SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
MONITORING AND ANALYSIS

Rule 1158 Follow-Up Study #4

Sampling Conducted
May and June, 2001

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EXECUTIVE SUMMARY

Purpose

In June 1999, Rule 1158 affecting storage, handling and shipment of petroleum coke, coal, and sulfur was amended to further reduce particulate emissions from these sources. This study is one of an ongoing series, examining targeted compounds contained in the inhalable particulate fraction (PM_{10}) in the greater Long Beach/Wilmington area. This series of studies consists of PM_{10} sampling in the spring/summer and fall/winter, observing trends in ambient PM_{10} concentration and the elemental carbon content of collected samples.

Sampling

Sampling was conducted coincident with the AQMD PM_{10} monitoring network one-in-six day schedule between May 25, 2001 and June 30, 2001. Sampling locations were identical to those utilized for the previous Rule 1158 Follow-Up studies. It is intended that these sites be used throughout the entire series of studies. Field operations were contracted to RES Environmental, Inc. (Colton, CA), while all laboratory operations and data analysis were performed by AQMD personnel. Twenty-one samples were collected over seven non-consecutive sampling days.

Key Findings

1. The percentage of EC in ambient PM_{10} steadily decreased over the course of the six studies conducted in the greater Long Beach/Wilmington area, the largest decreases occurring during the earlier studies in the series, and during the fall/winter studies.

2. Over the course of the six studies ranging from 1997 to 2000, no easily definable trend of change in three- study average PM_{10} concentration, differentiable from seasonal/annual variation, was observed for the Long Beach study area.

3. The fall/winter series of studies show a significant decline in ambient elemental carbon (EC). However, ambient EC concentrations showed no easily definable trend of change over the series of spring/summer studies, which most recently exhibited a modest increase from the spring/summer 2000 to 2001 studies.

4. Amended Rule 1158 targets specific sources of ambient EC. Initial implementation of the controls prescribed by the Rule were expected to produce immediate, measurable decreases in ambient EC, such as has been observed in previous studies in this series. As the full benefits of the Rule are realized, dramatic reductions in EC may be expected to become less evident. While measurable EC decreases were noted in the most recent fall/winter study, results of the current study suggest that spring/summertime studies are approaching the point where it is difficult to differentiate between changes due to seasonal variation and changes due to Rule compliance.

1.0 INTRODUCTION

From May 25, 2001 to June 30, 2001, PM_{10} monitoring was conducted at three locations in the cities of Long Beach (two sites) and Wilmington (one site). This study constituted the fourth of multiple studies evaluating improvements in local air quality precipitated by implementation of Rule 1158, as amended on June 11, 1999. The next sampling event is slated to begin in November 2001.

This study builds on a base of knowledge established by five previous studies: two spring/summer studies (1997, 2000)[1,2] and three fall/winter studies (1998, 1999, and 2000)[3,4,5]. The primary objectives of the current study were to collect data suitable for the evaluation of:

Current inhalable particulate (PM_{10}) ambient concentration trends for the study area.

Speciation of the carbonaceous component of the collected particulate samples for elemental and organic carbon content.

Comparison of 2001 concentration and carbon data with that obtained during the earlier Rule 1158 studies.

The prevailing winds in the study area place portions of the community downwind of coal and coke production and/or storage facilities, and fugitive dust from these activities has been a longstanding community concern. This fugitive dust contributes to increases in the PM_{10} particulate concentration. Mobile sources such as diesel trucks, trains and ships in the area also contribute to the overall ambient particulate matter concentrations.

The June 1999 amendment of Rule 1158 affected storage, handling and shipment practices for petroleum coke, coal, and sulfur. Removal and enclosure of open coke storage piles, and modification to equipment and work practices to comply with Rule 1158 requirements is ongoing. The Rule 1158 compliance schedule mandates implementation of the majority of control measures by August 1999, with full implementation of all measures by June 2004. Compliance field staff have documented a high rate of compliance with the initial rule implementation requirements, including

[1] South Coast Air Quality Management District. (September 1997) *Micrometeorological and Ambient Air Quality Monitoring Conducted Simultaneously in the Vicinity of the Los Angeles and Long Beach Harbors.* Diamond Bar, CA.
[2] South Coast Air Quality Management District. (October 2000) *Rule 1158 Follow-Up Study #2.* Diamond Bar, CA.
[3] South Coast Air Quality Management District. (March 1999) *Micrometeorological and Ambient Air Quality Monitoring Conducted Simultaneously in the Vicinity of the Los Angeles and Long Beach Harbors.* Diamond Bar, CA.
[4] South Coast Air Quality Management District. (May 2000) *Rule 1158 Follow-Up Study #1.* Diamond Bar, CA.
[5] South Coast Air Quality Management District. (May 2001) *Rule 1158 Follow-Up Study #3.* Diamond Bar, CA

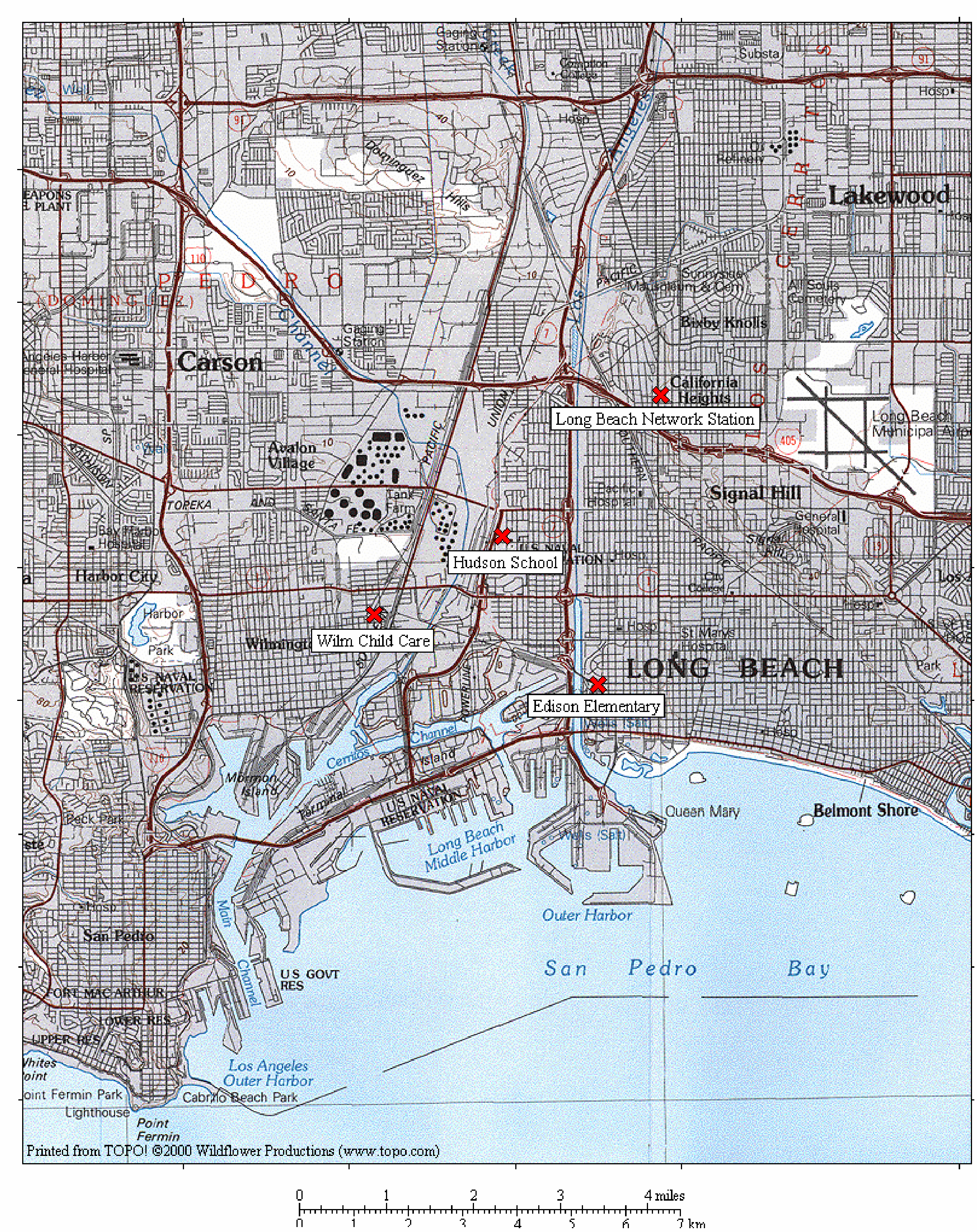

Figure 1 – Study Sampling Sites

covered transport, truck washing, prompt roadway/spill clean-up and the removal of several large open coke piles that has resulted in the reduction of fugitive coke emissions from storage, handling, and shipping operations. It is anticipated that full implementation of Rule 1158 will contribute to a decrease in ambient PM_{10} concentrations in the local area. Indeed, such a trend has been observed since implementation of the initial phases of the rule.

2.0 PROJECT DISCUSSION

Site selection and the sampling calendar were influenced by several factors. Sampling dates were scheduled to repeat as closely as possible the sampling dates of the previous spring/summer studies, while coinciding with the EPA one-in-six monitoring schedule utilized by the AQMD in its PM_{10} monitoring network. Samples were scheduled for collection on May 25, and 31 and June 6, 12, 18, 24 and 30, producing a data set consisting of twenty-one samples.

All three sites in the current study were included in the spring/summer 2000 study, while both the HUD and WIL sites were included in the 1997 study (See Figure 1.) The three current monitoring sites were chosen from seven sites used in the fall/winter 1998 study, *Micrometeorological and Ambient Air Quality Monitoring Conducted Simultaneously in the Vicinity of the Los Angeles and Long Beach Harbors* (March 1999); the sites have remained constant during the course of the *Rule 1158 Follow-Up* series of studies. Site selection criteria included site locations relative to coal and coke facilities with respect to the local prevailing wind patterns, and their importance as locations containing student populations (the sites include two schools and a child care center). In addition, of the seven sites included in the 1998 study, the two school sites had exhibited the highest levels of ambient PM_{10} and elemental carbon. Detailed site maps can be found in Appendix A-2.

2.1 SITE DESCRIPTIONS

RES Environmental, Inc. (RES), was contracted by the AQMD to perform field operations for the current study. The consultant described the sampling locations as follows[6]:

Site 1: School Building Services Facilities/Hudson School (HUD)
2401 Webster Avenue
Long Beach, California

The monitoring site is located at the Long Beach School Building Services facility (maintenance yard), adjacent to the Hudson Middle School. The PM_{10} sampler was installed on top of two adjoining steel containers. Meteorological exposures were composed of (1), Henry Ford Freeway, which runs parallel to the monitoring site to the west and (2), maintenance yard to the north, east and south of the monitoring site. The maintenance yard consists of repairs and fabrication of materials, including welding.

Site 2: Edison Elementary School (EDI)
625 Maine Avenue
Long Beach, California

Site #2 was located at the Edison Elementary School in Long Beach. The PM_{10} sampler was located on a steel container at the western side of the school and playground. The sampler was also installed on a five-foot platform to clear the school building to the east. The meteorological exposure consists of (1), a main street artery (16^{th} Street) which carries heavy vehicle traffic, is located to the north (2), school buildings to the east and south and (3), a small bus terminal to the west of the monitoring site.

Site 3: Wilmington Childcare Center (WIL)
1419 Young Street
Wilmington, California

The monitoring site was installed on the roof of the Childcare Center, near a elementary and middle school in the City of Wilmington. The meteorological exposure consists of (1), a residential area to the north (2), commercial/industrial development to the east (3), school to the south and (4) parking area/residential area to the west of the monitoring site.

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[6] RES Environmental, Inc. (February 2000) *The South Coast Air Quality Management District –Rule 1158 Follow-up Study.* Colton, CA.

2.2 SAMPLING AND ANALYSIS METHODOLOGY

The AQMD maintains a PM_{10} monitoring network throughout the South Coast Air Basin (the Basin). The Federal Reference Method (FRM) SSI PM_{10} samplers utilized in the PM_{10} network and standard AQMD analytical procedures are summarized here:

The SSI sampler used in this study is the EPA's FRM sampler found in 40CFR50 Appendix J. It is used to monitor PM less than 10 microns in size (PM_{10}). For the purposes of this study, the SSI samplers are used to collect PM_{10} samples, which were also used for the determination of organic carbon (OC), elemental carbon and total carbon.

The SSI sampler contains a pump controlled by a programmable timer. An elapsed time accumulator, linked in parallel with the pump, records total pump-operation time in hours. During operation, a known quantity of air is drawn through a particle size separator, which achieves particle separation, by impaction. The correct flow rate through the inlet is critical to collection of the correct particle size so that after impaction, only particles 10 microns in size or less remain suspended in the airstream. The flow of air then passes through a quartz filter medium, upon which the particles are collected. A programmable timer automatically turns the pump off at the end of the 24-hour sampling period.

Once a sample has been collected it is returned to the laboratory, following chain-of-custody protocols, where both PM_{10} mass and carbon content are determined. Ambient PM_{10} mass is determined by subtracting the weight of the clean unsampled filter (measured in the laboratory prior to sampling) from the weight of the sampled filter containing the collected PM_{10}, to yield the mass of the PM_{10} collected on the filter. This mass is then divided by the amount of air drawn through the filter to give the ambient concentration, expressed as mass per cubic meter ($\mu g/m^3$).

Ambient carbon levels are determined by taking a small portion of the PM_{10} filter and putting it into a carbon analyzer. The analyzer consists of a computer-controlled programmable oven, computer controlled gas flows, a laser, and a flame ionization detector (FID). The sample is first heated in the oven in increasing amounts of oxygen. As the temperature rises, first organic carbon and then elemental carbon are evolved from the filter. The laser beam passes through the filter, and the transmitted intensity increases at the detector as the light-absorbing carbon leaves the filter, causing the filter to become less black. The evolved carbon is swept from the oven by gas flow, and is transported to the FID where it is detected (in the form of methane) throughout the heating process. The computer that controls these processes collects data on the oven temperature profile, laser light absorption, and FID response to determine the OC and EC content of the filter. This information, combined with the volume of air sampled, provides the OC and EC concentration in the ambient air.

3.0 DATA ANALYSIS

Data from the current study were compared with data obtained in previous Long Beach/Wilmington area studies.

3.1 PM_{10} AMBIENT CONCENTRATION ANALYSIS

Table 1: Spring/Summer 2001 PM_{10} Concentrations ($\mu g/m^3$) at Sampling Sites

Location	5/25/01	5/31/01	6/6/01	6/12/01	6/18/01	6/24/01	6/30/01	Average
HUD	39	70	47	34	63	36	38	47
EDI	31	67	41	32	49	36	33	41
WIL	39	56	43	36	47	35	35	42
LB Station	30	48	45	29	43	32	37	38

Table 1 presents the PM_{10} ambient concentrations observed during the study. Complete data tabulations can be found in Appendix A-1. Long Beach values are provided for comparison. Twenty-four hour ambient PM_{10} concentrations during the study period ranged from a maximum of 70 $\mu g/m^3$ at HUD on May 31, to a minimum of 31 $\mu g/m^3$ obtained at the EDI site on May 25. The average concentration for the three study sites was 43.2 $\mu g/m^3$.

The State of California has established 50 $\mu g/m^3$ as the PM_{10} 24-hour standard. Four of the twenty-one (19%) samples collected during the course of the study exceeded this standard. During the 2000 study no samples exceeded the standard. The highest site average (47 $\mu g/m^3$) over the course of the study occurred at the HUD site. This continues the trend observed in previous studies, where HUD ranked highest for PM_{10}.

For all studies except the fall/winter 2000 study, the HUD site has exhibited the highest study PM_{10} average. While Appendix A-1 illustrates that HUD had the maximum study PM_{10} observation on many dates, it should be noted that on several occasions in this and the previous five studies the HUD site produced PM_{10} samples significantly higher than those observed at EDI and WIL. Example dates include June 18, 2001, November 8 and 20, 2000, and December 14, 1999. Such elevated samples may be the result of local sources or meteorological conditions influencing the immediate area adjacent to the sampler, and underscore the complexity and variety of particulate sources that contribute to ambient PM_{10}.

Figure 2: 2001 PM_{10} Study Average vs. Long Beach Network Station

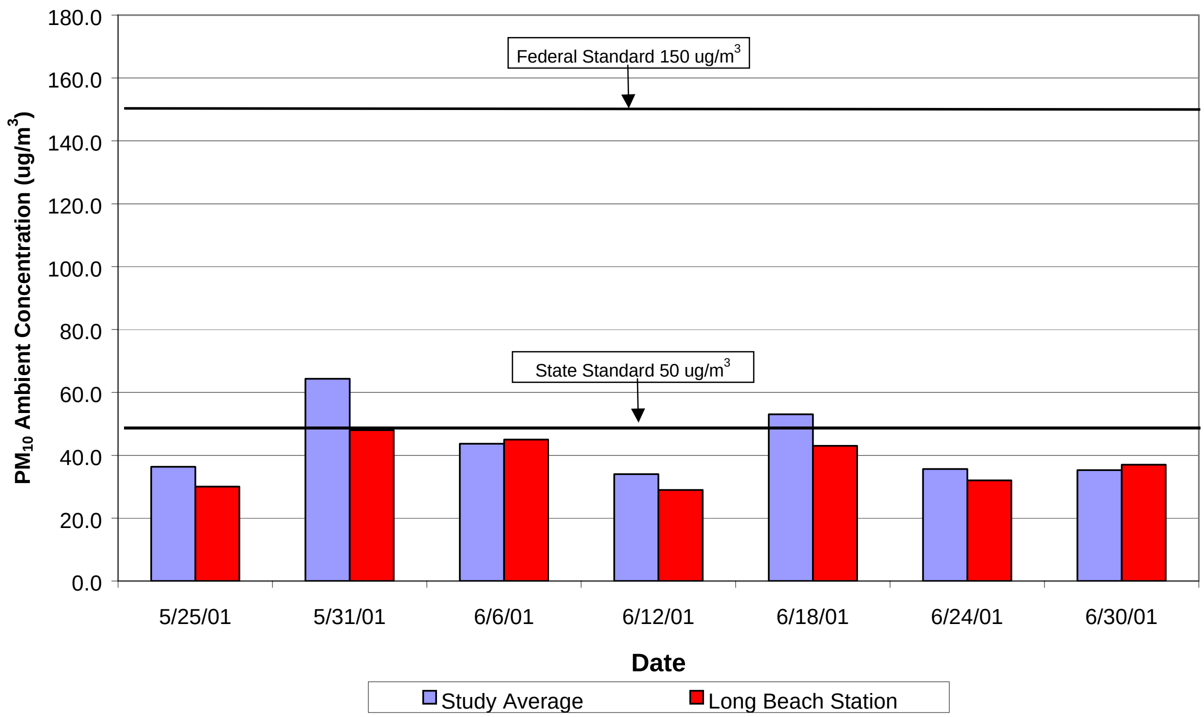


Figure 2 compares the average value for the three study sites with the Long Beach network station on each day of the 2001 study. For all dates other than May 31 and June 18, the study average and the Long Beach station yield very similar values. On May 31, the PM_{10} results at all study sites were significantly higher than the result at the Long Beach Network station. On June 18, the PM_{10} result at HUD was higher than all other sites, suggesting that a localized source influenced sampling at HUD. Thus, localized source or sources may account for the elevation of the study average on that date.

The agreement between the study average and the Long Beach station illustrated by Figure 2 indicates that during the 2001 spring/summer sampling period, station results continued to be representative of community conditions on most sampling days, as was recently observed during the 2000 fall/winter study. Earlier studies in the Rule 1158 follow-up series had shown larger differences between the study sites and the Long Beach network station.

3.2 PM_{10} TREND ANALYSIS

Figure 3: Average PM_{10} Concentration by Site and Year

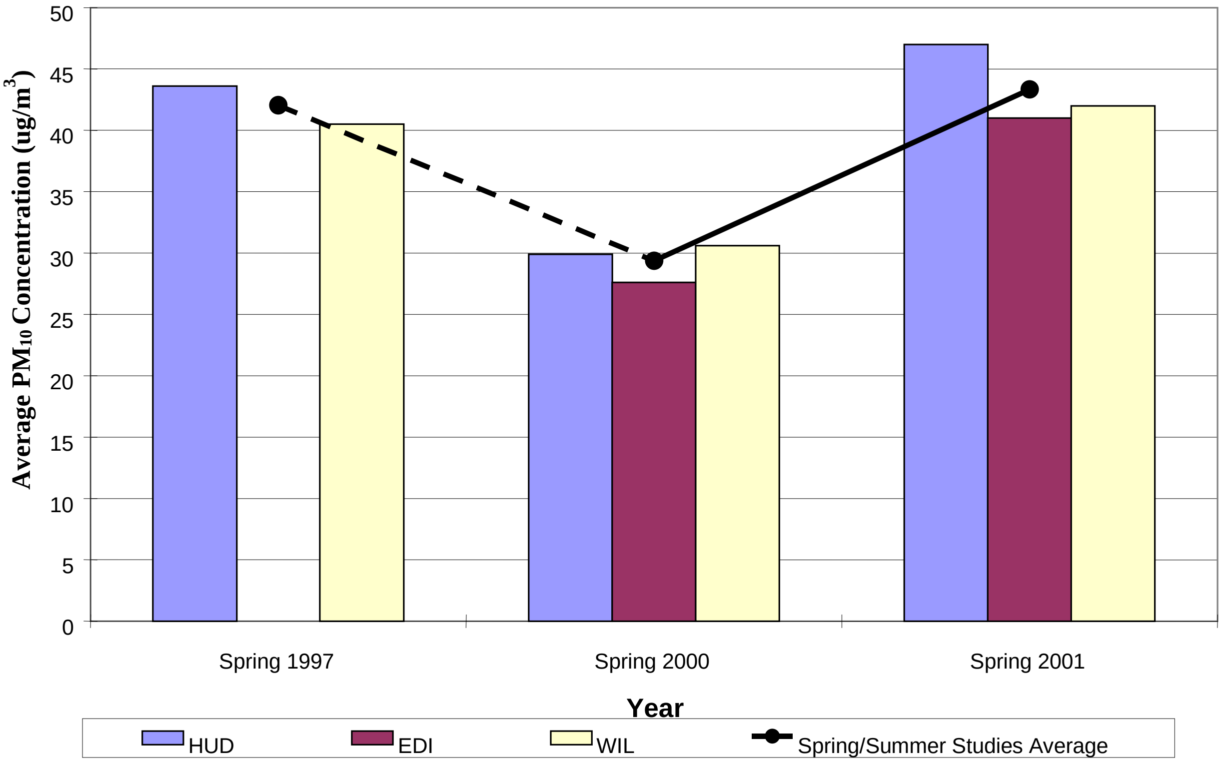
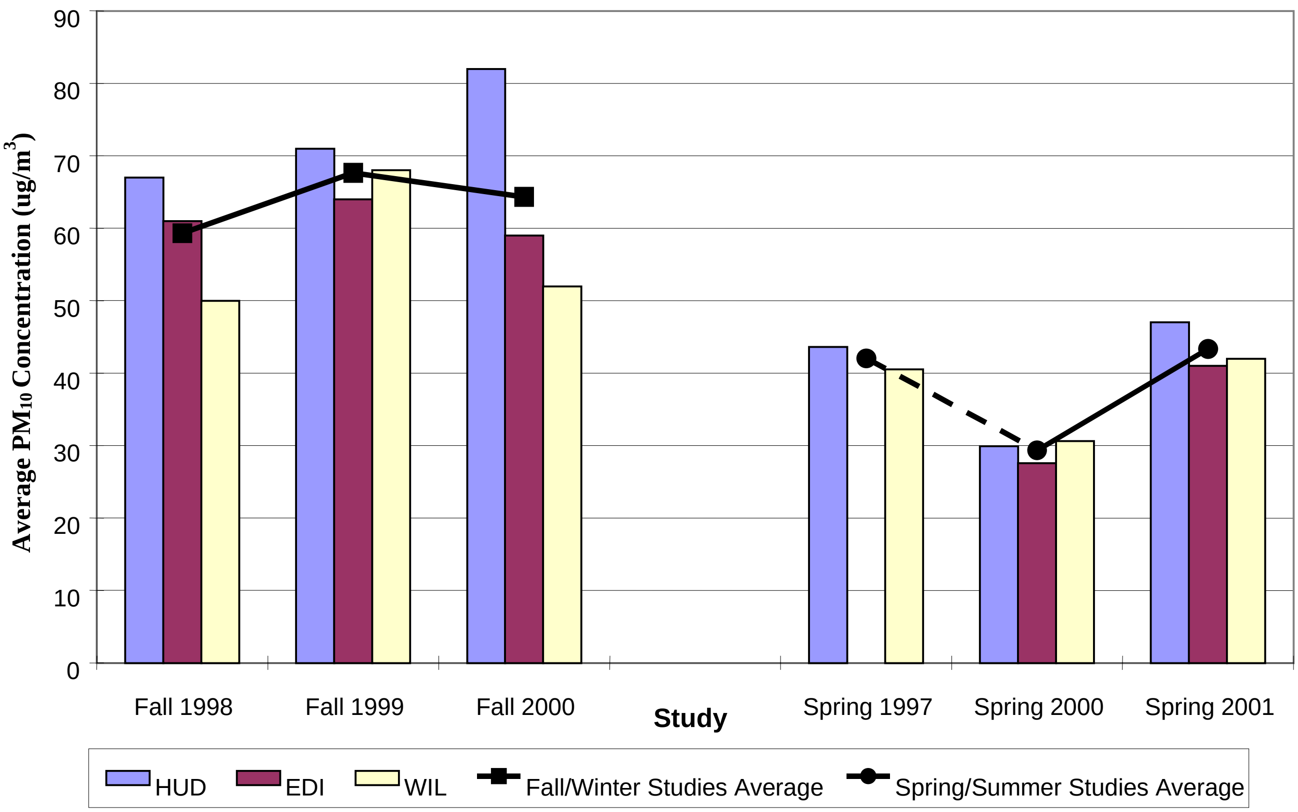


Figure 3 summarizes the ambient PM_{10} concentrations observed over the course of the three spring/summer studies. The black line represents the three-site study average for each study, and is dashed between the 1997 and 2000 points to indicate that the data are not from consecutive years. The 1997 and 2001 studies produced similar average PM_{10} concentration values while the 2000 study average concentrations were lower.

When looking at these results, it must be kept in mind that PM_{10} consists of a variety of chemical species.[7] These include carbonaceous components (EC and OC), crustal materials and wind-blown soils, sulfate and nitrate formed by precursor SOx and NOx emissions primarily as a result of combustion, and sodium chloride particulate resulting in part from wind-carried sea salt. Increases in PM_{10} observed at study sites may be the result of contributions from one or several of these sources. Particle formation is also highly influenced by meteorological conditions, which vary seasonally and from year to year.

[6] Kim. B.M., Teffera, S., Zeldin, M.D. Characterization of $PM_{2.5}$ and PM_{10} in the South Coast Air Basin of Southern California: Part 1 – Spatial Variations. *J. Air and Waste Manage. Assoc.* **2000** 50:2034-2044.

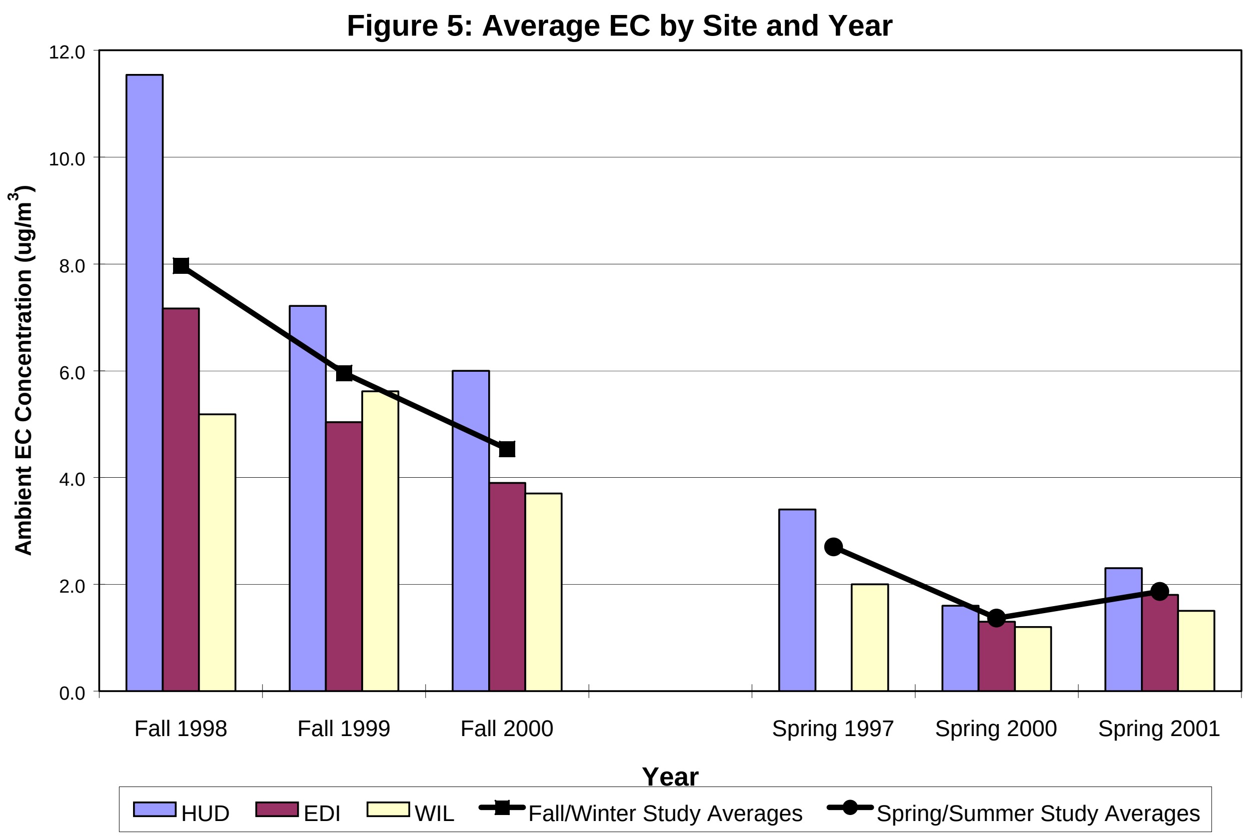
Figure 4: Ambient PM_{10} Concentrations During Long Beach Study Series



Displaying the fall/winter data alongside spring/summer data, Fig. 4 illustrates these seasonal and year to year variations. PM_{10} concentrations in the Basin have been observed to be highest in the fall/winter season, when the airmass over the Basin is particularly prone to stagnation due to high pressures in inland and desert areas. Similarly, Santa Ana wind conditions, resulting from even higher inland pressures, also occur during the fall/winter timeframe and contribute to higher PM_{10} values. As winter gives way to spring, lower PM_{10} concentrations are observed, gradually increasing throughout summer and fall. In the figure above, spring/summer study PM_{10} concentrations are lower than fall/winter concentrations, in agreement with historical trends in the basin.

Study average PM_{10} values (the average value for all three sites during a given study) are illustrated by the black lines in Fig. 4 and show no easily definable year to year trends. Average values for individual sites (represented by bars in Figure 4) appear to show only a trend of increasing PM_{10} for HUD over the course of the fall studies.

3.3 ELEMENTAL CARBON TREND ANALYSIS



Elemental carbon is of particular interest in this study, as it arises in part from coke and coal storage as well as from transportation including diesel emissions from trucks, trains and ships. Elemental carbon concentrations were averaged for the three study sites over the duration of each study, and results are represented in Fig. 5 above. Complete data tabulations can be found in Appendix A-1. The results obtained in the current study were lower than those obtained in the 1997 study, but were higher than the results obtained in 2000.

In the previous section it was noted that the only consistent trend either for study average ambient PM_{10} concentrations or for individual site average PM_{10} was a steadily increasing PM_{10} value at HUD over the course of the fall/winter studies. Examining both Fig. 4 and Fig. 5, it should be noted that the changes in EC concentrations for fall/winter studies show a steady decreasing trend, independent of ambient PM_{10}.fluctuations. During the spring/summer studies, EC concentrations changed in a pattern similar to the ambient PM_{10} fluctuations.

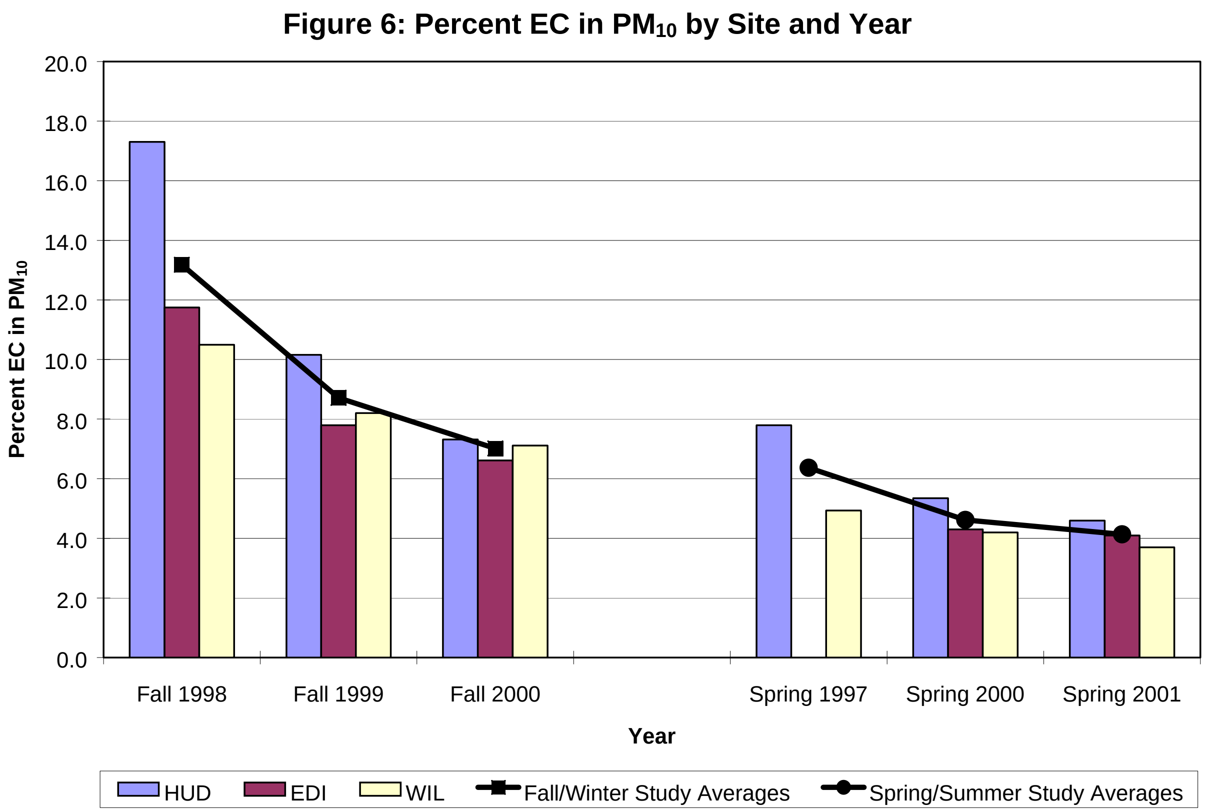
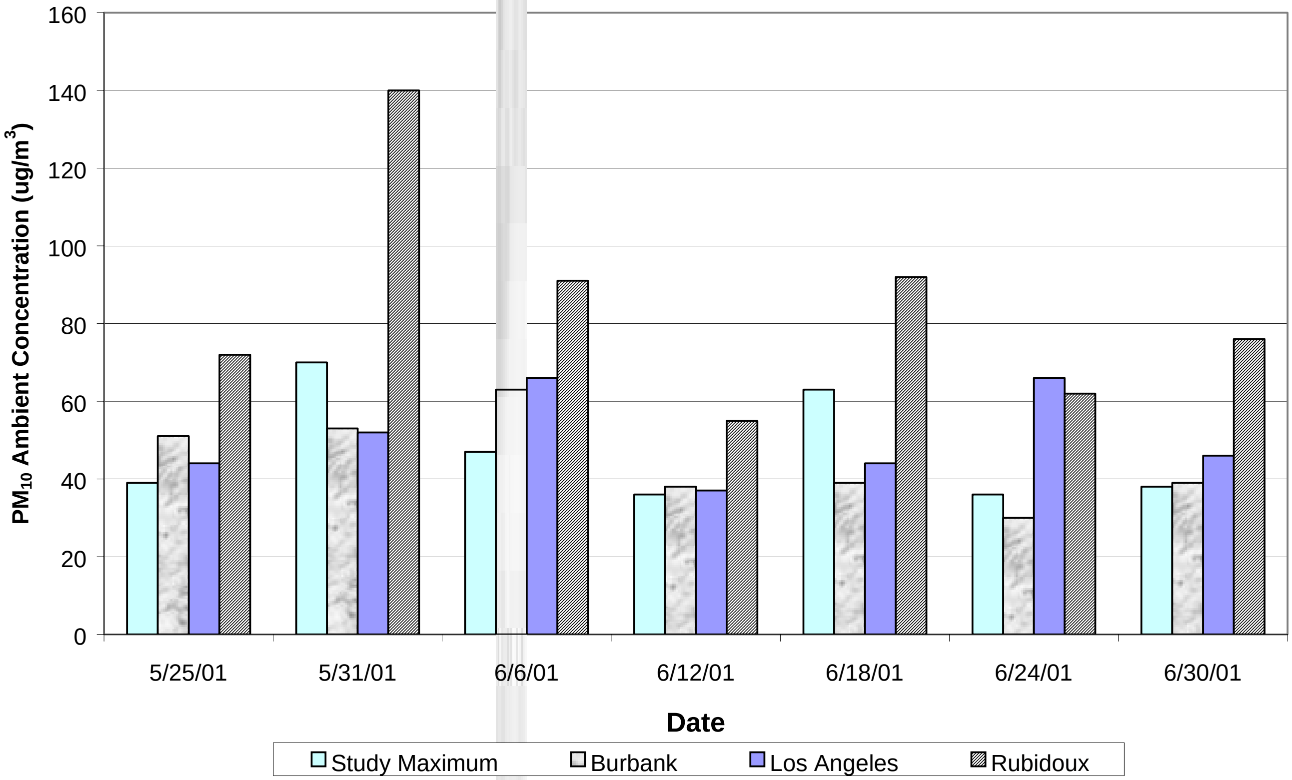


Figure 6 illustrates that the composition of PM_{10} has changed with respect to elemental carbon during the span covered by the six studies. A clear decrease in the percentage of EC in PM_{10} is evident each year at all sites. The most marked decrease was observed during the course of the fall/winter studies, but a decreasing trend exists for the spring/summer data as well. This trend indicates that while ambient PM_{10} concentrations fluctuate seasonally and annually, the amount of EC in each microgram of ambient PM_{10} has decreased consistently during the series of Rule 1158 Follow-up studies.

3.2 BASIN-WIDE PM_{10} COMPARISON

In order to place the study results in context, the study maximum PM_{10} value for each day was compared to results obtained concurrently at several other PM_{10} network sites within the Basin (Figure 7). The sites chosen for comparison are representative of the spectrum of conditions encountered in the Basin. In general, Rubidoux is among the highest PM_{10} sites in the Basin, with particulate high in nitrate and crustal materials; it is representative of the southeastern portion of the Basin. Los Angeles reflects conditions within the urban core, with particulate higher in sulfate and carbonaceous compounds than Rubidoux, resulting from a higher contribution to ambient particulate by vehicle emissions.

Figure 7: 2001 Study PM$_{10}$ Maximum vs. PM$_{10}$ Network Sites



On all study dates the maximum PM$_{10}$ concentration was measured at Rubidoux, as anticipated. As in the spring/summer 2000 study, the study maximum value varied within the range of values observed at PM$_{10}$ network sites, while remaining considerably lower than the Basin maximum concentrations observed at Rubidoux. Interestingly, the two dates which produced the highest study PM$_{10}$ results (May 31 and June 18 - see figures 2 and 7) also produced the highest values at Rubidoux for the same period.

Table 2: Central Los Angeles vs. Study Average EC (μg/m^3) By Date

Sample Date	05/25/01	05/31/01	06/06/01	06/12/01	06/18/01	6/24/01	06/30/01
Central L.A. EC	1.6	1.8	2.2	1.2	2.2	*	1.9
Study Average EC	1.7	2.7	1.8	1.1	2.9	1.2	1.5

* No Sample Available

Carbon analysis was conducted on PM$_{10}$ samples collected at the Central Los Angeles network monitoring site (1630 N. Main St., Los Angeles, CA). The results of these analyses are compared to the daily study average result in Table 2 above. The study EC results closely track the results obtained in Los Angeles, indicating that ambient carbonaceous particulate levels in the Long Beach/Wilmington study area are comparable to another area with similar heavy vehicle traffic and residential/industrial land use.

4.0 CONCLUSIONS

The composition of ambient PM_{10} has changed over the course of the six studies conducted in the greater Long Beach/Wilmington area. The fall/winter and the spring/summer studies show a consistent decline in the percentage of EC in PM_{10} for all study sites, indicating the amount of EC in each microgram of ambient PM_{10} has decreased consistently during the series of Rule 1158 Follow-up studies. As discussed earlier, elemental carbon arises in part from coke and coal storage as well as from transportation including diesel emissions from trucks, trains and ships. Changes in EC may be attributable to changes in the contributions from one or more of these sources.

Ambient elemental carbon concentrations decreased steadily over the series of fall/winter studies, but fluctuated during the spring/summer studies. Ambient EC increased from the spring/summer 2000 study to the current study, mirroring increases in ambient PM_{10} for the same time frame. However, spring/summer EC concentrations remain far lower than fall/winter concentrations, and the increase in ambient EC during the current study is much smaller in magnitude than the decreases seen during the fall/winter studies.

Study (three-site) average values showed no clear trends for PM_{10}, other than the expected seasonal variation. For the second consecutive study, the study average PM_{10} results showed agreement with results obtained at the Long Beach network station. The study PM_{10} average markedly exceeded the Long Beach network station result on only two dates: May 31 and June 18. On May 31, all three study sites were higher than the Long Beach network station, while on June 18, an elevated result at the HUD site skewed the study average upward. This indicates that a local source may have increased the PM_{10} concentration near HUD on that date. Earlier studies in the series routinely produced results markedly higher at study sites than at the Long Beach Network site.

Basin-wide comparison of PM_{10} data yielded results similar to the spring/summer 2000 study: PM_{10} concentrations that did not differ significantly from the majority of Basin network sites. Rubidoux consistently produced the highest PM_{10} results in the Basin during the current study.

The low spring/summer study PM_{10} and EC values, taken in concert with the comparisons drawn to Basin-wide PM_{10} and Central Los Angeles EC, respectively – indicate that the during spring/summer months the Long Beach/Wilmington area experiences particulate pollution similar to that seen in communities throughout the Basin. Further, due to the typically lower particulate concentrations in the spring/summer months and the seasonal variations observed over the last three spring/summer studies, it will become increasingly difficult to measure changes of a magnitude large enough to be easily attributable to Rule 1158 implementation in studies conducted during the spring and summer months.

APPENDIX A-1 LONG BEACH PM_{10} MONITORING DATA

2001 Spring/Summer PM_{10} Ambient Concentration Results

Location	5/25/01	5/31/01	6/6/01	6/12/01	6/18/01	6/24/01	6/30/01	Average
HUD	39	70	47	34	63	36	38	47
EDI	31	67	41	32	49	36	33	41
WIL	39	56	43	36	47	35	35	42
LB Station	30	48	45	29	43	32	37	38

2001 Spring/Summer Organic Carbon Ambient Concentration Results

Location	5/25/01	5/31/01	6/6/01	6/12/01	6/18/01	6/24/01	6/30/01	Average
HUD	3.6	6.6	4.6	3.1	6.1	3.2	3.4	4.4
EDI	3.4	5.1	4.9	2.5	4.9	3.4	3.3	3.9
WIL	4.1	3.7	4.0	3.2	4.8	3.1	3.1	3.7

2001 Spring/Summer Elemental Carbon Ambient Concentration Results

Location	5/25/01	5/31/01	6/6/01	6/12/01	6/18/01	6/24/01	6/30/01	Average
HUD	1.7	3.9	2.0	1.1	3.5	1.3	2.2	2.3
EDI	1.0	2.9	1.6	1.1	3.0	1.2	1.5	1.8
WIL	2.3	1.2	1.8	1.1	2.1	1.1	0.9	1.5

2001 Spring/Summer Total Carbon Ambient Concentration Results

Location	5/25/01	5/31/01	6/6/01	6/12/01	6/18/01	6/24/01	6/30/01	Average
HUD	5.3	10.5	6.6	4.2	9.6	4.6	5.6	6.6
EDI	4.4	8.0	6.5	3.6	7.9	4.7	4.8	5.7
WIL	6.4	4.9	5.8	4.3	6.9	4.2	4.0	5.2

2000 Spring/Summer PM_{10} Ambient Concentration Results

Location	5/24/00	5/30/00	6/5/00	6/11/00	6/17/00	6/23/00	6/29/01	Average
HUD	27	31	40	32	18	19	42	30
EDI	20	28	37	31	25	17	35	28
WIL	22	38	41	33	19	24	37	31
LB Station	*	*	32	30	17	19	34	26

* No Sample

2000 Spring/Summer Organic Carbon Ambient Concentration Results

Location	5/24/00	5/30/00	6/5/00	6/11/00	6/17/00	6/23/00	6/29/01	Average
HUD	2.9	2.6	3.8	3.0	2.3	2.0	3.7	2.9
EDI	2.5	2.6	3.6	2.8	2.6	2.1	3.1	2.8
WIL	2.5	2.9	3.7	3.0	2.4	2.9	3.3	3.0

2000 Spring/Summer Elemental Carbon Ambient Concentration Results

Location	5/24/00	5/30/00	6/5/00	6/11/00	6/17/00	6/23/00	6/29/01	Average
HUD	1.7	1.2	2.6	1.4	0.7	0.8	2.5	1.6
EDI	1.2	1.2	1.7	1.4	0.8	0.6	1.3	1.3
WIL	1.3	1.2	1.8	1.1	0.9	1.0	1.6	1.2

2000 Spring/Summer Total Carbon Ambient Concentration Results

Location	5/24/00	5/30/00	6/5/00	6/11/00	6/17/00	6/23/00	6/29/01	Average
HUD	4.6	3.7	6.4	4.4	3	2.8	6.2	4.4
EDI	3.7	3.8	5.3	4.2	3.4	2.7	4.4	3.9
WIL	3.8	4.1	5.5	4.1	3.3	3.9	4.9	4.2

1997 Spring/Summer PM_{10} Ambient Concentration Results

Location	5/4/97	5/8/97	5/12/97	5/14/97	5/20/97	5/22/97	5/27/97	Average
HUD	48	50	36	*	32	39	58	44
EDI	*	*	*	*	*	*	*	*
WIL	43	50	35	42	30	36	48	41
LB Station								

* No Sample

1997 Spring/Summer Organic Carbon Ambient Concentration Results

Location	5/20/97	5/22/97	5/27/97	Average
HUD	3.6	4.3	6.9	4.9
EDI	*	*	*	*
WIL	4.1	4.2	5.8	4.7

1997 Spring/Summer Elemental Carbon Ambient Concentration Results

Location	5/20/97	5/22/97	5/27/97	Average
HUD	2.3	2.4	5.4	3.4
EDI	*	*	*	
WIL	1.2	1.6	3.3	2.0

1997 Spring/Summer Total Carbon Ambient Concentration Results

Location	5/20/97	5/22/97	5/27/97	Average
HUD	5.9	6.7	12.3	8.3
EDI	*	*	*	
WIL	5.3	5.8	9.1	6.7

2000 Fall/Winter PM_{10} Ambient Concentration Results

Location	11/8/00	11/14/00	11/20/00	11/26/00	12/2/00	12/8/00	12/14/00	Average
HUD	134	56	143	73	100	28	43	82
EDI	52	48	78	73	105	18	37	59
WIL	56	45	55	65	93	16	37	52
LB Station	44	49	92	*	105	20	35	58

* No Sample

2000 Fall/Winter Organic Carbon Ambient Concentration Results

Location	11/8/00	11/14/00	11/20/00	11/26/00	12/2/00	12/8/00	12/14/00	Average
HUD	17.1	10.6	22.6	9	9.2	4.6	8.7	11.7
EDI	8.9	9.7	15.4	7.6	10.2	2.8	7.8	8.9
WIL	10.5	9.7	10.9	7	8.1	2.9	7.2	8.0

2000 Fall/Winter Elemental Carbon Ambient Concentration Results

Location	11/8/00	11/14/00	11/20/00	11/26/00	12/2/00	12/8/00	12/14/00	Average
HUD	7.6	6.4	11.6	4.8	4.6	3.7	3.6	6.0
EDI	3.8	4.1	7.4	4.3	3.3	2	2.1	3.9
WIL	4.6	4.1	5.1	3.8	3.6	1.7	2.9	3.7

2000 Fall/Winter Total Carbon Ambient Concentration Results

Location	11/8/00	11/14/00	11/20/00	11/26/00	12/2/00	12/8/00	12/14/00	Average
HUD	24.7	17	34.2	13.8	13.8	8.3	12.3	17.7
EDI	12.7	13.8	22.8	11.9	13.5	4.8	9.9	12.8
WIL	15.1	13.8	16	10.8	11.7	4.6	10.1	11.7

1999 Fall/Winter PM_{10} Ambient Concentration Results

Location	11/2/99	11/8/99	11/14/99	11/20/99	11/26/99	12/2/99	12/8/99	12/14/99	Average
HUD	92	38	50	30	47	69	68	171	71
EDI	85	33	47	37	49	74	93	97	64
WIL	92	89	46	30	65	70	*	87	68
LB Station	77	22	38	27	38	50	55	59	46

* No Sample

1999 Fall/Winter Organic Carbon Ambient Concentration Results

Location	11/2/99	11/8/99	11/14/99	11/20/99	11/26/99	12/2/99	12/8/99	12/14/99	Average
HUD	9.9	6	6	4.5	11	13.3	10.4	22.2	10.4
EDI	8.3	4.8	5.8	4.9	10.5	14.1	13.4	14.2	9.5
WIL	8.1	14.1	6.4	4.4	12.6	13.5	*	12.2	10.2

1999 Fall/Winter Elemental Carbon Ambient Concentration Results

Location	11/2/99	11/8/99	11/14/99	11/20/99	11/26/99	12/2/99	12/8/99	12/14/99	Average
HUD	7.9	4.1	4.8	2.7	5.9	7.9	6.6	17.8	7.2
EDI	5.7	2.6	4	2.7	4.6	6.1	6.1	8.5	5.0
WIL	6	6.7	4.1	2.4	7.4	5.5	*	7.2	5.6

1999 Fall/Winter Total Carbon Ambient Concentration Results

Location	11/2/99	11/8/99	11/14/99	11/20/99	11/26/99	12/2/99	12/8/99	12/14/99	Average
HUD	17.8	10.1	10.8	7.2	16.9	21.2	17	40	17.6
EDI	14	7.4	9.8	7.6	15.1	20.2	19.5	22.6	14.5
WIL	14.1	20.8	10.5	6.8	20	19	*	19.4	15.8

1998 Fall/Winter PM_{10} Ambient Concentration Results

Location	11/1/98	11/7/98	11/13/98	11/19/98	11/25/98	12/13/98	Average
HUD	61	56	72	89	*	55	67
EDI	50	49	67	73	74	55	61
WIL	54	43	45	52	70	33	50
LB Station	43	31	39	54	*	27	39

* No Sample

1998 Fall/Winter Organic Carbon Ambient Concentration Results

Location	11/1/98	11/7/98	11/13/98	11/19/98	11/25/98	12/13/98	Average
HUD	7.5	6.4	11.2	14.2	*	8.6	9.6
EDI	7	5.5	11.3	10.4	9.3	10.1	8.9
WIL	6.9	5.7	8.4	8.3	9.9	5.8	7.5

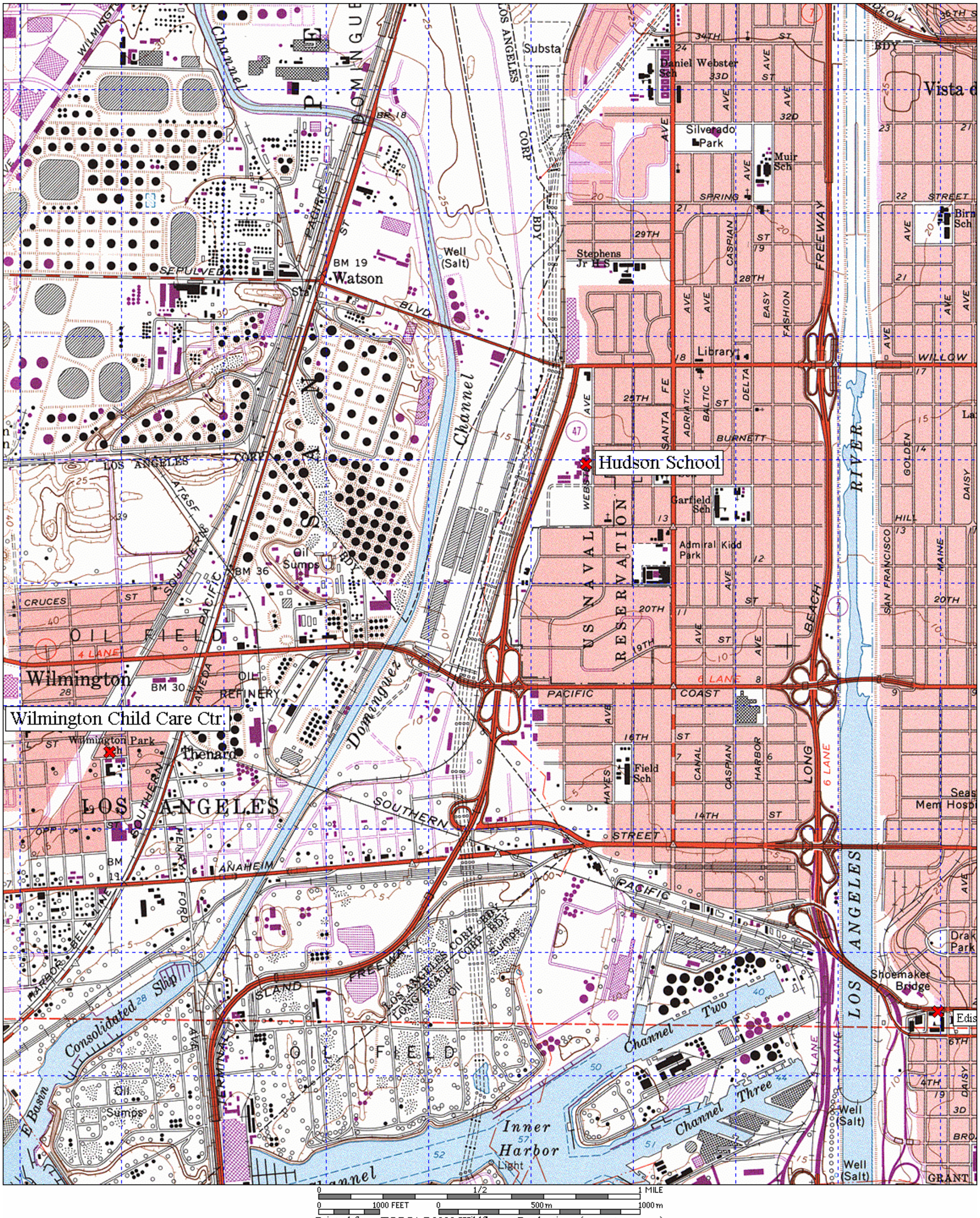
1998 Fall/Winter Elemental Carbon Ambient Concentration Results

Location	11/1/98	11/7/98	11/13/98	11/19/98	11/25/98	12/13/98	Average
HUD	6.2	6.2	16.6	19.8	*	8.9	11.5
EDI	4.3	3.3	9.2	12.5	7.9	5.8	7.2
WIL	4.1	3.8	5.9	7.3	6.6	3.4	5.2

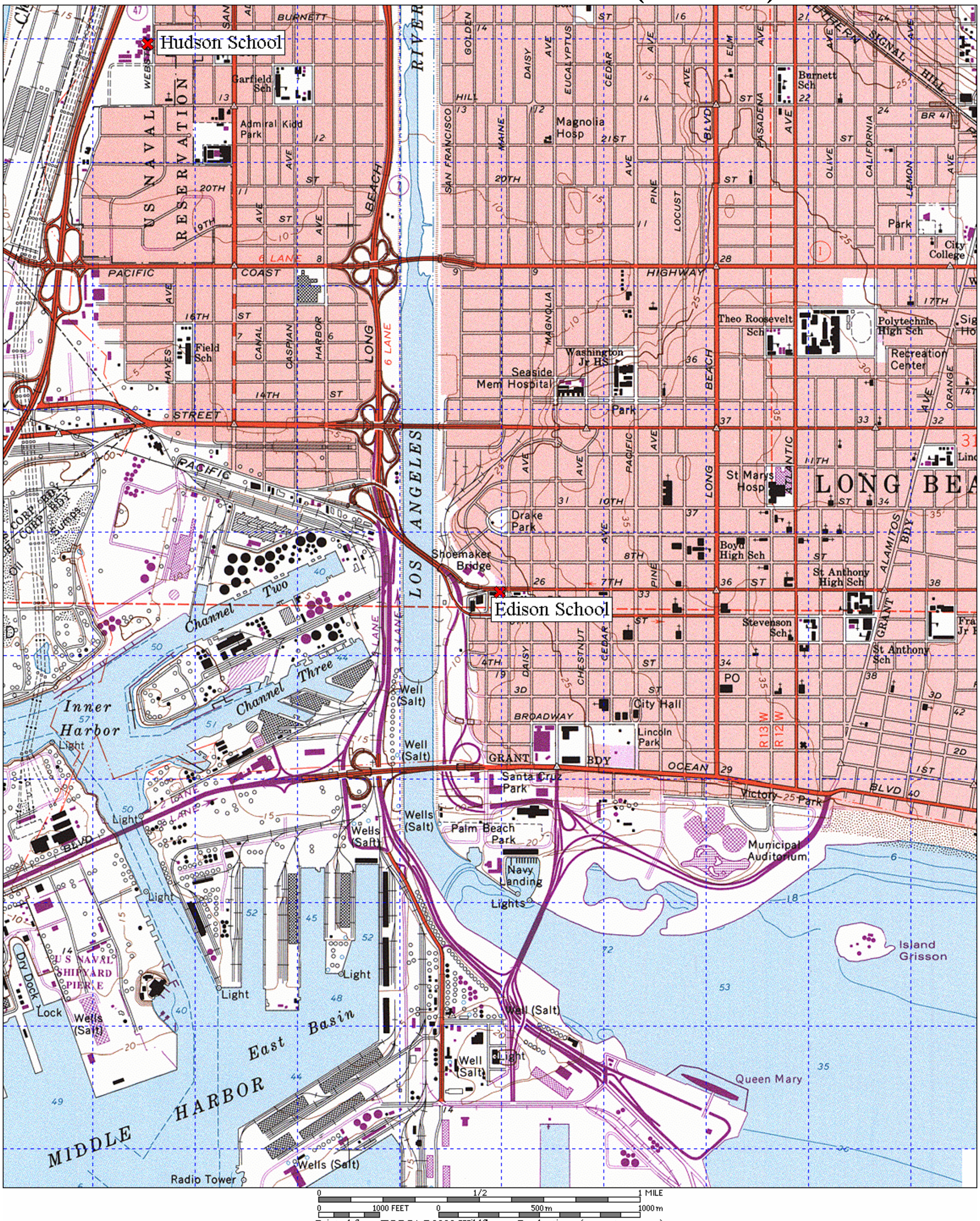
1998 Fall/Winter Total Carbon Ambient Concentration Results

Location	11/1/98	11/7/98	11/13/98	11/19/98	11/25/98	12/13/98	Average
HUD	13.7	12.6	27.9	34	*	17.5	21.1
EDI	11.3	8.8	20.5	22.9	17.2	15.9	16.1
WIL	11	9.4	14.4	15.6	16.5	9.2	12.7

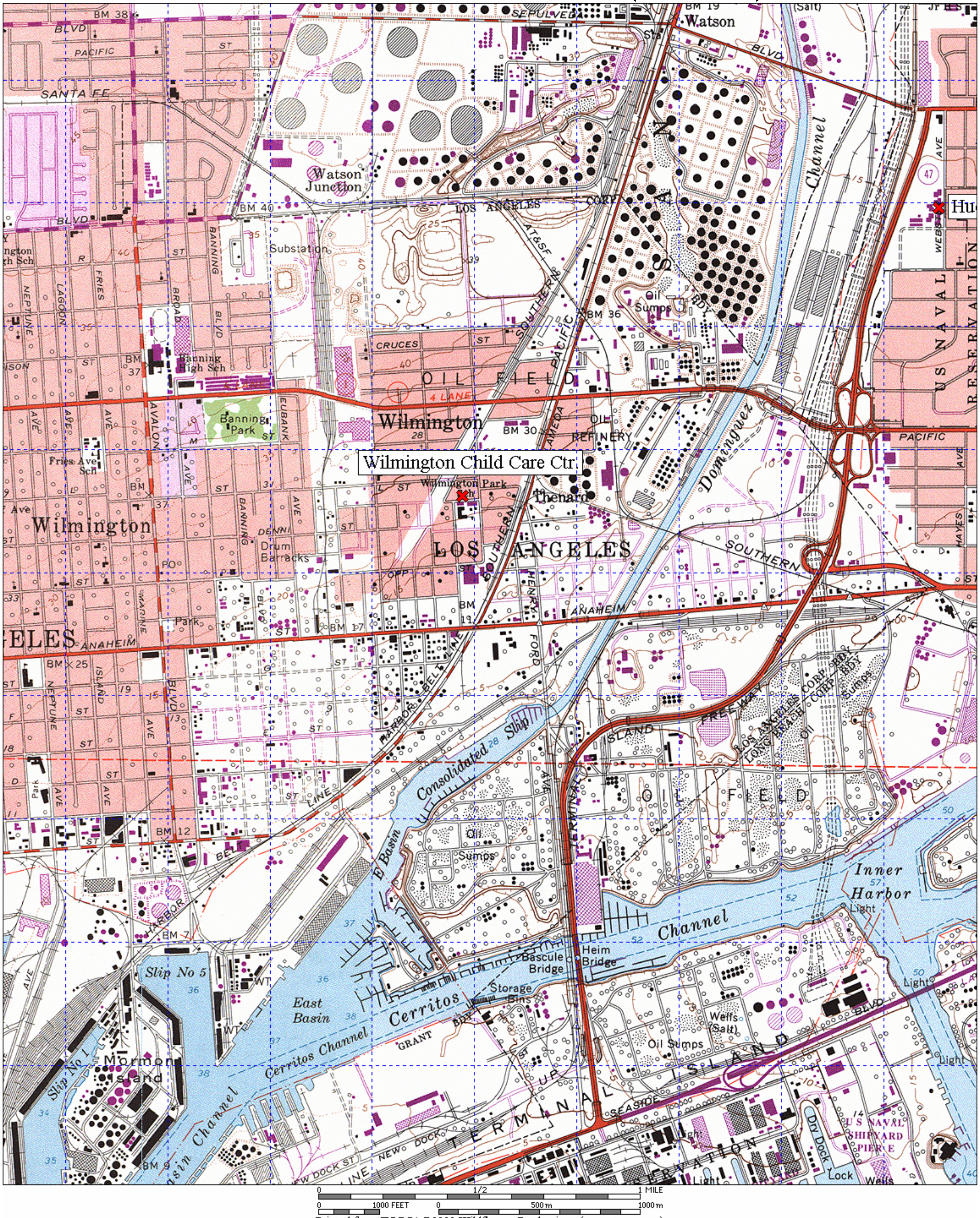
APPENDIX A-2 SAMPLING LOCATION DETAIL MAPS



Hudson School and Surrounding Area



Edison School and Surrounding Area



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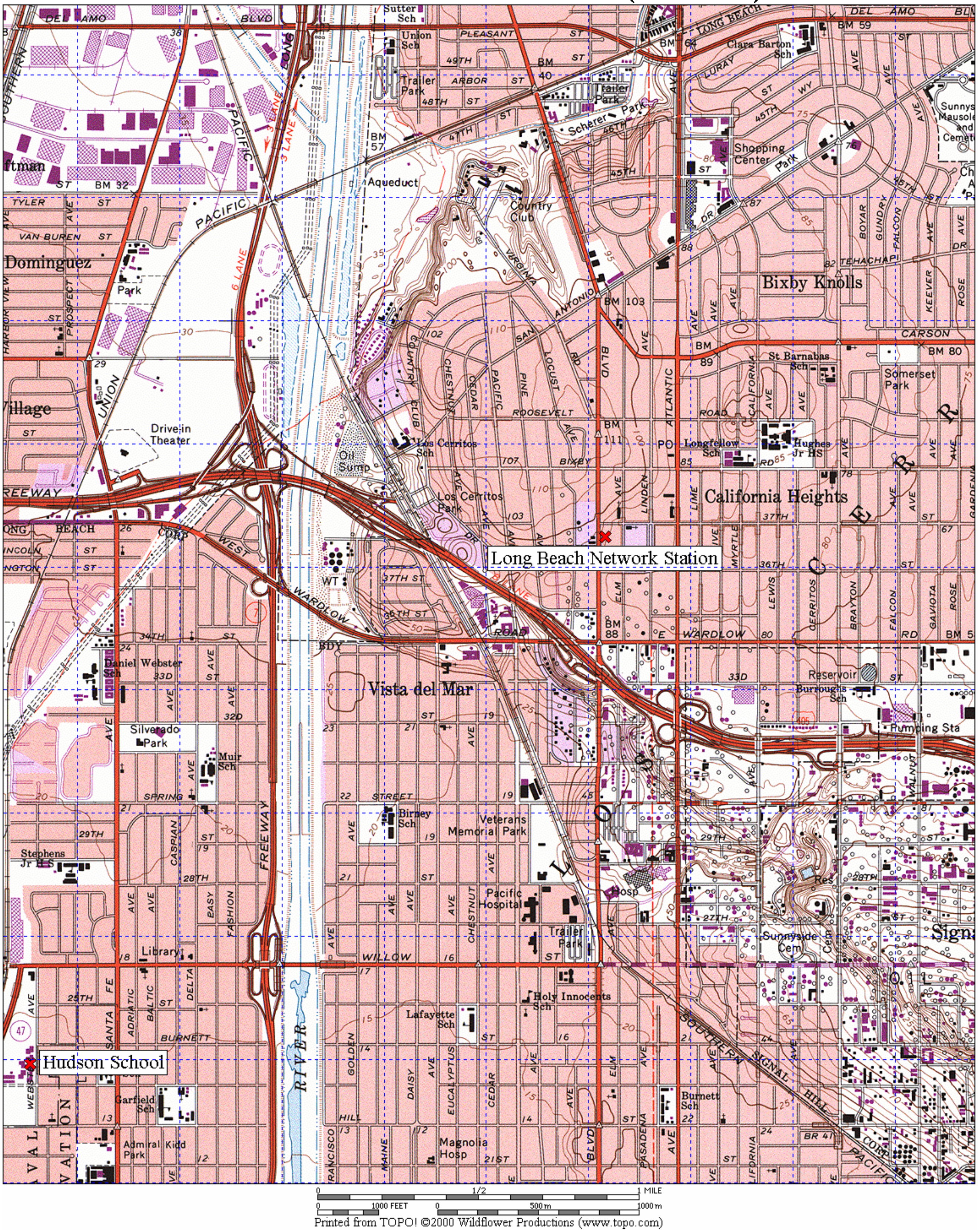
Wilmington Childcare Center and Surrounding Area



Long Beach Station and Surrounding Area