

**SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
MONITORING AND ANALYSIS**

Rule 1158 Follow-Up Study #5

Sampling Conducted
November 2001 – January 2002

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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 (PM₁₀) in the greater Long Beach/Wilmington area. This series of studies consists of PM₁₀ sampling in the spring/summer and fall/winter, observing trends in ambient PM₁₀ concentration and the elemental carbon content of collected samples.

Sampling

Sampling was conducted coincident with the AQMD PM₁₀ monitoring network one-in-six day schedule between November 27, 2001 and January 8, 2002. 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 samples were collected over seven non-consecutive sampling days.

Key Findings

1. Study (three-site) average PM₁₀ values showed expected seasonal variation, accompanied by a Basin-wide decrease in PM₁₀ for the 2001 fall/winter study; however the study average consistently produced the highest PM₁₀ results among the Basin comparison sites during the current study.
2. Study sites continue to exceed PM₁₀ results collected at the Long Beach network station, singly or in groups. The Hudson School site continues to produce higher results than the Edison School and Wilmington Childcare sites. Both of these conditions have been noted in the previous Long Beach studies.
3. The Long Beach studies have shown a significant decline in ambient elemental carbon (EC) through fall/winter 2000. However, ambient EC concentrations showed slight increases for both of the 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 Rule becomes fully implemented, reductions in EC may be less evident, approaching the point where it may be difficult to differentiate between changes due to seasonal variation and changes due to Rule compliance.

1.0 INTRODUCTION

Over the course of several years prior to 1997, residents of Long Beach and Wilmington area neighborhoods lodged several complaints of black, oily airborne dust with the AQMD. Surveys of the area noted that there were numerous coal and petroleum coke production, storage, and shipment facilities. These included open stockpiles of green coke, enclosed “coke barns”, refinery kilns producing petroleum coke, and a variety coke and coal carrying trains and trucks. Other industrial processes including sulfur distribution facilities, heavy traffic patterns, and general construction activities were also noted in the area.

In August of 1996, the District attended a public meeting in San Pedro, which focused on public concern over the levels of particulate matter in the region. Subsequently, the AQMD coordinated with various public action groups to select several sites for particulate monitoring, including sites located at specific areas of community concern.

Two studies were conducted at these sites, one in May 1997¹ and one in fall/winter 1998². These studies were designed to characterize local micrometeorological parameters, and to microscopically and chemically characterize airborne particulate collected in the area. The most pronounced findings of these studies were the elevated levels of elemental carbon and inhalable particulate matter at some study sites, including a monitoring site adjacent to Elizabeth Hudson Elementary School in Long Beach.

In June 1999 the AQMD amended of Rule 1158 affected storage, handling and shipment practices for petroleum coke, coal, and sulfur. Subsequent California State legislation HSC 40459 (AB 1775 – Lowenthal) requires that the AQMD, in conjunction with CARB, prepare an annual study for the California State Legislature examining the frequency and severity of violations related to AQMD Rule 1158. To monitor the efficacy of the rule and provide supporting data for the Legislative Report, the AQMD initiated a series of *Rule 1158 Follow-up Studies*. These studies are conducted twice annually on an ongoing basis; once each spring/summer and fall/winter.

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 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

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. (March 1999) *Micrometeorological and Ambient Air Quality Monitoring Conducted Simultaneously in the Vicinity of the Los Angeles and Long Beach Harbors*. Diamond Bar, CA.

that full implementation of Rule 1158 will contribute to a decrease in ambient PM₁₀ concentrations in the local area.

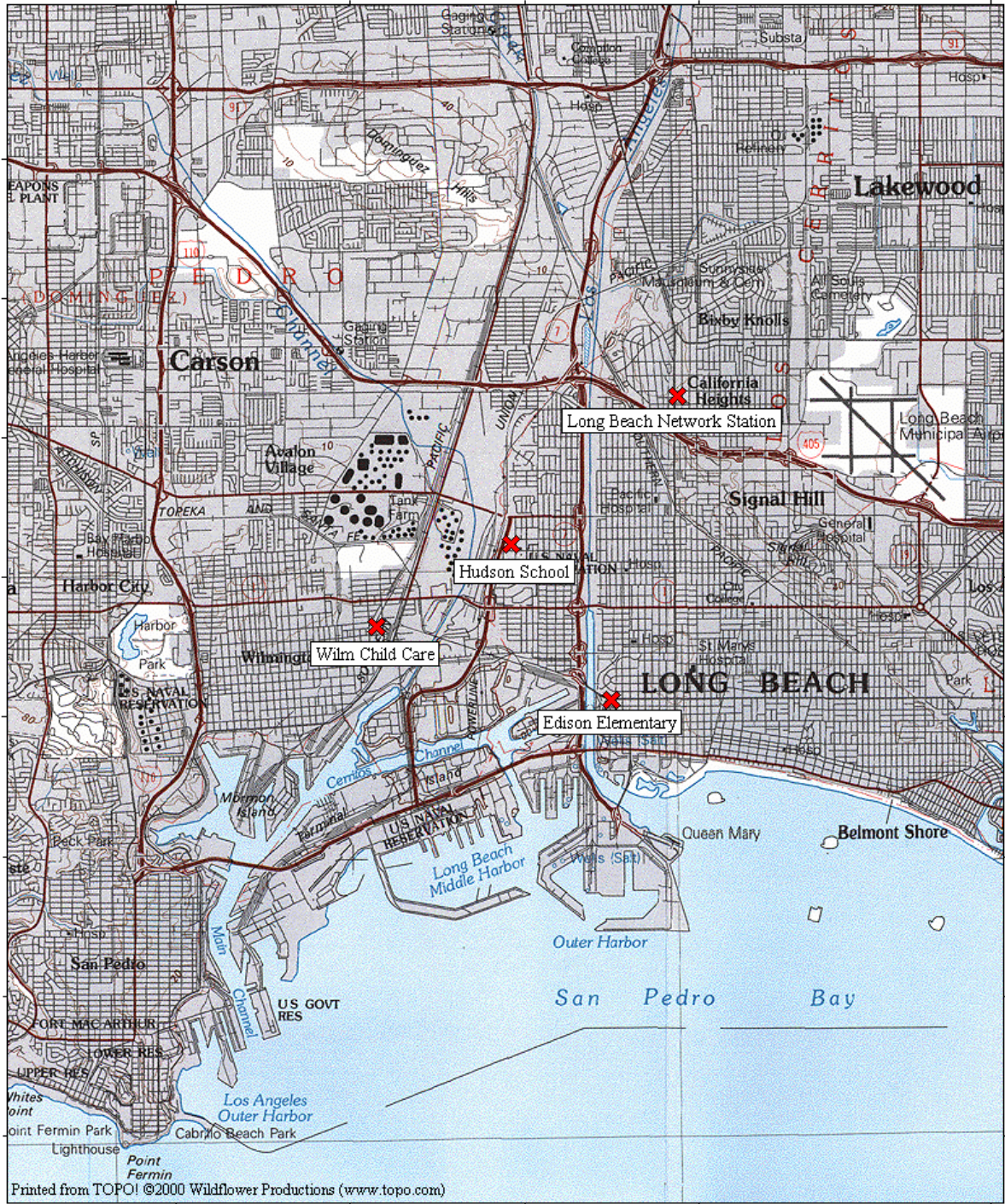


Figure 1 – Study Sampling Sites

2.0 PROJECT DISCUSSION

From November 27, 2001 to, January 8, 2002, PM₁₀ monitoring was conducted at three locations in the cities of Long Beach (two sites) and Wilmington (one site). This study constituted the fifth in a series of follow-up studies evaluating improvements in local air quality precipitated by implementation of Rule 1158, as amended on June 11, 1999. The next sampling event began in May 2002.

This study builds on a base of knowledge established by six previous studies: two prior to Rule amendment and four follow-up studies. Together they constitute a set of three spring/summer studies (1997, 2000, 2001)^{3,4} and three fall/winter studies (1998, 1999, and 2000)^{5,6}. The primary objectives of the current study were to collect data suitable for the evaluation of:

Current inhalable particulate (PM₁₀) 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 PM₁₀ mass 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 PM₁₀ particulate concentration. Mobile sources such as diesel trucks, trains and ships in the area also contribute to the overall ambient particulate matter concentrations.

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 studies, while coinciding with the EPA one-in-six monitoring schedule utilized by the AQMD in its PM₁₀ monitoring network. Samples were scheduled for collection on November 27 and December 3, 9, 15, 21, 27, 2001 and January 8, 2002, producing a data set consisting of twenty-one samples. An equipment failure at one site on December 3, 2001 necessitated the invalidation of one sample; therefore, the final data set consisted of twenty samples.

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

³ South Coast Air Quality Management District. (September 1997)

⁴ South Coast Air Quality Management District. *Rule 1158 Follow-Up Study #2 and #4*. Diamond Bar, CA.

⁵ South Coast Air Quality Management District. (March 1999)

⁶ South Coast Air Quality Management District. *Rule 1158 Follow-Up Study #1 and #3*. Diamond Bar, CA.

1999); the sites have remained constant during the course of the *Rule 1158 Follow-Up* series of studies (Figure 1.) 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 PM₁₀ 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 follows⁷:

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 PM₁₀ 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 PM₁₀ 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 (16th 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.

⁷ RES Environmental, Inc. (February 2000) *The South Coast Air Quality Management District –Rule 1158 Follow-up Study*. Colton, CA.

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.

2.2 SAMPLING AND ANALYSIS METHODOLOGY

The AQMD maintains a PM₁₀ monitoring network throughout the South Coast Air Basin (the Basin). The Federal Reference Method (FRM) SSI PM₁₀ samplers utilized in the PM₁₀ 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 (PM₁₀). For the purposes of this study, the SSI samplers are used to collect PM₁₀ 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 PM₁₀ mass and carbon content are determined. Ambient PM₁₀ 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 PM₁₀, to yield the mass of the PM₁₀ 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 ($\mu\text{g}/\text{m}^3$).

Ambient carbon levels are determined by taking a small portion of the PM₁₀ 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 PM₁₀ AMBIENT CONCENTRATION ANALYSIS

Table 1: Fall/Winter 2001 PM₁₀ Concentrations (µg/m³) at Sampling Sites

Location	Date							Average
	11/27/01	12/3/01	12/9/01	12/15/01	12/21/01	12/27/01	1/8/02	
HUD	40	62	97	39	36	76	86	62
EDI	24	*	105	33	33	63	72	55
WIL	16	43	47	37	25	75	70	45
Long Beach	25	14	24	30	24	56	*	29

* No sample

Table 1 presents the PM₁₀ 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 PM₁₀ concentrations during the study period ranged from a maximum of 105 µg/m³ at EDI on December 9th, to a minimum of 16 µg/m³ obtained at the WIL site on November 27th. The average concentration for the three study sites was 54.0 µg/m³.

The State of California has established 50 µg/m³ as the PM₁₀ 24-hour standard. Nine of the twenty (45%) samples collected during the course of the study exceeded this standard. The highest site average (62 µg/m³) over the course of the study occurred at the HUD site. This continues the trend observed in previous studies, where HUD ranked highest for PM₁₀.

For all studies except the fall/winter 2000 study, the HUD site has exhibited the highest study PM₁₀ average. It should also be noted that on several occasions in this and the previous five studies the HUD site produced PM₁₀ samples significantly higher than those observed at EDI and WIL. Taken together, these trends suggest that HUD consistently experiences higher PM₁₀ concentrations than elsewhere in the study area. 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 PM₁₀.

As has been noted in several previous studies, the three study sites produced average PM_{10} values markedly higher than those observed at the Long Beach PM_{10} network station. While absent during the fall/winter 2000 and spring/summer 2001 studies, this trend was common in earlier studies.

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

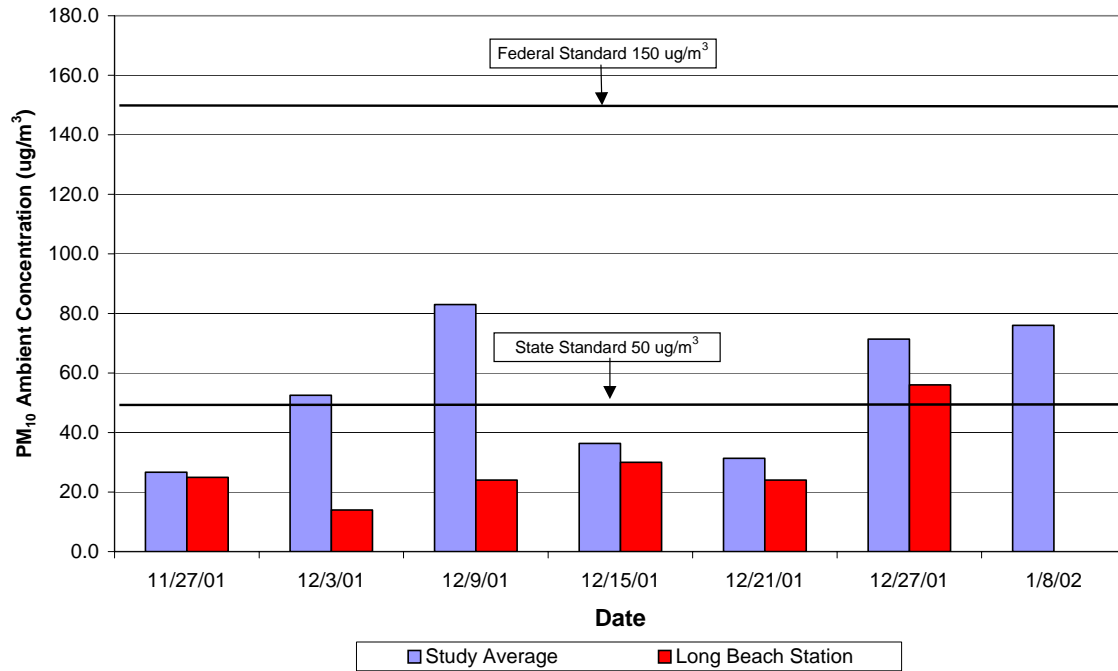


Figure 2 compares the average value for the three study sites with the Long Beach network station on each day of the 2001 study. When looking at these results, it must be kept in mind that PM_{10} consists of a variety of chemical species.⁸ These include carbonaceous components (EC and OC), crustal materials and wind-blown soils, sulfate and nitrate formed by precursor SO_x and NO_x 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.

For all dates other than December 3rd and 9th, the study average and the Long Beach station yield very similar values. On December 3rd PM_{10} results at study sites were significantly higher than the result at the Long Beach Network station. On December 9th, the PM_{10} results at HUD and EDI were higher than at WIL and the Long Beach station. A shared source or independent localized sources may account for the elevation of the study average on that date.

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.

3.2 PM₁₀ TREND ANALYSIS

Figure 3: Ambient PM₁₀ Concentrations by Site and Year

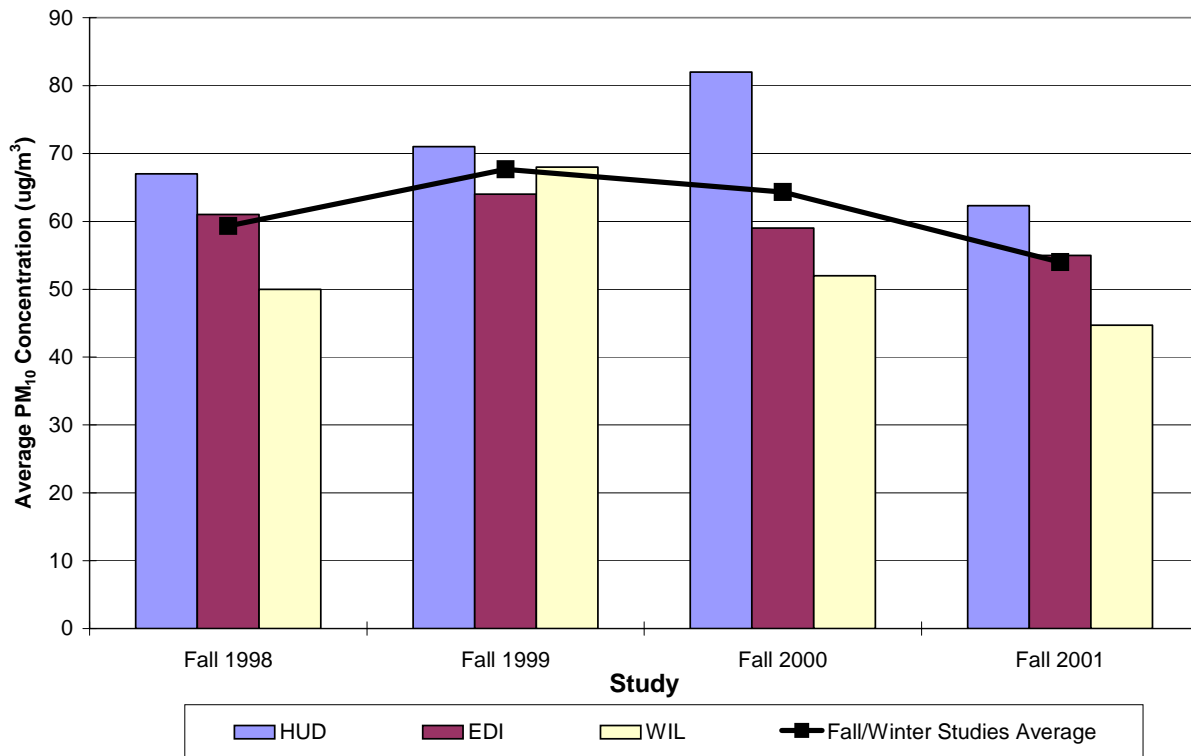
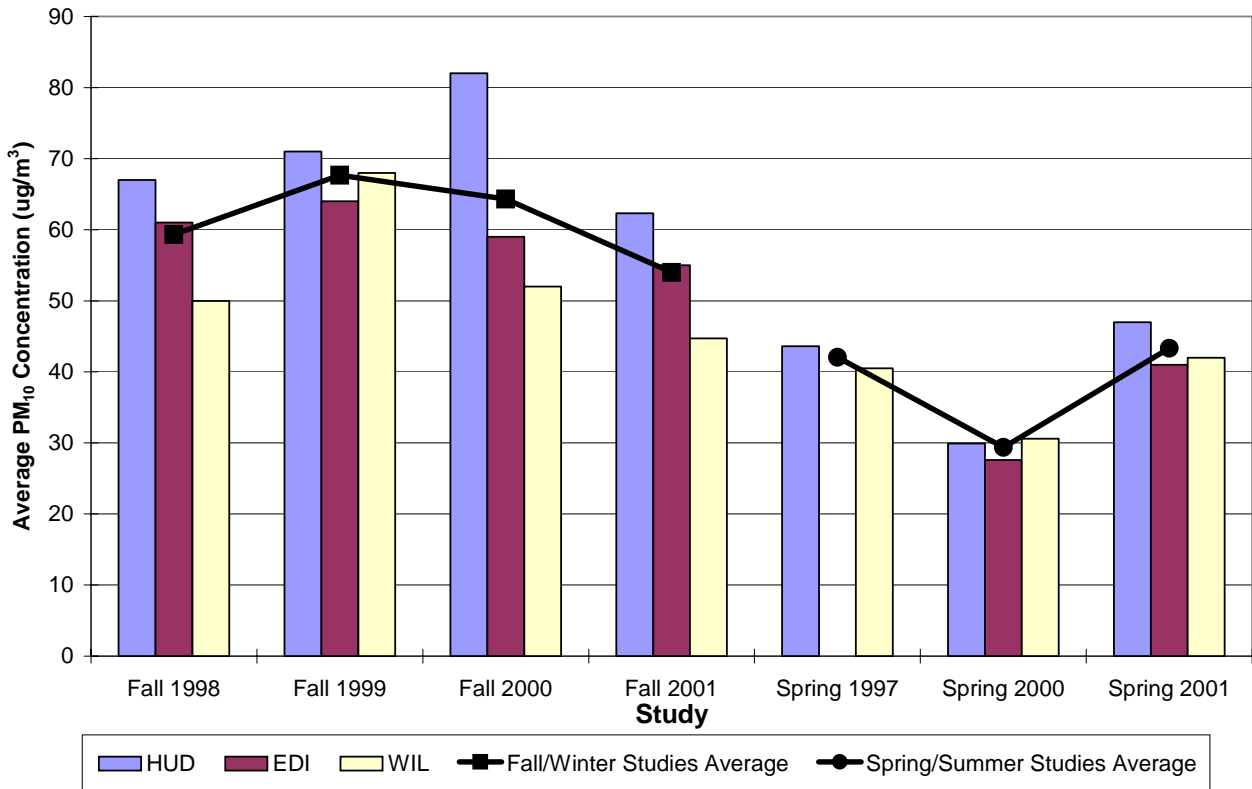


Figure 3 summarizes the ambient PM₁₀ concentrations observed over the course of the four fall/winter studies. The black line represents the three-site study average for each study. The data show a moderately varying three-site seasonal PM₁₀ average centered on $61\mu\text{g}/\text{m}^3$, with a standard deviation of approximately $\pm 6\mu\text{g}/\text{m}^3$ (or about 10%.)

Figure 4: Ambient PM₁₀ Concentrations During Long Beach Study Series

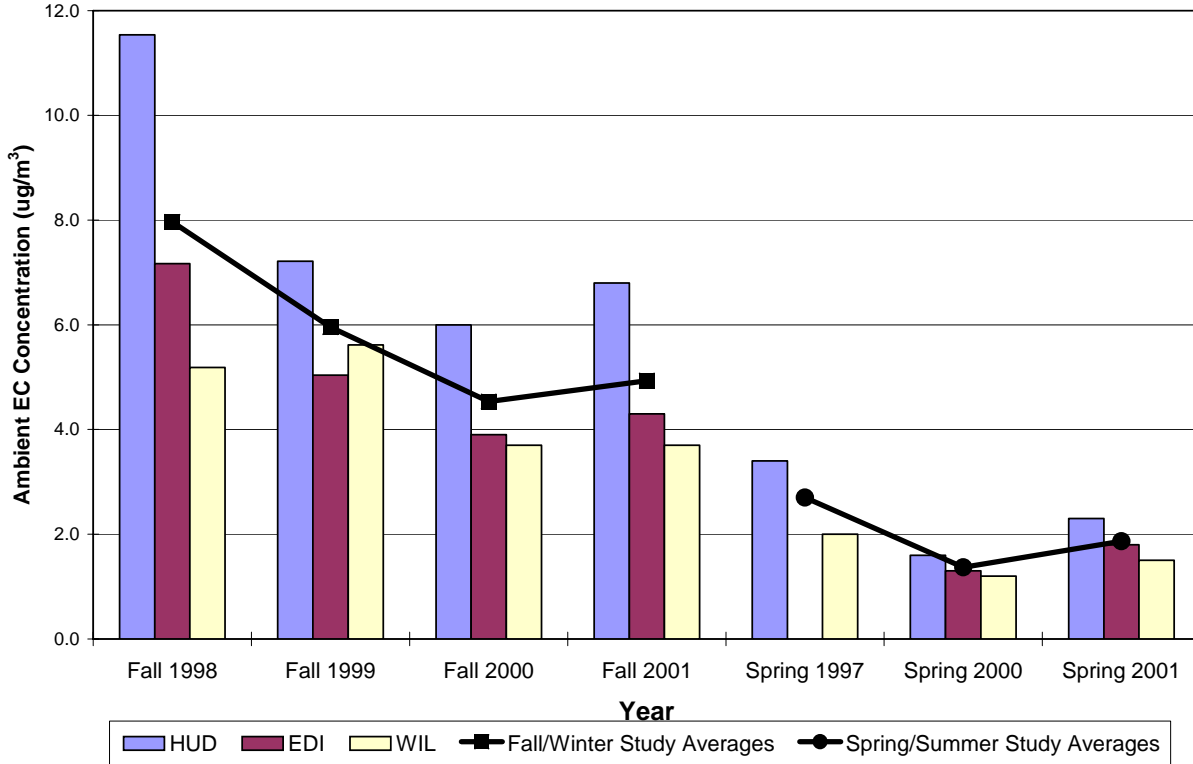


Displaying the fall/winter data alongside spring/summer data, Fig. 4 further illustrates these seasonal and year to year variations. PM₁₀ concentrations in the Basin have been observed to be highest in the fall/winter season, when the air mass over the Basin is particularly prone to stagnation due to 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 PM₁₀ values. As winter gives way to spring, lower PM₁₀ concentrations are observed, gradually increasing throughout summer and fall. In the figure above, spring/summer study PM₁₀ concentrations are lower than fall/winter concentrations, in agreement with historical trends in the basin.

Study average PM₁₀ 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.

3.3 ELEMENTAL CARBON TREND ANALYSIS

Figure 5: Average EC by Site and Year



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 higher than those observed in the 2000 fall/winter study, mirroring the recent increase noted in the spring/summer 2001 study.

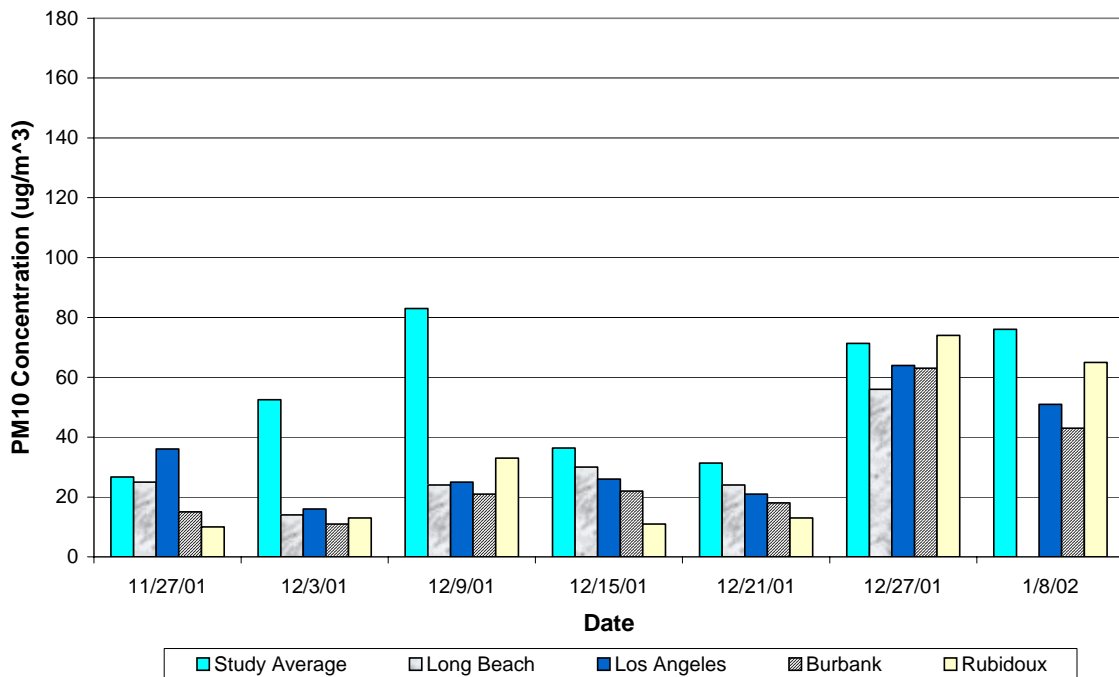
In the previous section it was noted that there are no consistent trends for study average PM₁₀ concentrations or for individual site averages. Examining both Fig. 4 and Fig. 5, it should be noted that the changes in EC concentrations occur without direct correlation to ambient PM₁₀ fluctuations during the fall/winter studies. During the spring/summer studies, EC concentrations changed in a pattern similar to the ambient PM₁₀ fluctuations.

For both of the 2001 studies, the study average EC increased to levels slightly above the 2000 averages, but below earlier averages

3.2 BASIN-WIDE PM₁₀ COMPARISON

In order to place the study results in context, the study maximum PM₁₀ value for each day was compared to results obtained concurrently at several other PM₁₀ 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 PM₁₀ 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.

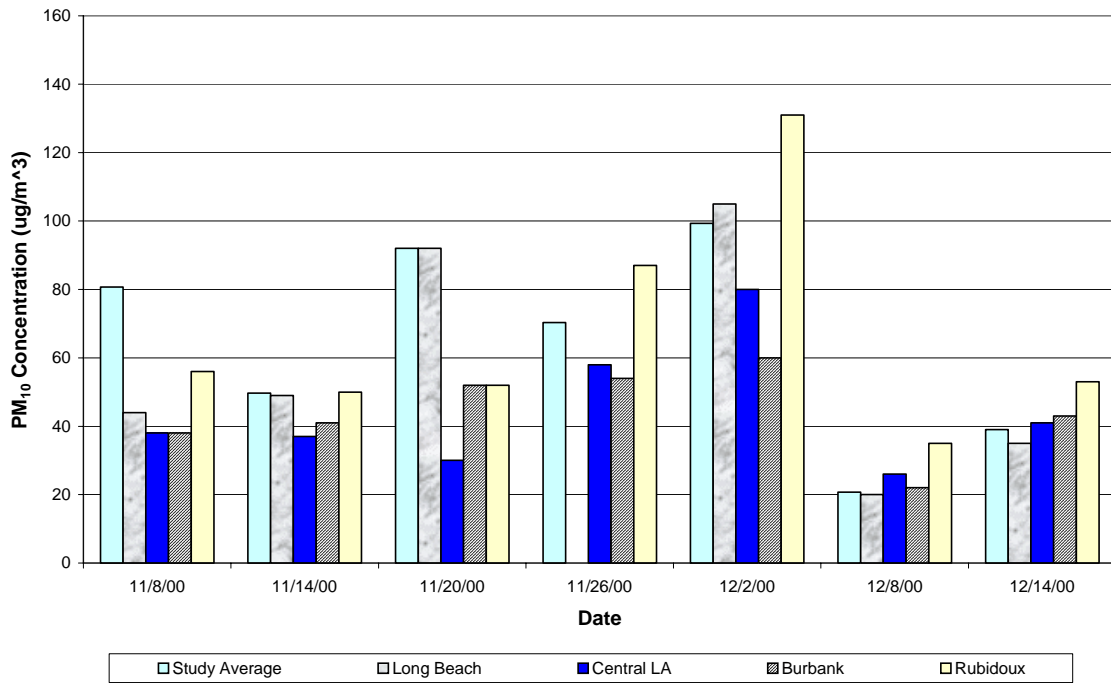
Figure 6: 2001 Study PM₁₀ Average vs. PM₁₀ Network Sites



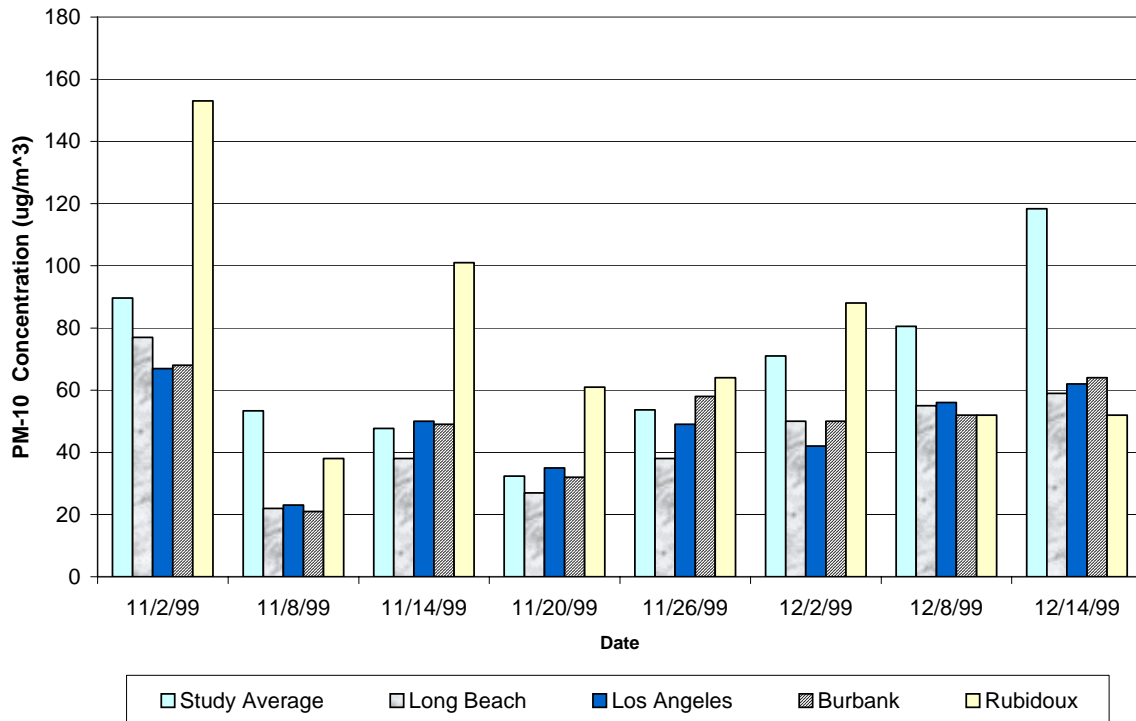
On five of seven sampling dates the study average PM₁₀ concentration exceeded the Basin comparison sites; on two of those dates the difference was considerable. For the two remaining dates, Rubidoux and Los Angeles each had the maximum value once. During the fall/winter 2000 study, the study average exceeded all Basin comparison sites on three days, while Rubidoux measured the maximum for four days.

Figure 7 reproduces the Basin-wide results for 1999 and 2000, with all graphs sharing the same vertical scale. It is clear that rather than being limited to the study area, a Basin wide decrease in PM₁₀ was experienced throughout the Basin during the fall/winter 2001 study.

Figure 7: 2000 PM₁₀ Average vs. PM₁₀ Network Sites



1999 Study PM₁₀ Average vs. PM₁₀ Network Sites



4.0 CONCLUSIONS

Study (three-site) average PM_{10} values showed expected seasonal variation, accompanied by a Basin-wide decrease in PM_{10} for the 2001 fall/winter study, as compared to the 1999 and 2000 studies. The study PM_{10} average markedly exceeded the Basin-wide results on two dates: December 3 and 9. On December 9, HUD and EDI collected significantly higher PM_{10} than WIL or the Long Beach station. This indicates that a shared source or independent localized sources may account for the elevation of the study average on that date. Earlier studies in the series have also routinely produced results markedly higher at study sites than at the Long Beach Network site.

Basin-wide 2001 PM_{10} results compared favorably to 1999 and 2000 results, showing a lower PM_{10} season during the 2001 study. However, the study average consistently produced the highest PM_{10} results among the Basin comparison sites during the current study.

Ambient EC increased slightly during both of the 2001 studies. From 1998 – 2000, ambient elemental carbon concentrations had decreased steadily over the series of fall/winter studies, but fluctuated during the spring/summer 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.

APPENDIX A-1

LONG BEACH PM₁₀ 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

APPENDIX A-1

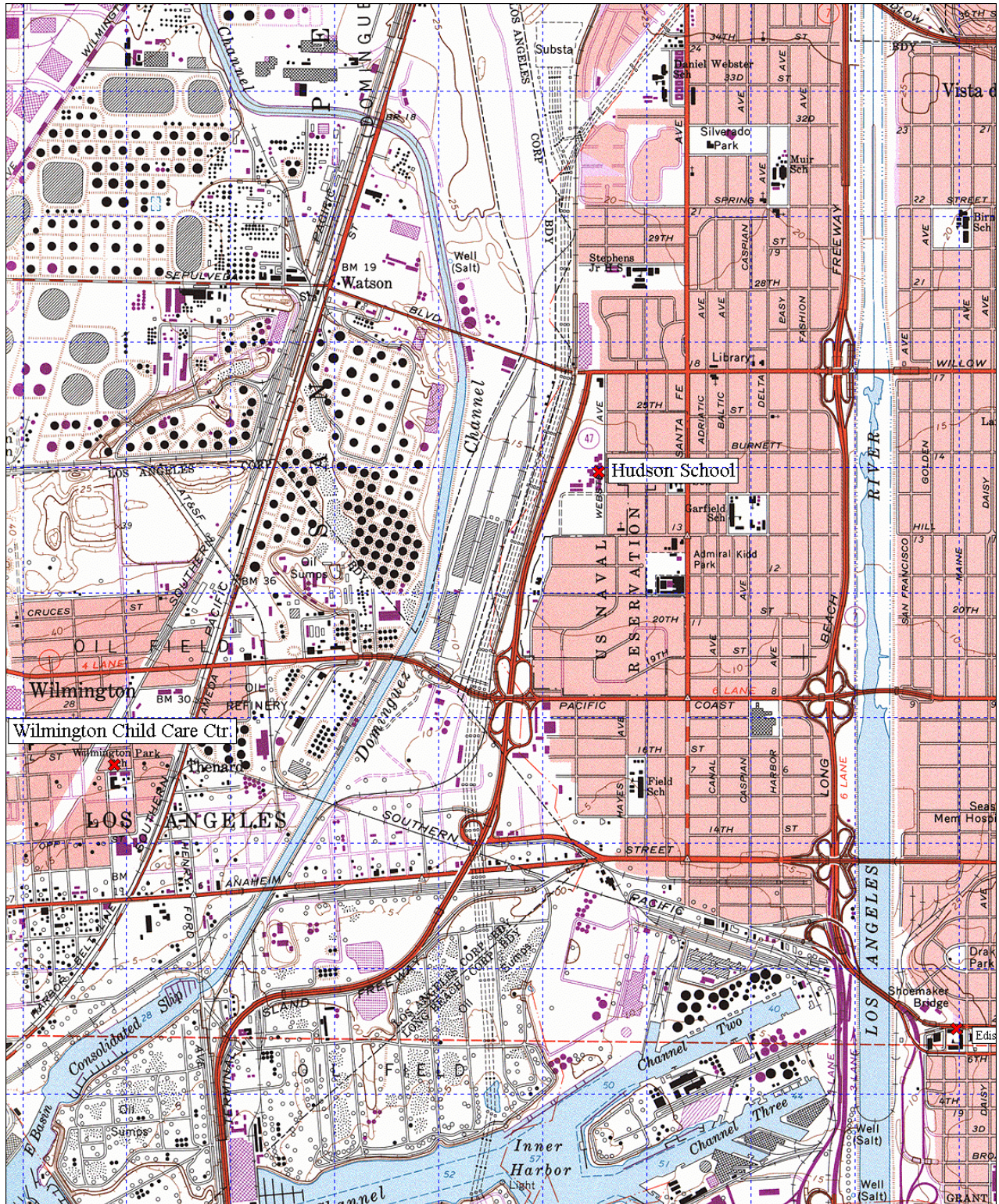
LONG BEACH PM₁₀ MONITORING DATA (CONTINUED)

2001 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	40	62	97	39	36	76	86	62
EDI	24	*	105	33	33	63	72	55
WIL	16	43	47	37	25	75	70	45
LB Station	25	14	24	30	24	56	*	29
* No Sample								
2001 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	5.6	12.9	10.9	9.7	6.9	16	17.2	11.3
EDI	3.3	*	8.8	8.7	7	13.9	15.9	9.6
WIL	2.9	9.2	6.9	9.4	4.7	15.5	13.5	8.9
2001 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	5.2	7.8	7.1	4.7	4.6	8.4	9.7	6.8
EDI	2.3	*	4.3	3.8	3.3	5.5	6.6	4.3
WIL	1.4	4.2	2.7	4.1	1.8	6.2	5.4	3.7
2001 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	10.8	20.7	18	14.4	11.5	24.4	26.9	18.1
EDI	5.6	*	13.1	12.5	10.3	19.4	22.5	13.9
WIL	4.3	13.4	9.6	13.5	6.5	21.7	18.9	12.6

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

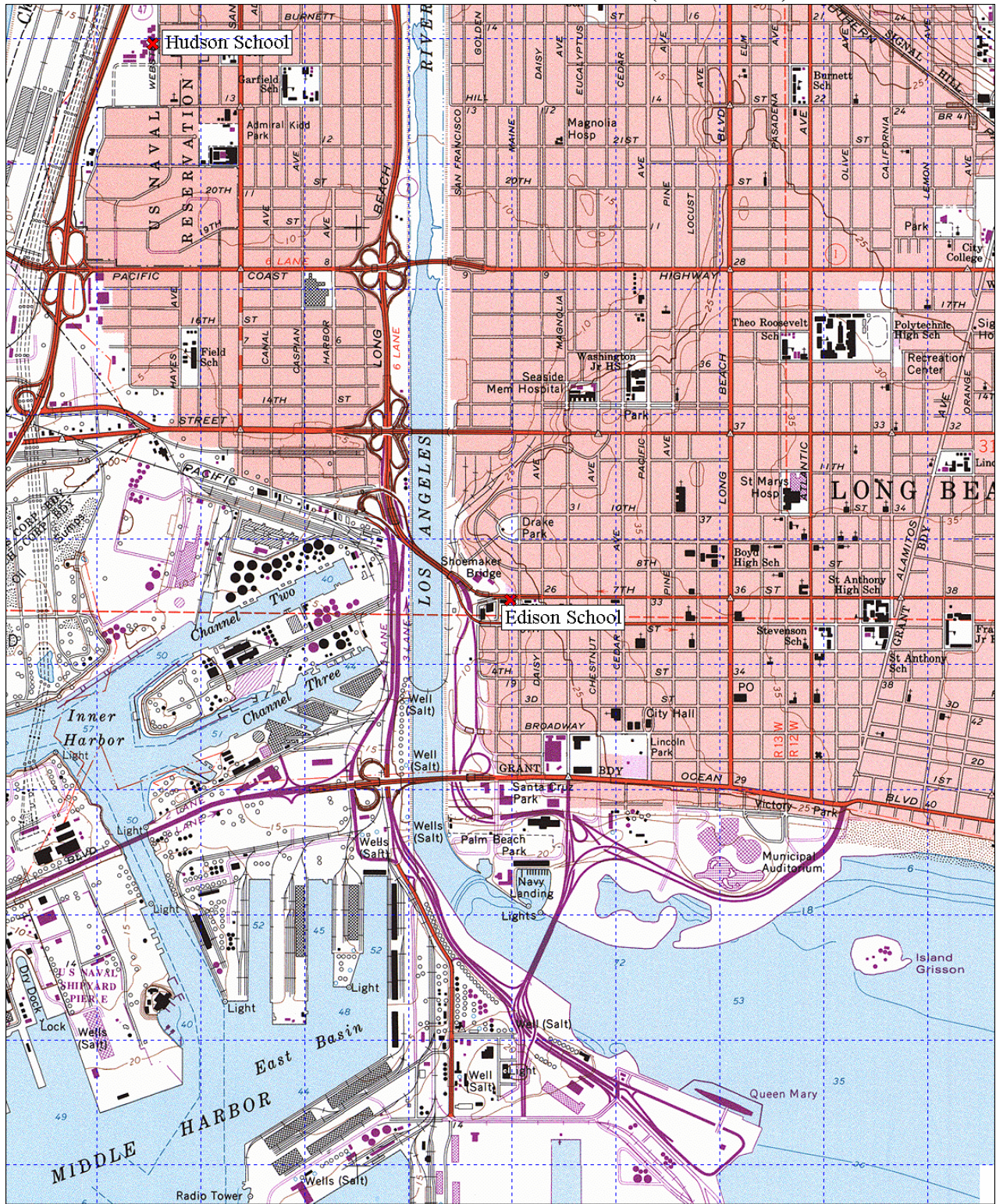
1999 Fall/Winter PM ₁₀ Ambient Concentration Results									
Location	11/2/99	11/8/99	11/14/99	11/20/99	11/26/99	12/2/99	12/8/99	12/14/99	Average
HUD	92	38	50	30	47	69	68	171	71
EDI	85	33	47	37	49	74	93	97	64
WIL	92	89	46	30	65	70	*	87	68
LB Station	77	22	38	27	38	50	55	59	46
* No Sample									
1999 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	12/1/98	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	12/1/98	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	12/1/98	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	12/1/98	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

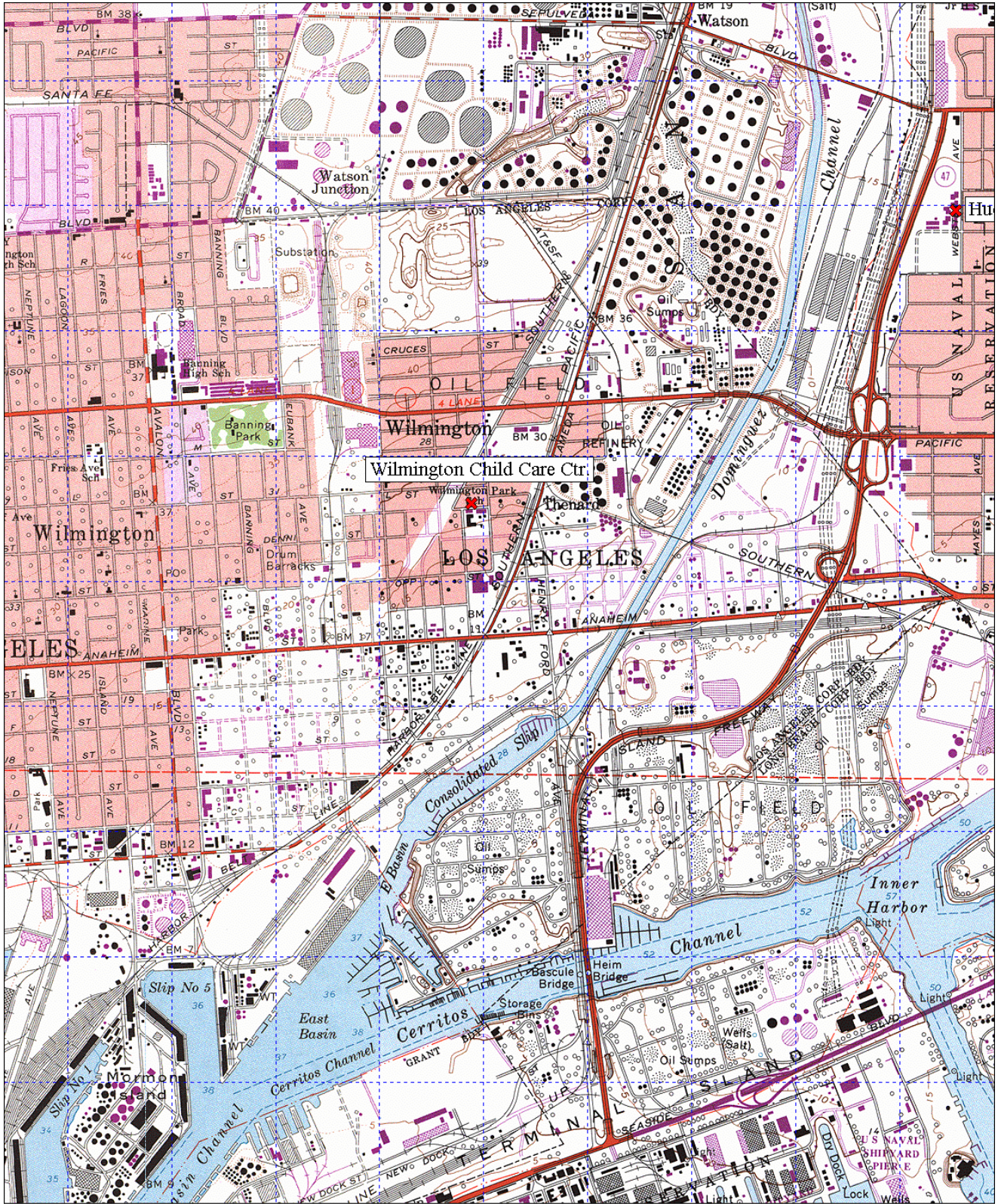


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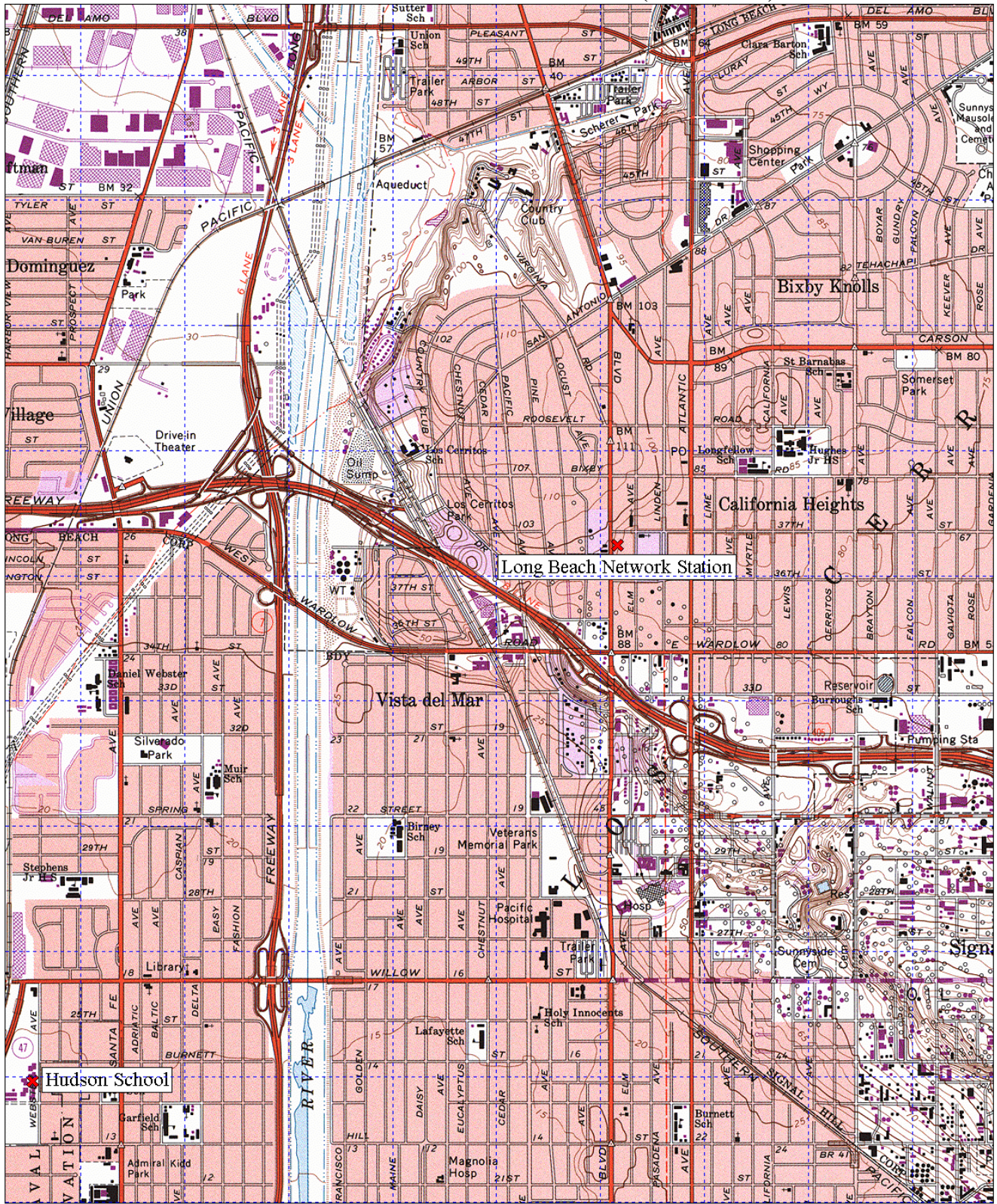
Hudson School and Surrounding Area



Edison School and Surrounding Area



Wilmington Childcare Center and Surrounding Area



Long Beach Station and Surrounding Area