two zones of vegetation on the treatments, themselves, which may offset the decrease of vegetation on the lake margin, if this does occur. A good comparison point for vegetation establishment on the playa is the sulfate artesian well located in Range 37 East, Township 16 South, Section 18. The waters from this well have fostered vegetation of grass and grasslike species (both emergent aquatic and phreatophytic assemblages) that are valuable for wildfowl.

The degree of the changes which may occur in existing vegetation of the emergent aquatic and phreatophytic assemblages depends upon the hydrologic connection to the waters developed for the project and should be again evaluated as planning and testing are developed. It should be noted, however, that the species which may be impacted by the project are relatively easily established given a sufficient source of relatively freshwater.

Zoology Section to be included in the SIP Initial Study
Prepared for Great Basin Unified APCD by Debra K. Lawhon

20 October 1988

This report is a general discussion of the vertebrate zoology of the Owens Lake area with reference to the potential impacts of measures proposed in the State Implementation Plan (Sept. 1988) to control airborne particulate matter from the dry lakebed. Field work to determine <u>in</u>vertebrate faunal composition of the area can be done prior to the implementation of any specific measures; After examining the California Dept. of Fish and Game Special Animals List, I don't believe there are any threatened or endangered invertebrate species around Owens Lake but such conclusions are outside my field of expertise.

Information was obtained primarily from literature review, but also includes observations from a recent trip out to Owens Lake, and prior knowledge about Great Basin and Mojave Desert ecology from my own research experience.

Common literature review sources such as books or journal articles have little information concerning animal species specifically in either the Owens Lake or Owens Valley region. Several biologists have noted that this area is essentially an ecotone between the northern Mojave Desert and the southeastern portion of the Great Basin Desert as it laps over into a small part of California (Billings, 1949; Kenagy, 1973; Matson, 1976). Billings (1949) classified this area a part of the shadscale (<u>Atriplex</u> <u>confertifolia</u>) zone between the sagebrush (<u>Artemisia</u> <u>tridentata</u>) of the north and the creosote bush (<u>Larrea</u> <u>divaricata</u>) zone to the south in the Mojave. Thus one would initially expect to find animal species from either or both regions. Range maps for both Mojave and Great Basin animal species often include this portion of California. However, the Owens Lake area has the dry, hot summers characteristic of the Mojave, and with elevations around the lake of 1100 to 1300 m, the colder winters of the Great Basin. These rigorous climate conditions eliminate many of the species one might otherwise expect to find.

Many of the proposed control measures concern parts of the old lakebed surface only. Those areas appear barren, without vegetation, and there are no readily discernible animal species present. However, projects which would affect either the several aquatic marshes and spring areas, or the desert scrub above the old shoreline could have an impact on the animal species currently using those habitats. Of primary interest in these areas are those species who are not very mobile, have relatively small home ranges, and thus have little ability to tolerate changes to even small portions of their habitat, such as desert fishes, reptiles and amphibians, and small mammals such as rodents. Since desert scrub and aquatic habitats contain very different species communities, I will consider them separately in the discussion that follows.

AQUATIC AND MARSH ENVIRONMENTS
(D. Groeneveld's Vegetation Assemblage 1 - Emergent Aquatic Vegetation, and the moist grass areas of Assemblage 2 - Phreatophytic Vegetation.)

There are undoubtedly invertebrate species, and perhaps some fish species in the various springs and marshy areas along the eastern edge of Owens Lake. I understand that the California Dept. Of Fish and Game has conducted some surveys of the species in these water environments. This information should be used in conjunction with any plans to drain or move the current aquatic areas. Since desert ponds sometimes provide unique communities, a collaborative effort with Fish and Game aquatic experts to determine the presence or absence of species of concern will be important.

On a visit to the area, I observed many shorebird species foraging in the aquatic areas, although my observations were casual and brief. American Avocets (Recurvirostra americana) were numerous, as well as several types of small sandpiper-type birds, Snowy Egrets (Egretta thula), and several species of ducks. Since the Owens Lake area is relatively close to Mono Lake and similar in some features, I would expect to find the more common birds of Mono Lake at Owens Lake as well. These include the California Gull (Larus californicus), the Long-tailed Duck (Clangula hyemalis), the Eared Grebe (Podiceps nigricolis), the Northern Phalarope (Phalaropus lobatus), and Wilson's Phalarope (Phalaropus tricolor) (Winkler and Cooper, 1986). The Endangered Species List contains birds which frequent these types of environments and might be found in the Owens Lake region, so it will be important to obtain an accurate census of the numbers and kinds of bird species. Since birds are highly mobile it should be possible to mitigate any undesireable effects by avoiding the disturbance of key aquatic areas or by creating new ones.

Of mammals, published work to-date shows no endangered subspecies present in the marshy areas. A study of the distribution of rodents around the lake (Matson, 1976) found sign of Antelope Ground Squirrels (Ammospermophilus leucurus leucurus), and Pocket Gophers (Thomomys bottae operarius, and Thomomy b. perpes), and live-trapped Mojave Panamint Kangaroo Rats (Dipodomys panamintinus mohavensis), Merriam's Kangaroo Rat (Dipodomys merriami merriami), Western Harvest Mice (Reithrodontomys megalotis megalotis), and Deer Mice (Peromyscus maniculatus sonoriensis). Trap densities, often expressed as number of animals captured per 100 traps per night, in similar habitats at the same time of year might be anywhere from 10-30. Since this study had a density of 2-3 total animals captured/100 trap-nights, these populations were definitely sparse. Low population numbers suggest that this locality is only marginal habitat for these species.

DESERT GRASS AND SCRUB ENVIRONMENTS
(The dry grass and shrub components of Assemblage 2, and Assemblage 3 - Desert Fan / Lake Margin Vegetation.)

According to the literature there is no record of any threatened or endangered animal species in the drier areas around the lake shoreline. The following lists of species are amphibians, reptiles, and small birds (passerines and ground dwelling birds) that may occur in the general area. In reality, these lists probably over-estimate the number of actual species present, given the harsh conditions and some earlier man-made disturbances to the shore area. For mammals I list those rodents actually seen or trapped in the proposed control measure areas from the 1976 study mentioned previously. I also list a few non-rodents likely to be present in desert scrub.

Amphibians and Reptiles:
Great Basin Spadefoot (Scaphipus intermontanus), Red-spotted Toad (Bufo punctatus), Desert Banded Gecko (Coleonyx variegatus variegatus), Mojave Zebra-tailed Lizard (Callisaurus draconoides rhodostictus), Desert Iguana (Dipsosaurus dorsalis dorsalis), Long-nosed Leopard Lizard (Gambelia wislizenii wislizenii), Southern Desert Horned Lizard (Phrynosoma platyrhinos calidiarum), Western Chuckwalla (Sauromalus obesus obesus), Northern Sagebrush Lizard, (Sceloporus graciosus graciosus), Desert Side-blotched Lizard (Uta stansburiana stejnegeri), Great Basin Western Whiptail (Cnemidophorus tigris tigris), Western Blind Snake (Leptotyphlops humilis), Desert Rosy Boa (Lichanura trivirgata gracia), Western shovel-nosed Snake (Chionactis occipitalis), Desert Night Snake, (Hypsiglena torquata deserticola), California Kingsnake, (Lampropeltis getulus californiae), Red Coachwhip (Masticophis flagellum piceus), Desert Striped Whipsnake (Masticophis taeniatus taeniatus), Western Spotted Leaf-nosed Snake, (Phyllorhynchus decurtatus perkinsi), Great Basin Gopher Snake (Pituophis melanoleucus deserticola), Western Long-nosed Snake (Rhinocheilus lecontei lecontei), Mojave Patch-nosed Snake (Salvadora hexalepis mojavensis), Ground Snake (Sonora semiannulata), Western Black-headed Snake (Tantilla planiceps utahensis), Mojave Desert Sidewinder (Crotalus cerastes cerastes), Panamint Speckled Rattlesnake (Crotalus mitchelli stephensi), and Mojave Rattlesnake (Crotalus scutulatus scutulatus).

Small Passerine or Ground Birds:
Gambel's Quail (Lophortyx gambelii), Black-throated Sparrow (Amphispiza bilineata), House Finch (Carpodacus mexicanus), Green-tailed Towhee (Pipilo chlorurus), Black-chinned Sparrow (Spizella atrogularis), Poor-will (Phalaenoptilus nuttallii), Sage Thrasher (Oreoscoptes montanus), and Sage Sparrow (Amphispiza belli).

Rodent Species Trapped on N. and E. Shore Areas:
Antelope Ground Squirrel (Ammospermophilus leucurus leucurus), Chisel-toothed Kangaroo Rat (Dipodomys microps microps), Merriam's Kangaroo Rat (Dipodomys merriami merriami), Desert Kangaroo Rat (Dipodomys deserti deserti), Deer Mouse (Peromyscus maniculatus sonoriensis), Southern Grasshopper Mouse (Onychomys torridus clarus), and Little

Pocket Mouse (Perognathus longimembris longimembris). The trap densities for these shore areas ranged from 2-8 total captures per 100 trap-nights (Matson, 1976), once again indicative of low population densities.

Other Mammals of Probable Occurrence:
California Myotis Bat (Myotis californicus), Western Pipistrelle Bat (Pipistrellus hesperus), Townsend's Big-eared Bat (Plecotus townsendii), Pallid Bat (Antrozous pallidus), Desert Cottontail (Sylvilagus audubonii), Black-tailed Jack Rabbit (Lepus californicus), Coyote (Canis latrans), and Striped Skunk (Mephitis mephitis).

Unlike plants, many animal species are either cryptic, nocturnal, or only present in an area during certain seasons of the year. Thus field observations and/or trapping surveys have to be fairly rigorous to reveal the real numbers and kinds of animal species at a locality. Readily accessible literature contains only one such animal study in the Owens Lake vicinity - the rodent survey mentioned previously. In the absence of fieldwork, however, one can make reasonable predictions about the faunal composition of an area based on the known home ranges and habitat requirements of a species. Having done this for vertebrates, I have found no terrestrial animal species which would be adversely affected in a significant way by the proposed dust control measures. Those that are likely to occur there are fairly common throughout similar areas in California and Nevada. In fact, where densities are known, as for the rodents, the Owens Lake area supports only low population numbers, and thus represents a relatively unimportant locality for these species.

Having less information regarding the aquatic species which use the marshes and springs, I recommend that field studies be undertaken to 1st) examine the community structure, and 2nd) determine what steps are necessary to maintain habitat for any rare animals which may occur. These actions can be taken once the details of the dust control projects are completely specified.

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October 19, 1988

Ms. Debra Lawhon
Great Basin Unified A.P.C.D.
157 Short Street, Suite 6
Bishop, CA 93514
FAX #: 619-872-6109

Dear Ms. Lawhon,

Enclosed with this letter is a report addressing archaeological concerns associated with preliminary development of the Owens Valley State Implementation Plan. Short ethnographic and archaeological background sections are provided, and an evaluation of archaeological resources at Owens Lake follows. The latter is based on data supplied by the Eastern Information Center of the California Archaeological Inventory, located at the University of California, Riverside.

Note that only small areas of the project appear to include sensitive archaeological resource zones. The actual extent of potential damage, however, can only be judged once more specific plans are drawn for Owens Lake surface treatment. Some basic guidelines and suggestions are provided.

If you have further questions or require our assistance in the future, please contact us at any time.

Sincerely,

Paul D. Bouey, Ph.D.

ARCHAEOLOGICAL REVIEW OF THE OWENS VALLEY STATE IMPLEMENTATION PLAN

The proposed stabilization of the Owens Lake surface to control airborne dust is to entail various measures which might impact archaeological resources within active work areas. Most surface alterations are to occur within a broad sector along the east side of the lake and in a small area in the northwest corner. Ethnographic and extant archaeological information indicate that both areas are proximal to archaeological sites. Whether construction activities will adversely impact any of those resources awaits more detailed plans of dust control measures and more specific determination of site locations and boundaries. Mitigation strategies can be designed once those data have been obtained.

Ethnographic Background

Data regarding native lifeways in Owens Valley were collected during the first half of this century. While that information provides clues about aboriginal life before first contact with Euroamericans, the complete range and variability of prehistoric behaviors are not necessarily depicted nor are those characteristics to be assumed free from historic influence.

Julian Steward (1933, 1938) records a linguistic boundary along the southern edge of Owens Lake, dividing Northern Paiute groups to the north from Shoshoni groups to the south. Subsistence-settlement patterns for those associated populations contrast sharply, in that Northern Paiute patterns are based on primary villages with associated task camps and stations, while Shoshoni behaviors are notably more mobile and less affiliated with semi-sedentary strategies (also see Bettinger 1978). The Northern Paiute depiction is the model for Steward's Owens Valley lifeways with family-based, property-owning organizations. Territories typically formed transects from the Sierra Nevada mountains east to the Inyos and Whites. Villages commonly were located on streams emanating from the Sierra (e.g., Richter Creek, Carrol Creek, Cottonwood Creek), and subsistence-related procurement forays would occur within designated properties. Occasionally groups would disperse and re-settle in smaller collectives, in response to procurement practices tied to resources with greater spatial diffusion.

Shoshoni groups were not as rigidly organized as their Northern Paiute neighbors and lacked comparable forms of land ownership and control. The population was less densely distributed, and those groups which did form had access to virtually all resources in the larger region. That area included parts of Death and Panamint Valleys, Saline Valley, Eureka Valley, Coso Mountains, the east slope of the Sierra, and the north edge of the Mojave Desert. Villages were not as large or permanent as those of the Northern Paiute and frequently moved in response to resource availability. Principal locations were adjacent to water sources, for example, at Olancha, Little Lake, Coso Hot Springs, and Cold Springs (Steward 1938:81).

Groups from both the Northern Paiute and Shoshoni language families had access to Owens Lake, but according to Steward's data (1933, 1938), the extent of that use was limited to the collection of larvae in May, waterfowl in the fall, and antelope on the plains south of the lake (1938:58, 73, 82-83). Owens Lake does not appear to have been a major resource zone for the late populations depicted in the ethnohistoric record, however, the lake region did provide abundant quantities of food stuffs during narrow periods of each year.

Archaeological Background

The prehistoric record in Owens Valley is unique in a Great Basin context because of resource diversity and density, as well as because of the valley's proximity to the California culture area. Locally abundant resources and economic relations with groups to the west were catalysts leading Owens Valley populations into lifeways considered unusual for a desert setting. The archaeological record is extensive in Owens Valley, covering a period on the order of about 9,000 years and exhibiting considerable dynamic as populations readjusted to changing conditions in natural and social environments. Evidence from the earliest occupations is very rare (e.g., Basgall 1987), and not until approximately 3500 B.P. do materials become relatively abundant (Bettinger 1975, 1977, 1979). This latter shift is documented in a large-scale survey conducted by Bettinger (1975), which to this day stands as the foundation study of Owens Valley. Survey units were selected from within a transect which stretched from the Sierra Nevada to the White Mountains in the vicinity of Big Pine. Although those data represent only surface manifestations, adaptive transformations are recognized in the relocation of lowland residences from riverine to desert scrub settings between 3450-1350 B.P., in the appearance of pinyon camps in the uplands between 1350-950 B.P., and in the reduction of hunting-related camps in both upland and desert scrub environs following 950 B.P.

Interpretations regarding Owens Valley prehistory are constrained by the geographic limits of Bettinger's survey, and also by the general lack of excavation in the valley to date. Attempts at explanation have been made on the basis of those data (e.g., Bettinger 1975; Bettinger and Baumhoff 1982, 1983; Bouey 1979), but knowledge of the exact nature of prehistoric behavioral patterns associated with Owens Lake has remained unfortunately vague. Only with recent excavations near Lone Pine at CA-INY-30 (Basgall and McGuire 1988) has the role of Owens Lake in prehistory begun to take shape. Abundant evidence of lake and marsh resources was recovered, documenting use of Owens Lake from approximately 5000 B.P. to late times. Resource use was not consistent throughout that entire period, but the causes of those shifts are not yet evident. CA-INY-30 represents the most extensive excavation conducted in the vicinity of Owens Lake, and with only survey data as an interpretive context, the extent, duration, and character of lacustrine resource exploitation remains little known.

Archaeological Resources at Owens Lake

A record search for archaeological resources adjacent to Owens Lake was conducted at the Eastern Information Center of the California Archaeological Inventory, University of California, Riverside. The regions covered in that review include the project area as delineated on the maps supplied and a perimeter of approximately 1.5 miles wide surrounding the dust control areas. Various surveys have been conducted in this region, but those studies typically are restricted to narrow highway corridors or small tracts of land. A large variety of artifact assemblages are represented, as well as diverse environmental settings (e.g., springs, sand dunes, beach terraces, etc.). Little detailed data regarding those loci are available, but there are indicators that most of the 9000 year spectrum of occupation is represented here.

Relative to the project area, only one documented site falls within the impact zone, on the northeast side of the lake, but numerous others lie in close proximity. Of the grand total, all sites are above the 3590 foot contour line; this same contour also lies just above the lake margin. Based on this distribution, if the 3590 foot contour is designated the sensitivity threshold, that is, site frequencies are predictably greater above 3590 feet, it also is noteworthy that that same contour is outside the project boundary along much of its path. Nearly all of the impact zone is within a low-sensitivity archaeological area.

The measures proposed to control Owens Lake dust include considerable earth constructions, water channels, and wells. If those activities are restricted to the mapped boundary of the impact area, damage to archaeological resources would be of relatively low probability. Of particular concern are those areas in the project above the 3590 foot contour; the potential for archaeological resources is greater, and they will be subject to serious impacts. Also note that the proposed wells are outside the general impact zone and lie in more sensitive tracts. The proposed water channelization is potentially damaging if directed across an archaeological site. Berm construction would destroy the context and integrity of the locus, and moving water would transport artifactual materials away from the area of original deposition. Sprinkler systems, while restricted to the lake proper, would require pipelines across archaeologically sensitive stretches. Tree rows are planned for an area almost completely above the 3590′ contour, and surface modifications would result from ground preparation, excavation for trees, irrigation channels, and all associated traffic. Surface treatments for the dust area, for example, gravels, chemicals, compaction, fences, etc., probably would have no direct impact on archaeological resources. In conjunction with all impacts, however, are access corridors. Roads will originate at extant roadways, which typically are above the 3590 foot contour, and must cross highly sensitive cultural resource domains.

Given those conditions of potential impact, a number of alternatives can be considered, each of which might be enlisted independently or in combination with others. Before any mitigative measures are initiated, however, two initial stages require implementation: maps detailing the dust control measures need to be obtained, and those tracts within the more highly sensitive zone need to be surveyed to determine the locations and boundaries of archaeological sites. Pursuant to that work, if sites are found within impact areas, testing procedures to determine eligibility for the National Register of Historic Places and mitigative measures can be devised for the most effective treatment of those resources. Construction tasks or drainage channels might be redesigned to avoid site destruction, or if complete avoidance is not practical, minimization of damage is the next alternative; this strategy would require excavation at those sites. Methods also might be devised to protect sites (e.g., cover with gravel) against construction, maintenance, and drainage damage, thereby precluding the need for excavation procedures. If resource destruction cannot be circumvented, an excavation program must be designed to recover archaeological data from eligible sites before project-related impacts destroy the sites.

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