Appendix D

Dispersion Model Results for Coso Junction PM10 Planning Area

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February 25, 2010

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

Attn: Mr. Duane M. Ono

Re: Dispersion Modeling Results
Coso Junction PM_{10} Nonattainment Area

Dear Duane:

Environ performed a dispersion modeling study to examine PM_{10} concentrations during high wind events along the southern boundary of the Owens Valley PM_{10} Planning Area. Dust source areas on Owens Lake were simulated using the methods described in the Owens Valley PM_{10} Planning Area 2003 and 2008 State Implementation Plan revisions (2003 and 2008 RSIPs). We understand the current simulations will be used to update the attainment demonstration for the Coso Junction PM_{10} SIP. Based on the sand flux and meteorological data collected during July 2006 to June 2009, our simulations suggest PM_{10} concentrations from dust source areas on Owens Lake will not cause violations of the PM_{10} National Ambient Air Quality Standards (NAAQS) in the neighboring Coso Junction PM_{10} Nonattainment Area (NAA). The remainder of this letter describes the dispersion modeling techniques employed for the simulations, model performance, and presents the results of the analysis.

Dispersion Modeling Techniques

Dispersion model simulations were performed with the regulatory version 5.8 of the CALPUFF modeling system following the techniques of the Owens Lake Dust ID Program summarized in the 2003 and 2008 RSIPs. The data collected by the Owens Lake Dust ID Program include surface meteorological data, upper air meteorological soundings, source area delineations, and horizontal sand flux observations. Sand flux measurements are used as the basis for PM_{10} emission rates from windblown sources on Owens dry lakebed. In most respects the current modeling protocol followed the methods employed in the RSIP, which can be found in Board Order 080128-01, Attachment C, Section 6.0. Features of the current simulations are as follows:

- The period for the simulations was July 2006 to June 2009 using the last three years of data available from the Owens Lake Dust ID Program.
- The RSIP study domain was extended to the south to include the common boundary of the southern Owens Valley and northern Coso Junction PM_{10} NAAs. The revised modeling domain is depicted in Figure 1. The revised study domain is 36 km-by-67 km versus the RSIP domain of 34 km-by-48 km. The same vertical and horizontal mesh sizes are used in both modeling analyses.
- Land use and terrain data were prepared for the current domain using the preprocessors that accompany the CALPUFF modeling system. The resulting terrain and land use fields are shown in Figure 1.

- Data collected at two additional surface meteorological stations in the southern portions of the current domain were used to construct the wind fields for the simulations. Data from the Coso Junction (CoJu) and Coso Gate (CoGa) sites shown in Figure 1 were prepared using the same methods as described in the RSIP.

- To assess attainment, PM_{10} concentration predictions were obtained at 90 receptors placed along the southern Owens Valley PM_{10} Planning Area boundary. The receptor interval shown in Figure 1 is 300-600 m. A receptor was also placed at the Coso Junction site where current and historical PM_{10} observations are/have been collected.

- Area source PM_{10} emission fluxes were calculated using hourly Sensit sand motion data and seasonal proportionality constants (K-factors) for July 2006 to June 2009. The procedures used to derive the seasonal 75th percentile K-factors are described in the 2003 and 2008 RSIPs. The K-factors used in the current simulations are shown in Table 1.

- Twelve different area source configurations were available from the Owens Lake Dust ID Program based on source delineations for the three-year period. The periods for the area source configurations are listed in Table 1. As an example, Figure 2 shows the area source outlines used to simulate the period from February 17, 2009 to June 30, 2009.

- No additional controls were assumed for the Owens Lake sources. Sources were characterized as observed during the simulation period without the effects of controls planned for many of these areas.

- As in the 2003 and 2008 RSIP attainment demonstrations, the current simulations only include windblown emissions from sources on the lakebed and the Keeler Dunes. In order to account for background sources, model predictions were added to a background concentration of 20 $\mu g/m^3$. This background concentration was also used in both the 2003 and 2008 RSIPs.

Attainment for the 24-hour PM_{10} NAAQS was assessed using the fourth highest daily prediction at the same receptor during the three-year simulation.

Model Performance

Environ conducted a model performance evaluation to assess the dispersion model techniques described above by comparing predictions to 24-hour PM_{10} observations during July 2006 through June 2009. The methods employed followed the performance evaluation techniques included in the 2003 and 2008 RSIP attainment demonstrations. Features of the model performance evaluation are as follows:

- The 24-hour statistics and plots are based on calendar day averages of hourly TEOM data. When hourly PM_{10} observations were missing both the observations and the corresponding model predictions were excluded from the daily averages. Only daily averages based on 18 or more hourly pairs were included in the analysis

- The data pairs were filtered requiring the sum of the model prediction plus the observation must be greater than 150 $\mu g/m^3$. This symmetrical screen allows examination of both model under prediction and model over prediction while removing periods when both are less significant

- Predictions and observations were compared for the ten monitoring sites of Dirty Socks, Keeler, Lone Pine, Olancha, Flat Rock, Shell Cut, Stanley, Lizard Tail, North Beach and Coso Junction. The locations of the PM10 monitoring sites are shown in Figure 1

- The Coso Junction monitoring site is located just east of an unpaved parking lot and materials storage area. Windblown dust from this local source occasionally affects the monitor. Since this source of PM_{10} is not in the simulations, hours with westerly winds and PM_{10} concentrations above 50 $\mu g/m^3$ were removed from the Coso Junction data set. Such hours were treated as missing for the purposes of calculating the 24-hour averages.

- Quantile-quantile (Q-Q) plots were prepared to test the ability of the model predictions to represent the frequency distribution of the observations. Q-Q plots are simple ranked pairings of prediction and observed concentration, such that any quantile of the predicted concentration is plotted against the same ranking of the observed concentration

- Log-log scatter diagrams were prepared to test the ability of the model to explain the temporal variability in the daily observations. When all sites are combined the scatter diagrams can also be used to infer whether the model can explain the spatial variability

- Tabular statistics were also prepared comparing predicted versus observed: arithmetic mean, geometric mean, maximum, 98th percentile, and the number of concentrations greater than 150 $\mu g/m^3$

- Both linear and geometric correlation coefficients were calculated to supplement the log-log scatter diagrams. Since the data are more log-normal than normally distributed the geometric correlation coefficient is a better measure of the model's ability to explain the variability in the observations

The results of the model performance evaluation are summarized in Table 2. The Q-Q plot in Figure 3 shows how well the model characterizes the frequency distribution of 24-hour PM_{10} concentrations at each of the ten sites. Figure 4 is Q-Q plot where the data are combined (e.g. unpaired in space). Figure 5 is a log-log scatter plot of 24-hour PM_{10} predictions versus observations.

The model performance statistics suggest the model predictions as a whole are relatively unbiased. The predicted frequency distributions for each site are generally within a factor-of-two of the observed distribution. The predictions exhibit scatter and are not well correlated with the observations.

Dispersion Model Results

Table 3 summarizes the results for the CALPUFF simulations of Owens Lake dust events during July 2006 through June 2009, conservatively assuming no future controls would reduce emissions. Figure 6 shows predicted 24-hour design concentrations at the common NAA boundary. The 24-hour PM_{10} design concentration including background is 137 $\mu g/m^3$ predicted for January 5, 2007. Figure 7 shows a plot of the 24-hour concentrations predicted for the January 5, 2007 design day with the observations for the same day posted on the plot. The predicted PM_{10} concentration at the northern boundary of the Coso Junction PM_{10} NAA is under the 24-hour NAAQS of 150 $\mu g/m^3$.

The highest 24-hour PM_{10} concentrations at the southern boundary occur near the Owens Valley floor and along the western sides of the valley. These concentrations are much lower than predicted for receptors at the Owens Lake monitoring sites and along the Owens Lake historical shoreline. For example, the 24-hour design concentration at Dirty Socks during the July 2006 to June 2009 is 585 $\mu g/m^3$. The added distance to the southern boundary of the Owens Valley PM_{10} Planning Area and associated greater dilution of dust source plumes, produces much lower predictions than for receptors placed along the Owens Lake historical shoreline.

The dust sources on the Owens lakebed were simulated as ground level area sources located inside the historical shoreline. The CALPUFF modeling system assumes passive, non-buoyant ground based sources remain ground based as they travel downwind and concentrations within individual dust plumes always decrease with downwind distance. Stagnation and re-circulation of dust source plumes that might result in pockets of higher concentrations at fixed downwind receptor locations generally do not occur concurrently with the regional high wind events that are necessary to produce emissions on the lakebed. When only emissions from lakebed sources are considered, attainment of the PM_{10} NAAQS at the northern boundary of the Coso Junction PM_{10} NAA is sufficient to demonstrate attainment within the entire NAA.

Finally, the current analysis used estimates of windblown emissions during July 2006 through June 2009. Environ did not account for controls currently planned on many of these source areas that will be implemented in the future. If such planned controls were considered, predicted concentrations would be much lower than suggested by the current simulations.

If the District has any questions regarding the simulations presented in this letter, please do not hesitate to contact Environ.

Sincerely,
Environ

Ken Richmond
Senior Air Quality Scientist

Attachments: Tables and Figures

Table 1 – Source Configurations and Seasonal K-Factors						
			Seasonal 75th Percentile K-factors ($x10^{-5}$) by General Source Area			
Source Setup	Period		Keeler Dunes	North	Central	South
1	7/1/2006	11/30/2006	1.7	4.4	6.9	1.9
	12/1/2006	12/31/2006	2.3	3.9	12.0	13.8
2	1/1/2007	1/31/2007	2.3	3.9	12.0	13.8
3	2/1/007	4/30/2007	2.3	3.9	12.0	13.8
	5/1/2007	6/30/2007	2.5	1.5	6.9	1.9
4	7/1/2007	11/30/2007	2.5	1.5	6.9	1.9
5	12/1/2007	1/4/2008	2.6	3.9	17.5	4.7
6	1/5/2008	1/24/2008	2.6	3.9	17.5	4.7
7	1/25/2008	2/12/2008	2.6	3.9	17.5	4.7
8	2/13/2008	2/21/2008	2.6	3.9	17.5	4.7
9	2/22/2008	4/13/2008	2.6	3.9	17.5	4.7
10	4/14/2008	4/30/2008	2.6	3.9	17.5	4.7
	5/1/2008	5/1/2008	2.6	1.5	17.5	4.7
	5/2/2008	5/22/2008	4.6	1.5	17.5	4.7
	5/23/2008	6/30/2008	4.6	1.5	6.9	1.9
11	7/1/2008	11/30/2008	4.6	1.5	6.9	1.9
	12/1/2008	2/16/2009	3.4	15.4	19.0	10.3
12	2/17/2009	3/31/2009	3.4	15.4	19.0	10.3
	4/1/2009	4/30/2009	3.4	15.4	7.9	2.6
	5/1/2009	6/30/2009	3.4	1.5	7.9	2.6

Table 2 – Summary of Model Performance 24-hour PM_{10} Samples from July 2006 to June 2009		
	10 Sites [1]	
Parameter	Observed	Predicted [2]
No. O+P>150 µg/m[3] 3	245	
Mean (µg/m^3)	207	204
Geometric Mean(µg/m^3)	150	134
Maximum (µg/m^3)	2101	1952
Days > 150 µg/m^3	114	115
98th Percentile	744	683
Linear Correlation Coef.	0.559	
Geometric Correlation Coef.	0.146	

1. The 10 sites are Dirty Socks, Keeler, Shell Cut, Olancha, Flat Rock, Lone Pine, Stanley, Lizard Tail, North Beach and Coso Junction
2. Predictions based on seasonal 75th percentile K-factors
3. Statistics based on the number of 24-hour samples where the Prediction (P) plus the Observation (O) is greater than 150 µg/m^3. Twenty-four hour averages calculated from hourly samples for days with at least 18 samples.

Table 3 – Summary of Maximum PM_{10} Predictions July 2006 to June 2009		
Statistic	Period	PM_{10} (µg/m^3)
Max 24-hour	3q06-2q09	225.5
2nd 24-hour	3q06-2q09	164.2
3rd 24-hour	3q06-2q09	150.5
4th 24-hour	3q06-2q09	136.6 [1]

1. The design concentration is the 4th highest 24-hour prediction in the three-year simulation at the same location

Figure 1. Dispersion Modeling Domain
Monitoring Stations Shown on 1-km Mesh Size Land Use and Terrain
Terrain Contours in Meters, USGS Land Use

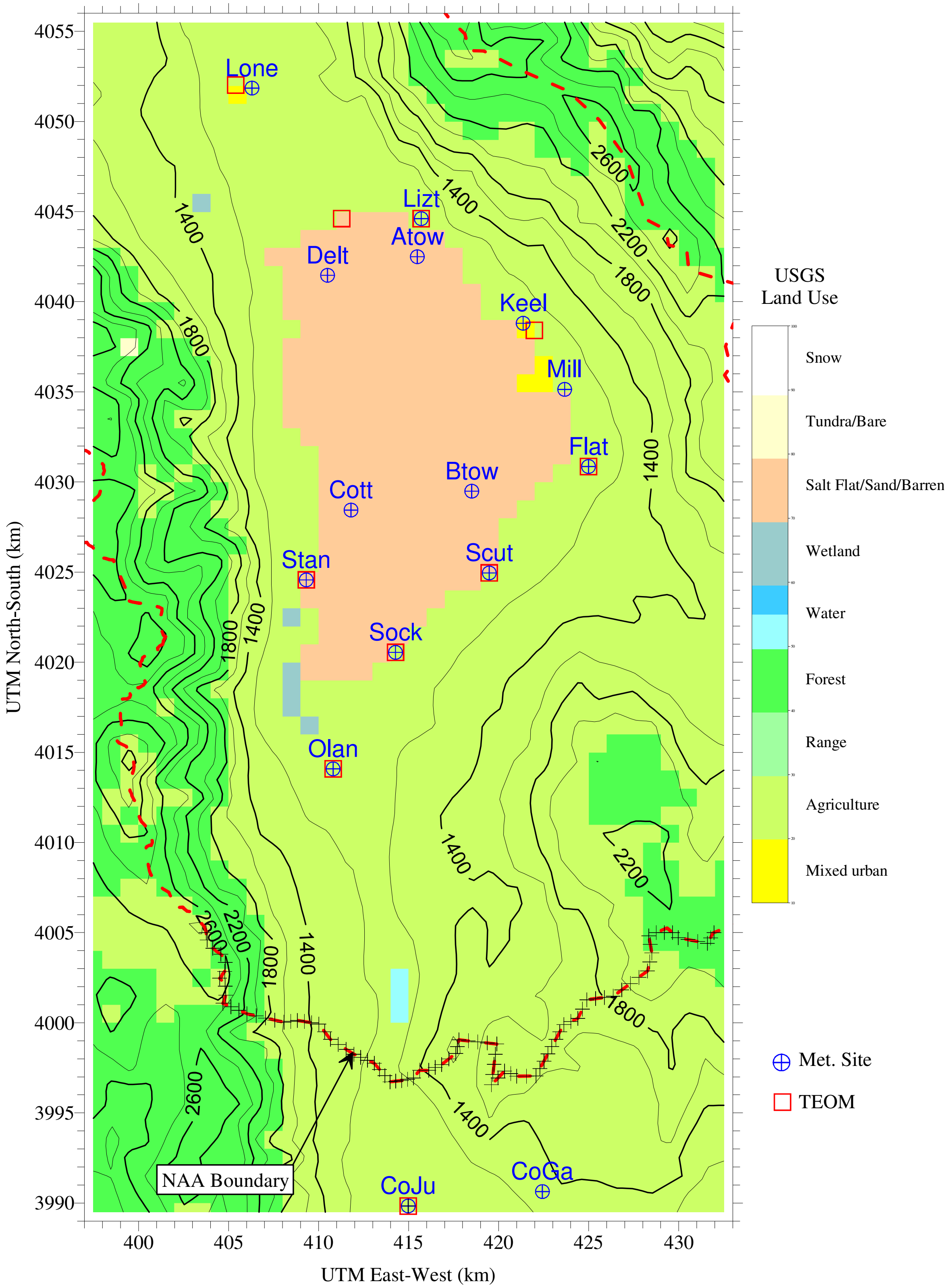

**Figure 2. Owens Lake Source Areas and Sensits
February 17, 2009 to June 30, 2009**

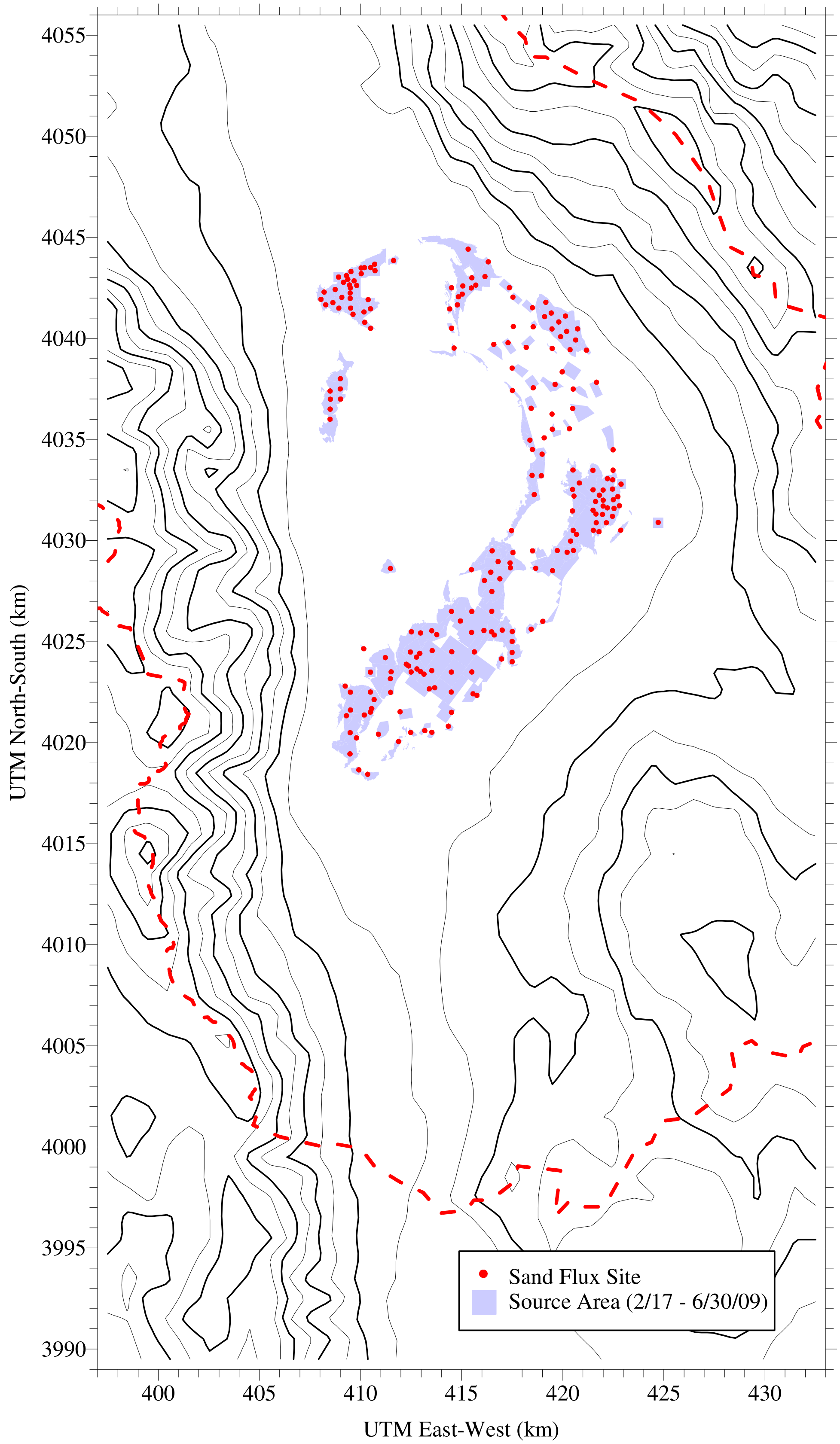

Figure 3. Q-Q Plot, by Site, P+O>150
7/1/2006 - 6/30/09, 24-hour Averages, 75% filled with RSIP Default K-factors

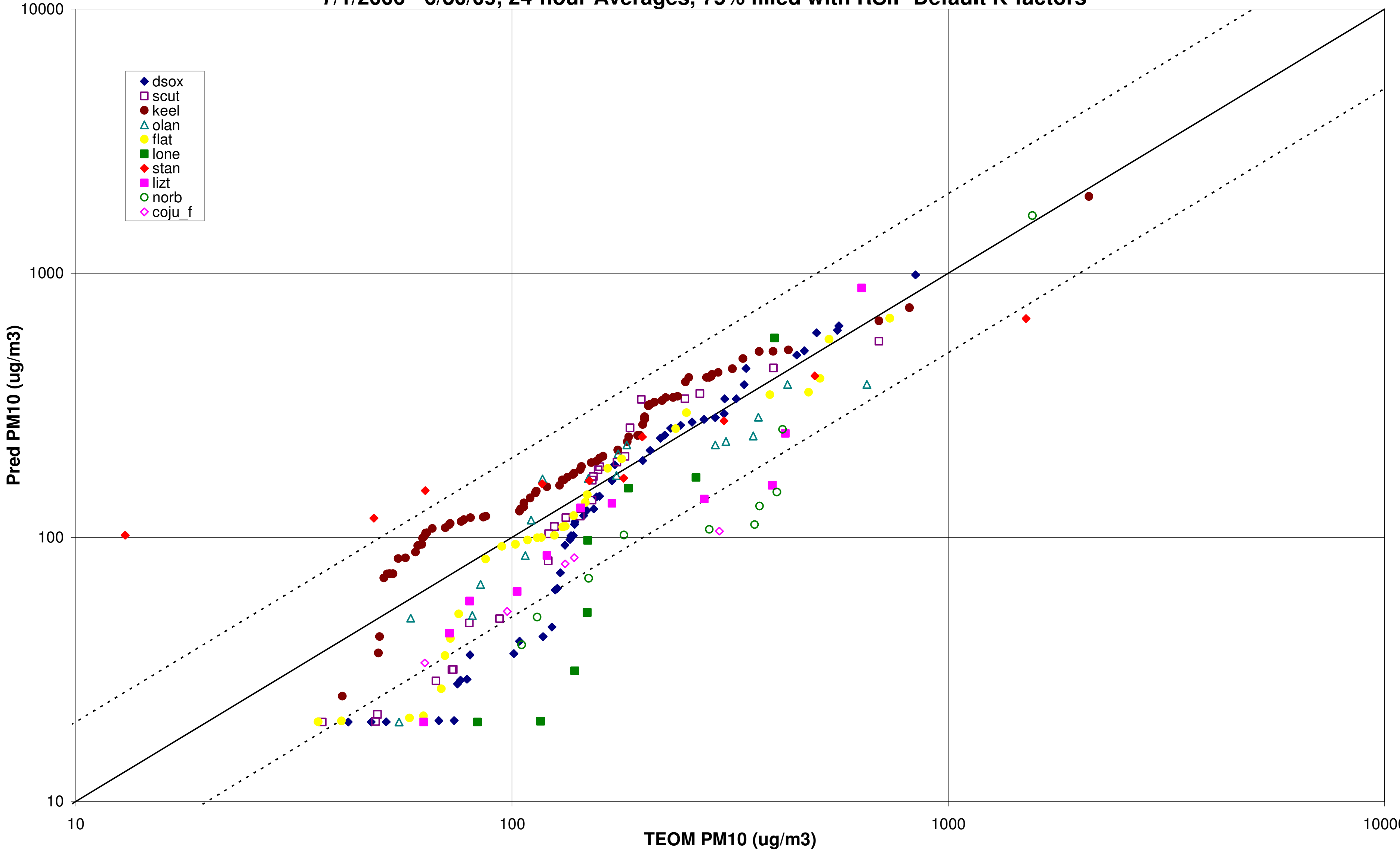

Figure 4. All Sites Q-Q Plot
7/1/2006 - 6/30/2009, 24-hour Averages, 75% filled with RSIP Default K-factors

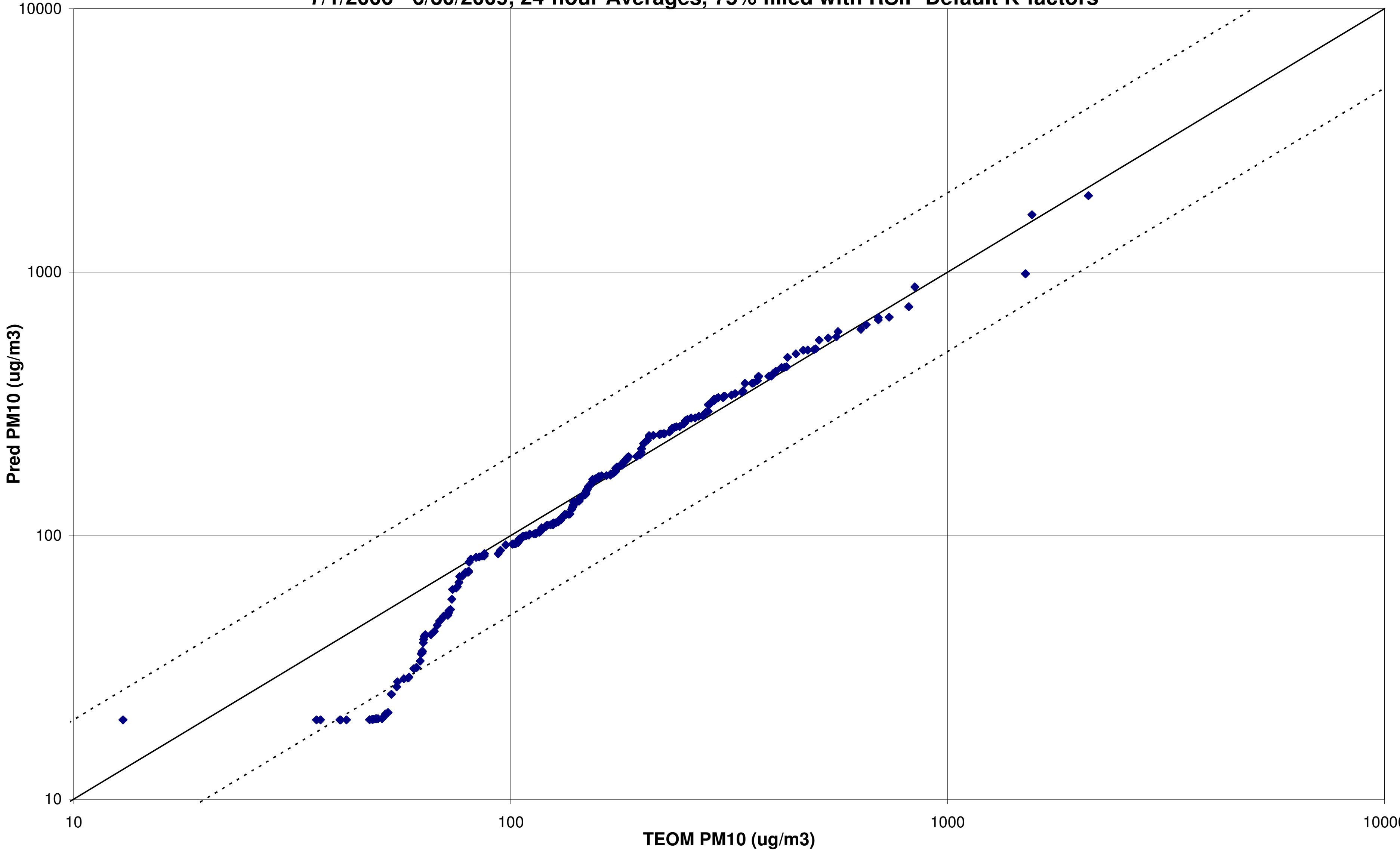

Figure 5. Scatter Diagram by Site, P+O>150
7/1/2006 - 6/30/2009, 24-hour Averages, 75% filled with RSIP Default K-factors

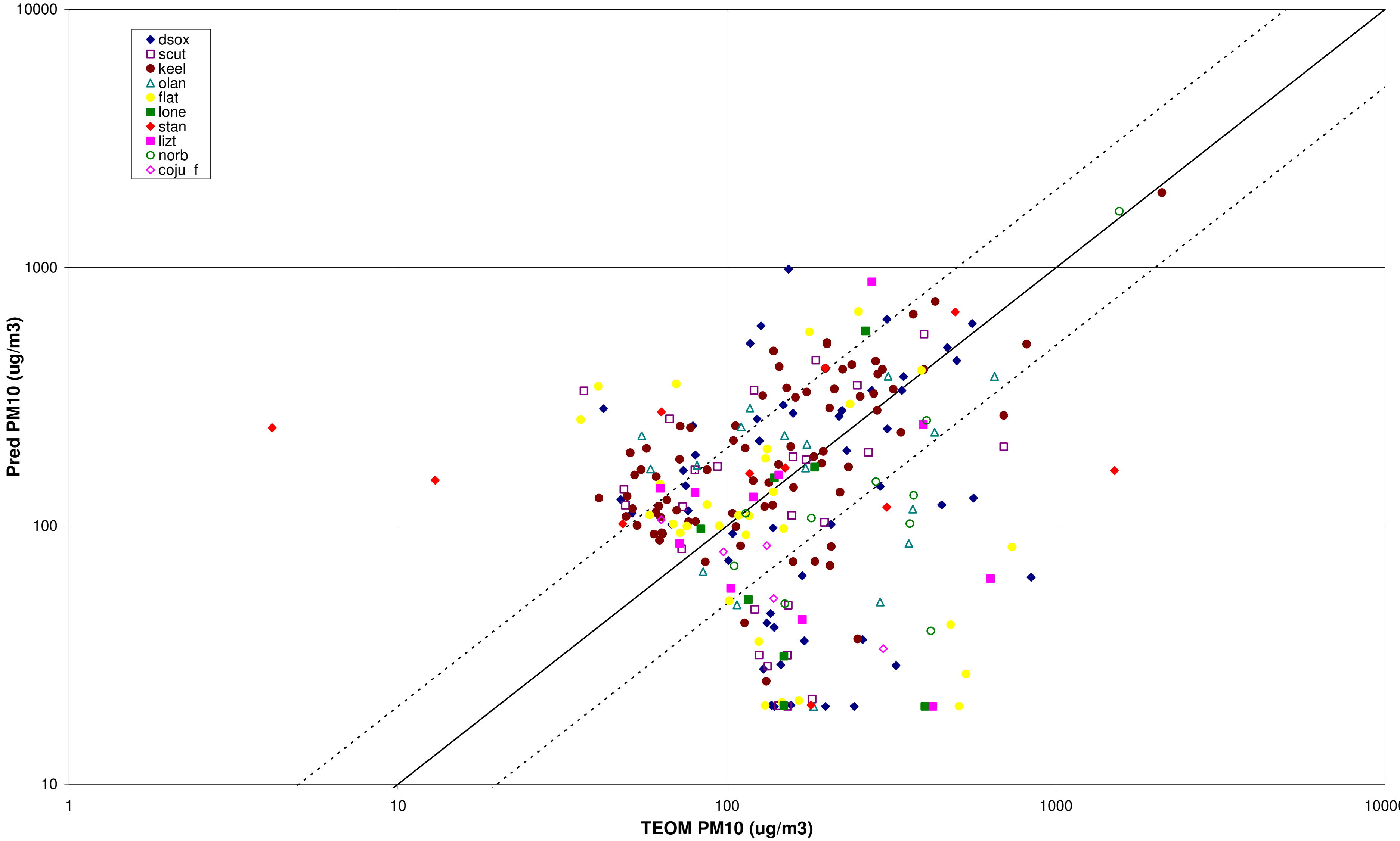

**Figure 6. Predicted 4th Highest 24-hour PM10 (µg/m3)
Receptors at Southern Limit of Owens Valley PM10 Planning Area
July 2006 to June 2009, Every 4th Prediction Plotted**

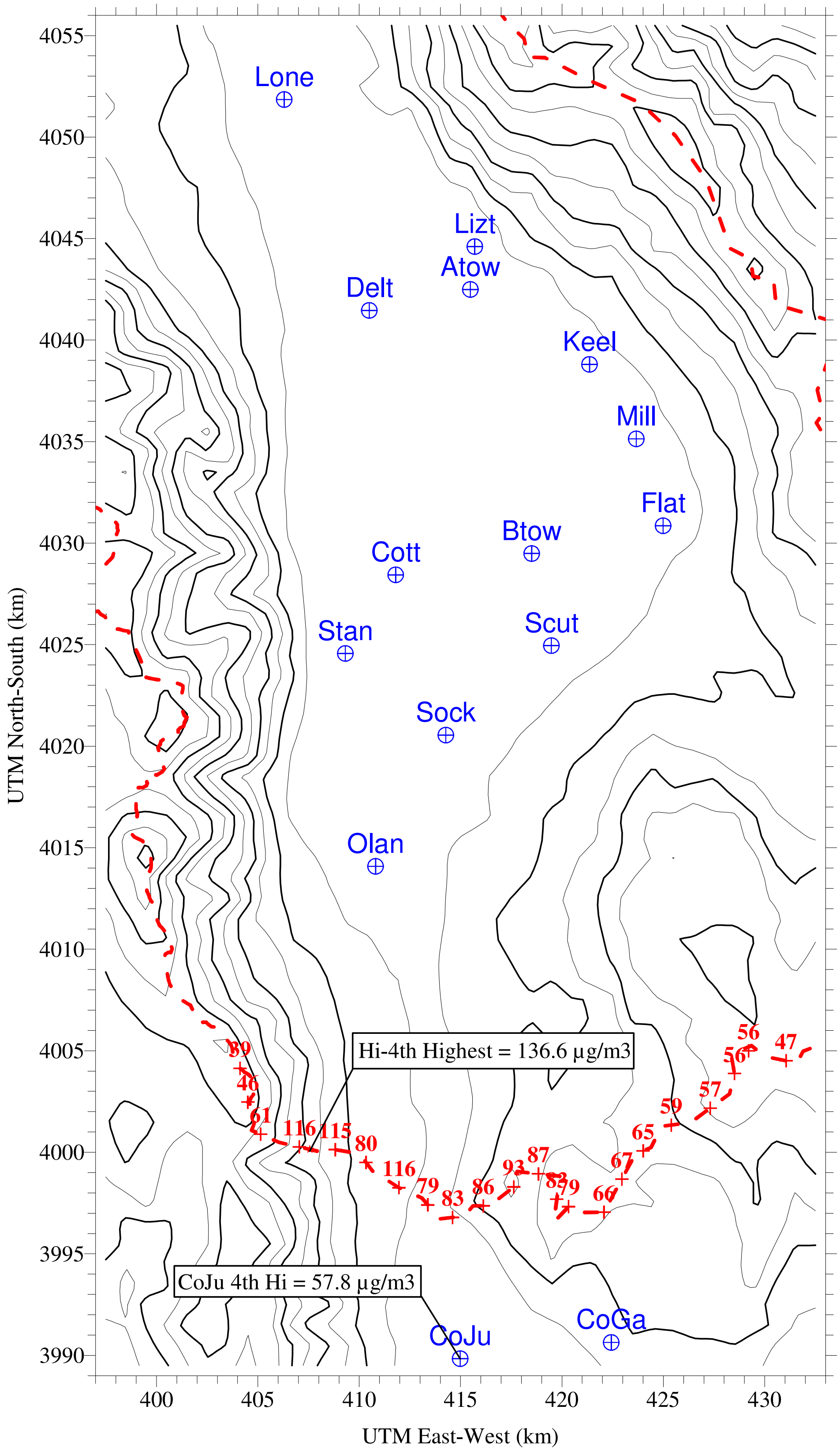

Figure 7. Predicted 24-hour PM10 (µg/m3) on Jan 05, 2007
Background of 20 µg/m3