REASONABLE FURTHER PROGRESS

REPORT FOR THE

MONO BASIN PM-10

STATE IMPLEMENTATION PLAN

October 2007

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This document provides a progress report on air quality trends in the Mono Basin federal PM-10 nonattainment area since the adoption of the Mono Basin PM-10 State Implementation Plan in May 1995. It was preceded by similar RFP Reports prepared in 2001 and 2004.

Introduction

The Mono Basin PM-10 planning area experiences episodes of high PM-10 concentrations due to dust storms from the exposed lakebed of Mono Lake. PM-10 stands for particulate matter less than 10 microns in average diameter. PM-10-sized particles are extremely small, less than one tenth the diameter of a human hair. Because of their small size they can penetrate deeply into the lungs, causing health problems for people, and can aggravate asthma, bronchitis, heart disease and other lung diseases.

The exposure of the lakebed to wind erosion has resulted primarily from the diversion of Mono Lake's tributary streams by the City of Los Angeles from 1941 through 1989. During this period, the City's water diversions caused the Mono Lake surface level to drop approximately 45 feet, exposing more than nine square miles of highly erodible material to wind erosion. Lakebed sediments and efflorescent salts provide sources of PM-10-sized particles that can become airborne under windy conditions. During spring and late fall, conditions are most conducive to the production of large dust storms. Prior to 1995, PM-10 monitors located downwind from dust source areas at Mono Lake measured peak PM-10 concentrations of around 1,000 micrograms per cubic meter ($\mu g/m^3$), which was more than six times higher than the National Ambient Air Quality Standard (federal standard) of 150 $\mu g/m^3$ for a 24-hour average.

These high air pollution levels at Mono Lake prompted the U.S. Environmental Protection Agency to designate the portion of the Mono Lake hydrologic basin within California a federal PM-10 nonattainment area in 1993. It is formally referred to as the Mono Basin PM-10 Nonattainment Area. A Mono Basin PM-10 State Implementation Plan (SIP) was adopted by the Great Basin Unified Air Pollution District (District) and the State of California in response to this federal nonattainment designation in accordance with the requirements of the 1990 Clean Air Act (Patton and Ono, 1995). The SIP provides an analysis of the air quality problem and identifies the control measures necessary to reduce air pollution to a level that will attain the federal air quality standards. The Mono Basin SIP relies on a decision of the California State Water Resources Control Board (SWRCB), known as Decision 1631, to provide an enforceable mechanism to reduce particulate air pollution by raising the lake level to 6,391 feet above mean sea level, which will submerge most sources of windblown dust around Mono Lake's shoreline.

Clean air was only one of several public trust values considered in SWRCB Decision 1631, which was approved on 28 September 1994. Decision 1631 amended the City's water rights licenses in the Mono Basin to require specific actions to provide the recovery of resources degraded by 48 years of diversion of Mono Lake's tributary streams. The decision established minimum stream flows and higher flushing flows in tributaries to protect fisheries. It also required an increase in the surface level of Mono Lake to 6,391 feet to protect aquatic and terrestrial ecosystems, enhance scenic resources, and meet clean air standards by submerging sources of windblown PM-10 (SWRCB, 1994).

Air Quality and Lake Level

The air quality modeling analysis in the SIP predicted that the 6,391-foot lake level would likely be sufficient to bring the area into attainment with the federal PM-10 standard, since the lake would then submerge much of the exposed lakebed that was causing dust storms. The time it would take to reach this final lake level would depend on yearly runoff in the Mono Basin.

The SIP estimated (Figure 1) that it would take 26 years for Mono Lake to rise to 6,391 feet under normal runoff conditions. Hydrologic modeling shows that if there is a series of extremely wet years, the lake could reach the target level in as little as nine years. Conversely, a prolonged series of drought years could extend the period to reach attainment to 38 years (Figure 2).

After the adoption of the SIP in 1995, Mono Lake benefited from higher than normal runoff between 1995 and 1999, which brought the lake level up about nine feet to 6,384.8 feet above sea level. However, as shown in Figure 1, an ensuing series of dry years undid this early progress, and the lake level dropped. However, recent wet years have brought the level back to the lake's previous post-decision high of 6,384.8 feet. At the current level as measured on April 1, 2007, the lake is at the predicted level for long-term normal runoff.

Figure 3 provides a comparison of lake level to annual runoff (April 1 – March 31) from four creeks that are monitored in the Mono Basin by the City of Los Angeles: Rush, Lee Vining, Parker and Walker Creeks (LADWP, 2007 and MLC, 2007). These runoff data do not include other creeks in the basin, but they do include a high percentage of annual inflow to the basin and have long been considered to be representative of total annual basin inflow. Although the long-term mean runoff of the four creeks is 118,600 ac-ft/yr, based on runoff data from 1946-1995, LADWP has exported 16,000 ac-ft/yr in accordance with its amended license since 1997. Thus, the exported volume is subtracted from the annual average runoff to determine the long-term mean creek runoff to Mono Lake shown in Figure 3.

Reasonable Further Progress

An air quality modeling analysis was performed as part of the SIP to estimate PM-10 concentrations at the historic Mono Lake shoreline as the lake level rose to submerge source areas for wind-blown dust. The air quality model predicted that the 6,391-foot lake level, required by Decision 1631, would bring the Mono Basin into attainment with the federal air quality standards for PM-10. Figure 4 shows the results of modeled PM-10 impacts for Receptor 45, which is the receptor site with the highest modeled PM-10 concentrations. Predicted concentrations at Receptor 45 are shown for each year, based on the lake level trend for normal runoff, as shown in Figure 1. The Receptor 45 trend line shown in Figure 4 is the "reasonable further progress" trend expected as a result of implementation of the SIP.

In addition to the Receptor 45 normal runoff trend line, Figure 4 also includes modeled air quality trends from 1995 to 2004 at four receptor sites (Simis, Warm Springs, Mono Shore and Receptor 45), based on the actual April 1 lake level for each year. Due to higher than normal runoff from 1995 through 1999, modeled air quality improvement was ahead of schedule, as indicated by the lower than expected modeled concentrations at Receptor 45. The modeled design day PM-10 concentration for Receptor 45 dropped from 838 μg/m^3 in 1995 to 374 μg/m^3 in 1999. After fluctuations of the lake level between 2000 and 2007 due to variations in the amount of runoff, the lake level and model design day concentrations are currently back to their 1999 levels.

The modeled design day concentration is the 6th highest PM-10 concentration that would be expected over a 5-year period.[1] Figure 4 shows that Receptor 45 is meeting the Reasonable Further Progress trend based on the current lake level of 6,384.8 feet. However, PM-10 concentrations monitored near Receptor 45 at the Mono Shore monitor site have exceeded levels predicted by the model. The 6th highest monitored PM-10 concentration at Mono Shore from July 2002 through June 2006 was 1,909 μg/m^3. This is about 4 times higher than the expected concentration based on the model, which is around 500 μg/m^3. This indicates that the model is under predicting concentrations near the Mono Shore site. However, a comparison of modeled and monitored concentration at the Simis site shows good agreement between the model prediction and monitor concentrations. The statistical 6th high concentration monitored value for the last five years at Simis was 110 μg/m^3 (monitored 2nd high for a 1 in 3-day sampling schedule). For the same period the model predicted a 6th high concentration around 110 μg/m^3 for the Simis site. Since the emissions used for the model were based on wind tunnel measurements of surface erosion at sites near Simis, good model predictions for this area

[1] Compliance with the federal PM-10 standard allows no more than 1 exceedance of the 24-hour standard per year, thus if the 6th highest monitor value over a 5 year period is less than 150 μg/m^3 then the site would be considered to be in compliance.

seem reasonable. The amount of under prediction by the model at the Mono Shore site, however, indicates that PM-10 emissions near Mono Shore may have been significantly higher than estimated by the model.

The District plans to improve the air quality modeling analysis in the Mono Shore area by utilizing measurement and modeling techniques that have been applied successfully to model wind blown dust at Owens Lake. The District is currently in the process of installing additional monitoring equipment to measure wind erosion using sand flux monitors and hourly PM-10 concentrations at the Mono Shore site. This equipment should be operating in December 2007.

Ambient PM-10 Monitor Concentrations

In January 2000, an ambient PM-10 monitoring site was installed on the north shore of Mono Lake, near Receptor 45, to characterize the area of highest expected PM-10 concentrations in the nonattainment area. Currently, Simis and Lee Vining are the only other active PM-10 monitor sites in Mono Basin. Monitoring at the Warm Springs site, which was used for the 1995 SIP, was discontinued in 1993. These sites are shown in Figure 5, which includes a graphical representation of source areas for wind-blown dust.

The federal Clean Air Act requires attainment of air quality standards in all areas where the public has access, not just at ambient monitoring sites. PM-10 monitor data can be used to demonstrate attainment with federal air quality standards if the monitor site is deemed to be representative of the worst case air quality in the area, after the control strategy has been implemented. The air quality model used for the 1995 SIP determined that Receptor 45 would have the highest PM-10 concentrations when the lake level reached 6,391 feet.

To help verify attainment in the future, the District installed the Mono Shore PM-10 monitor site to represent the worst-case air quality site in the Mono Basin. Since it began operation in January 2000, 74 violations of the federal PM-10 standard (>150 $\mu g/m^3$) have been monitored at the Mono Shore site, or about 10 violations per year (see Table 1). The 24-hour average concentrations on 18 of these violation days exceeded 1,000 $\mu g/m^3$, with the highest concentration over 10,000 $\mu g/m^3$. These concentrations are much higher than predicted by the model, and it likely indicates that the source areas near the Mono Shore site have higher emission rates than assumed in the model. As previously discussed, the District plans to operate additional monitoring equipment in this area to improve model predictions in the future.

No violations of the federal PM-10 standard were monitored at the Simis site due to wind-blown dust, which is in keeping with the modeled reduction in PM-10 that should have resulted from the higher lake level (see Figure 4). One violation was measured on August 31, 1996 at Simis with a PM-10 concentration of 158 $\mu g/m^3$, but this was due to a wildfire in nearby Yosemite National Park. The first violation ever recorded at the Lee Vining sampler occurred on February 28, 2002, when very unusual wind patterns carried high concentrations of Mono Lake dust into Lee Vining, resulting in a 24-hour average concentration of 222 μg/m^3 there. Annual average concentrations at Simis and Lee Vining have not violated federal standards.

Conclusion

Dust storms and federal PM-10 violations continue to occur in the Mono Basin PM-10 nonattainment area. Since it began operation in January 2000, the Mono Shore monitor on the north shore of Mono Lake has recorded 74 violations of the federal PM-10 standard, or about 10 per year. The Simis PM-10 data indicate that PM-10 concentrations at this site currently meet the federal standard. No violations have been recorded at Simis since 1996 and the highest concentration in the last five years was 120 μg/m^3, and the statistical 6th highest monitored concentration for the same period was 110 μg/m^3. The air quality model was found to properly predict the concentrations at Simis, but under predicted the concentrations at Mono Shore site. This indicates that PM-10 emissions near Mono Shore were higher than expected. The District plans to operate additional monitoring equipment at the Mono Shore site starting in December 2007, and to use modeling techniques developed at Owens Lake to improve the model predictions at Mono Lake.

References

LADWP, 2007. Creek flow data for the Mono Basin were provided by the Los Angeles Department of Water and Power. Bishop, California, 2007.

MLC, 2007. Mono Lake Committee, *Current Lake Level – Tracking the Progress of a Rising Lake*. http://www.monolake.org/live/level.htm, August 2007.

Patton, Christopher and Duane Ono, 1995, *Mono Basin Planning Area PM-10 State Implementation Plan – Final*. Great Basin Unified Air Pollution Control District, Bishop, California, May 1995.

SWRCB, 1994. State of California Water Resources Control Board, *Mono Lake Basin Water Right Decision 1631*. Sacramento, California, September 28, 1994.

Table 1. Summary of PM-10 Violations at Mono Shore monitor (Jan 2000-Jun 2007).

Violation Date	PM-10 (µg/m^3)
2000 – 9 violations	
November 29, 2000	10,466
April 8, 2000	690
May 4, 2000	1,063
May 6, 2000	490
May 9, 2000	3,059
May 10, 2000	1,513
June 7, 2000	1,642
June 8, 2000	241
October 9, 2000	387
2001 – 2 violations	
June 2, 2001	414
June 27, 2001	150
September 25, 2001	4,482
2002 – 8 violations	
February 28, 2002	195
March 10, 2002	396
April 14, 2002	3,089
April 15, 2002	1,157
May 18, 2002	201
May 19, 2002	6,505
May 20, 2002	1,481
November 7, 2002	1,745
2003 – 9 violations	
March 13, 2003	487
March 14, 2003	1,658
March 26, 2003	333
April 13, 2003	1,170
April 21, 2003	467
April 24, 2003	5,283
April 25, 2003	5,745
April 26, 2003	341
April 27, 2003	399
2004 – 11 violations	
May 11, 2004	192
May 12, 2004	843
May 17, 2004	913
June 7, 2004	447
September 18, 2004	987
October 8, 2004	430
October 17, 2004	322
October 18, 2004	898
October 19, 2004	871
October 26, 2004	208
November 3, 2004	152
2005 – 14 violations	
April 7, 2005	285
April 13, 2005	386
May 28, 2005	990
June 6, 2005	507
June 17, 2005	235
June 18, 2005	292
June 19, 2005	328
June 20, 2005	298
June 21, 2005	541
September 10, 2005	546
September 11, 2005	487
October 1, 2005	940
October 2, 2005	264
October 13, 2005	477
2006 – 16 violations	
May 19, 2006	1,915
May 20, 2006	238
May 21, 2006	174
June 12, 2006	450
June 13, 2006	168
June 27, 2006	210
September 14, 2006	1,012
September 15, 2006	306
November 8, 2006	624
November 10, 2006	434
November 21, 2006	231
November 22, 2006	174
November 28, 2006	1,764
December 8, 2006	300
December 23, 2006	721
December 26, 2006	4,300
2007 (through June) – 5 violations	
January 10, 2007	1,909
January 11, 2007	359
April 6, 2007	168
April 14, 2007	2,008
April 17, 2007	726

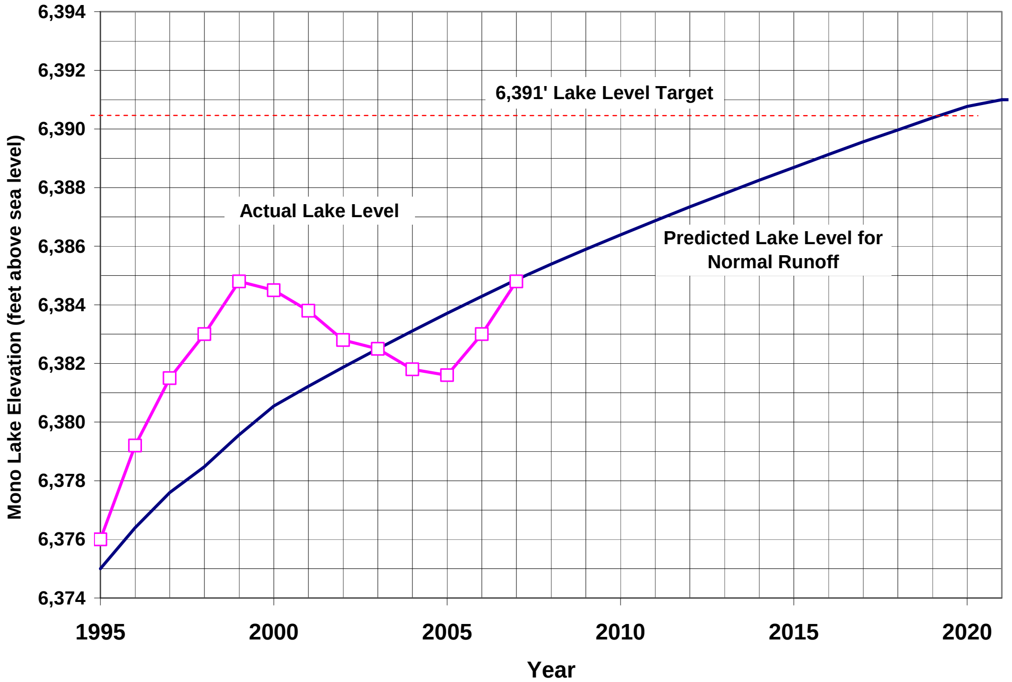

Figure 1. Predicted lake level for normal runoff and actual Mono Lake elevations on April 1.

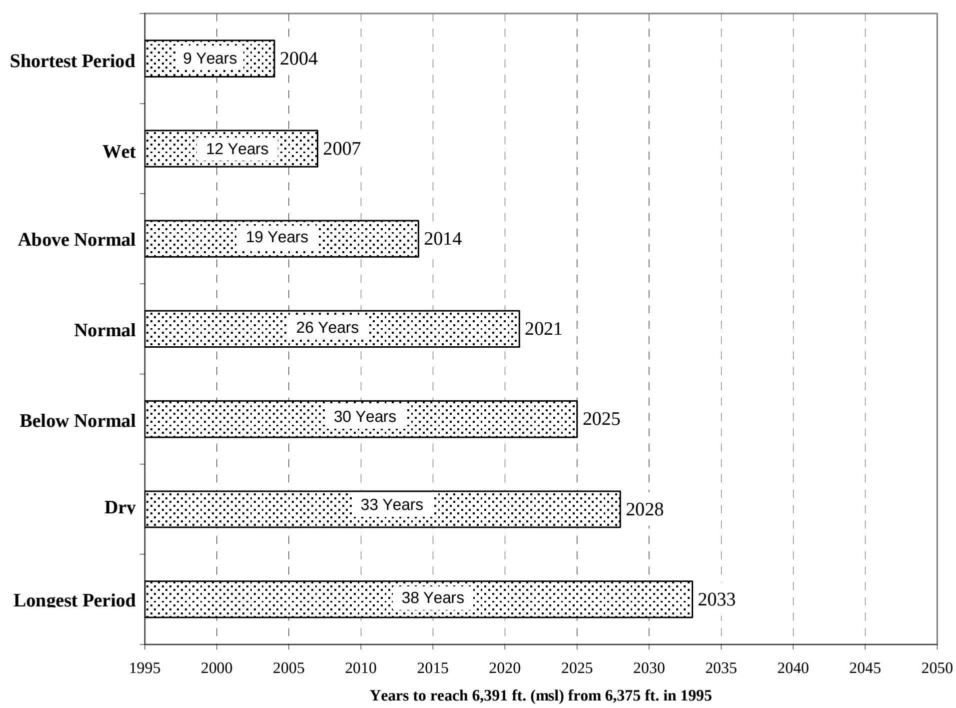

Figure 2. Transition Period Scenarios for Mono Lake Elevation to Reach 6,391 Feet, using D-1631 Operational Rules.

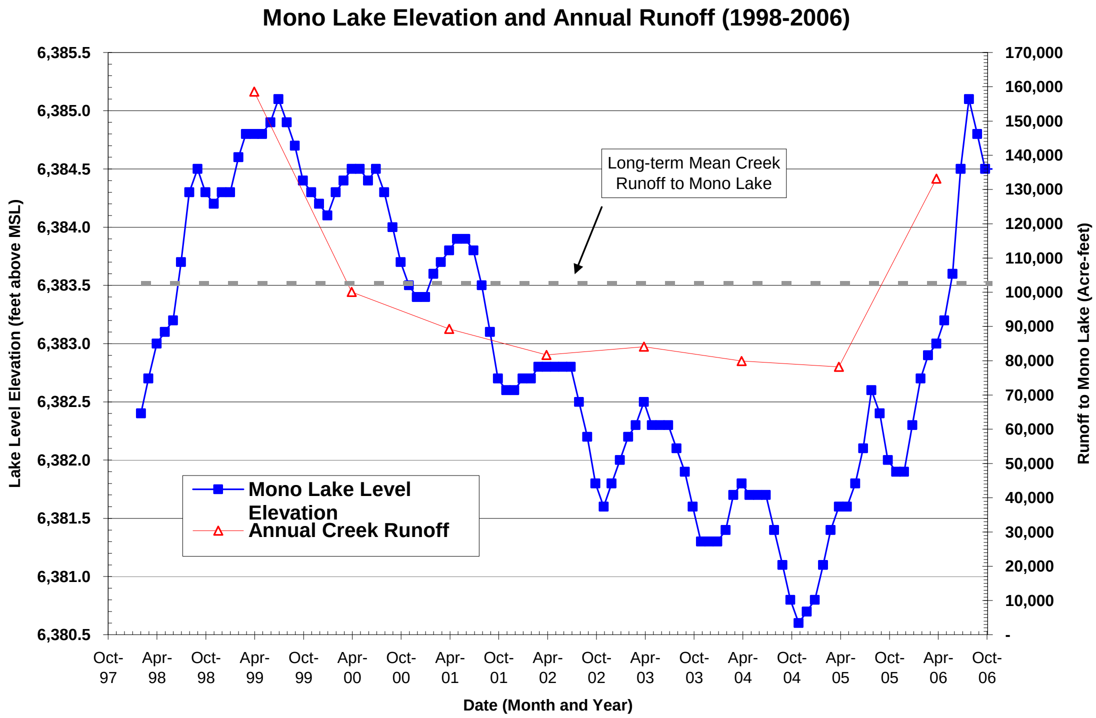

Figure 3. Runoff into Mono Lake and lake level elevations for January 1998 through 2006 for Rush, Lee Vining, Parker and Walker Creeks (LADWP, 2007 and MLC, 2007).

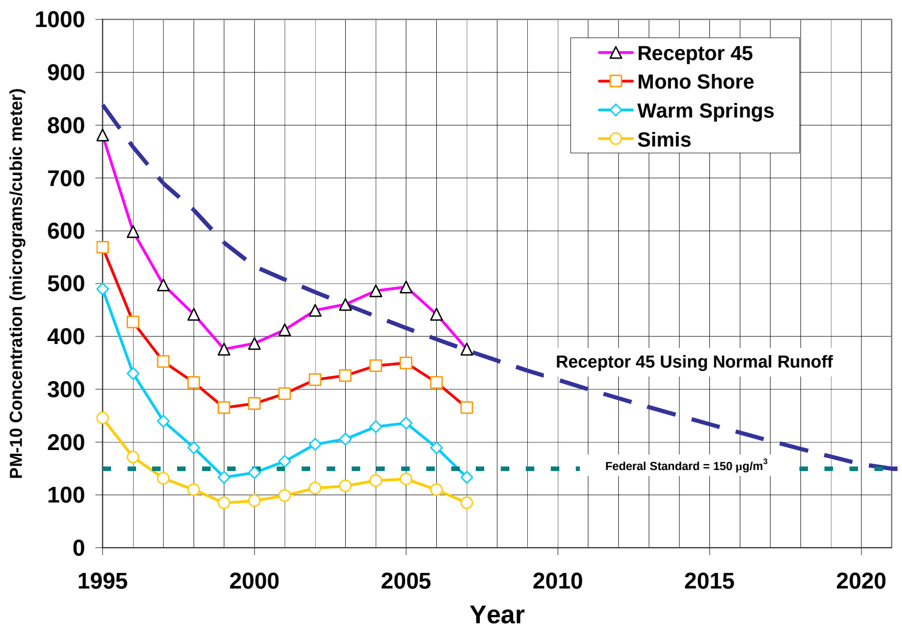

Figure 4. Modeled PM-10 impacts at Mono Lake sites compared to the reasonable further progress trend at Receptor 45 for normal runoff.

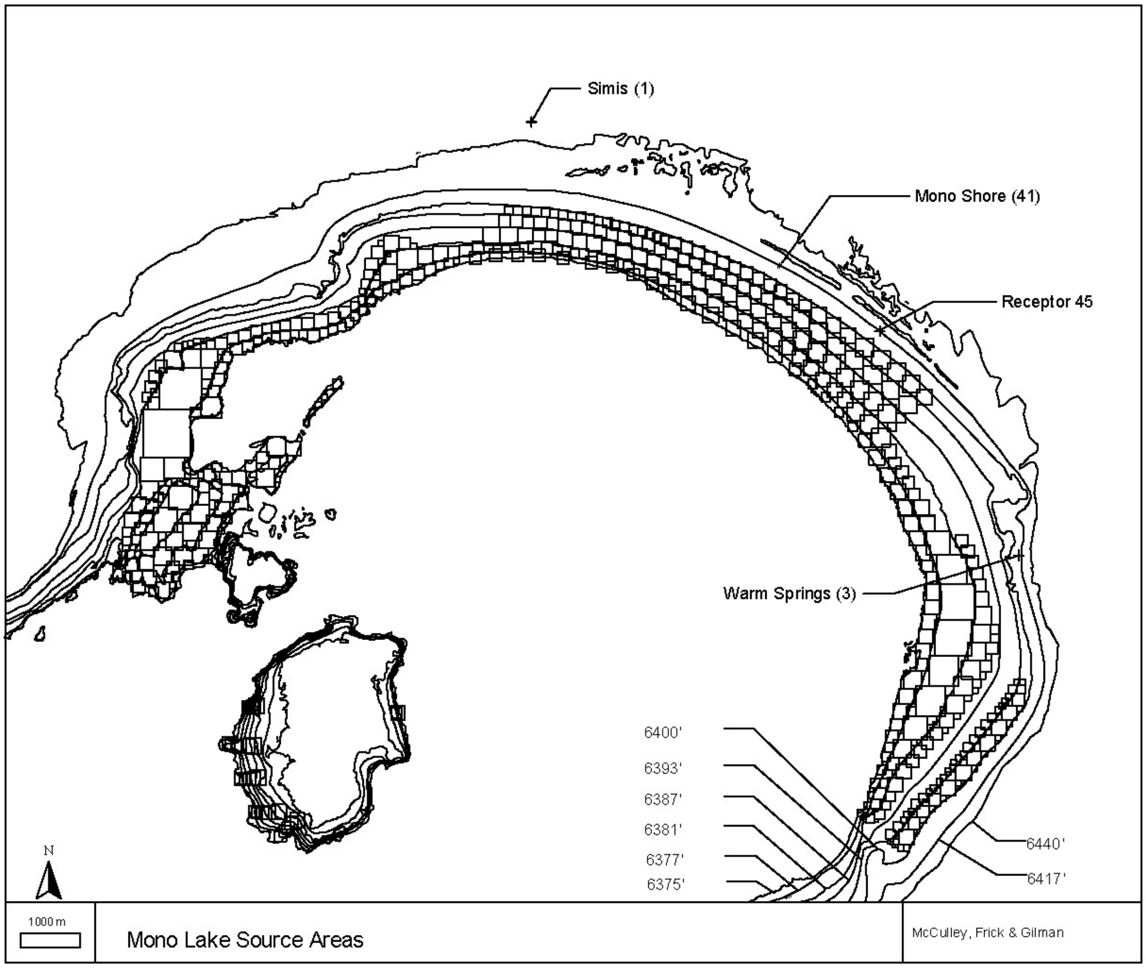

Figure 5. Mono Lake dust source areas and locations of Receptor 45 and monitoring sites at Simis, Mono Shore and Warm Springs.