

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

Rule 1158 Follow-Up Study #8

Sampling Conducted  
May 2003 – June 2003

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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, required under State law, examining targeted compounds contained in the inhalable particulate fraction (PM<sub>10</sub>) in the greater Long Beach/Wilmington area. This series of studies consists of PM<sub>10</sub> sampling in the spring/summer and fall/winter, observing trends in ambient PM<sub>10</sub> concentration and the elemental carbon content of collected samples.

### Sampling

Sampling was conducted between May 15, 2003 and June 20, 2003, coincident with the AQMD PM<sub>10</sub> monitoring network one-in-six day schedule. 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 three study sites recorded higher average ambient PM<sub>10</sub> than the AQMD Long Beach network station for the duration of the study, and recorded higher ambient PM<sub>10</sub> than the AQMD Central Los Angeles network station on dates where the wind was predominantly from the west and northwest.
2. The current and previous monitoring studies indicate that higher PM<sub>10</sub> and elemental carbon (EC) concentrations are measured at the Hudson School site than any other study sites, and the site often yields higher measurements than many AQMD network sites for PM<sub>10</sub>. During this study the average EC at Hudson School was 63% higher than the next highest study site, Wilmington Child Care Center, and 21% higher than the AQMD network site at Central Los Angeles. The wind data suggests that the impact is greatest at the Hudson School site when the wind is from the southwest or northwest directions. The Hudson School site is adjacent to a variety of transportation sources and the Arco facility. The higher measurements ~~are~~ may be attributable to nearby transportation sources and the Arco facility when the winds are from the west.
3. Monitoring at Long Beach show a significant decline in ambient elemental carbon (EC) since Rule 1158 was amended in July 1999. Results through fall/winter 2000 showed a steady decline in EC, while more recent studies have shown modest fluctuation in EC concentration. The magnitude of this fluctuation is consistent with expected seasonal variation.
4. Monitoring during the spring/summer period shows lower and more consistent PM<sub>10</sub> levels, whereas fall/winter measurements (which are historically higher throughout the Basin than springtime measurements) have been illustrative of trends in the area. Examining all of the monitoring data for spring and fall suggests that the measurable benefits of Rule 1158 have been observed, and other sources of PM<sub>10</sub> and EC in the area are now providing a greater contribution to PM<sub>10</sub> than the coke/coal sources.

## 1.0 INTRODUCTION

Over the course of several years prior to 1997, the AQMD had received complaints of black, oily airborne dust from residents of Long Beach and Wilmington area neighborhoods. 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, AQMD staff attended a public meeting in San Pedro, which focused on public concern over the levels of particulate matter in the region. Subsequently, the AQMD staff 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 1997<sup>1</sup> and one in fall/winter 1998<sup>2</sup>. 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 Rule 1158 affecting 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 the California Air Resources Board (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. AQMD 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

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<sup>1</sup> 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.

<sup>2</sup> 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.



operations. Implementation of Rule 1158 has contributed to a decrease in ambient PM<sub>10</sub> concentrations in the local area.

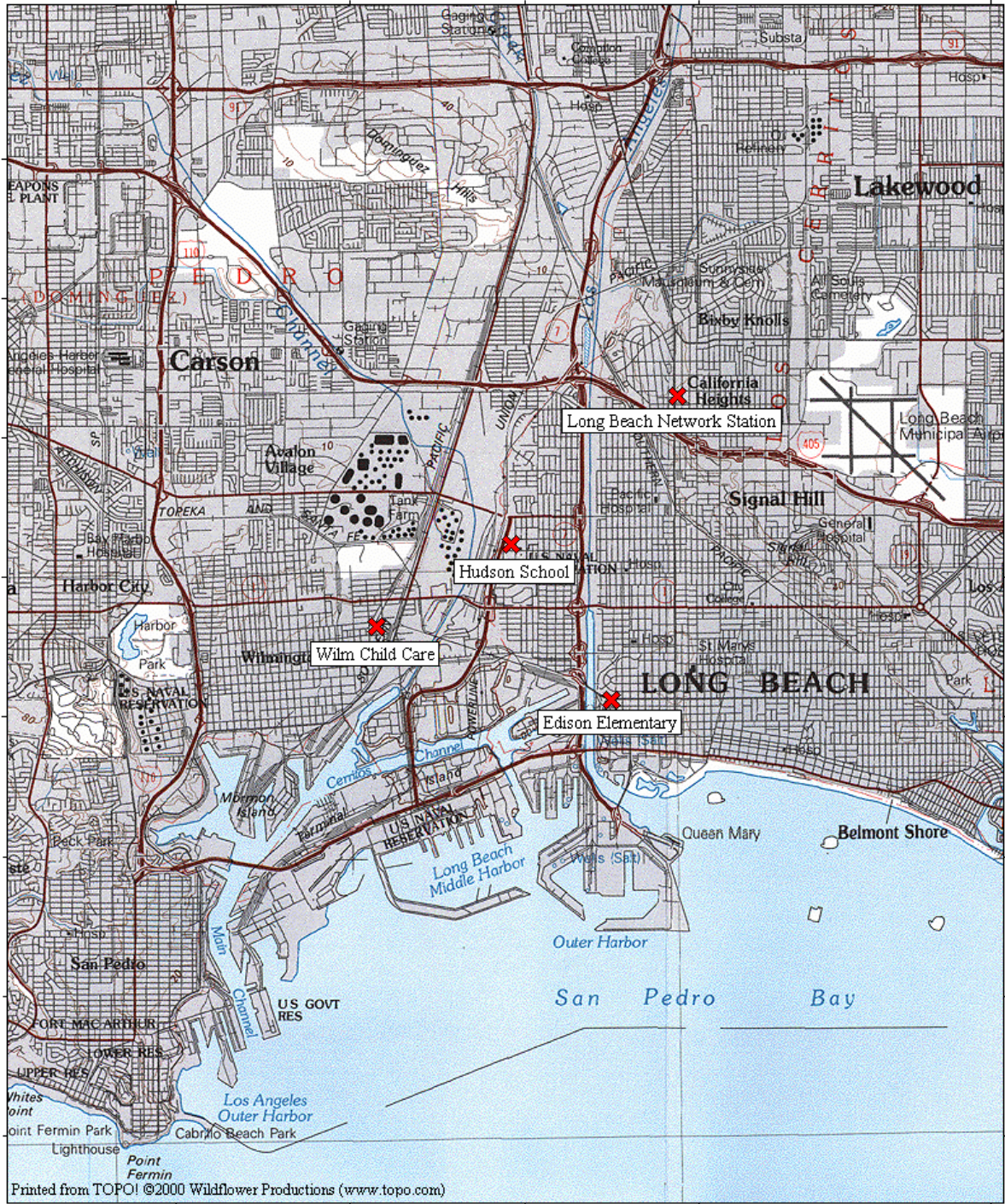


Figure 1 – Study Sampling Sites

## 2.0 PROJECT DISCUSSION

From May 15, 2003 to June 20, 2003, PM<sub>10</sub> monitoring was conducted at three locations in the cities of Long Beach (two sites) and Wilmington (one site). This study constituted the eighth in a series of follow-up studies evaluating improvements in local air quality precipitated through implementation of Rule 1158, as amended on June 11, 1999.

This study builds on a base of knowledge established by several previous studies: two prior to Rule amendment and seven follow-up studies. Together they constitute a set of five spring/summer studies (1997, 2000, 2001, and 2002)<sup>3,4</sup> and four fall/winter studies (1998, 1999, 2000, 2001, and 2002)<sup>5,6</sup>. The primary objectives of the current study were to collect data suitable for the evaluation of:

- Current inhalable particulate (PM<sub>10</sub>) 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 2002 PM<sub>10</sub> 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 PM<sub>10</sub> 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 U.S. EPA one-in-six monitoring schedule utilized by the AQMD in its PM<sub>10</sub> monitoring network. Samples were scheduled for collection on May 15, 21, 27 and June 2, 8, 14 and 20, 2003, producing a data set consisting of 21 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 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

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<sup>3</sup> South Coast Air Quality Management District. (September 1997)

<sup>4</sup> South Coast Air Quality Management District. *Rule 1158 Follow-Up Study #2, #4 and #6*. Diamond Bar, CA.

<sup>5</sup> South Coast Air Quality Management District. (March 1999)

<sup>6</sup> South Coast Air Quality Management District. *Rule 1158 Follow-Up Study #1, #3,#5, and #7*. Diamond Bar, CA.



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<sub>10</sub> 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<sup>7</sup>:

**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<sub>10</sub> 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. Meteorological monitoring equipment was included at this site.

**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<sub>10</sub> 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<sup>th</sup> 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.

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<sup>7</sup> 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 an elementary and a 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 PM<sub>10</sub> monitoring network throughout the South Coast Air Basin (the Basin). The Federal Reference Method (FRM) SSI PM<sub>10</sub> samplers utilized in the PM<sub>10</sub> 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<sub>10</sub>). For the purposes of this study, the SSI samplers are used to collect PM<sub>10</sub> samples, which were also used for the determination of organic carbon (OC), elemental carbon (EC) 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<sub>10</sub> mass and carbon content are determined. Ambient PM<sub>10</sub> 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<sub>10</sub>, to yield the mass of the PM<sub>10</sub> 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 PM<sub>10</sub> 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 are compared with data obtained in previous Long Beach/Wilmington area studies. The following sections discuss the results of the analysis.

#### 3.1 PM<sub>10</sub> AMBIENT CONCENTRATION ANALYSIS

Table 1 presents the PM<sub>10</sub> ambient concentrations observed during the study. Complete data tabulations can be found in Appendix A-1. Long Beach values are provided for comparison, while the Central Los Angeles station reflects conditions within the urban core, with particulate typically higher in sulfate and carbonaceous compounds, resulting from a higher contribution to ambient particulate by vehicle emissions.

Table 1: Spring/Summer 2003 PM<sub>10</sub> Concentrations (µg/m<sup>3</sup>) at Sampling Sites

Location	Date							Average
	5/15/03	5/21/03	5/27/03	6/2/03	6/8/03	6/14/03	6/20/03	
HUD	29	53	44	31	20	41	37	36
EDI	28	50	48	26	9	48	31	34
WIL	29	48	38	32	19	33	27	32
Long Beach	26	38	49	22	18	31	24	30
Los Angeles	35	46	53	58	35	41	28	42

Twenty-four hour ambient PM<sub>10</sub> concentrations during the study period ranged from a maximum of 53 µg/m<sup>3</sup> at HUD on May 21<sup>st</sup>, to a minimum of 9 µg/m<sup>3</sup> obtained at the EDI site on June 8<sup>th</sup>. The average PM<sub>10</sub> concentration for the three study sites is 34 µg/m<sup>3</sup>.

The State of California has established 50 µg/m<sup>3</sup> as the PM<sub>10</sub> 24-hour standard. Only one of the 21 (5%) school samples collected during the course of the study exceeded this standard. The Federal PM<sub>10</sub> 24-hour standard (150 µg/m<sup>3</sup>) was not exceeded in the current study. The highest site average (36 µg/m<sup>3</sup>) over the course of the study occurred at the HUD site. This continues the trend observed in previous studies, where data from HUD ranked highest for PM<sub>10</sub>.

The circled data represent days where one or more study samples exceeded both the nearby Long Beach network station and the Central Los Angeles network station for

PM<sub>10</sub>. Wind data collected during the study shows that days not circled above were characterized by a predominant onshore flow, whereas the circled days had far less onshore wind (Appendix A-2).

For all studies except the fall/winter 2000 study, the HUD site has exhibited the highest study PM<sub>10</sub> average. It should also be noted that on several occasions in the previous studies the HUD site produced PM<sub>10</sub> samples significantly higher than those observed at EDI and WIL. Taken together, these trends suggest that HUD consistently experiences higher PM<sub>10</sub> 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 PM<sub>10</sub>.

### 3.2 PM<sub>10</sub> TREND ANALYSIS

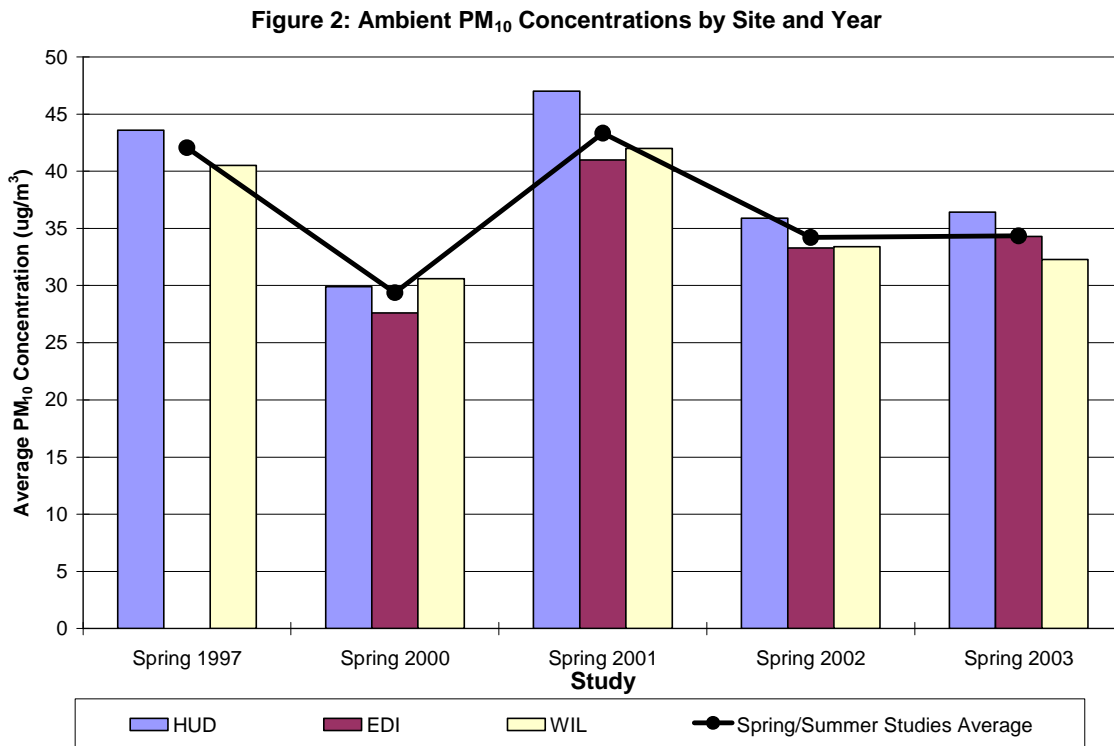


Figure 2 summarizes the ambient PM<sub>10</sub> concentrations observed over the course of the four spring/summer studies. The black line represents the three-site study average for each study. The data show a varying three-site seasonal PM<sub>10</sub> average centered on 37μg/m<sup>3</sup>, with a standard deviation of approximately ±12 μg/m<sup>3</sup> (or about 32%.) compared to a fall 61μg/m<sup>3</sup>, with a standard deviation of approximately ±6 μg/m<sup>3</sup> (or about 10%.)

### 3.3 ELEMENTAL CARBON ANALYSIS

Elemental carbon (EC) 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. During the 2003 study, EC analysis was performed on samples collected at the Long Beach and Central Los Angeles network stations in addition to the samples collected at the study sites. A summary of the EC data is provided in Table 2.

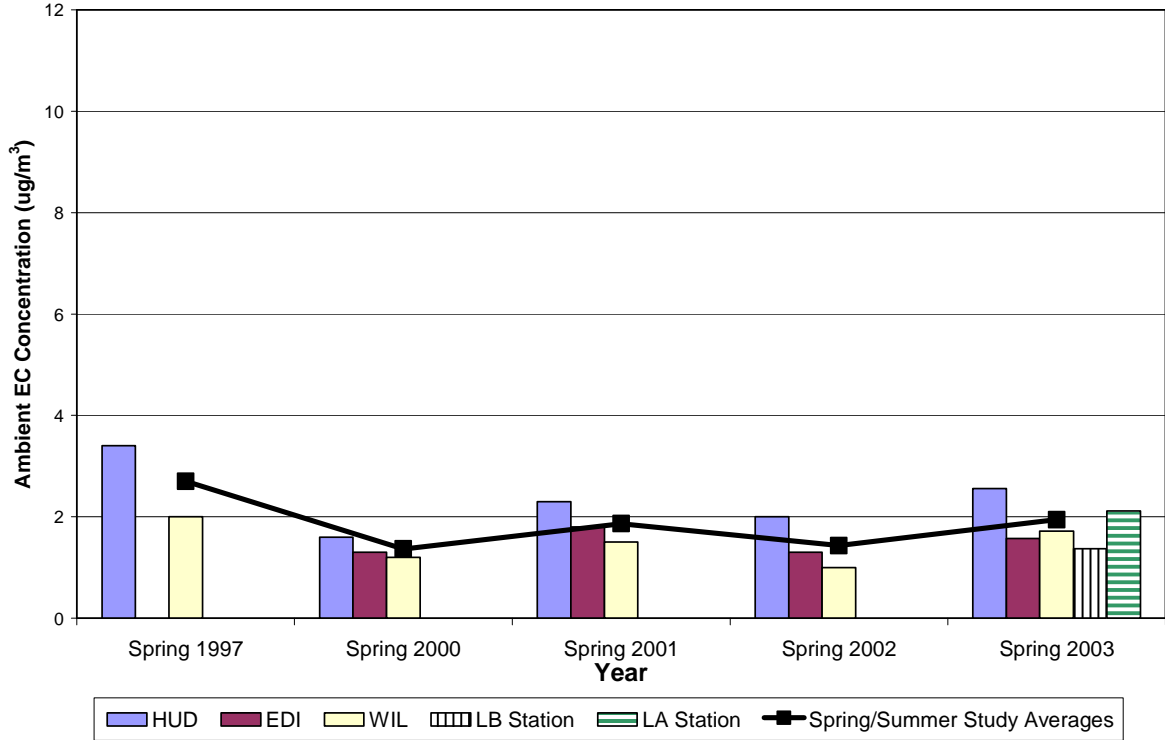
Table 2: Spring/Summer 2003 EC Concentrations ( $\mu\text{g}/\text{m}^3$ ) at Sampling Sites

Location	Date							Average
	5/15/03	5/21/03	5/27/03	6/2/03	6/8/03	6/14/03	6/20/03	
HUD	1.5	3.9	1.7	1.4	1.6	3.3	4.5	2.6
EDI	1.1	3.4	0.9	0.9	0.6	2.4	1.7	1.6
WIL	1.1	4.7	1.4	1.0	1.0	1.7	1.1	1.7
Long Beach	1.1	2.3	2.4	0.5	0.9	1.1	1.3	1.4
Los Angeles	2.1	3.7	3.4	0.9	0.4	3.2	1.1	2.1

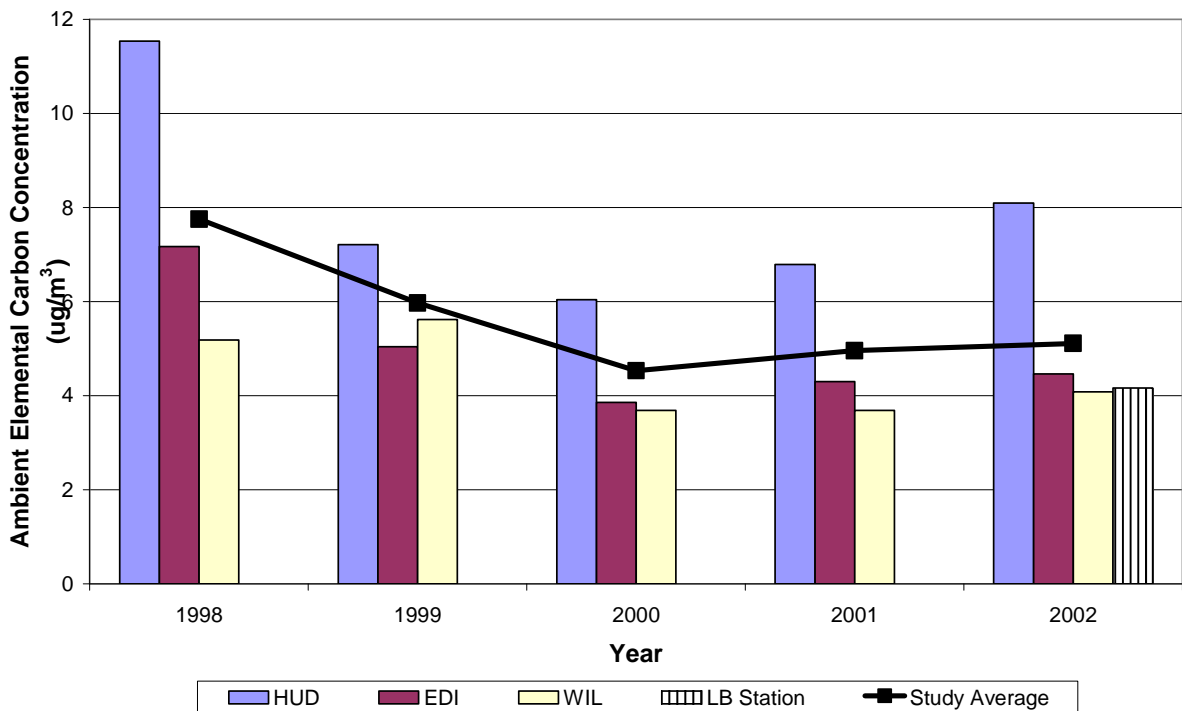
The HUD site measured the highest average ambient EC of all sites during the study. Days characterized by a predominant onshore flow would be expected to maximize the ambient EC contribution from coke and coal dust located at the ports. Interestingly, EC measurements at the monitoring sites were higher on days that were characterized by winds primarily from the southwest or northwest, as indicated by the circled dates above. These are the same days noted for elevated  $\text{PM}_{10}$  in section 3.1.

Elemental carbon concentrations were averaged for the three study sites over the duration of each study, and results are represented in Figure 3. Complete data tabulations can be found in Appendix A-1. The results obtained in the current study do not differ significantly from other spring/summer follow-up studies, and show no clear trend for average ambient EC at the study sites. This may be due largely to seasonal conditions. As the changes in EC concentration become smaller from year to year (illustrated particularly in the 2000-2003 spring studies) it has become difficult to differentiate between changes due to seasonal variation, experimental error, and changes due to Rule compliance.  $\text{PM}_{10}$  and EC concentrations are typically much higher during fall and winter, facilitating trend observations during those seasons as is shown in Figure 4. The compiled fall/winter data in Figure 4 clearly shows the ambient EC downward trend from 1998 through implementation of Rule 1158 revisions in 2000. Subsequently, EC rises slightly and appears to level off.

**Figure 3: Spring/Summer Average EC by Site and Year**



**Figure 4: Fall/Winter Average EC by Site and Year**



#### 4.0 CONCLUSIONS

Average PM<sub>10</sub> values from the three sites show expected seasonal variation. However, the three study sites recorded higher ambient PM<sub>10</sub> than the Long Beach network station for the duration of the study, and recorded higher ambient PM<sub>10</sub> than the Central Los Angeles network station on dates where the wind was predominantly from the west and northwest.

For six of seven sampling days, the highest concentrations were measured at the Hudson School site. Earlier studies in the series showed higher results at the Hudson site than at other study locations. This indicates that localized sources or meteorological conditions may disproportionately impact the Hudson site. Again, higher EC results were seen at all study sites on days where the wind was predominantly from the southwest and northwest. Hudson School is located in close proximity to several transportation sources and industrial sources such as Arco, a large oil refining facility, which is located to the northwest (see map, Appendix A-3). The higher measurements ~~are~~ may be attributable to the Arco facility and nearby transportation sources when the winds are from the west.

Ambient EC remains well below concentrations observed in studies prior to Rule 1158 amendment (June 1999). From 1998 – 2000, ambient elemental carbon concentrations had decreased steadily over the series of fall/winter studies, but assumed a seasonal variation pattern during subsequent fall/winter and spring/summer studies from 2000-2003.

In summary, the spring/summer series of studies is yielding increasingly less information on the impact of Revised Rule 1158; fall/winter measurements, during the high PM season, have been more illustrative of trends in the area. The longer trend shown in the data for spring and fall studies suggests that the measurable benefits of Rule 1158 revision have been observed, and competing sources of PM<sub>10</sub> and EC in the area are now more dominant than the coke/coal contribution.

The studies indicate more PM<sub>10</sub> and EC at the Hudson school site than at other study sites, and that monitoring at Hudson school often results in higher measurements than many of the AQMD PM<sub>10</sub> network sites. The wind data suggests that, like EC, PM<sub>10</sub> is greatest at the Hudson site when the winds are from the northwest and ~~west, and not~~ when the wind is onshore (from the port).



APPENDIX A-1

LONG BEACH PM<sub>10</sub> MONITORING DATA

2003 Spring/Summer PM <sub>10</sub> Ambient Concentration Results								
Location	5/15/03	5/21/03	5/27/03	6/2/03	6/8/03	6/14/03	6/20/03	Average
HUD	29	53	44	31	20	41	37	36
EDI	28	50	48	26	9	48	31	34
WIL	29	48	38	32	19	33	27	32
LB Station	26	38	49	22	18	31	24	30
LA Station	35	46	53	58	35	41	28	42

2003 Spring/Summer Organic Carbon Ambient Concentration Results								
Location	5/15/03	5/21/03	5/27/03	6/2/03	6/8/03	6/14/03	6/20/03	Average
HUD	4.0	8.7	5.5	2.9	2.9	5.3	3.2	4.6
EDI	3.2	6.9	6.0	2.7	2.8	5.0	2.8	4.2
WIL	3.4	6.6	4.2	2.9	2.7	4.2	2.6	3.8
LB Station	3.2	4.7	3.7	2.9	2.8	4.1	3.0	3.5
LA Station	4.7	7.6	6.9	6.1	4.1	3.4	3.0	5.1

2003 Spring/Summer Elemental Carbon Ambient Concentration Results								
Location	5/15/03	5/21/03	5/27/03	6/2/03	6/8/03	6/14/03	6/20/03	Average
HUD	1.5	3.9	1.7	1.4	1.6	3.3	4.5	2.6
EDI	1.1	3.4	0.9	0.9	0.6	2.4	1.7	1.6
WIL	1.1	4.7	1.4	1.0	1.0	1.7	1.1	1.7
LB Station	1.1	2.3	2.4	0.5	0.9	1.1	1.3	1.4
LA Station	2.1	3.7	3.4	0.9	0.4	3.2	1.1	2.1

2003 Spring/Summer Total Carbon Ambient Concentration Results								
Location	5/15/03	5/21/03	5/27/03	6/2/03	6/8/03	6/14/03	6/20/03	Average
HUD	5.5	12.6	7.2	4.3	4.5	8.6	7.7	7.2
EDI	4.3	10.3	6.9	3.6	3.4	7.4	4.5	5.8
WIL	4.5	11.3	5.6	3.9	3.7	5.9	3.7	5.5
LB Station	4.3	7.0	6.1	3.4	3.7	5.2	4.3	4.9
LA Station	6.8	11.3	10.3	7.0	4.5	6.6	4.1	7.2

2002 Spring/Summer PM <sub>10</sub> Ambient Concentration Results									
Location	5/8/02	5/14/02	5/20/02	5/26/02	6/1/02	6/7/02	6/13/02	6/19/02	Average
HUD	50	58	22	22	28	20	55	32	36
EDI	40	56	18	21	31	18	50	32	33
WIL	37	54	47	19	21	17	41	31	33
LB Station	NS	NS	16	27	24	21	34	30	25

2001 Spring/Summer Organic Carbon Ambient Concentration Results									
Location	5/8/02	5/14/02	5/20/02	5/26/02	6/1/02	6/7/02	6/13/02	6/19/02	Average
HUD	5.4	4.8	3.3	2.1	1.8	2.4	5.0	2.4	3.4
EDI	3.4	4.5	3.1	2.3	2.6	2.0	3.5	2.8	3.0
WIL	2.8	4.5	2.2	1.9	2.0	2.4	3.2	2.6	2.7

2001 Spring/Summer Elemental Carbon Ambient Concentration Results									
Location	5/8/02	5/14/02	5/20/02	5/26/02	6/1/02	6/7/02	6/13/02	6/19/02	Average
HUD	3.5	2.2	2.6	0.9	1.0	1.2	3.5	1.0	2.0
EDI	1.5	2.0	1.7	1.1	0.8	0.9	1.7	0.9	1.3
WIL	1.1	1.8	0.7	0.8	0.5	1.1	1.3	1.1	1.0

2001 Spring/Summer Total Carbon Ambient Concentration Results									
Location	5/8/02	5/14/02	5/20/02	5/26/02	6/1/02	6/7/02	6/13/02	6/19/02	Average
HUD	8.9	7.1	5.9	3.1	2.8	3.6	8.5	3.4	5.4
EDI	4.9	6.5	4.9	3.4	3.4	3.0	5.2	3.7	4.4
WIL	3.8	6.3	2.9	2.7	2.5	3.5	4.5	3.7	3.7

2001 Spring/Summer PM <sub>10</sub> 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

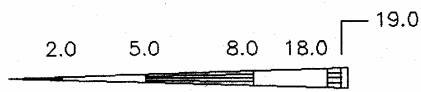
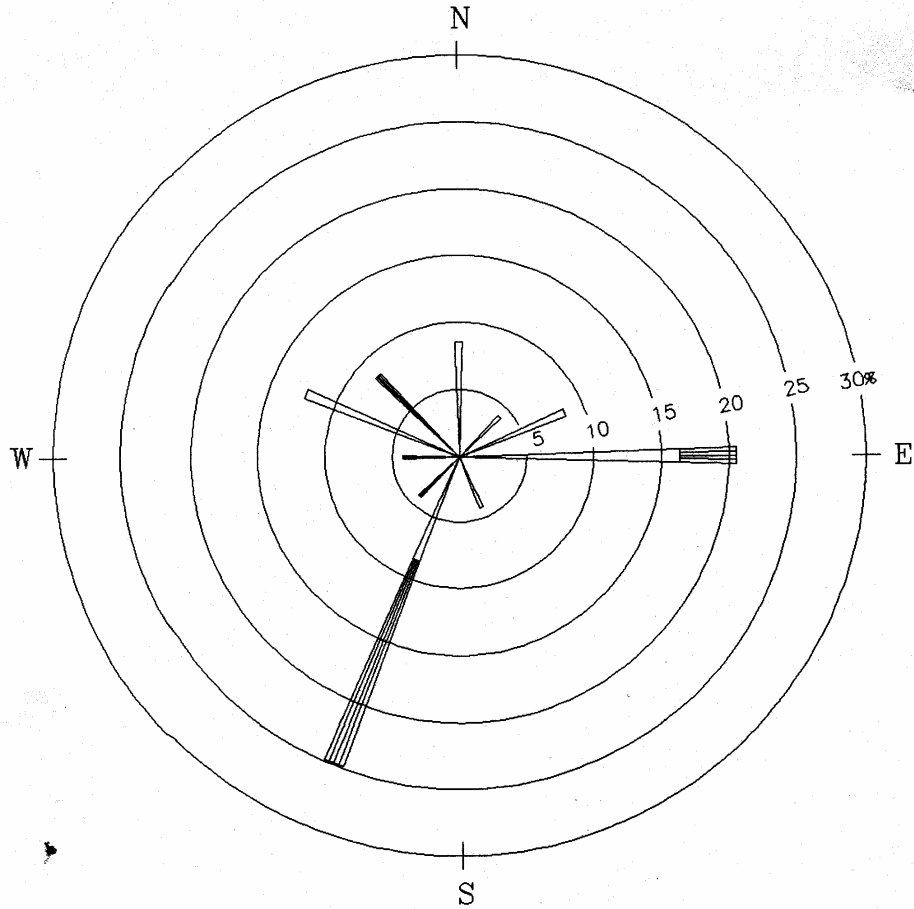
2001 Spring/Summer Total Carbon Ambient Concentration Results								
Location	5/25/01	5/31/01	6/6/01	6/12/01	6/18/01	6/24/01	6/30/01	Average
HUD	5.3	10.5	6.6	4.2	9.6	4.6	5.6	6.6
EDI	4.4	8.0	6.5	3.6	7.9	4.7	4.8	5.7
WIL	6.4	4.9	5.8	4.3	6.9	4.2	4.0	5.2

**APPENDIX A-1**

**LONG BEACH PM<sub>10</sub> MONITORING DATA (CONTINUED)**

2000 Spring/Summer PM <sub>10</sub> 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 <sub>10</sub> 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				

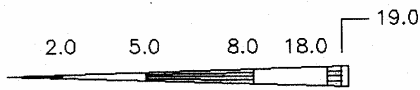
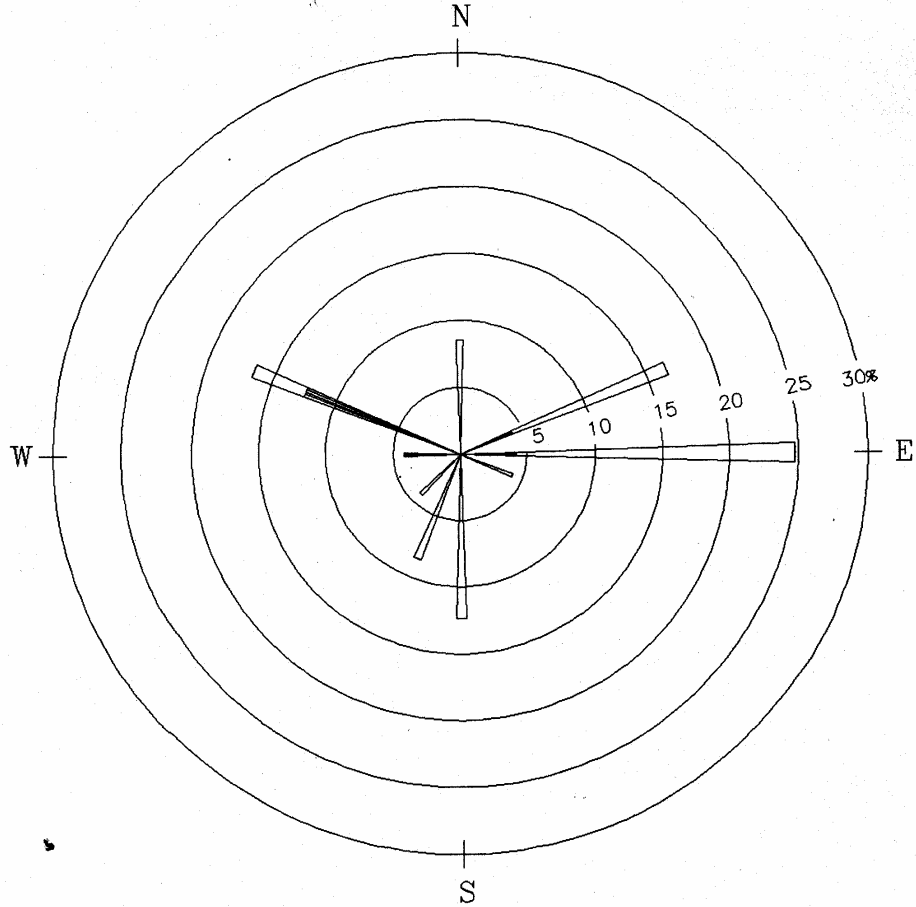


WIND SPEED CLASS BOUNDARIES  
(MILES/HOUR)

NOTES:  
 DIAGRAM OF THE FREQUENCY OF OCCURRENCE FOR EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE - WIND IS BLOWING FROM THE NORTH 8.5 PERCENT OF THE TIME.

# WINDROSE

LONG BEACH  
 PERIOD: 5/15/03

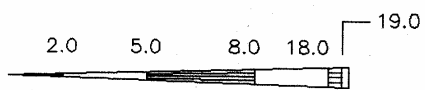
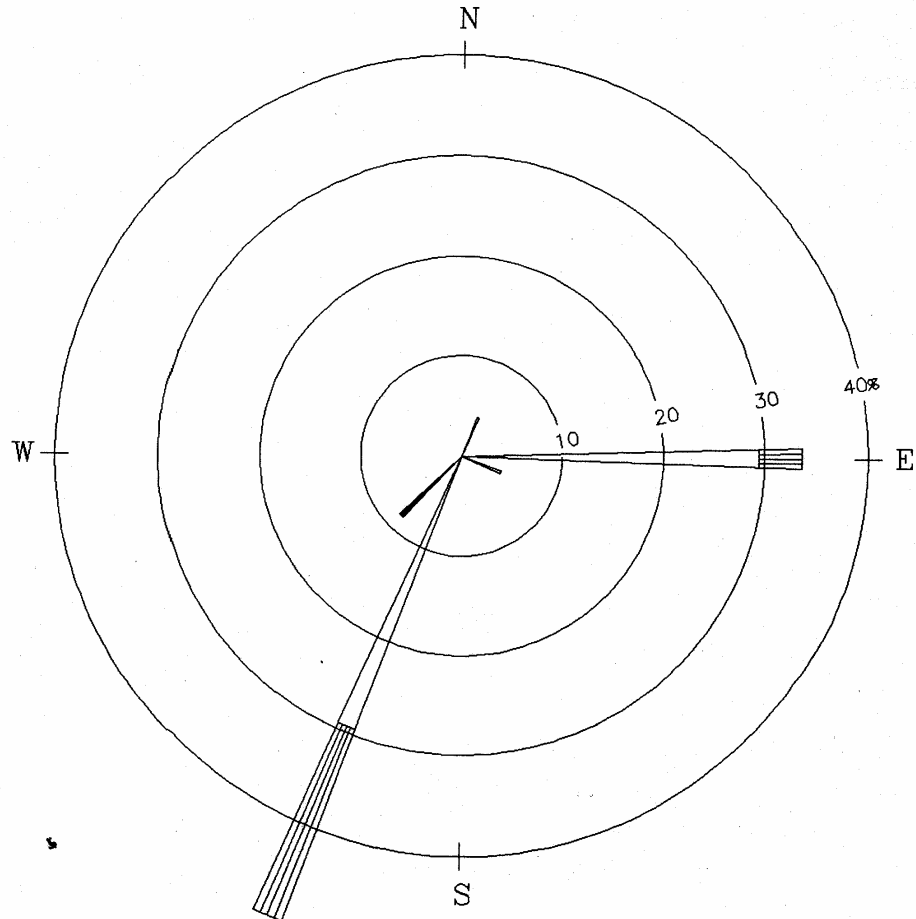


WIND SPEED CLASS BOUNDARIES  
(MILES/HOUR)

NOTES:  
DIAGRAM OF THE FREQUENCY OF OCCURRENCE FOR EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE - WIND IS BLOWING FROM THE NORTH 8.5 PERCENT OF THE TIME.

### WINDROSE

LONG BEACH  
PERIOD: 5/21/03

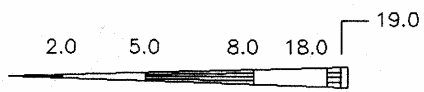
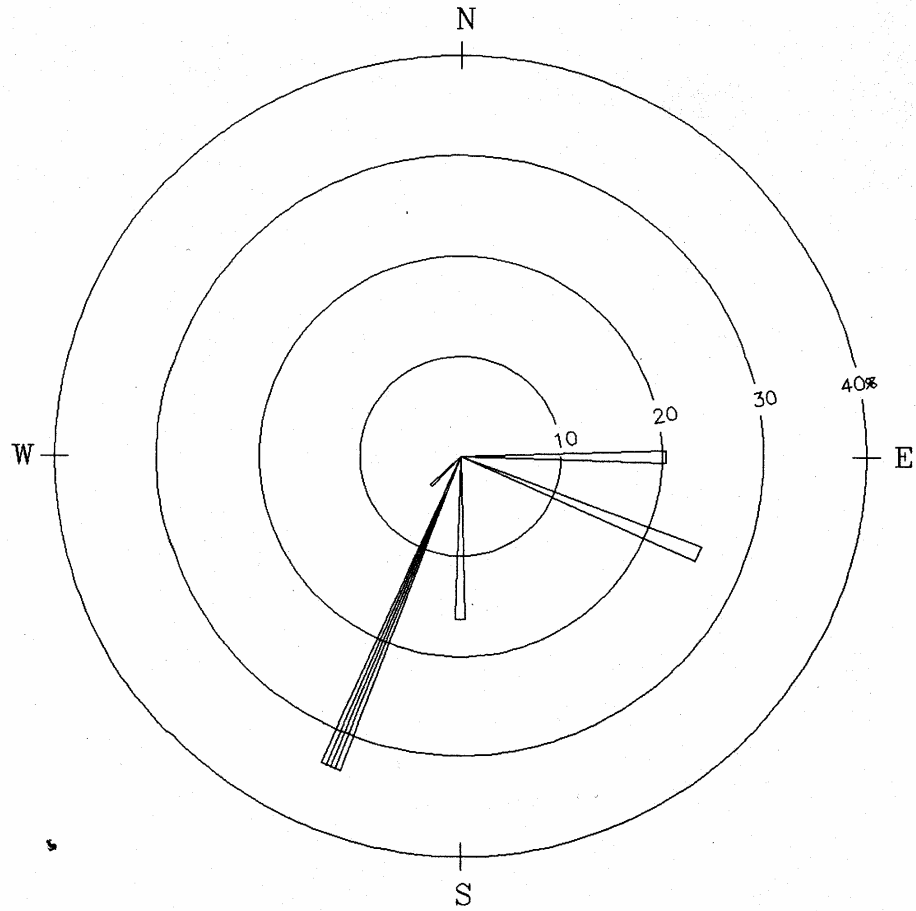


WIND SPEED CLASS BOUNDARIES  
(MILES/HOUR)

NOTES:  
 DIAGRAM OF THE FREQUENCY OF OCCURRENCE FOR EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE - WIND IS BLOWING FROM THE NORTH .0 PERCENT OF THE TIME.

# WINDROSE

LONG BEACH  
 PERIOD: 5/27/03



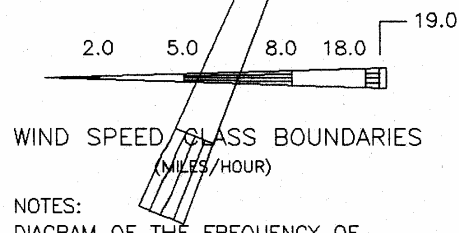
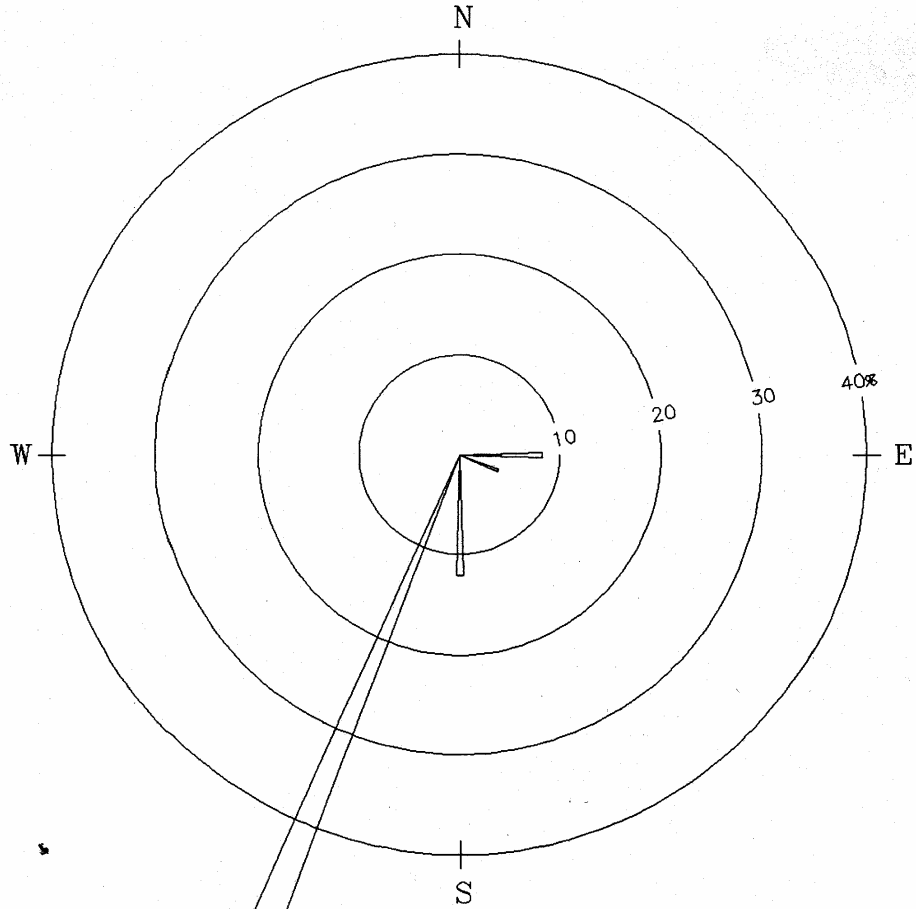
WIND SPEED CLASS BOUNDARIES  
(MILES/HOUR)

NOTES:  
 DIAGRAM OF THE FREQUENCY OF OCCURRENCE FOR EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE - WIND IS BLOWING FROM THE NORTH .0 PERCENT OF THE TIME.

## WINDROSE

LONG BEACH  
 PERIOD: 6/2/03



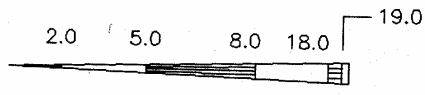
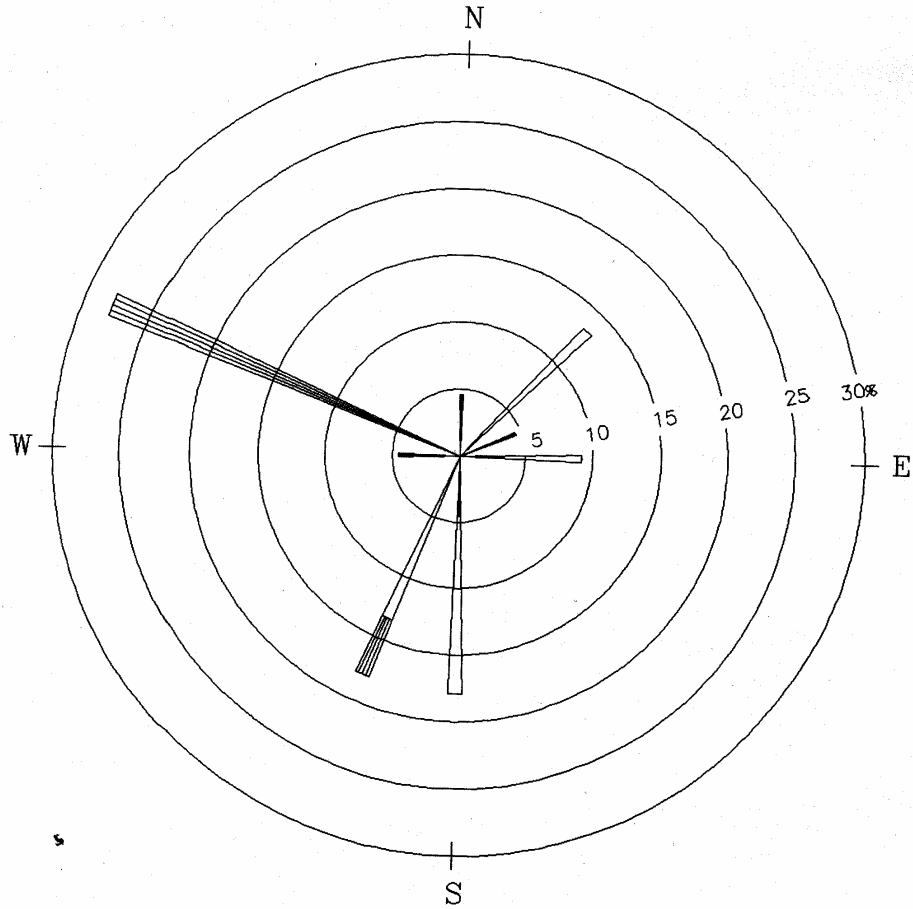


WIND SPEED CLASS BOUNDARIES  
(MILES/HOUR)

NOTES:  
 DIAGRAM OF THE FREQUENCY OF OCCURRENCE FOR EACH WIND DIRECTION.  
 WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING.  
 EXAMPLE - WIND IS BLOWING FROM THE NORTH .0 PERCENT OF THE TIME.

WINDROSE

LONG BEACH  
 PERIOD: 6/8/03



WIND SPEED CLASS BOUNDARIES  
(MILES/HOUR)

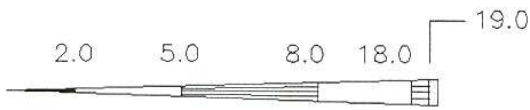
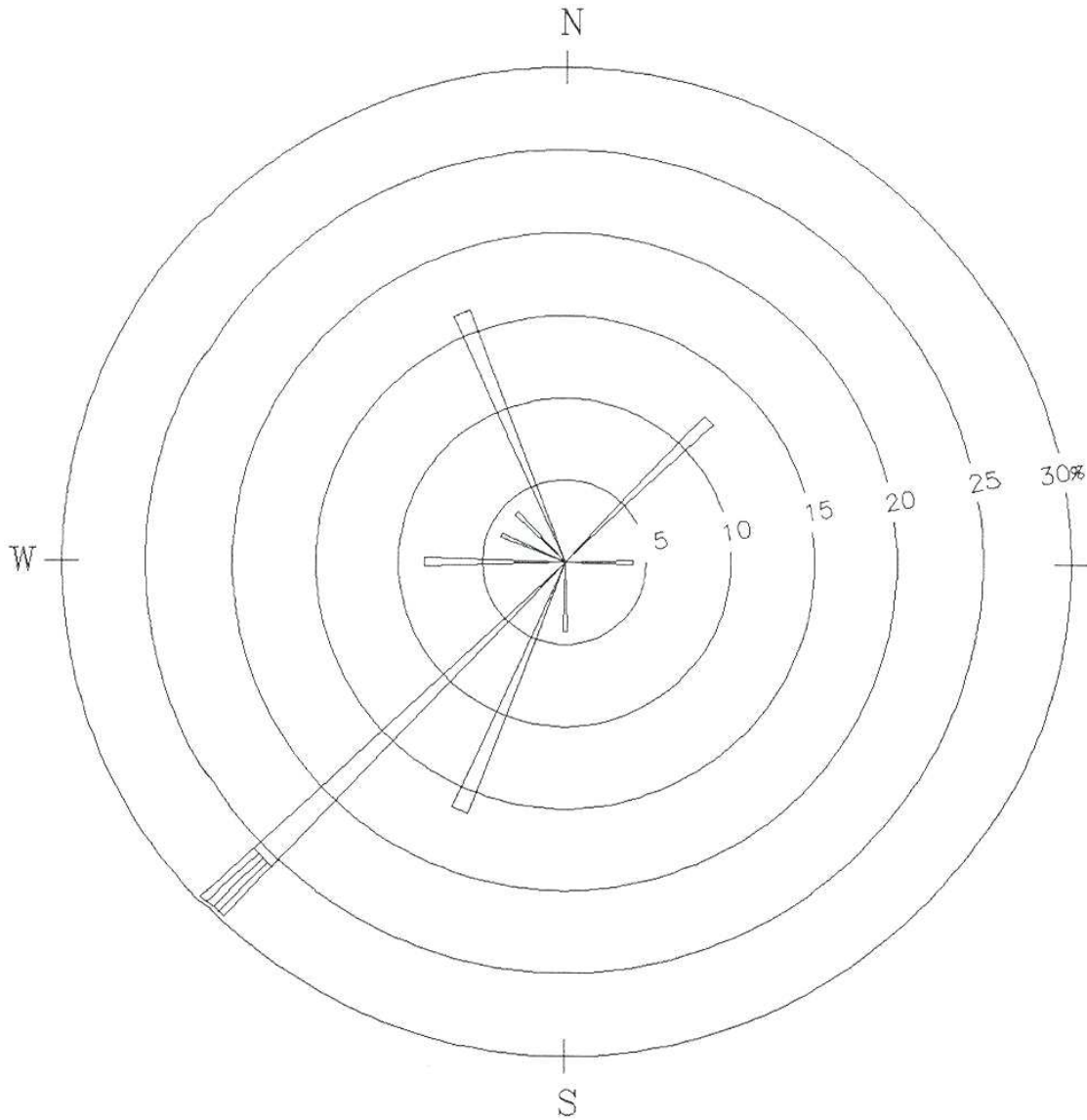
NOTES:  
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# WINDROSE

LONG BEACH  
 PERIOD: 6/14/03

**APPENDIX A-2**

**STUDY WIND DATA**



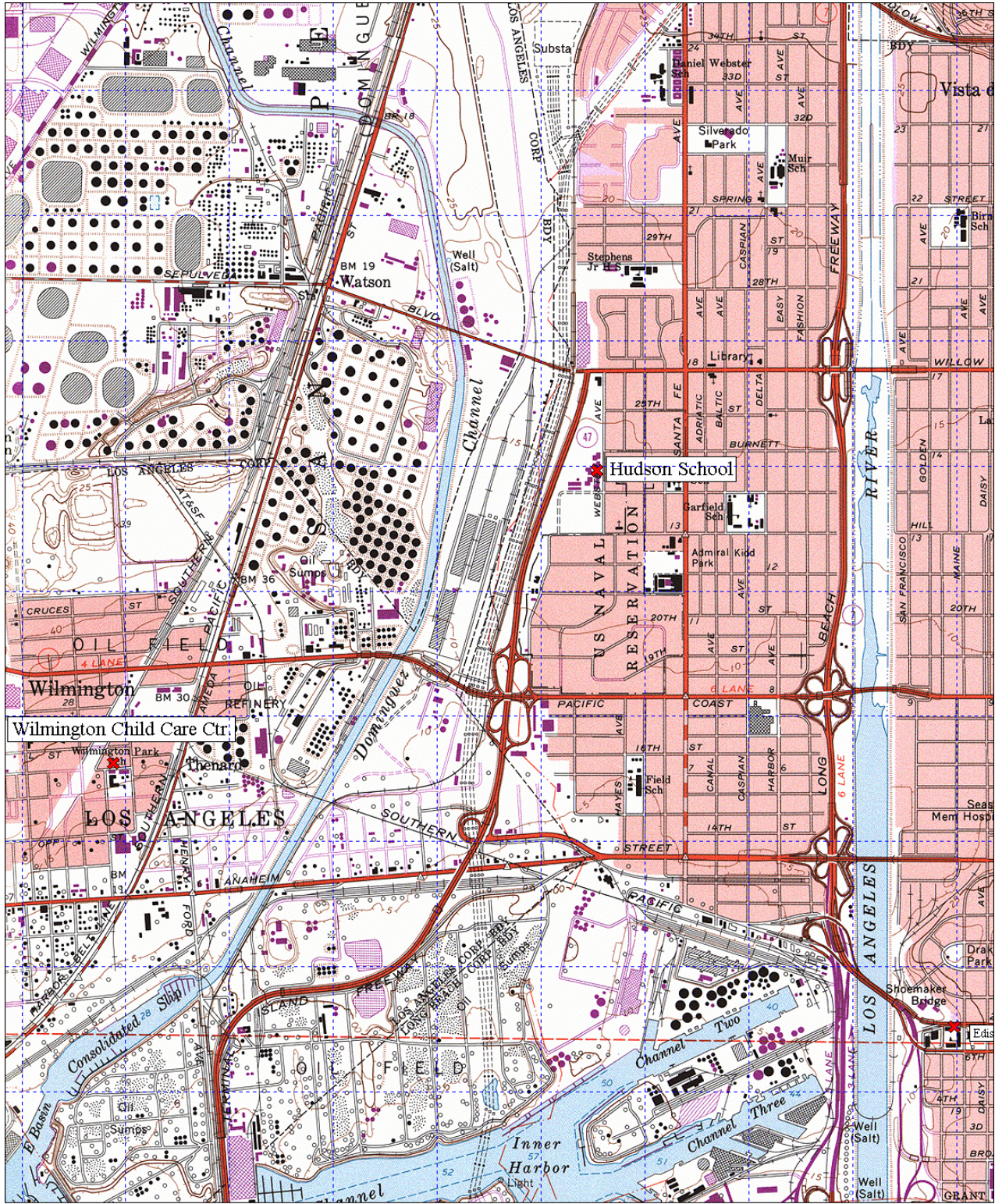
WIND SPEED CLASS BOUNDARIES  
(MILES/HOUR)

NOTES:  
 DIAGRAM OF THE FREQUENCY OF OCCURRENCE FOR EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE - WIND IS BLOWING FROM THE NORTH .0 PERCENT OF THE TIME.

**WINDROSE**

LONG BEACH/AQMD  
 PERIOD: 6/20/03

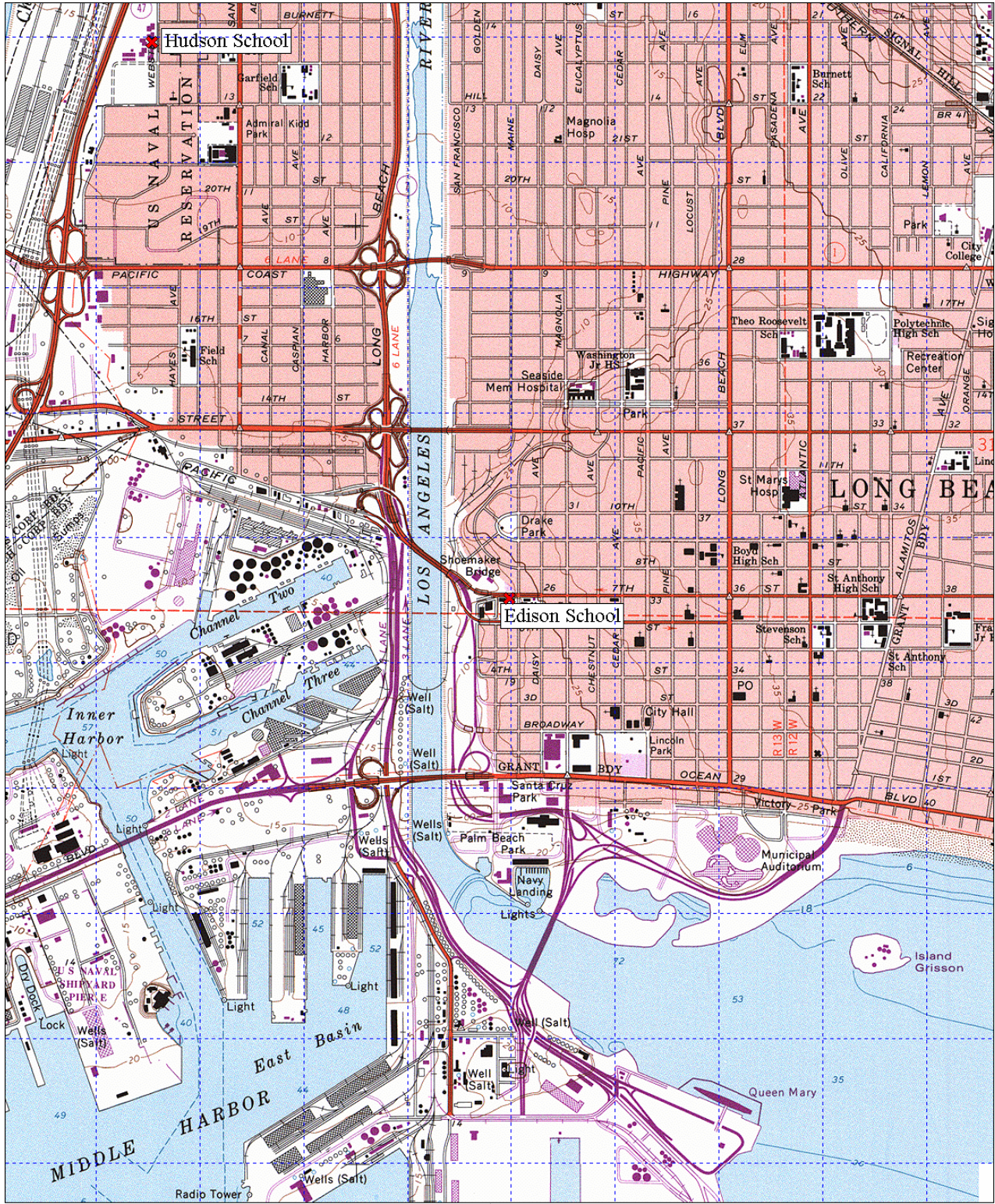




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Printed from TOPOI ©2000 Wildflower Productions (www.topo.com)

Hudson School and Surrounding Area

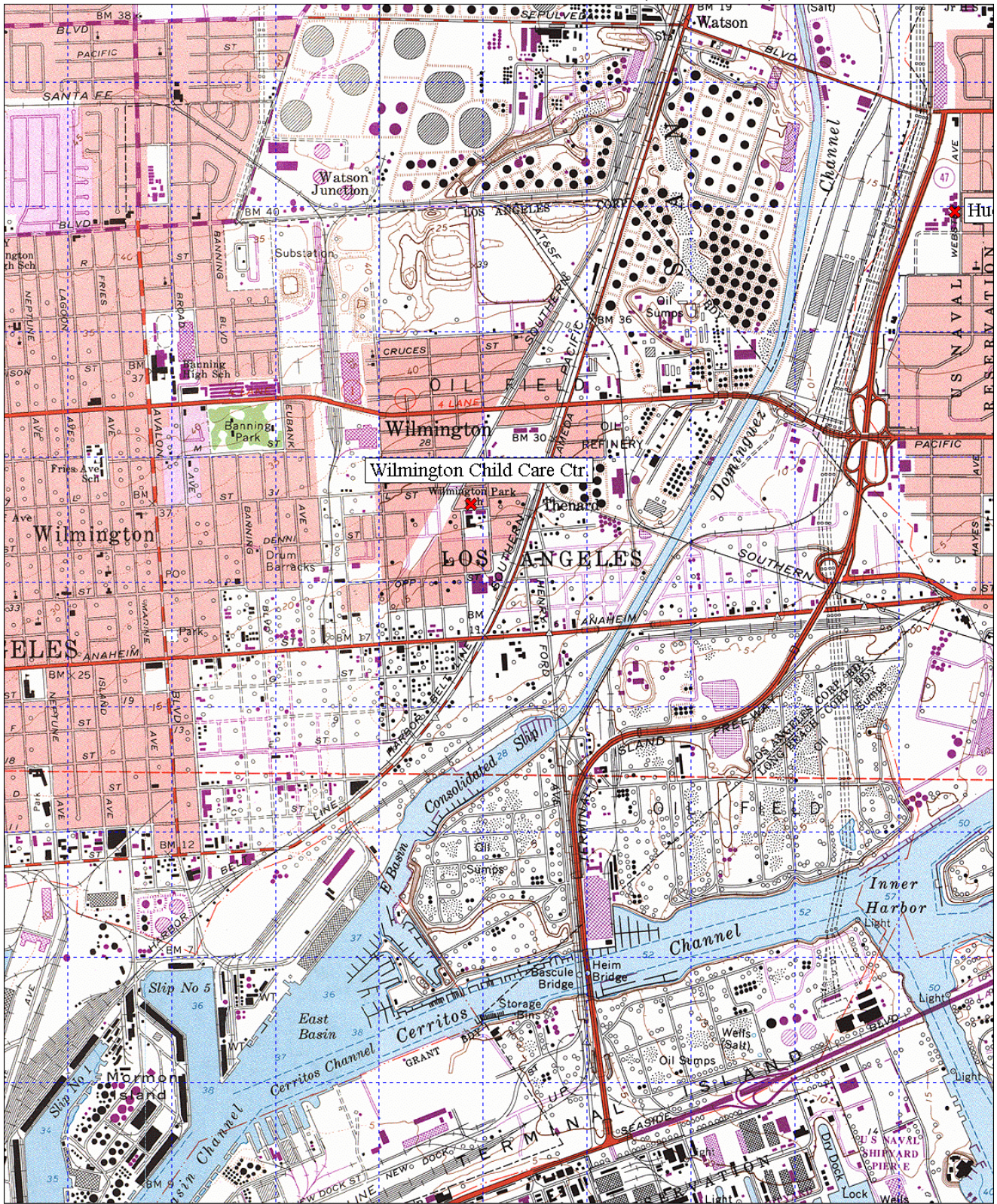




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Edison School and Surrounding Area

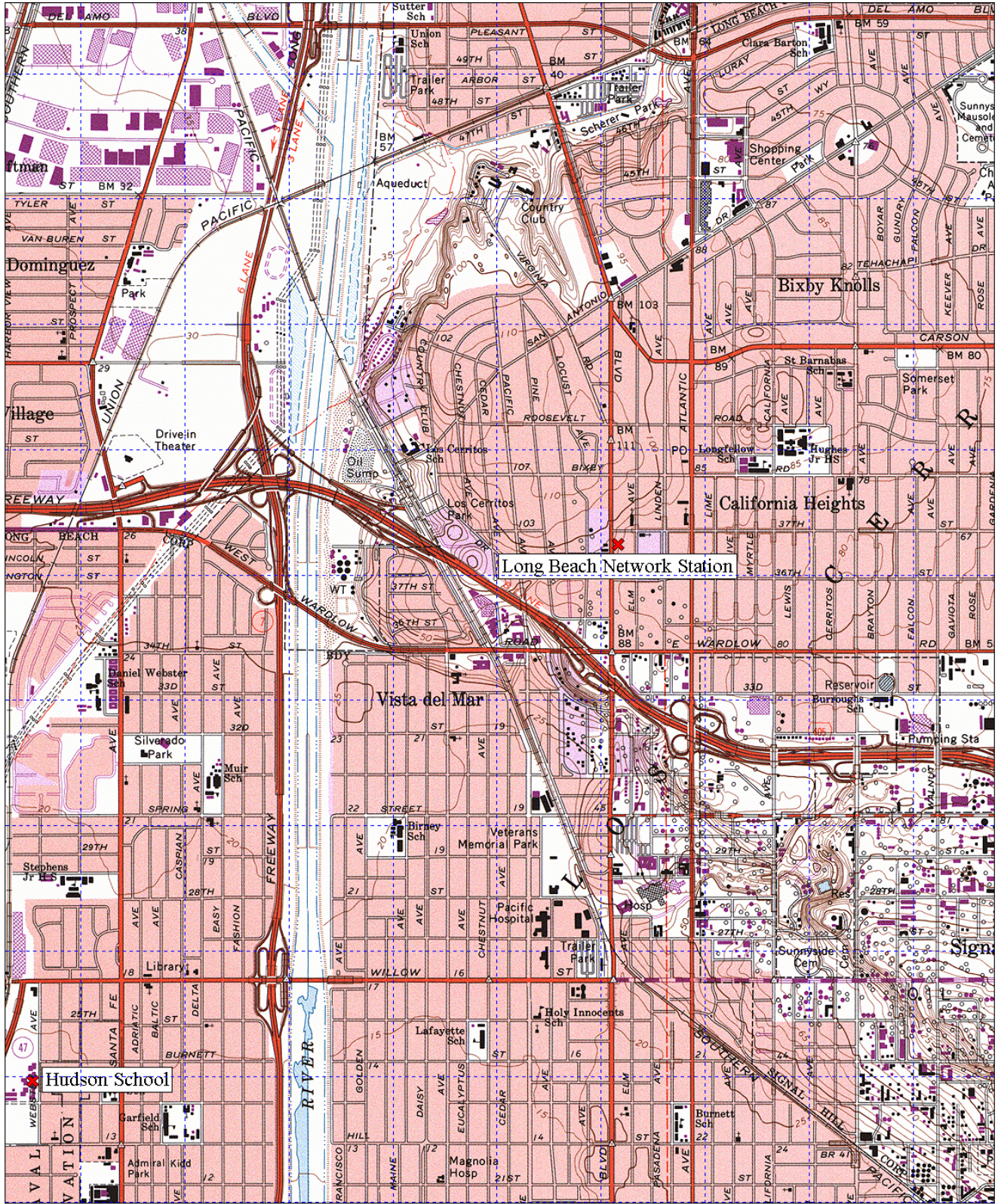




0 1000 FEET 0 1/2 500 1000 m MILE  
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Wilmington Childcare Center and Surrounding Area





Long Beach Station and Surrounding Area